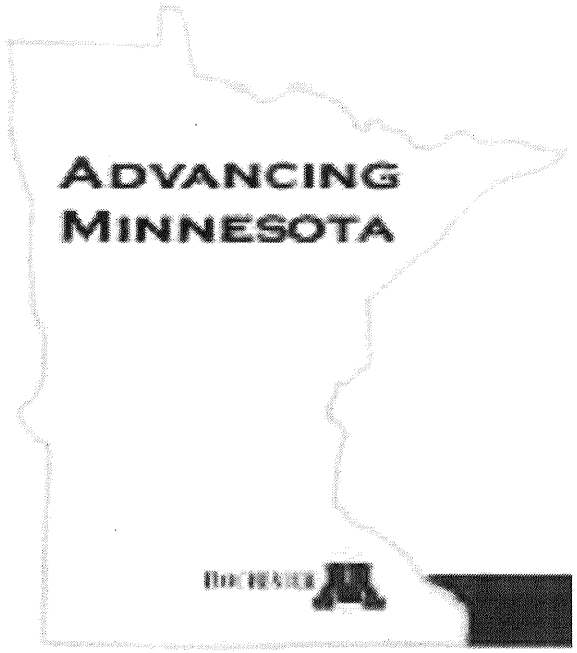


Rochester Higher Education Development Committee

Report to Governor Pawlenty and the Minnesota Legislature

January 25, 2006

Rochester Higher Education Development Committee

Appointed by Governor Pawlenty July 2005

- **Dr. Claire Bender** Mayo Clinic radiologist and Dean of Mayo School of Health Sciences
- **Al Berning** CEO, Pemstar, Past Chair GRAUC
- **Al DeBoer** Attorney, Businessman, Rochester civic leader, GRAUC Board of Directors
- **Drew Flaada** IBM Director of IBM /Mayo Clinic Collaboration and Life Sciences Development, GRAUC Board of Directors
- **Dwight Gourneau** President NAM Tech, MN Private Colleges Council, Earned Masters degree from UMR via Unite/ITV program while employed by IBM Rochester. Currently serves as Chair of Board of new Smithsonian American Indian Museum in DC.
- **Dr. Robert Hoffman** Vice President Taylor Corporation, Mankato, Chair of MNSCU Board of Trustees, former Superintendent Waseca Public Schools
- **Dr. David Metzen** Metzen Leadership, Inc, University of MN Board of Regents, former Superintendent South St. Paul Public Schools
- **Jayne Rankin** Executive Budget Officer, Minnesota Department of Finance
- **Dr. Wendy Shannon** Superintendent Byron Public Schools, Past Chair GRAUC , Past Chair UCR Council
- **Michael Vekich, CPA** Vekich and Associates, Minneapolis, Past Chair MNSCU Board of Trustees
- **Marilyn D. Stewart** Branch Manager, Edina Realty Rochester/Austin/Kasson, Past Chair GRAUC, Past Chair UMR Advisory Committee, Past Chair Rochester Area Chamber of Commerce, Past President MN Association of REALTORS

ADVANCING MINNESOTA

The 21st Century Knowledge Economy

Key Growth: Genomics, Healthcare, Biosciences, Information Technology

Unique opportunity: Confluence between medicine/biology and engineering/information technology

Success = Technological Innovation + Capital + Talent

ADVANCING MINNESOTA

Minnesota's Unique Opportunity in SE Minnesota

Rochester

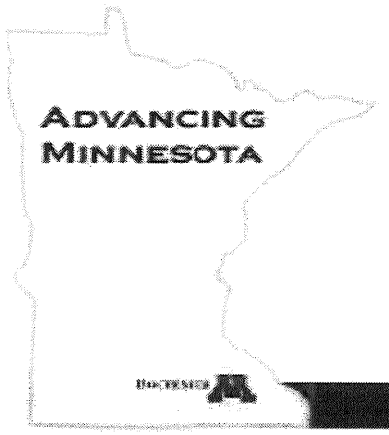
Strong, sustained growth
High percentage of degreed professionals
Nationally recognized as an innovation center
30 companies on cutting edge of bioscience advances
Bioscience tax-free zone

IBM

Minnesota's largest high-tech employer
Key IBM Development Laboratory
$500M in annual R&D in Rochester
Local research in Bioinformatics and Life Sciences
Blue Gene development and production
$2M annually in tuition reimbursement

mayo

Minnesota's largest private employer
Bioscience research giant
Worldwide reach and reputation
Mayo Medical Labs
$372M annually in research
$5M annually in tuition reimbursement

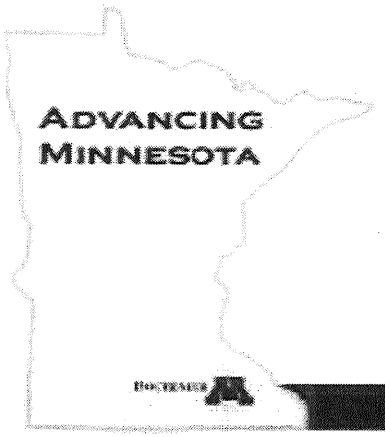


Minnesota Partnership for Biotechnology and Medical Genomics | University of Minnesota | Mayo Clinic

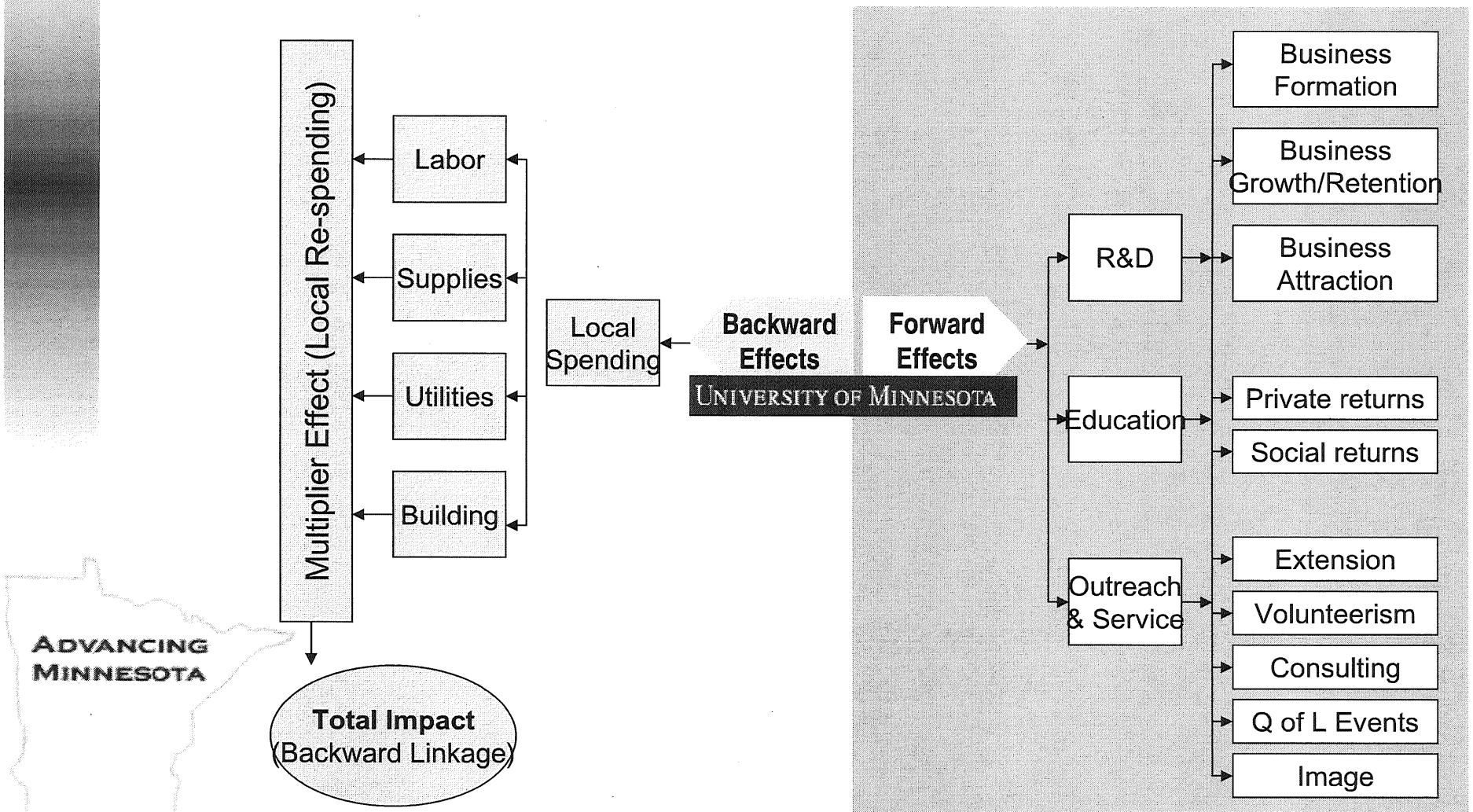
University of Minnesota
Hormel Institute

The Missing Piece for Minnesota's Economic Engine in SE Minnesota

- A public mechanism to provide:
  - Technology development and transfer
  - Management skills development
  - Workforce skill development



Expanded University Research Economic Impacts

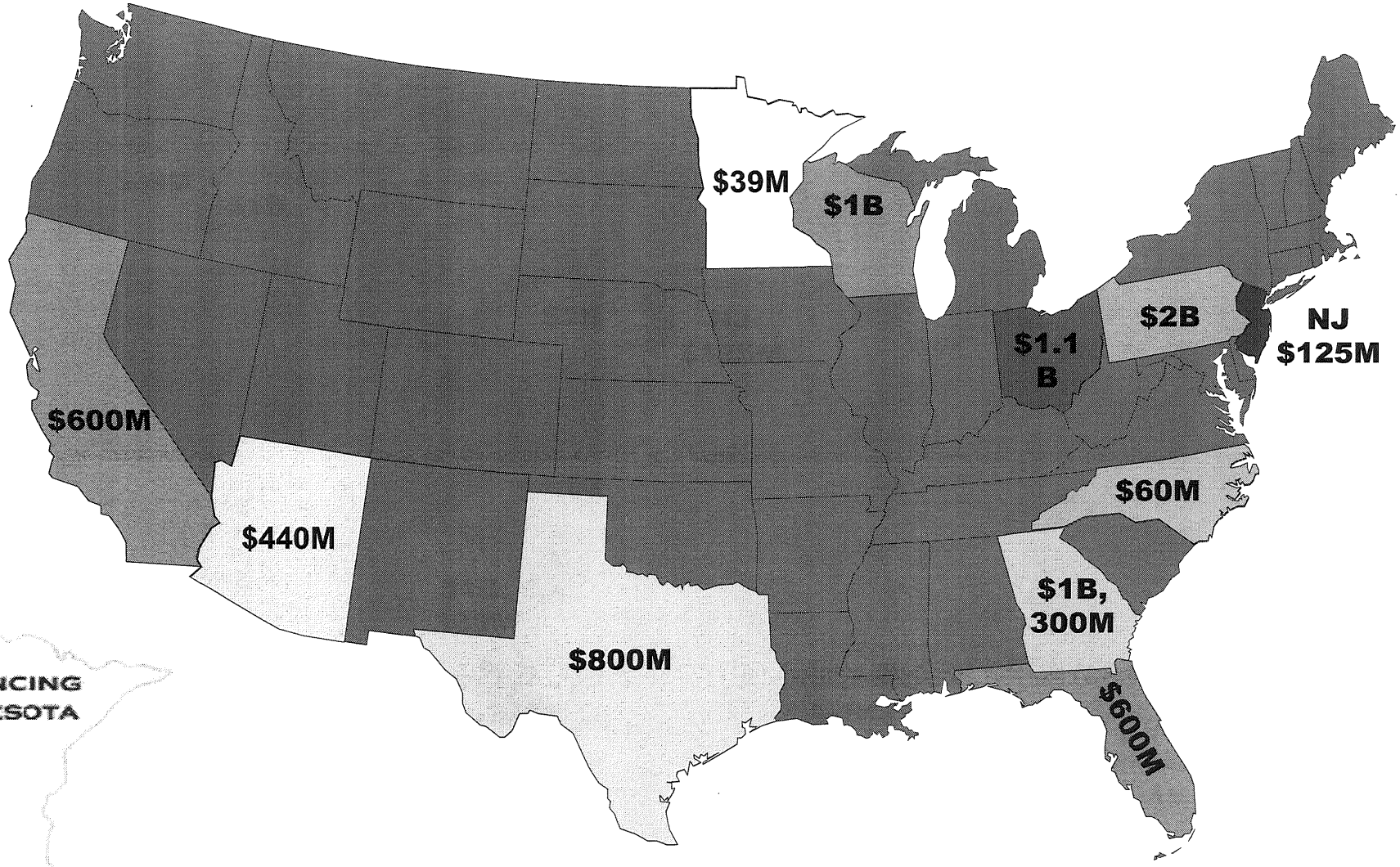


Source: Simon Tripp, Impact Economics

ADVANCING MINNESOTA

The Competition

State Bioscience Research Investments

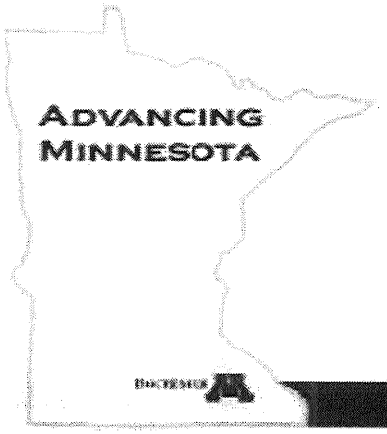


ADVANCING MINNESOTA

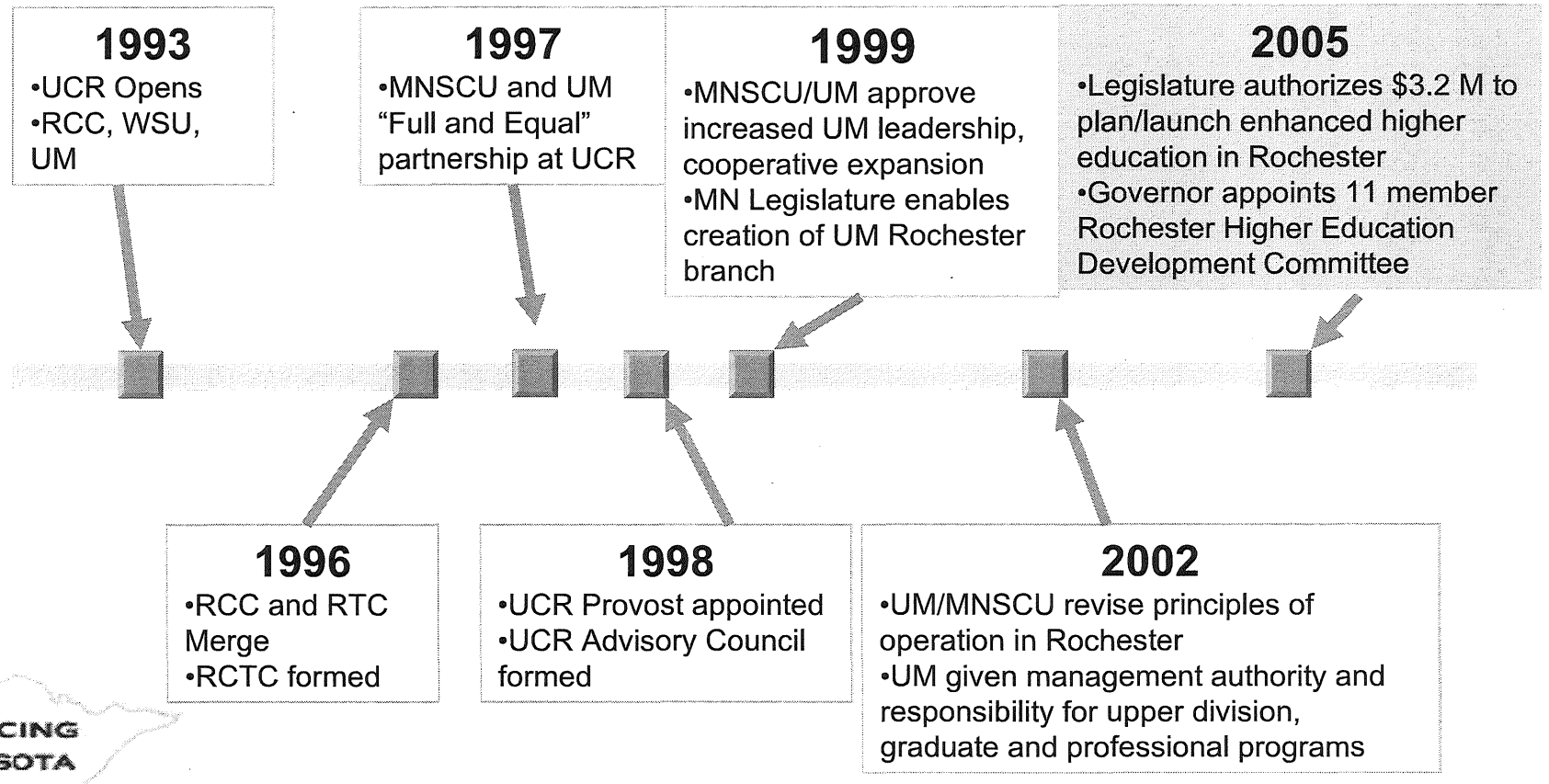
The Vision

- Advance world-class higher education that leverages the University of Minnesota's research capability, in partnership with IBM, Mayo Clinic, and other industry leaders, to build signature academic and research programs that complement southeast Minnesota's existing leadership roles in health sciences, biosciences, engineering and technology.

- Educational programs will provide application to economic activities via innovation, translational research, and clinical experiences. This institution will have a distinct identity and one governing entity. This institution will be the University of Minnesota, Rochester Campus.



Evolution of Higher Education Structure in Rochester



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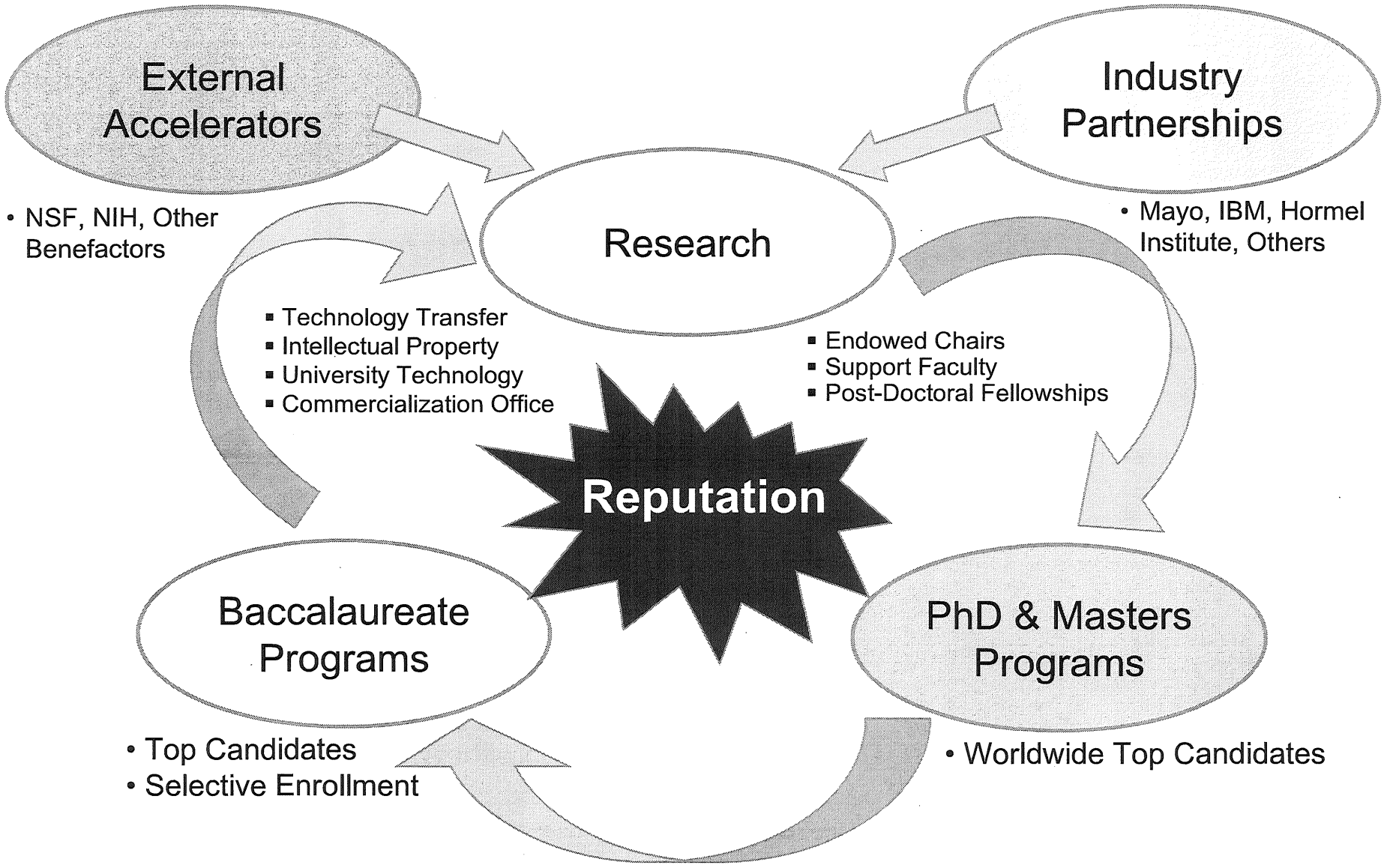
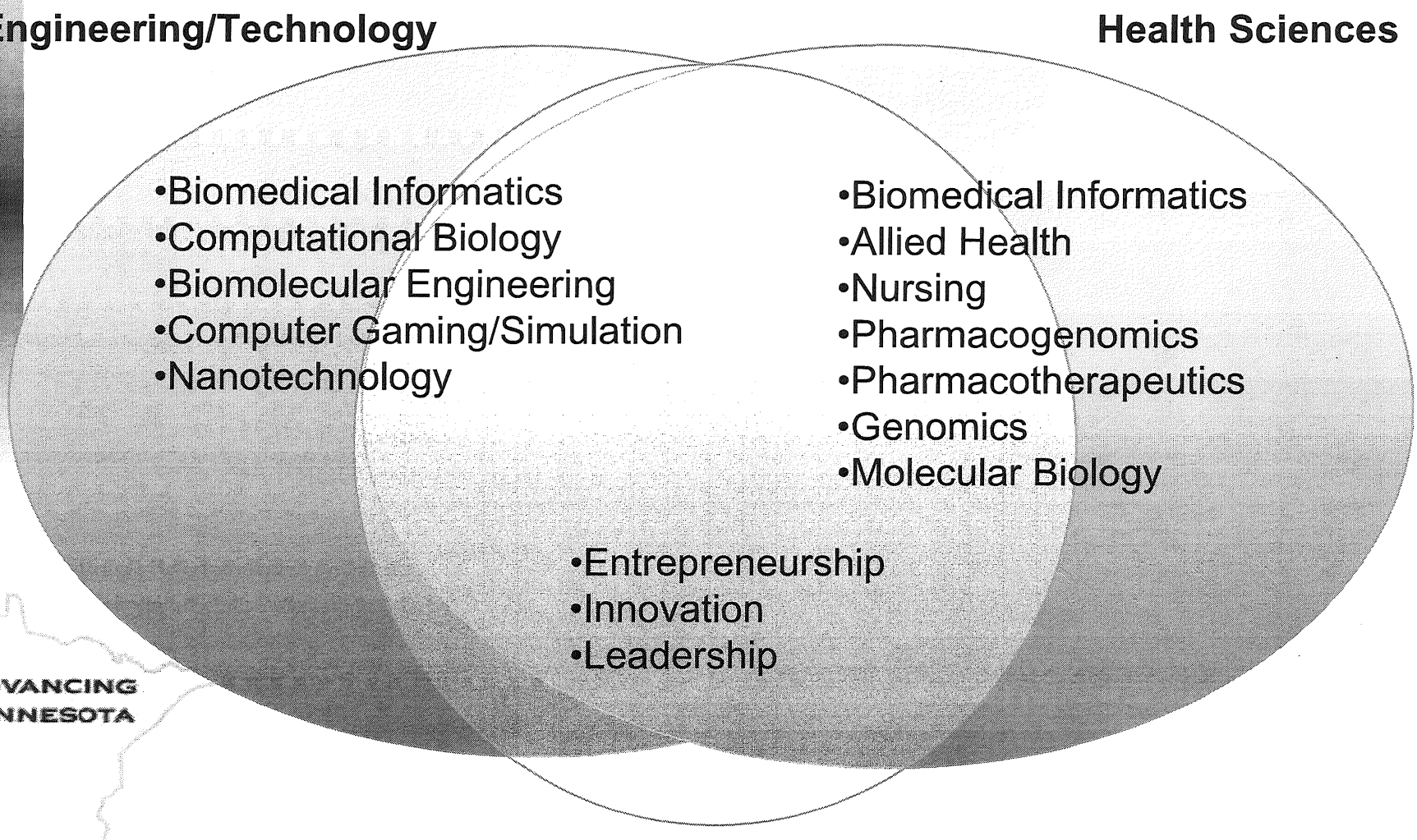
Signature Academic Partnerships



Signature Programs



ADVANCING MINNESOTA

Facilities

- Downtown Rochester location required
- Proximity and access to Mayo Clinic paramount
  - Convenience to Mayo researchers and faculty
  - Joint professorships achievable
  - Access to common lab space and facilities

ADVANCING MINNESOTA

Investment for the Future

- Special appropriation from State of Minnesota plus local commitment
- Staged investment to create prioritized signature programs
- Staged growth in facilities, faculty and number of students

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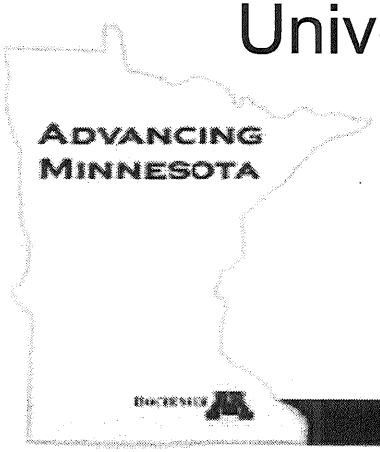
Conclusion

- Invest in an economic engine for Minnesota
- Capitalize on strategic assets and partnerships in the community
- Define new, unique value
- Build upon an historic evolution of higher education in Rochester
- Extend and enhance the strategic direction of the University of Minnesota



Next Steps: Partner for Minnesota's Future

- Adopt the recommendations of the Rochester Higher Education Development Committee
- Support implementation of the recommendations, including programmatic growth and securing incremental funding
- Work in partnership with the Rochester Higher Education Development Committee and Rochester community leaders to capitalize on the unique resources and opportunities in Rochester for the advancement of economic development in Minnesota

ADVANCING MINNESOTA

Rochester Higher Education Development Committee

Report to

Governor Tim Pawlenty

and the

Minnesota Legislature

Committee Members

Marilyn D. Stewart, Chair
C. E. Bender
Al Berning
Al DeBoer
Drew Flaada
Dwight A. Gourneau
Jayne Sprinthall Rankin
Robert H. Hoffman
David Metzen
Wendy Shannon
Michael Vekich

Rochester Higher Education Development Committee
Report to Governor Tim Pawlenty and the Minnesota Legislature

Executive Summary

Minnesota is uniquely poised today to capture an extraordinary opportunity for economic growth. Converging in southeast Minnesota, particularly in the Rochester area, is a combination of high-powered business, academia, health care, and technology enterprises. Partnerships between IBM, Mayo Clinic, and the University of Minnesota position the State of Minnesota to become one of the fastest growing and dynamic biomedical economies of the 21st century.[1] Yet, Minnesota is faced with fierce competition from other states and regions that are quickly developing their resources and investing millions, even billions, of dollars in research partnerships.

The Rochester Higher Education Development Committee was established by the 2005 session of the Minnesota Legislature to recommend the form of higher education that would best meet the unique opportunities presented in southeast Minnesota (See Appendix A for complete legislation.). Building on an existing base of collaboration in Minnesota's third largest city, the Committee recommends that Minnesota:

Establish a world-class higher education institution that leverages the University of Minnesota's research capability, in partnership with IBM, Mayo Clinic, and other industry leaders, to build signature academic and research programs that complement southeast Minnesota's existing leadership roles in health sciences, biosciences, engineering and technology. Educational programs will provide application to economic activities via innovation, translational research, and clinical experiences. This institution will have a distinct identity and one governing entity. This institution will be the University of Minnesota Rochester.

The Rochester Higher Education Development Committee concludes that the University of Minnesota is uniquely and exclusively qualified to effectively capitalize on the opportunities in Rochester, Minnesota. It recommends that the University of Minnesota expand its existing work in Rochester to garner the benefits of this rapidly growing economic sector for our state. The intent is not to duplicate what exists on the University of Minnesota Twin Cities campus, but to draw more extensively on its resources and combine them with the unique knowledge and skills inherent in the region. The University of Minnesota Rochester is encouraged to:

- Implement baccalaureate and graduate programs in areas of high demand, which might include:
    - *Engineering/Technology* - Biomedical Informatics, Computational Biology, Biomolecular Engineering, Computer Gaming/Simulation, and Nanotechnology.

[1] Milken Institute, America's High-Tech Economy, 1999

- *Health Sciences*- Biomedical Informatics, Allied Health, Nursing, Pharmacogenomics, Pharmacotherapeutics, Genomics, and Molecular Biology.
- *Business* - Entrepreneurship, Innovation, and Leadership focused on the translation of research into practical application and new business creation.

- Deliver instruction through innovative use of technology, clinical and internship experiences, research and development, and adjunct faculty in partnership with the University of Minnesota Twin Cities, other University of Minnesota campuses, and southeast Minnesota partners.

- Expand research in these disciplines through collaborations with Mayo Clinic, IBM, and other high-tech employers.

The Rochester Higher Education Development Committee recommends that the University of Minnesota Rochester be located in downtown Rochester, adjacent to Mayo Clinic. This will facilitate the achievement of both the near term and long term vision and will provide students and faculty access to Mayo Clinic facilities and its laboratories some of which are currently shared with the University of Minnesota through the Minnesota Partnership for Biotechnology and Medical Genomics. The transition plan proposed by the Committee honors current lease arrangements on the University Center Rochester campus, which can no longer accommodate the growth needs of the University of Minnesota Rochester.

The Rochester Higher Education Development Committee recommends that initial funding to grow the University of Minnesota Rochester be made through the immediate release of $3 million allocated to the Office of Higher Education for Rochester higher education development, and an additional allocation of $16.3 million spread over the next three years. Once operational, the University of Minnesota's current funding for the University of Minnesota Rochester, tuition, and other public and private funds, as proposed in the financial model, would support ongoing operations. Funding will be generated with new resources, not by supplanting or shifting current levels of state monies from the University's existing budget.

The University of Minnesota Board of Regents will be the governing body for the University of Minnesota Rochester programs and activities as proposed by the Rochester Higher Education Development Committee. The Rochester Higher Education Development Committee recommends that the existing Joint Powers Agreement between the University of Minnesota and the Minnesota State Colleges and Universities should be phased out as soon as practical, with the University of Minnesota honoring existing financial commitments. The Rochester Higher Education Development Committee further recommends that a University of Minnesota Rochester advisory group composed of key partners in this effort be established to consult on the growth and development of this unique institution.

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I. The Opportunity

Rochester's confluence of world-class medicine, advanced technology and bioscience industry makes it uniquely poised to be a major player in the 21st century bio-economy. This potential cannot be fully realized without further investments, most notably in the area of human capital generated through a research university and associated academic programs. Partnerships between the University of Minnesota, IBM, Mayo Clinic, and related businesses position the State of Minnesota to become one of the fastest growing and dynamic biomedical economies in the world.

To ensure a competitive advantage, Minnesota must invest now in developing the missing ingredient to fuel economic growth: a prominent higher education research institution in Rochester.

Sustaining Minnesota's Economic Growth

Minnesota has enjoyed longstanding economic success. Its economic growth rate exceeds the national average and its population growth leads the Frost Belt. Minnesota proudly ranks with leading states across the nation on many social and economic indicators. Our state's strong commitment to education at all levels has been a key contributor to this success.

Minnesota has the opportunity to leverage the capabilities of three great institutions - a strength that would be hard to find in any other geographic region.

Walt Ling
IBM Senior State Executive

While Minnesota enjoys a track record of performance, there is an increasing risk it may not be sustained. The U.S. economy is facing great challenges as globalization forces and the increasing performance of overseas competitors cuts into its economic leadership. It is clear that in today's highly competitive, knowledge-driven economy, an underperforming state will not be able to sustain quality-of-life and standard-of-living increases for its population. In the United States, where states have the freedom to chart their own courses through the free market economy, the challenge of global competition is likely to produce winners and losers as some make the correct decisions and investments while others choose poorly or fail to react at all. Minnesota faces a choice.

The keys to performance in the modern global economy may be simplified into three core elements:

1) *Technology* – Producing and using technological innovations to generate income and enhance productivity.
2) *Capital* – Having the equity and loan capital required to start and grow business enterprise.
3) *Talent* – Having skilled and creative human capital to drive innovation, develop businesses, and staff key positions.

Each of these three elements must be in place in a modern economy in order for economic progress to be sustained. It is also important to note that within a state these three resources must come together at specific locations. Thus, the regions within Minnesota - indeed anywhere - that will be growth magnets will be those that are able to combine the three elements of technology, talent, and capital.

Minnesota also faces domestic competition and is not alone in efforts to generate innovation-driven economic development. Technology-based development and the requisite talent and capital, are frequently the key differentiator in a region's economic performance. A study by the Milken Institute, evaluating economic growth across 315 regions in the U.S. between 1975 and 1998 found that 65 percent of the difference in economic success for regions is accounted for by the growth and presence of high technology industries. Moreover, the Milken Institute found that research centers and institutes are "indisputably the most important factors in incubating high tech industries." [2]

It should also be noted that states and regions with the greatest health care resources could be big economic winners in the decades ahead. As people are living longer, the elderly population is growing and the demands for better health care are pushing new innovations in medicine. Health care consumption in the U.S. has doubled since 1970, from seven percent of GDP to 14 percent. It is expected to reach 17 percent by 2011 as this country's senior population grows. Globally, the over-65 population is expected to expand from 600 million to more than one billion by 2020.

Minnesota's strengths are clear. The Milken Institute[3] ranked the top 20 metro areas on its "health pole" index, which ranks metropolitan regions based on the concentration of health care employment in their economy and as a share of U.S. health care employment. (The word "poles" is used, since these regions act as magnets, drawing other health industries and related companies, and the employment and incomes associated with them.) Minneapolis-St. Paul ranked 10th and Rochester ranked 18th. The study noted that biotechnology and biomedicine are important drivers to creating employment opportunities.

The BioBusiness Alliance of Minnesota, an organization developed in 2004 to encourage and foster investment in biobusiness in Minnesota, illustrates the strong commitment already in place for Minnesota to grow as a leader in the biosciences and in the medical device industry in particular. As home to nationally recognized health care institutions and medical industrial giants, Minnesota provides fertile ground for cross-

[2] Milken Institue, *America's High-Tech Economy*, 1999

[3] Milken Institute, *American's Health Care Economy*, 2003

pollination between private and public partnerships in the biosciences. To be competitive, Minnesota must continue to develop creative partnerships between industry, academia, and the government and address barriers to making the increased investment to develop these partnerships.

The Competition

Many regions across the nation are focusing on how to leverage their base of academic research facilities to create an intellectual environment that can be supportive of, and a magnet for, technology-based economic development. In particular, a new wave of strategically planned "mixed use" campus expansions are taking place across major research universities in urban settings. Communities such as Raleigh, Seattle, Portland, New York City, Denver, Chicago, Austin, Phoenix, and San Francisco are engaged in significant new mixed use, campus expansions for their leading research universities – expansions focused on generating economic growth from university and private sector interactions.

Fueled by the historic convergence of health sciences and technology, closer alignment to the University of Minnesota is in the best interest of the State's economy.

Jim Clausen,
IBM, (retired)
Greater Rochester Area University Center
Board Chair, 2005

Currently, 40 states specifically target the biosciences for development and all 50 states have economic development initiatives available to assist bioscience companies. Other states are investing aggressively in a comprehensive range of bioscience programs to promote research and commercialization. Many are pursuing bioscience development strategies, including strengthening research, increasing university-industry collaborations, and enhancing their business development support. Examples of bioscience investments over the last few years include the following:

- California is investing $100 million in a bioengineering and biotechnology institute, and $500 million in pension funds toward the California Biotechnology Program.
- Pennsylvania has committed to invest $2 billion over a 20-year period in the biosciences including $100 million specifically for the Life Sciences Greenhouses initiative.
- Michigan, through its Life Sciences Corridor initiative, planned to invest $1 billion in the biosciences over a 20-year period. However, this investment level may be scaled back due to programmatic modifications and budgetary concerns.
- Georgia has invested more than $300 million over a 10-year period to build core research facilities and to attract eminent scholars, the majority of whom are in the biosciences and has created a $1 billion Georgia Cancer Coalition.
- Texas appropriated $800 million for seven new or expanded health science research centers.

- North Carolina has allocated half of the state's tobacco settlement to an endowment that has dispersed many of the funds to applied research projects in the biosciences, including a $60 million grant for biomanufacturing and pharmaceutical workforce development.
- New Jersey's university-based bioscience research and development centers accounted for a major share of $125 million in capital funding through two bond issues over the last 15 years.
- Ohio Governor Taft proposed the $1.1 billion "Third Frontier Project" in an effort to make Ohio a leader in new, high paying jobs. This 2002 initiative includes a $500 million allocation to build the "Wright Centers of Innovation," world-class research facilities designed to accelerate the pace of science commercialization. The Centers are collaborations among Ohio higher education institutions, nonprofit research organizations and commercial companies in the biosciences and other technologies.
- Florida used $310 million in one-time federal economic stimulus funds and nearly $200 million in county and local resources to establish a Scripps Institute in West Palm Beach as well as a $30 million Technology Development Fund to create university-based centers of excellence at $10 million each. Florida will expand on this 2003 initiative with $20 million in funding for two additional Centers of Excellence and $25 million to match private donations to state universities.

By comparison, Minnesota is lagging far behind in its investment, yet comparable growth opportunities clearly exist here only if the right strategic investments are made.

Rochester's Unique Advantage

The economic profile of Rochester includes a strong emphasis on research and knowledge-based industries. Its resources are extraordinary:

- Rochester is the state's third largest city with a diverse population approaching 100,000 and a metropolitan statistical area of 172,476.
- It is home to the world-renowned Mayo Clinic, Minnesota's largest private employer with 47,000 workers of which 28,100 work in Rochester. Mayo is a major player in American bioscience research, receiving and investing approximately $372 million dollars in research funds in 2004 and investing $5 million in tuition reimbursement for employee education.

- Rochester's nearly 500 acres, designated for a Bioscience Tax-free Zone, stimulated Mayo Medical Laboratories to move into a vacant building there and complete a $7 million renovation. In the last two years, it has increased its staff by more than 200 FTEs to meet the increased testing workload generated by worldwide customers.
- IBM is Minnesota's largest high-tech employer with 4,400 employees in Rochester. IBM has created a Center of Advanced Studies in Life Sciences and Bioinformatics in Rochester to focus on applied research leading to new products and technology. Notably, IBM Rochester is the development laboratory and production center for BlueGene, the world's fastest supercomputer. IBM invests about $500 million annually in research and development in Rochester, and commits $7 million annually to employee education of which $2 million is for tuition reimbursement.
- In the last ten years, Rochester has grown as a research and development hotbed, attracting more than 30 companies working at the cutting edge of technological, medical, and biological advances. In 1999, a Milken Institute study noted Rochester as having the highest concentration of high tech businesses in the United States.

Several research and academic partnerships exist in Rochester. In 2003, Governor Pawlenty recognized bioscience as a key driver of Minnesota's economic growth. He encouraged the University of Minnesota and Mayo Clinic to form the Minnesota Partnership for Biotechnology and Medical Genomics with $2 million of state funding. This successful partnership fuels the synergy between Minnesota's leading research institutions – Mayo Clinic and the University of Minnesota. It provides Minnesota with the potential to emerge as a leader in the rapidly growing field of biotechnology and medical genomics by leveraging the scientific leadership of its renowned institutions in a powerful research collaboration. In 2005, the Legislature approved a $21.7 million medical genomics research addition atop Mayo's Stabile Building and earmarked $15 million in state research funding for the Partnership. This will attract more research scientists and provide more opportunity for new treatments and technology to fight disease. The Hormel Institute, a unit of the office of the Vice President of Research of the University of Minnesota, housed in Austin, MN, employs some of the world's leading scientists on the cutting edge of cancer research. The Hormel Institute has created collaborative research partnerships with the University of Minnesota Cancer Center, Mayo Clinic, Rutgers University, and the University of Arizona. It is supported by the Hormel Foundation which is one of the

world's largest foundations supporting medical research in the coming decades.

The upside economic potential of these partnerships and research engines for Rochester and the state are substantial. In 2004 an economic impact study[4] was released that examined the potential impacts of the Minnesota Partnership for Biotechnology and Medical Genomics. Mid-range projections from this study showed that economic activity generated by the Partnership could conservatively result in 4,000 Minnesota jobs and $290 million in annual Minnesota economic activity by 2010. By 2020, the study projected that impacts for the Partnership could reach 12,400 jobs and over $900 million in annual economic impacts. Yet, Rochester is projected to be 27,000 workers short by 2020 and will need to grow and attract more talent. Having already exhausted its local labor supply, Mayo Clinic Rochester now relies heavily on buses to carry employees from 36 southeastern Minnesota communities.

While Minnesota has a number of strengths in the biosciences area, what exists in Rochester is different from what is in the Twin Cities corridor. Rochester's strength is currently based on the combination of two principal elements – the Mayo Clinic and IBM. Mayo is the powerhouse when it comes to the clinical application of new technologies in patient care and in the translational research that brings innovation in clinical practice and new procedures. Clearly Mayo also engages in basic science research, but the primary institutional emphasis is on research that transfers results into clinical practice benefiting patients. IBM's focus is in the application of information technology to solve complex problems. The intersection of these two areas is where partnering occurs, and it is happening on a variety of fronts.

In his presentation before the Rochester Higher Education Development Committee in December 2005, Simon Tripp, Principal of Impact Economics, LP, who has conducted several economic impact studies in Minnesota, noted that economic indicators for Minnesota clearly show that our state is well positioned to be a leader in the biosciences given the unique convergence of business, research, and technology, particularly in the Rochester area. This potential growth is highly likely to increase established business retention and expansion, new business formation, and attract more business to the region. However, a critical ingredient is missing to stimulate the economy for Minnesota: the presence of a research university, complementing the research and development focus of IBM and Mayo**.** Studies have emphasized that fast-growing, technology-oriented economies are typically anchored by major research universities interacting with a robust technology-oriented private sector. A study

[4] Tripp, S. and Umbach, P. *Economic Impact Study, Minnesota Partnership for Biotechnology and Medical Genomics*, February 2004.

prepared for the U.S. Small Business Administration found that "Research universities and investment in research universities are major factors contributing to economic growth in the labor market areas in which the universities are situated."[5] Studies by the Office of Technology Policy and others have found that all areas of technology-based economic development in the U.S. have strong concentrations of both university and private research.[6] (The Rochester Higher Education Committee has contracted with Simon Tripp to conduct a complete economic impact study to be finalized in April 2006.)

While the Rochester region has made progress in building a private-sector research and development base, its success at linking this to a university research and education base has only begun to be leveraged. While higher education institutions have a footprint in Rochester, their presence is not yet as visible and impactful as that enjoyed in many other parts of the nation. Rochester has many institutions offering programs, but no four-year or graduate university has established a major identity which is strongly and strategically linked to the technology industry and health care with a research focus.

Current Providers of Higher Education

Several higher education institutions provide programming in Rochester. The University Center Rochester, established through a series of agreements between the Minnesota State Colleges and Universities and the University of Minnesota, was designed to serve Rochester's higher education needs through the public institutions. The Center houses the three public institutions: Rochester Community and Technical College, Winona State University – Rochester Center, and the University of Minnesota Rochester.

The academic scope of most local institutions is focused on business, management, management information systems, education, nursing and other technical and lower division programs. The University of Minnesota and Mayo Clinic are the only institutions that support and conduct advanced research in biosciences and offer doctoral degrees in those areas. Table 1[7] shows approximate degree offerings for higher education programs[8] that now operate in Rochester.

[5] Kirchhoff, Bruce. *The Influence of R&D Expenditures on New Firm Formation and Economic Growth*. Maplewood, N.J.: BJK Associates, 2002.
[6] U.S. Department of Commerce, Office of Technology Policy. Washington, D.C. *The Dynamics of Technology-based Economic Development: State Science and Technology Indicat*ors, 2000.
[7] Greater Rochester Area University Center, 2006.
[8] Additional higher education providers may serve the Rochester area with satellite services.

Table 1
Higher Education Institutions in Rochester

Institution	Approximate Degree Offerings
• Rochester Community and Technical College	70 career, trade Associate
• University of Minnesota Rochester	6 Baccalaureate, 14 Masters, 4 Doctorates, 6 certificates, 5 licensures
• Winona State University – Rochester Center	11 Baccalaureate, 6 Masters with 13 programs
• Mayo Graduate School	Extensive Ph.D./M.S. in Science and Health
• Mayo Medical School	M.D.
• Mayo Graduate School of Medicine	Residencies and Fellowships
• Mayo School of Health Sciences	31 (No Baccalaureate), 1 Masters, 1 Doctorate
• Augsburg College	4 Baccalaureate, 1 graduate
• Cardinal Stritch University	1 Associate, 3 Baccalaureate, 2 Masters, 3 certificate
• Concordia University of Accelerated Learning	5 Baccalaureate; 2 Masters
• Crossroads College (Minnesota Bible College)	Associate, 2 Baccalaureate, 12 majors
• Minnesota School of Business Globe College (opened in 2005)	Associate, diplomas, Baccalaureate, and MBA
• Rochester School of Cosmetology	Specialty careers
• St. Francis University	Unknown
• St. Mary's University of Minnesota – Rochester Center	6 graduate, 1 post Masters, 1 Doctorate
• University of St. Thomas	1 graduate

Many of Rochester's higher education needs have been well served by Minnesota State College and University programs. Rochester Community and Technical College, anchored in Rochester, has grown extensively over

the years. Many private higher education providers have entered the Rochester market, as seen above, providing limited degree offerings and meeting niche needs, but not fulfilling the workforce demands in specialized areas.

The University of Minnesota Rochester has not grown quickly enough to meet the needs of the region. The University of Minnesota established the University of Minnesota Rochester in 1999, although it has offered programs in Rochester since 1966. With a focus on upper division and graduate coursework, it provides four doctoral, fourteen masters, six baccalaureate degrees, six certificates, and five licensure programs. The University of Minnesota Regional Extension Service Office in Rochester is the state's largest regional extension center. In addition to the Minnesota Partnership for Biotechnology and Medical Genomics and the Hormel Institute collaboration, the University of Minnesota has established a Digital Technology Center Industrial Liaison position located jointly at the University of Minnesota Twin Cities and University of Minnesota Rochester. President Bruininks has also recommended the immediate establishment of the University Technology Commercialization Office at the University of Minnesota Rochester.

When Governor Pawlenty asked what he could do to help IBM, I said 'grow research and academic programs that can be provided uniquely by the U of M and do so in Rochester.'

Walt Ling
IBM Senior State Executive

While the University of Minnesota has established a presence in Rochester, what exists now is simply not enough. Despite the investments and incremental steps to advance higher education, funding for expanding upper division, professional, and graduate programs has not come close to meeting the need created by the region's economic and demographic changes and does not have the capacity to serve the research-based needs of Rochester's global industries, particularly health care and technology. For over 30 years, consulting firms and community groups have studied the higher education needs for Rochester and all have concluded that the lack of a research institution is a major impediment to economic growth. Rochester businesses and residents repeatedly call for expanded baccalaureate and graduate programs to meet the region's economic requirements, particularly in specialized areas of health sciences and engineering.

While attempts have been made to collaborate on academic programming at the University Center Rochester, the University of Minnesota has had difficulty transferring courses into its more specialized upper division programs. While highly valued for its open access and workforce development, the academic scope of the Rochester Community and Technical College does not entirely support the academic requirements for the lower division prerequisites of the highly specialized programs proposed by the Rochester Higher Education Development Committee.

Obtaining adequate and appropriate space for the University of Minnesota Rochester, particularly for faculty and staff offices, is become increasingly difficult at the University Center Rochester. Increasingly, large ITV classrooms cannot be scheduled at times that meet University of Minnesota Rochester academic needs. As the University of Minnesota Rochester launches new degree programs, many of which will be taught via hybrid technology methods, enrollments are increasing beyond the current capability of the University Center Rochester to provide classrooms and advanced health sciences facilities such as chemistry and biology laboratories. Even at its current enrollment, the University of Minnesota Rochester and the University of Minnesota Regional Extension Office have outgrown the availability of acceptable facilities.

Minnesota must strategically align its higher education resources to keep our industries globally competitive so our state continues to create new medical and technology opportunities that benefit all of Minnesota, our nation, our world.

A.M. (Sandy) Keith
Chief Justice, Minnesota Supreme Court (retired)
Executive Director, Rochester Downtown Alliance

Because of the lack of a university research, development, and education engine to support parallel progress in the private sector, Rochester has so far failed to reach its full potential in producing a critical mass of new technologies, new enterprises, and resulting employment and economic gains. **Currently, Rochester is unable to compete with other states in fully developing a technology-driven economic base, despite having powerhouse institutions like Mayo and IBM, because it does not have the research university driver – a key, proven catalyst for modern technology-driven economic development.**

The Opportunity Lost in Not Making the Investment

By not growing the University of Minnesota in Rochester, the state will be choosing to significantly limit its participation in the "knowledge economy" – the central driver of economic growth, quality of life gains and economic success. Rochester has key private-sector research and development engines, but national studies prove that the presence of a major research university is also required to really power the knowledge economy and to provide the skilled human capital required to populate and grow innovation-driven enterprises.

Technology, talent, and capital are geographically mobile and without the presence of a research-based knowledge-generating university, it is unlikely that southeast Minnesota can attract and retain the talent that it needs to grow and staff technology-based and biosciences industry. Both the Mayo Clinic and IBM are multi-location organizations and may choose to grow somewhere other than Rochester if better partnerships, talent, and other resources are available in competing locations outside of Minnesota. As a high technology economy, many of Rochester's enterprises recruit the top twenty-five percent of college graduates, most of whom come from other parts of the county, because the specialized talent they need is not grown in Rochester.

Spin-off research enterprises tend to locate close to the institutional source of knowledge that created them, most often that being a university. So Minnesota stands to lose significant potential growth without a research university in Rochester.

II. The Vision

The Rochester Higher Education Development Committee recommends the establishment of a world class higher education institution that leverages the University of Minnesota's research capability, in partnership with IBM, Mayo Clinic, and other industry leaders to build signature academic and research programs that complement southeast Minnesota's existing leadership roles in health sciences, biosciences, engineering, and technology. Educational programs will provide application to economic activities via innovation, translational research and clinical experiences. This institution will have a distinct identity and one governing entity. This institution will be the University of Minnesota Rochester.

The University of Minnesota is best positioned to fulfill the vision, given its international prominence in academic programs and research in health care and technology as well as its existing presence and commitment to partnerships with IBM, Mayo Clinic, and the University of Minnesota Hormel Institute. As stated by Dr. Hugh Smith, chairman of the Mayo Clinic Board of Governors, who voiced his support for a research-oriented University of Minnesota in Rochester before the Rochester Higher Education Development Committee in October 2005, "You can draw only one conclusion. It's going to need the muscle of the University of Minnesota." President Robert Bruininks in his October presentation to the Rochester Higher Education Development Committee stated, "The University of Minnesota is ready to take the lead in public higher education in Rochester."

> *You can draw only one conclusion. It's going to need the muscle of the University of Minnesota.*
>
> Dr. Hugh Smith
> Chair
> Board of Governors
> Mayo Clinic

The growth of the University of Minnesota in Rochester, and the associated biosciences business expansion that would result, will create opportunities for other institutions of post-secondary education through stimulation of the need for an appropriately educated workforce at multiple educational levels. While four-year and advanced degreed professionals are crucial to new knowledge development and innovation, it is also the case that increased skills and knowledge are required across the total workforce. Lester C. Thurow, author of Building Wealth: The New Rules for Individuals, Companies and Nations in a Knowledge-Based Economy[9] notes that:

[9]Lester C. Thurow. *Building Wealth: The New Rules for Individuals, Companies, and Nations in a Knowledge-Based Economy*. New York: Harper Collins, 1999.

A knowledge economy requires two interlocking but very different skills sets. Knowledge creation requires highly educated creative skills at the very top of the skill distribution. Knowledge deployment requires high-quality skills and education in the middle and bottom of the skills distribution.

I would classify this as an absolute must-do investment for the state.

Simon Tripp
Economic Analyst
Impact Economics

The public investment in a research university in Rochester will serve as an innovation engine, a technology incubator, and a catalyst for partnerships and new enterprise formation. It will provide a breeding ground for new ideas and a route to market for the intellectual property created. It will provide critical human capital in the form of entrepreneurs, managerial leadership, and uniquely skilled science and technology workers to staff high paying jobs.

A. Signature Academic Partnerships and Programs

Signature academic and research partnerships, primarily with Mayo Clinic, IBM, and the University of Minnesota Hormel Institute and others would provide the focal point of an expanded University of Minnesota in Rochester which would be a unique and complementary institution for the region, state, nation and international communities, dedicated to technology, engineering, biosciences, health care, and leadership education. The Rochester Higher Education Development Committee recommends that these signature academic partnerships be:

- Research-based
- Innovative
- Distinctive

The Twin Cities campus and other University of Minnesota resources would be leveraged to provide top quality academic programs and economic development activities in Rochester. This higher education institution would capitalize on the unique technical capabilities and synergies of the activities in the Rochester area and be recognized as a renowned international higher education institution. The intent is not to duplicate what exists on the University of Minnesota Twin Cities campus, but to draw more extensively on its resources and combine them with the unique knowledge and skills inherent in the region.

Rochester programs would be high quality, research-based programs that draw upon the expertise of world-class University faculty. Research would focus on technology transfer, intellectual property development, and the incubation of new ideas and products. Endowed chairs, joint professorships with IBM and Mayo Clinic, support faculty, post-doctoral

and graduate students would contribute to the powerhouse of research and academic talent. External accelerators would include the National Science Foundation (NSF), National Institute of Health (NIH), and other benefactors to fund research projects.

Program development could expand upon existing business and industry partnerships to maximize efficiency and effective use of resources (e.g., faculty, facilities, research capability) and provide unparalleled internship experiences for students. Existing University outreach and technology transfer mechanisms would maximize the benefit to the state and national economy and quality of life.

This expansion of higher learning represents an integral piece of Rochester's contribution to the state and nation.

John Wade
President
Rochester Area Chamber of Commerce

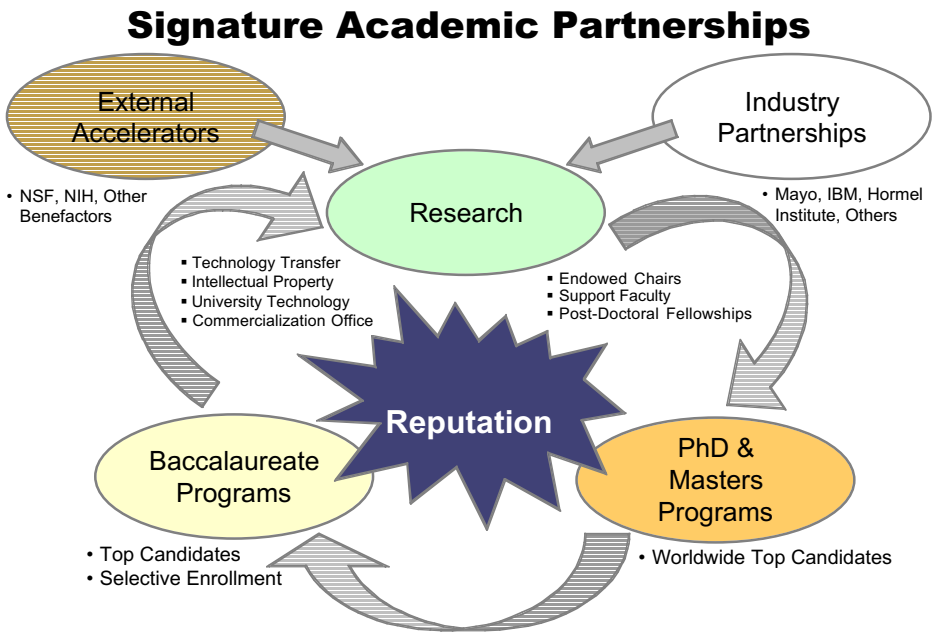
A new innovative, hybrid learning platform would be created that employs the University's most up-to-date learning technologies and delivery mechanisms and embeds leadership and entrepreneurship processes in its design. Expansion of public higher education offerings would avoid unnecessary duplication of existing programs in the greater Rochester region and with the Twin Cities campus.

These academic programs should result in three outcomes that will contribute to Minnesota's economic growth:

1) *Technology transfer into the marketplace,* i.e. turning the applied research into new innovations leading to new companies, including the development of intellectual property and a mechanism to license/release.
2) *Development of management skills* for graduate students and professors who can then take the ideas and turn them into viable products and companies.
3) W*ork force development*, with the starting point being the unique and enhanced skills and programs Mayo has defined in the allied health sciences area.

Academic programs would focus on the baccalaureate, masters, and Ph.D. level, attracting worldwide top candidates and employing selective enrollment. The University of Minnesota would be responsible for expanded undergraduate programs in specialized areas, i.e. Engineering/Technology and Allied Health as proposed below. Figure 1 below depicts the Signature Academic Partnerships.

Figure 1



The University of Minnesota Rochester would continue to collaborate with other higher education providers seeking partnerships to develop, market, and deliver baccalaureate and graduate degree programs in a creative, timely and efficient manner, benefiting students.

Signature Program Areas

The following signature programs are recommended for development and are in priority order. The Rochester Higher Education Development Committee believes that these are the subjects that most closely align with Rochester's economic needs and are not now addressed in a major way by other higher education institutions. These align to current work underway in Rochester between IBM, Mayo, and the University of Minnesota. By leveraging these specialized fields of study, Minnesota will benefit by attracting talent to these critical higher education opportunities and from the resulting technology transfer.

Engineering/Technology

1. Biomedical Informatics

   Bioinformatics explores and seeks to understand biological data from complex experiments, such as genome sequencing and gene expression chips. The proposed program builds on the research and

academic strengths of cross-disciplinary faculty in Computer Science, Biomolecular Engineering, and Health Sciences.

Powerful data management tools and computational techniques are required now more than ever to store, share, study and compare the burgeoning library of biological information. Bioinformatics combines the tools of mathematics, computer science, and biology with the aim of uncovering patterns and associations within and between sets of biological data. The primary focus of the collaboration between Mayo Clinic and IBM is in this area, and, as a result, Rochester is an international leader in this field.

2. Computational Biology

Computational biology entails the discovery and implementation of algorithms that facilitate the understanding of biological processes through the application of statistical and machine learning (i.e. "self learning" whereby the computer can adapt to the unique problems being solved) techniques as well as computer simulation capabilities, all enabled through the application of super computing technologies. The combination of Mayo's expertise in the areas of biological system modeling with IBM's leadership in supercomputing in Rochester make this a natural fit. Projects are already underway in this area as a part of the collaboration between Mayo and IBM.

3. Biomolecular Engineering

The immense growth of biological information stored in computerized databases has led to a critical need for people who can understand the languages, tools, and techniques of mathematics, science, and engineering. A classically trained scientist may be unfamiliar with the statistical and algorithmic knowledge required in this field. A classically trained engineer may be unfamiliar with the chemistry and biology required in the field. This type of program strives for a balance of the two: an engineer focused on the problems of the underlying science, or, conversely, a scientist focused on the use of engineering tools for analysis and discovery.

Biomolecular engineering will develop professionals that deliver innovative solutions while conducting pioneering high-impact research spanning basic science to clinical and technological applications, and serve to stimulate the growth and development of economies focused on this scientific arena. Biomolecular engineers solve medically relevant problems. The areas of interest may include medical device design, fabrication and testing; biomedical informatics; functional imaging and tomography; biomaterial

development and biocompatibility; artificial tissue and organ fabrication; cell- and biomodule-based sensors and therapeutics; gene therapy development; and biomedical microsystems. These skills are needed to provide essential expertise for the Rochester-based bioscience and biotechnology partnerships.

4. Computer Gaming/Simulation

   Computer gaming technology today is setting the agenda for the overall future of computer design. Computer gaming hardware and software technologies, especially in the areas of visualization and simulation capabilities, directly align with emerging needs in the biosciences. IBM's global leadership in the computer gaming space, combined with Mayo's increasing focus on visualization and simulation technology applications in medicine make this a natural fit.

5. Nanotechnology

   Nanotechnology is just emerging in biomedical applications, as well as in information technology products and services. Nanotechnology is the science of the ultra-small. (One nanometer equals one billionth of a meter; it would take 100,000 nanometers lined up side-by-side to equal the diameter of a human hair). This area of science and engineering might create manmade molecules that can deliver drugs directly to sick cells; tiny sensors that monitor oxygen levels in the bloodstream; or molecular surgery to remove defective genes. It is particularly important to the Rochester higher education initiative because of its application of cross-disciplinary engineering and health sciences knowledge. The goal would be to develop professionals that can create and market applications for nanotechnology in medicine, the biological sciences, and the environment.

   The base technologies behind nanotechnology are firmly rooted in the same studies as those required for semiconductor and integrated circuit production. The confluence between these areas, especially as nanotechechnology is applied to biomedical issues, is a natural build upon the skills inherent in the region. **This is an emerging area where the University of Minnesota Rochester and the State of Minnesota could provide leadership to the world.**

Health Sciences

1. Biomedical Informatics

Biomedical Informatics is the science underlying the acquisition, maintenance, retrieval and application of biomedical knowledge and information to improve patient care, medical education, and health sciences research. It is an interdisciplinary and interprofessional field of scholarship that applies to computer, information and cognitive sciences to promote the effective and efficient use and analysis of information to improve the health of society. Establishing a biomedical informatics program in Rochester would foster partnerships that bring together the expertise and resources of the University of Minnesota, IBM, and Mayo Clinic into a unique and distinctive collaborative research and education model. (This program is also listed under the Engineering/Technology section of this report.)

2. Allied Health

Allied Health education programs include a wide variety of health care professions requiring different levels of educational attainment. Regional, state, and national workforce needs in many of these allied health professions have not been met by current education programs. Today there is a shortage of qualified health care workers and many of these professions are expected to have personnel with increased academic preparation at the baccalaureate, masters, and doctorate levels. Recently, the University partnered with Mayo to provide baccalaureate degrees in radiation therapy and respiratory care. The need for additional degrees in many specialty areas must also be considered along with increasing accreditation standards. There is a need for baccalaureate and masters level programs to include a research component. A masters degree program in Health care Administration is one example, to be offered through the School of Public Health.

The University of Minnesota Academic Health Center (AHC) is developing the "The University of Minnesota Center for Allied Health Programs." The goal of this initiative is to address the increasingly serious workforce shortages of allied health professionals throughout Minnesota. The development of the Center will initially focus on Rochester and the Twin Cities and will include two University of Minnesota Allied Health Center health programs in clinical laboratory science and occupational therapy. The programming is being designed as a hybrid educational model that will use classroom and online instruction, simulations, and integrated experiential education.

I cannot say enough good things about the University of Minnesota's Executive Masters in Public Health program. I hope that the University of Minnesota continues to grow and offer more opportunities to students in Rochester.

Dr. Ericka Tung
Student
University of Minnesota
Rochester

3. Nursing

Currently there are over 6,000 nurses employed in the Rochester region. Nurses provide direct patient care and also serve as educators and researchers. Issues of workforce shortages, advancing median age of nursing professionals, increased educational requirements by employers and accrediting agencies, and expansion of mid-level providers, contribute to the health care community needs which are not currently being met and are not expected to be met in the future.

The School of Nursing at the University of Minnesota is a leader in developing distance education and expedited professional degree models. In 2000, the University of Minnesota Rochester established a baccalaureate degree nursing program in Rochester. Its faculty is committed to strengthening programs in Rochester through public/private partnerships to increase the nurse leadership capacity to positively affect the care of Minnesota citizens. The University of Minnesota Rochester connection with the School of Nursing will continue to strengthen clinical research innovation through knowledge creation and the clinical translation from the laboratory bench and classroom to the bedside.

To achieve this vision in Rochester, the School of Nursing faculty is committed to offering a professional masters degree for second degree students. This degree is designed for students with a variety of academic foundations to enter the expedited professional masters degree in nursing programs. The School is also committed to developing the Doctor of Nursing Practice in Rochester. Through the synergy of these programs and academic partnerships, the School of Nursing seeks to increase research capacity by identifying the most capable nurses to seek the Ph.D. degree.

4. Pharmacogenomics

Pharmacogenomics is the study of how drugs and genes interact. This is the application of genomics information and technologies in drug discovery and development to identify, on the basis of genetic make-up, those individuals who will respond more favorably to a drug or those who are at risk of side effects from the drugs. It also is the genetic approach to identifying drug targets linked to a critical disease pathway and to understand the genetic variation of those targets. Expansion of this program in Rochester would provide the opportunity to build on the University of Minnesota – Mayo partnership in Biotechnology and Genomics. **This collaboration, with the computer technology infrastructure supported by IBM, will propel Rochester and Minnesota into a leadership role in this arena.**

5. Pharmacotherapeutics

Pharmacotherapeutics is the study of how specific drugs treat different disease states. The program has a pharmacology foundation. It also builds on pharmacogenomics and its focus is the targeting of specific drugs to specific sites or locations in the body for a desired result. This research-based program is directed toward ultimately meeting the health care needs of the citizens of Minnesota. Establishing this program, in partnership with the Hormel Institute, would include a focus on agricultural influences relating to human health care and disease.

6. Genomics

Genomics is the field of study that seeks to understand the structure and function of all genes in an organism, based on knowledge of the organism's entire DNA sequence and extensive reliance on powerful computer technologies. Genomics is the comprehensive study of the interactions and functional dynamics of whole sets of genes and their products. The partnership in genomics is now entering its third year of successful collaborative research. Initial funding supported four projects and recent allocated funding will support an additional seven to eight projects. This new program will educate a new talent pool to help this research partnership flourish.

7. Molecular Biology

Molecular Biology chiefly concerns itself with understanding the interactions between the various systems of a cell, including the interrelationships of DNA, RNA, and protein synthesis, and the mechanisms by which these interactions are regulated. This study of biology at the molecular level overlaps with other areas of biology, particularly genetics and biochemistry. Research-focused education in this program would prepare graduates to enter the competitive laboratory environment in the Rochester area. Unique partnering opportunities with inclusion of state-of-the-art computer technology would distinguish this program.

Business

Business and management skills are critical in developing the management talent necessary to drive the economic development from the proposed programs. These processes and skill sets would be imbedded in the signature academic programs:

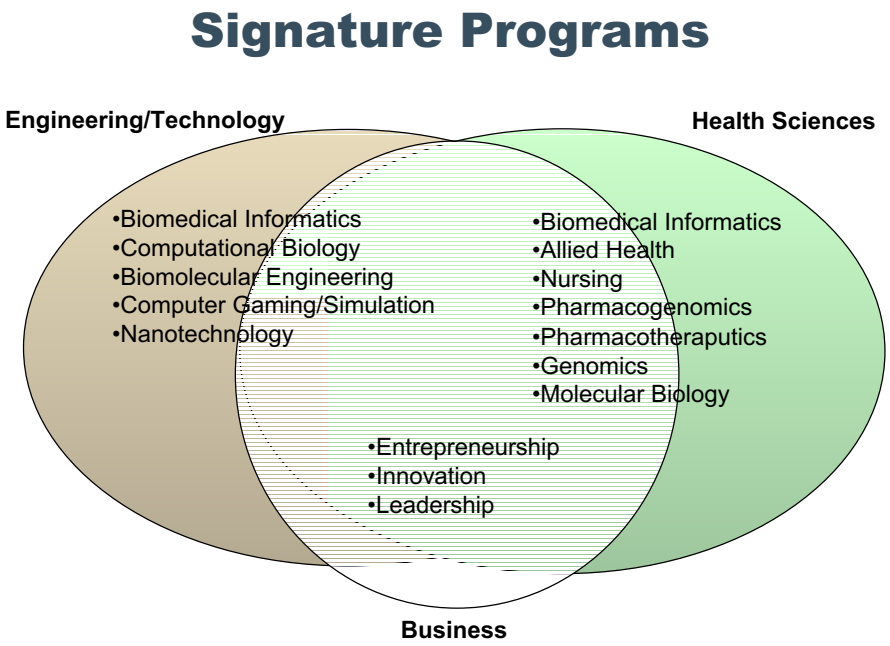
- Entrepreneurship
- Innovation
- Leadership

Business education allows students to develop opportunity, marshal resources, and understand how to develop a team to accomplish the building of a new venture. These skills are essential to the transfer of technology to the marketplace leading to significant economic development for the area, state, and nation.

The planned Technology Commercialization Office at the University of Minnesota Rochester is an industrial liaison function that will be the essential link in moving from ideas to the marketplace. The Rochester Higher Education Development Committee recommends this initiative have a high priority and sufficient resources. The Technology Commercialization Office will serve as the catalyst to foster the development of public and private biosciences partnerships and spur economic development in parallel with the simultaneous development of the academic programming at the University of Minnesota Rochester. Public and private partnerships are envisioned between and among bioscience and biotechnology companies, Mayo/University of Minnesota Genomics research partnership, Mayo/IBM informatics initiatives, new start-up ventures, move-in companies, and the University of Minnesota Rochester.

Figure 2 summarizes the proposed Signature Programs at the University of Minnesota Rochester, and their relationship to one another.

Figure 2



B. Recommended Institutional Roles for Public Higher Education Providers in Rochester

Public and private colleges and universities, career schools and post-secondary education institutions will continue to have a very important and complementary role to play in Rochester and southeast Minnesota. The Minnesota State Colleges and Universities will remain an important player. Increased technology and innovation-driven economic development will drive demand for skilled workers across multiple educational levels and all regional education and training institutions have an opportunity to contribute and benefit from this.

The expansion of the University of Minnesota in Rochester will undoubtedly benefit MnSCU programs as the economy grows and new workers are needed at all levels of health science and technology fields. It's a win-win for both systems.

Senator Nancy Braatas (retired)
Minnesota State Colleges and Universities Trustee (retired)

C. Attracting and Retaining Top Students

Signature programs require signature students – recent high school graduates and transfers from other higher education institutions that have the necessary prerequisites. The students will be highly sought by other top colleges and universities before and during their college career, therefore, the University of Minnesota Rochester must be competitive in recruiting, teaching, academics, student services, facilities, and student life. Other universities will offer complete four-year baccalaureate programs with all of the advantages that come from attending one institution for the full four years. It is important that the University of Minnesota Rochester, in order to be successful, provide the following academic support commonly associated with a four-year institution:

- A single recruitment and admission process for students starting as freshman, including those who may transfer from other institutions.

- Advisors and faculty who are knowledgeable about each degree program from freshman through senior years and can advise students about the best choice of courses.

- Courses available to meet the requirements of the degree in the shortest possible time.

- General education elective courses that may be taken throughout the four years to add balance to the required professional courses thus allowing some of the major courses to be taken in the first two years. It should be possible for some of these courses to be taken at a partner institution under the direction of the University of Minnesota Rochester.

- A single course catalog, academic schedule, and student record keeping (transcripts and financial) system.

- Maximum financial aid benefits available to students taking courses from a single institution.

- More consistent and enhanced focus on student life activities to increase students' sense of the University of Minnesota Rochester community over the full four years, promoting retention and graduation rates.

- Transfer options in cooperation with public and private colleges and universities to attract highly competitive students into the new institution's signature baccalaureate/graduate degree programs.

D. Governance

There is an existing Joint Powers Agreement between the University of Minnesota and the Minnesota State Colleges and Universities dated November 24, 1997, as amended by Statements of Principle dated May 1999 and July 2002. The Rochester Higher Education Development Committee recommends that the existing Joint Powers Agreement between the University of Minnesota and the Minnesota State Colleges and Universities should be phased out as soon as practical, with the University of Minnesota honoring existing financial commitments.

The University of Minnesota Board of Regents will be the governing body for the University of Minnesota programs and activities in Rochester as proposed by the Rochester Higher Education Development Committee.

The current University of Minnesota Rochester Advisory Committee established pursuant to c. 703 of the Laws of Minnesota 1988 should be replaced by a high level "Board of Advisors" appointed by and reporting to the Chief Academic Officer of the University of Minnesota Rochester. This group should include leaders of major collaborative partners with the University of Minnesota in Rochester and other leaders of business and industry in the Rochester area.

E. Site and Facility Needs of Programs

Location of future facilities should take into account the close public and private partnerships that are the hallmark of this enterprise. New and existing University programs in Rochester will be most effective and efficient if operated in close proximity to Mayo Clinic to facilitate sharing of classroom, laboratory, and administrative space. The most viable concept is to establish a downtown presence for current and future programming. Such a site would serve well to support the University of Minnesota programs including the proposed University of Minnesota Center for Allied Health Programs. With a downtown location in close proximity to the Mayo Clinic, health sciences students will have the advantage and convenience of classroom lectures, practice labs, and clinical experiences within walking distance.

As the City of Rochester continues to focus on revitalizing its downtown area, the presence of the University of Minnesota Rochester will likely spawn private-sector research and development companies that are eager to harvest the pool of intellectual capital for sharing information, generating knowledge and employing team-based research in order to bring their products to market. As the University of Minnesota Rochester continues to increase its programming at the graduate level, many of the enrollees will be non-traditional students that work at Mayo or in downtown businesses. Close access to University graduate programs facilitates their continuing education. Graduate students and faculty would also be in close proximity to the Mayo/University of Minnesota biosciences partnership research initiatives and the Mayo/IBM bioinformatics project.

In order to be considered a world-class institution and attract equivalent faculty, it is imperative that the University of Minnesota Rochester itself achieve such a tenet by establishing its own identity independent of the University Center Rochester campus which the community associates primarily with the Rochester Community and Technical College.

Therefore, both interim and permanent facilities for the University of Minnesota Rochester must be built in a manner that:

1) Establishes the University of Minnesota Rochester as a premier student oriented instructional and research center;
2) Dovetails with the existing creative intellectual and economic vitality of the community; and
3) Helps create a physical sense of place that is recognized worldwide as an expression of excellence in collaboration with Mayo Clinic and IBM.

Together with the City of Rochester and private sector, it is envisioned that a University of Minnesota Rochester campus integrated into the central city will become an institution of choice for both outstanding students and world-class researchers.

Facilities Principles and Assumptions

Several broad principles and assumptions guide the facilities/campus planning. These include, but are not limited to:

1. Facilities and campus development must primarily be designed and located to support the academic programs, research initiatives, and outreach of the University of Minnesota Rochester and the Minnesota Regional Extension Office.

2. Short-term, the University of Minnesota Rochester may be required to lease space to support existing academic programs, including administrative space for Extension services, due to constraints at University Center Rochester.

3. Mid- to long-term, the University of Minnesota Rochester would most likely benefit from being located in downtown Rochester, adjacent to and integrated with the Mayo Clinic campus in order to leverage the knowledge, expertise, and unique research facilities each organization will bring.

4. The University of Minnesota Rochester will require a variety of partnerships with the City of Rochester, the State of Minnesota, and other public and private entities to share the various costs of facility projects (e.g., land acquisition, infrastructure improvements, debt service, etc.).

5. State-of-the art, technology-rich instructional space and research space will be constructed in a manner that fully supports programmatic

offerings in a financially responsible way, taking into account the amount of space needed and construction time.

6. Funding of new facilities must supplement - not supplant - and be in addition to the University of Minnesota's current six-year capital plan as approved by the Board of Regents.

Interim Campus Assumptions

The University of Minnesota Rochester currently has approximately 416 students, 30 staff/faculty, and 12 separate academic programs occupying roughly 26,000 gross square feet. This space is shared between the University of Minnesota Rochester and the University of Minnesota Regional Extension Office. The assumption is that both will relocate to downtown Rochester in phases over a five-year period.

Initially, approximately 50 percent of current University of Minnesota Rochester programs will relocate the first year, with the remainder relocating in year two. To accommodate an interim relocation, the University of Minnesota Rochester anticipates leasing up to 30,000 square feet in downtown Rochester for a period of five years – or to the point at which programmatic offerings, space requirements, and utilization give reason for construction of the first permanent campus facility. At such time, Rochester Higher Education Development Committee projections show a facility is merited. The Rochester Higher Education Development Committee proposes that the University of Minnesota Rochester establish a permanent campus in downtown Rochester adjacent to and integrated with the Mayo Clinic campus. To begin with, the University of Minnesota Rochester campus may require land area equal to two city blocks near Mayo Clinic, and eventually as many as six city blocks in total. Master planning is proposed to begin in year three and will lead to improved definition of the University of Minnesota Rochester's mid- and long-term requirements.

Additional interim assumptions include:

1. Years one through five assume leasing approximately 30,000 square feet in downtown Rochester. Leasehold improvements, incurred in year one and inclusive of furniture, fixtures and equipment, are estimated to cost roughly $1.4 million based on the projected instructional space-type needed.

2. An interior design allowance of 15 percent is anticipated for a consultant to design leasehold improvements.

3. Fifty percent of current University of Minnesota Rochester programs located at University Center Rochester will relocate in the first year, and the balance in years two through five together with the University of Minnesota Regional Extension Office. A facilities agreement dated September 2001 between the University of Minnesota Rochester and Minnesota State Colleges and Universities, with Rochester Community and Technical College as landlord, requires a six-month notice to vacate.

4. It is assumed the University of Minnesota Rochester will exercise notice provisions as outlined in current lease agreements. However, it is unlikely that sufficient notice can be given to Minnesota State Colleges and Universities/Rochester Community and Technical College in time to vacate without penalty in the first year and the entire $160,000 estimated annual obligation will be due. Year two assumes adequate notice is given for the remaining University of Minnesota Rochester space; hence, an obligation of $80,000. Years three through five assume that the Minnesota Regional Extension Office will remain in the Heinz Center until a permanent campus is developed.

5. Given project relocation costs, all lease and debt agreements will be reviewed, revised, and renegotiated in a manner that does not substantially disadvantage any current partner of the University Center Rochester. Impact to the current University Center Rochester campus will be addressed.

Permanent Campus Assumptions

1. Master planning of a permanent campus will be performed in union with the City of Rochester and private partnerships and is expected to commence in year three, utilizing a world-class land-planning firm.

2. Land acquisition assumes an initial purchase of approximately 90,000 square feet, or 2.1 acres, near the Central Development Core – Medical Area, at $50 per square foot. Construction of a new 60,000 square foot building would begin in year four for occupancy in year six. Ultimately, as many as six contiguous city blocks may be needed depending on the results of the master plan.

3. The initial 60,000 square foot building assumes three-stories with 20,000 square foot floor plates and designed with flexibility to accommodate other uses in the future.

4. Soft costs typically include fees for items such as architectural, engineering, geotechnical, environmental, and legal services; surveying;

permits; project management; financing; furniture; fixtures; equipment, and contingences.

5. Operating costs are the annual costs required to operate and maintain the building (e.g., electricity, heat, water, maintenance, reserves, etc.).

6. Use of sales tax revenue assumes the City of Rochester will assign the $11.49 million balance to the University of Minnesota Rochester for debt reduction of qualifying capital expenditures such as land acquisition and construction of permanent facilities.

7. Debt service assumes bond financing at 5 percent interest, 20-year term, comprised of the following capital expenditures: master planning, land acquisition, construction and build-out of 60,000 square feet, and soft costs.

F. Funding Requirements and Sources

Budget Principles and Assumptions

Given the programmatic and facilities plan cited above, several broad principles and assumptions have been developed to guide budget planning. These include:

1. Resources for new and additional efforts in Rochester must supplement, not supplant current University resources. This plan will require dedicated additional state and local funding augmented with strategic private investments, in order to be realized.

2. Current University resource commitments to the University of Minnesota Rochester will continue in support of current programming.

3. Tuition dollars generated through the University of Minnesota Rochester activities will continue to be invested in support of instructional programming offered to the citizens of southeast Minnesota.

4. Supporting the wide variety of programs proposed will continue to require investments both at the University of Minnesota Rochester and on the Twin Cities and/or coordinate campuses.

5. Many of the proposed programs are at the graduate and professional level, or are advanced undergraduate programs requiring specialized faculty and facilities. These will be relatively high cost programs compared to a standard undergraduate instructional model.

6. Enrollments will continue to grow as programs are developed and implemented, and it is assumed that growth will be sustained in health care and technology related employment in southeast Minnesota.

7. Because many of these programs are in the planning stage, standard revenue and cost estimation methodologies have been employed to estimate program budgets. Cost and revenue assumptions may change as program planning evolves.

Current Program Expenditures and Revenues

The University of Minnesota Rochester had 416 students (headcount) enrolled in Fall 2005. The student enrollment profile is shown below:

Fall 2005 Enrollment
University of Minnesota Rochester

Undergraduate	167	Areas of Study	
Graduate	249	Education	134
	416	Nursing	90
		MBA	33
		Health Sciences	33
		IT	32
		Social Work	17
		Liberal Arts	13
		Public Health	11
		BFA	7
		Rhetoric	6
		Continuing Ed	13
		Non-degree	27
			416

The University of Minnesota expends approximately $5.7 million annually on activities related to Rochester programming. Current expenditures can be broken into four large categories:

1. Expenditures attributed to the University of Minnesota Rochester, expended primarily for student services, technology support, library expenditures, ITV and other direct instructional costs, and administration: Approximately $1.7 million annually.

2. Expenditures on the Twin Cities and coordinate campuses, primarily related to delivery of instruction (e.g., faculty salaries and fringe, travel, library resources, ITV expenditures on the Twin Cities and Duluth campuses, etc.): Approximately $2.3 million annually.

3. Resources committed to delivering the University of Minnesota Extension Service programming: Approximately $1.4 million annually.

4. Lease and debt costs related to facilities and space at the University Center Rochester campus: Approximately $300,000 annually.

Revenues supporting these activities come from two primary sources: tuition (approximately $1.8 million), and state support. As noted above, it is assumed that these programs will continue approximately "as is" for the foreseeable future. The financial model appears in Appendix C – University of Minnesota Rochester Statement of Investment.

Proposed New Expenditures

New expenditures can be put into five broad categories:

1. Strengthen current programming
2. Allied Health Center technology infrastructure and academic leadership funding
3. New and expanded instructional programs
4. Research and liaison programs
5. Facilities

In all of the expenditure estimates, an annual cost growth of 5 percent per year is assumed, in line with the national standard Higher Education Price Index (HEPI), which serves as the best standard inflator for higher education costs. It is further assumed that a 10 percent enrollment growth in Fall 2007 and 15 percent enrollment growth thereafter will occur, resulting in an instructional cohort of approximately 1400 students.

Strengthening Current Programming – Higher education costs continue to grow beyond the rate of general inflation primarily due to three factors. First, as a people-intensive business, compensation increases – especially health care costs -- have had a disproportionate impact on higher education. Second, more recently facilities costs, and especially utilities, have caused cost increases at a faster than anticipated rate. Third, higher education has some unique costs not found in other industries such as libraries and high-end technologies. Maintaining current programming will require more than an additional $200,000 annually.

Investing in and expanding the University of Minnesota Rochester will prove to be one of the wisest choices our community and state leaders have ever made. The risk of doing nothing is far greater.

Claudia Knowlton-Chike
Chair
Greater Rochester Area University Center

New Allied Health Center Technology Infrastructure and Academic Leadership will include 4 components:

1. A customer-oriented student services and educational support technology platform, which will include expansion of the Minnesota Course Applicability System with the Minnesota State Colleges and Universities, a new transcript analysis tool, a statewide catalogue and schedule, and tools such as e-portfolio for continuous professional development.

2. A robust learning technology platform that includes extensive use of Web CT, Breeze technology, portals, and technology-enhanced learning toolkits.

3. A curriculum development technology platform that includes an instructional design unit, learning object library capacity, common web-based educational templates, and web-based tools for clinical rotations.

4. Academic leadership that includes an Allied Health Center director and administrative staff.

New and Expanded Instructional Programs – Costs for new programs have been estimated based on fully loaded instructional costs of similar University of Minnesota programs in the Institute of Technology and the Academic Health Center. It is further assumed that students in these new programs will attend on average about three-quarters time, a bit higher than the current average student at the University of Minnesota Rochester. Though it is anticipated that most of these programs will be able to accommodate full-time students, it is assumed that working professionals in southeast Minnesota will continue to be a significant portion of the student body. Finally, knowing that some of the proposed programs are truly cutting-edge with high delivery costs, it is assumed that half of the new students end up in higher cost programs, and the other half enroll in more moderate cost programs.

Research and Liaison Programs – The goal of the liaison program is to foster the development of public and private bioscience and technology partnerships to spur economic development in Rochester with simultaneous development of related academic programming at the University of Minnesota Rochester. Public and private partnerships are envisioned between and among bioscience and biotechnology companies, Mayo/University of Minnesota Genomics research partnerships, Mayo/IBM informatics initiatives, and University of Minnesota Rochester.

Facilities – As noted above, the Rochester Higher Education Development Committee recommends the University move from its current space at

University Center Rochester to leased space near the Mayo Clinic, with the assumption that University of Minnesota Extension Service operations might remain at the Heinz Center for a longer period of time. Annual lease costs are based on current Rochester downtown lease rates, and facility improvement estimates are based on recent facility conversion costs for Academic Health Center programs on the Twin Cities campus. Year six of this plan models building a 60,000 square foot facility costing $37.8 million, with a 20-year bond payback rate.

Potential Funding Sources

Funding for expansion of higher education efforts in Rochester is expected to come from a number of sources. The next three years are critical to the success of the venture. To ensure that the expansion of the University of Minnesota Rochester gets off to a strong start, the financial model included as Appendix C makes several resource assumptions, and presents a balanced budget scenario through FY09.

Office of Higher Education (OHE) Planning Allocation – In the model it is assumed that the $3 million of resources allocated to the Office of Higher Education is available to help fund this plan. It is further assumed that these resources will be released immediately so that some planning and start-up expenditures can begin in FY06.

State Support – As noted above, the state's share of expanding the University's commitment in the Rochester area must be funded by providing new resources from the state, not by supplanting or shifting current levels of state funding from the University's existing budget. In the financial model, which balances the budget through FY09, a $5 million allocation in each of the next two fiscal years is assumed, with $6.3 million required in FY09. Continued program growth will require additional investment in FY10 and beyond. However, it is important that the University have a sufficient infusion of start-up funding and a balanced program for the first three years, in order to get the planned expansion off to a strong start.

It is further assumed that the state will fund two-thirds of a new permanent facility for the University through a state capital allocation, and that the state pays for resultant debt service on the state capital allocation. The remaining one-third of construction costs is assumed to come through Rochester city sales tax revenues (see below). As with operating allocations, it is assumed that capital appropriations will supplement and not supplant the University's current six-year capital plan as approved by the Board of Regents.

Tuition and Fees – A 6% annual tuition increase has been modeled and as well as an increase in student credit hour load. The assumption in the model is that students in current programs will continue to average the same number of credit hours as they do currently. A portion of students in new programs, however, is assumed to have a profile more like full-time students. An attempt was made to provide a realistic tuition revenue projection, but note that the projection includes several growth assumptions.

City of Rochester - The financial model relies on using $11.49 million of city sales tax to fund facility planning, land acquisition, and construction of a new permanent University of Minnesota facility. This use would need approval by the City of Rochester. Appendix D acknowledges the contributions of the City of Rochester and Olmsted County to higher education initiatives since 1984, the majority of which have been to fund higher education programs other than the University of Minnesota Rochester.

Public-Private Partnerships – Though no resources of this type are included in the model, it is assumed that public-private partnerships can be expanded to help close future funding gaps and fund new opportunities.

External Grants and Contracts – It is assumed that once in a permanent facility, faculty at the University of Minnesota Rochester will apply for competitive external grants and contracts. These awards cannot generally be used to fund ongoing operational costs of a campus, but rather are to fund specific areas of research. Thus, while this should be seen as another potential benefit to investing in higher education in Rochester, external grants and contracts should not be seen as a way to pay for operating the unit. Indirect cost recovery, to the extent available, can be used to defray some operational costs such as administration and facilities.

Private Fundraising – It is expected that fundraising will be a part of the long-term future of the University of Minnesota Rochester. It is recognized that it typically takes a number of years to build an endowment of sufficient size to be useful in supporting endowed chairs, student scholarships and research. Ten endowed scholarships already exist for the University of Minnesota Rochester and would be used to attract top students.

The City of Rochester has long been among the strongest supporters of the efforts to expand higher education facilities and programs in Rochester, having championed $28 million in local sales tax funding to improve facilities at University Center Rochester. We fully support the plan to establish a world-class signature University of Minnesota Rochester higher education institution that will not only meet the educational needs of the Rochester area but will also spur economic development for the entire state of Minnesota.

Ardell Brede
Mayor
City of Rochester

Appendices

Appendix A
Laws 2005, Chapter 107 – the Omnibus Higher Education Appropriations Act

Two parts of this law relate to the Rochester Higher Education Development Committee.

Article 1, section 2, subdivision 16 of this law appropriates $3,200,000 for this project for fiscal year 2006:

Subd. 16. Rochester University 3,200,000

(a) $200,000 is for the Rochester Higher Education Development Committee to carry out its planning activities. This is a onetime appropriation.
(b) $3,000,000 is for a onetime appropriation that must be deposited into the Rochester higher education development account under article 4. With the approval of the Higher Education Services Office, money in this account may be used to:

(1) provide additional planning and development funds, if needed;
(2) provide initial funding for academic program development; and
(3) provide funding related to academic facilities, if needed.

The appropriation under this paragraph is available until June 30, 2009.

Article 4 of this law establishes the Rochester Higher Education Development Committee:

ARTICLE 4 ROCHESTER

Section 1. [ROCHESTER HIGHER EDUCATION DEVELOPMENT COMMITTEE.]

Subdivision 1. [ESTABLISHMENT.] The Rochester Higher Education Development Committee is established to research and make recommendations to the governor and legislature on the creation of mission-driven postsecondary educational programs or institutions in the Rochester area that meet the educational needs of the region and the state and that capitalize on the unique opportunities for educational partnerships presented in the Rochester area.

Subd. 2. [MEMBERSHIP.] The committee is composed of 11 members, to be appointed by the governor, as follows:
(1) a trustee of the Minnesota State Colleges and Universities, or the trustee's designee;
(2) a regent of the University of Minnesota, or the regent's designee;
(3) six persons from the Rochester area representing business, health and medical sciences, and technology;
(4) the commissioner of finance, as a nonvoting member, or the commissioner's designee;
(5) one person who by training or experience has special expertise in postsecondary finance and planning; and

(6) one person who by training or experience has special expertise in postsecondary academic planning and programming.
Before the first meeting of the committee, the governor shall select one person from the committee who shall serve as chair.

Subd. 3. [COMPENSATION AND REMOVAL.] Appointments to the committee are not subject to Minnesota Statutes, section 15.0597. Members of the committee are not entitled to reimbursement under Minnesota Statutes, section 15.059, subdivision 6. Members may be removed and vacancies filled pursuant to Minnesota Statutes, section 15.059, subdivision 4. The director of the Higher Education Services Office may provide administrative support to the committee.

Subd. 4. [DUTIES.]
(a) The committee shall develop a proposal for establishment and implementation of expanded higher education programs or institutions in Rochester. The committee's report must include recommendations on:

(1) the mission and focus of the programs or institutions;
(2) the nature of undergraduate and graduate programs to be offered;
(3) site and facility needs;
(4) funding sources and opportunities;
(5) operational needs;
(6) alliances or other types of cooperative arrangements with public and private institutions;
(7) governance structures; and
(8) mechanisms to ensure that the expanded programs are aligned with the unique needs and opportunities of the Rochester area and that programs take advantage of opportunities presented by regional business and industry.

(b) If the committee recommends any programmatic changes that result in institutional realignments, the committee must consult with the representatives of affected employees and address the continuation of collective bargaining and contractual rights and benefits, including accumulated sick leave, vacation time, seniority, time to tenure, separation or retirement benefits, and pension plan coverage.

(c) The committee must consider specifically whether expansion of the University of Minnesota in Rochester is the most appropriate method of meeting the region's needs.

(d) The committee may also research and provide recommendations on sites for the facilities and programs. The committee shall recommend any changes to Minnesota law required to implement recommendations of the committee.

Subd. 5. [REPORT.] The committee must issue a report with recommendations to the governor and the legislature by January 15, 006.

Subd. 6. [SUNSET.] The committee expires on December 31, 2007.
Sec. 2. [ROCHESTER HIGHER EDUCATION DEVELOPMENT ACCOUNT.]
A Rochester higher education development account is created in the state treasury in the special revenue fund. Money in this account is appropriated to the Higher Education Services Office for allocation to the committee established in section 1, subdivision 1, and the implementation activities outlined in article 1, section 2, subdivision 16, paragraph (b). The office shall serve as fiscal agent for the committee established in section 1.

Sec. 3. [EFFECTIVE DATE.]
This article is effective the day following final enactment.

Appendix B

University of Minnesota Rochester
Interim and Permanent Facilities Cost Projection

Table 1

University of Minnesota - Rochester

Rochester Higher Education Development Initiative

Ver. 5 1/17/2006

	Description	Variables		Current	Interim Downtown Campus					Permanent Downtown Campus				
					Year 1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Enrollment	Gross SF			25,822	30,000	30,000	30,000	30,000	30,000	60,000	60,000	60,000	60,000	60,000
	Students			416	458	503	554	637	732	842	968	1,162	1,395	1,673
	Annual Growth Rate				10%	10%	10%	15%	15%	15%	15%	20%	20%	20%
Interim DT Campus Assumptions	Net Lease Rate	Fixed		$ 13.00	$ 390,000	$ 390,000	$ 390,000	$ 390,000	$ 390,000					
	Operating Costs	CPI	3%	$ 11.75	$ 350,000	$ 360,000	$ 370,000	$ 390,000	$ 400,000					
	Total Annual Lease Cost				$ 740,000	$ 750,000	$ 760,000	$ 780,000	$ 790,000					
	Leasehold Improvement Costs:	% of Area	$ / PSF											
	General Classroom	17.5%	$ 50		$ 263,000									
	Lab	8.0%	$ 120		$ 288,000									
	Research	10.5%	$ 50		$ 158,000									
	Office	56.5%	$ 25		$ 424,000									
	Common Area	7.5%	$ 40		$ 90,000									
	Consultants (Architect & Engineer)		15%		$ 187,000									
	Total Leasehold Improvement Cost				$ 1,410,000									
	Relocation Expense		$ 4.00		$ 60,000	$ 60,000								
	RCTC Operating Lease Obligation			$ 160,000	$ 160,000	$ 80,000	$ 40,000	$ 40,000	$ 40,000					
	RCTC Debt Service Obligation			$ 150,000	$ 140,000	$ 130,000	$ 120,000	$ 110,000	$ 100,000	$ 90,000				
	Total Annual Interim Cost				***$ 2,510,000***	***$ 1,020,000***	***$ 920,000***	***$ 930,000***	***$ 930,000***	***$ 90,000***				
Permanent DT Campus	Master Planning						$ 250,000							
		SF	$ / PSF											
	Land Purchase	90,000	$ 50.00					$ 4,500,000						
	Building - Phase 1	60,000	$ 375.00					$ 11,250,000	$ 11,250,000					
	Construction Soft Costs		40%					$ 5,400,000	$ 5,400,000					
	City of Rochester Sales Tax Revenue						$ (250,000)	($7,050,000)	($4,190,000)					
	Debt Service I = 5%, N = 20	$ 26,560,000								$2,130,000	$2,130,000	$2,130,000	$2,130,000	$2,130,000
	Annual Operating Costs	$ 7.50	5%							$ 450,000	$ 470,000	$ 490,000	$ 500,000	$ 520,000
	Total Annual Permanent Cost				***$ -***	***$ -***	***$ -***	***$ 14,100,000***	***$ 12,460,000***	***$ 2,580,000***	***$ 2,600,000***	***$ 2,620,000***	***$ 2,630,000***	***$ 2,650,000***
	Subtotal - proposed new state support				**$ 2,510,000**	**$ 1,020,000**	**$ 920,000**	**$ 15,030,000**	**$ 13,390,000**	**$ 2,670,000**	**$ 2,600,000**	**$ 2,620,000**	**$ 2,630,000**	**$ 2,650,000**
	Combined				$32,870,000					$13,170,000				

Appendix C

University of Minnesota Rochester
Projected Statement of Investment

Table 2

University of Minnesota - Rochester
Projected statement of investment - Higher education development initiative
For the periods ended June 30, 2006 through 2015
The assumptions below are an integral part of this proforma

	Fiscal Year		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	Students		416	458	503	554	637	732	842	968	1162	1395
2	Student growth			10%	10%	10%	15%	15%	15%	15%	20%	20%
3	Cost growth			5%	5%	5%	5%	5%	5%	5%	5%	5%
4	Tuition and fee rate growth			6%	6%	6%	6%	6%	6%	6%	6%	6%
5												
6	**Current programming**											
7	Maintain current academic programs		$3,910,000	$4,110,000	$4,310,000	$4,530,000	$4,760,000	$5,000,000	$5,240,000	$5,510,000	$5,780,000	$6,070,000
8	Maintain current extension programs		$1,370,000	$1,440,000	$1,510,000	$1,590,000	$1,670,000	$1,750,000	$1,840,000	$1,930,000	$2,030,000	$2,130,000
9	**Allied Health Center academic leadership**											
10	Planning and start-up	(a)	$220,000	$600,000	$450,000	$350,000						
11	Student services platform			$180,000	$300,000	$310,000	$330,000	$340,000	$360,000	$380,000	$400,000	$420,000
12	Technology platform			$140,000	$280,000	$290,000	$300,000	$320,000	$330,000	$350,000	$370,000	$390,000
13	Curriculum development platform			$280,000	$560,000	$590,000	$610,000	$650,000	$680,000	$710,000	$750,000	$780,000
14	Administrative platform			$170,000	$330,000	$350,000	$370,000	$380,000	$400,000	$420,000	$450,000	$470,000
15	**New/expanded instructional programs**											
16	Planning and start-up	(a)	$350,000	$1,020,000	$1,120,000	$1,680,000	$2,540,000	$1,740,000	$910,000	$290,000		
17	Operating (direct and indirect costs)	(b)		$700,000	$2,440,000	$4,120,000	$7,010,000	$10,610,000	$15,060,000	$20,540,000	$29,190,000	$40,250,000
18	**Research and liaison programs**											
19	Industrial liaison office			$350,000	$370,000	$390,000	$410,000	$430,000	$450,000	$470,000	$490,000	$520,000
20	Expenditures from external grants	(c)							$2,500,000	$5,000,000	$7,500,000	$10,000,000
21	**Facilities**											
22	Current UM lease for UCR space		$160,000	$160,000	$80,000	$40,000	$40,000	$40,000				
23	Current debt service UCR ('91 & '93 bonds)		$150,000	$140,000	$130,000	$120,000	$110,000	$100,000	$90,000			
24	New leased facility improvement costs & relocation	(a)		$1,470,000	$60,000							
25	New leased facilities annual lease costs	(d)		$740,000	$750,000	$760,000	$780,000	$790,000				
26	New facility planning and land acquisition	(e)				$250,000	$4,500,000					
27	New facility construction and soft costs	(e)					$16,650,000	$16,650,000				
28	New facility debt service	(e)							$2,130,000	$2,130,000	$2,130,000	$2,130,000
29	New permanent facilities operating								$450,000	$470,000	$490,000	$500,000
30	**Total**		$6,160,000	$11,500,000	$12,690,000	$15,370,000	$40,080,000	$38,800,000	$30,440,000	$38,200,000	$49,580,000	$63,660,000
31												
32	**Currently available resources -- operating**											
33	Current U of M recurring state support		$3,880,000	$3,880,000	$3,880,000	$3,880,000	$3,880,000	$3,880,000	$3,880,000	$3,880,000	$3,880,000	$3,880,000
34	Tuition and fees from current U of M - Roch programs		$1,860,000	$1,980,000	$2,090,000	$2,220,000	$2,350,000	$2,490,000	$2,640,000	$2,800,000	$2,970,000	$3,150,000
35	Office of Higher Education planning allocation		$420,000	$2,580,000								
36	*Subtotal - currently available operating resources*		*$6,160,000*	*$8,440,000*	*$5,970,000*	*$6,100,000*	*$6,230,000*	*$6,370,000*	*$6,520,000*	*$6,680,000*	*$6,850,000*	*$7,030,000*
37												
38	**Proposed new state resources - operating**											
39	Proposed new recurring state support	(f)		$1,910,000	$3,370,000	$4,300,000	$4,300,000	$4,300,000	$4,300,000	$4,300,000	$4,300,000	$4,300,000
40	Proposed new non-recurring state support			$3,090,000	$1,630,000	$2,030,000						
41	*Subtotal - proposed new state support*			*$5,000,000*	*$5,000,000*	*$6,330,000*	*$4,300,000*	*$4,300,000*	*$4,300,000*	*$4,300,000*	*$4,300,000*	*$4,300,000*
42												
43	**Projected new U of M resources - operating**											
44	Tuition and fees from new offerings		$0	$450,000	$800,000	$1,220,000	$1,950,000	$2,860,000	$4,010,000	$5,440,000	$7,690,000	$10,610,000
45	Public-private partnerships											
46	External grants and contracts	(c)							$2,500,000	$5,000,000	$7,500,000	$10,000,000
47	F&A rate recovery (ICR)	(c)							$650,000	$1,300,000	$1,950,000	$2,600,000
48	Revenue from private fundraising											
49	*Subtotal - projected new operating resources*			*$450,000*	*$800,000*	*$1,220,000*	*$1,950,000*	*$2,860,000*	*$7,160,000*	*$11,740,000*	*$17,140,000*	*$23,210,000*
50												
51	**Proposed and projected new resources - capital**											
52	New state capital appropriation	(g)					$14,100,000	$11,100,000				
53	City of Rochester - dedicated sales tax revenue	(h)				$250,000	$7,050,000	$4,190,000				
54	New debt service								$2,130,000	$2,130,000	$2,130,000	$2,130,000
55	*Subtotal - proposed and projected capital resources*			*$0*	*$0*	*$250,000*	*$21,150,000*	*$15,290,000*	*$2,130,000*	*$2,130,000*	*$2,130,000*	*$2,130,000*
56	**Grand total**		$6,160,000	$13,890,000	$11,770,000	$13,900,000	$33,630,000	$28,820,000	$20,110,000	$24,850,000	$30,420,000	$36,670,000
57												
58	Investment provided/(required)			$2,390,000	($920,000)	($1,470,000)	($6,450,000)	($9,980,000)	($10,330,000)	($13,350,000)	($19,160,000)	($26,990,000)
59	Net accumulated investment provided/(required)			$2,390,000	$1,470,000	$0	($6,450,000)	($16,430,000)	($26,760,000)	($40,110,000)	($59,270,000)	($86,260,000)
60												

61 Notes

62 (a) Resources could begin to be expended in FY06. Assumes $420,000 of Office of Higher Education planning resources released in FY06.

63 (b) Assumes fully loaded direct and indirect instructional costs and tuition revenue for a current "typical" Rochester student attending approximately 50% time currently and 75% time for new students.

64 (c) External grants and contracts must be self-supporting. Assumes ramping to $10 million in external grants and contracts by FY15. F&A rate recovery could be used to defray other operational costs.

65 (d) Assumes lease in FY07 with classes beginning in new leased facility in Fall 2007

66 (e) Assumes 60,000 GSF facility with planning, land, and construction costs of $37.8 million and 20 year debt service.

67 (f) Assumes the State of Minnesota continues to fund ongoing recurring expenditures committed to as part of FY07-FY09 investments.

68 (g) Assumes $25.2 million in state capital appropriation, representing 2/3 of the cost of the capital project

69 (h) Assumes $11.49 million of Rochester city sales tax revenue -- $8 million from current legislation and $3.49 million from prior allocated and unspent amounts for higher education -- to be used to cover facility planning, land acquisition and construction costs.

Appendix D
City of Rochester and Olmsted County
Contributions to Expand Higher Education

- In 1984, Olmsted County donated $ 5,785,396 to the Minnesota Community College System to build East Hall to bring Winona State University to the Rochester Community College campus (1986). These funds came from the $14 million sale of the Rochester State Hospital to the Federal Bureau of Prisons.

- Since 1987, GRAUC has successfully advocated for over $70 million to advance higher education facilities and programs located on the 481 acre Minnesota State Colleges and Universities campus where Rochester Community and Technical College serves as landlord.

Science and Technology Wing (1991)	$17,825,000
Technology Infrastructure Upgrade (1998)	$ 9,320,000
UCR Regional Sports Center (1998)	$16,510,579*
Horticulture Technology Center (2000)	$ 4,500,000
Intercampus Roadways (2000)	$ 1,200,000
23rd Ave connects Hwy 14 & Cty 9 (2000)	$ 2,000,000
Soccer / Football / Baseball Fields (2001)	$ 1,450,000
UCR Health Science Renovation (2005)	$12,759,000
Community Health and Dental Clinic Renovation	$ 1,500,000*
Rochester Higher Ed Development (2005)	$ 3,200,000
Stadium Feasibility Study	$ 50,000*
TOTAL	**$70,314,579**
* City Sales Tax Contribution	$13,060,579
City Contribution (roads)	$ 2,000,000
City & Youth Sports Contribution	$ 1,450,000
State's Investment	$53,804,000

- In 1999, GRAUC advocated for a branch of the University of Minnesota in Rochester. The Legislature approved enabling language.

- Annually, Mayo invests approximately $5 million in tuition reimbursement for their employees and IBM Rochester contributes $7 million to employee education, including tuition reimbursement.

Appendix E
Rochester Higher Education Development Committee Members

Marilyn D. Stewart, Chair
Branch Manager, Edina Realty

C. E. Bender, M.D.
Dean, Mayo School of Health Sciences

Al Berning, CEO
Pemstar

Al DeBoer, J.D.

Drew Flaada
Director, IBM/Mayo Clinic Collaboration and Life Sciences Development
IBM Corporation

Dwight A. Gourneau
President, NAMTech, Inc.

Jayne Sprinthall Rankin
Executive Budget Officer, MN Department of Finance

Robert H. Hoffman, Ed.D.
Vice President, Taylor Corporation
Chair, Minnesota State Colleges and Universities
Board of Trustees

David Metzen, Ph.D.
Regent, University of Minnesota

Wendy Shannon, Ph.D.
Superintendent, Byron Public Schools

Michael Vekich, C.P.A.
Vekich and Associates

Staffed by:
Cheryl Maplethorpe, Ph.D.
Minnesota Office of Higher Education

Appendix F

Resources Used for Report Preparation

Presentations made before the Rochester Higher Education Development Committee:

July 22, 2005

Jim Clausen, Greater Rochester Area University Center
Randy Johnson, Executive Director, Rochester Workforce Development
Gary Smith, CEO, Rochester Area Economic Development
Philip Wheeler, Director, Rochester/Olmsted Department of Planning
Kevin Molloy, President, Marquis Hospitality Group
Kathy Meyerly, Attorney, Mayo Clinic Rochester
Dr. Valerie Pace, IBM Community Relations

August 19

Mayo Ardell Brede, City of Rochester
Dr. Roger Nelson, Mayo Clinic
Rick Thoni, Director, Augsburg College
Janet Lestock, University of St. Thomas
Mike Benson, Crossroads College
Dr. John Pyle, St. Mary's University
Dr. David Carl, Provost, University of Minnesota Rochester
Dr. Judith A. Ramaley, President, Winona State University
Don Supalla, President, Rochester Community and Technical College
Julie Nigon, Adult Family Literacy Program
Jeanne Herrmann, Globe/Minneapolis College of Business

September 8

Dr. Louellen Essex, Louellen Essex & Associates

October 14

Dr. Hugh Smith, Chair, Board of Governors, Mayo Clinic Rochester

October 28

Dr. Robert Bruininks, President, University of Minnesota
Walt Ling, IBM, Senior State Executive
Dr. Zigang Dong, University of Minnesota Hormel Institute

December 8

Simon Tripp, Principal, Impact Economics

Site Visits by Members of the Rochester Higher Education Development Committee:

University of Texas – Dallas and Chancellor Mark Yudolf

Other Resources:

Essex, L. *Follow-up Report on the University Center Rochester*, September 8, 2005.

Keith, A. M. *Minnesota Should Develop a Four-year University in Rochester,* Minnesota Journal, October 2005, p. 11.

Key Performance Indicators 2004 – University Center Rochester

Stolle, M. *Mayo Chair Speaks in Support of U of M Here.* Post Bulletin, Rochester, October 15, 2005.

University of Minnesota strategic planning documents, 2005

2002 Minnesota State Colleges and Universities/University of Minnesota Management Agreement

Appendix G

Letters of Support

UNIVERSITY OF MINNESOTA

Twin Cities Campus *Office of the President*

202 Morrill Hall
100 Church Street S.E.
Minneapolis, MN 55455-0110
612-626-1616
Fax: 612-625-3875

January 24, 2006

Marilyn Stewart
Rochester Higher Education Development Committee
1301 Salem Road S.W.
Rochester, MN 55902

Dear Marilyn:

I am writing to thank you and all the members of the Rochester Higher Education Development Committee (RHEDC) for your extraordinary commitment to addressing the future of higher education in the greater Rochester area. The background information, data analyses, and recommendations help frame educational, workforce, economic development and quality of life issues facing southeastern Minnesota and the entire state in the twenty-first century. You have produced a thorough and thoughtful report that governing bodies, elected officials, business leaders, and citizens can use to form reasoned judgments about the future direction of higher education in Rochester. I appreciate the valuable perspectives contributed by committee members from leading public and private sector organizations. This process has exemplified the power of public engagement in addressing community needs and interests.

I will ask the University of Minnesota Board of Regents to review and discuss your report in the coming weeks. In my conversations with Board members they have been enthusiastic about the process and optimistic that, with the required state support, the University of Minnesota can play a leading role in developing and expanding innovative research, educational and outreach programs to serve the region's people and industries.

We look forward to working together with you and with city and state officials, Minnesota State Colleges and Universities leaders, our public and private partners, and members of the community about these exciting proposals. Together I am confident we can make significant strides toward meeting the higher education aspirations and needs of the Rochester area.

Sincerely,

Bob

Robert H. Bruininks
President

RHB/so

OFFICE OF THE CHANCELLOR
JAMES H. McCORMICK
Chancellor

WELLS FARGO PLACE
30 7TH ST. E., SUITE 350
ST. PAUL, MN 55101-7804

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Minnesota
STATE COLLEGES
& UNIVERSITIES

January 20, 2006

Ms. Marilyn D. Stewart, Chair
Rochester Higher Education Development Committee
1301 Salem Road Southwest
Rochester, Minnesota 55902

Dear Chair Stewart:

Thank you for sending me a copy of the Rochester Higher Education Development Committee's Report to Governor Tim Pawlenty and the Minnesota Legislature. I congratulate you and the committee members on the hard work you have undertaken to gather data and information regarding delivery of higher education opportunities in Rochester and recommend new directions for consideration by Governor Pawlenty and the legislature.

I have had the opportunity to discuss the draft recommendations with our Board of Trustees. Since the Board met prior to the issuance of the final report, the Board has not yet reviewed the report in its final form and, thus, has not taken any formal position on the report. However, in our discussion earlier this week, Board members expressed their agreement with the general direction of the report's recommendations. In particular, highlighted below are several key concepts in the report that assure us that it captures an understanding of how the State and its higher education systems would move forward together to best serve the interests of our citizens:

- Recognition of the need for continued assessment for the development and expansion of proposed programs in Rochester and the region;

- Affirmation of the commitment of the University of Minnesota to engage in partnerships and collaborations in establishing programs and program pathways that serve the needs of Minnesota citizens and students;

- Recommendation of a phased expansion of University of Minnesota facilities that affirms its pre-existing financial commitments to the shared facilities of the University of Minnesota and the Minnesota State Colleges and Universities' Rochester Community and Technical College and Winona State University;

- Recommendation that the State of Minnesota provide new funding resources that do not supplant or shift current levels of funding from the University of Minnesota or Minnesota State Colleges and Universities; and

- Proposal for a governance structure that affirms the autonomy of the respective governing bodies to establish and manage the enterprises under their authority.

Finally, we are confident that Minnesota State Colleges and Universities is positioned well to support the University of Minnesota in achieving its program goals. I look forward to my continued work with President Bruininks and the University of Minnesota to better serve the citizens of the State of Minnesota.

Sincerely,

James H. McCormick

c: Robert H. Hoffman, Chair
Robert G. Bruininks, President

MAYO CLINIC

200 First Street SW
Rochester, Minnesota 55905
507-284-2511

Administration

January 23, 2006

Marilyn Stewart, Chair
Rochester Higher Education Development Committee
1301 Salem Road Southwest
Rochester, Minnesota 55902

Dear Ms. Stewart:

Mayo Clinic appreciates the efforts of the Rochester Higher Education Development Committee (RHEDC) in defining the vision and next steps to meet the higher education needs of southeast Minnesota and Rochester in particular. Mayo pledges to continue to work with the RHEDC in implementing the recommendations.

Through the presentations to the RHEDC by Doctors Hugh Smith and Roger Nelson and Ms. Kathleen Meyerle and the participation on the RHEDC by Dr. Claire Bender, Mayo has provided its perspective on the needs facing our organization and our community. Dr. Smith emphasized that the future of medicine is in procedures and information, and success for the United States and Minnesota means a focus on a knowledge-based economy. Minnesota will succeed if its lead institutions such as the University of Minnesota, Mayo and IBM remain at the cutting edge in knowledge development and dissemination. In addition, Mayo will continue to need a highly trained allied health workforce, especially nurses and clinical laboratory scientists. The RHEDC work will enable the development of these talented people and resources.

As Dr. Smith stated in his remarks to the Committee last fall Mayo is prepared to be a significant partner in advancing the growth of the University of Minnesota in Rochester. Mayo would support joint appointments and visiting professorships. Mayo can provide faculty and students as well as offering summer scholarships, internships and clinical placements. Mayo attracts world-renowned scientists and physicians who could serve as role models and mentors for students. Mayo currently spends over $5 million per year in tuition support for our employees in addition to an extensive internal program for staff training and advancement. Mayo could review its program to more directly encourage and support credits from programs implementing the RHEDC vision.

Mayo Clinic's participation in collaborations with IBM, the University of Minnesota in the Minnesota Partnership for Biotechnology and Medical Genomics and the Hormel Institute provide a solid basis from which the RHEDC vision can be realized. Mayo Clinic commits to working with the RHEDC and our community in advancing these recommendations and furthering the growth of the University of Minnesota in Rochester as a world-class signature research and teaching institution.

Sincerely,

Glenn Forbes, Chair
Chief Executive Officer

Jeffrey O. Korsmo,
Chief Administrative Officer

cc: Members of the University of Minnesota Board of Regents
James H. McCormick, Chancellor, Minnesota State Colleges and Universities
Robert J. Jones, Senior Vice President for System Administration
E. Thomas Sullivan, Senior Vice President for Academic Affairs and Provost
Frank Cerra, Senior Vice President for Health Sciences
David Carl, Provost, University of Minnesota Rochester

3605 Highway 52 N
Rochester, MN 55901

January 18, 2006

To: Rochester Higher Education Development Committee
Marilyn D. Stewart, Chair

From: Walt Ling, IBM VP and Minnesota Senior State Executive

Subject: Advancing Higher Education to Benefit Minnesota

IBM applauds the recommendations of the Rochester Higher Education Development Committee, and I offer the thanks of IBM for the diligent work you are doing on behalf of higher education for our region and our State.

IBM has worked long to advance higher education in our region, and our commitment has never been stronger. Technology, globalization and demographic changes require not just more education, but higher achievement by all, including our incumbent workforce.

When I testified before the RHEDC, I emphasized the unique work underway among IBM, Mayo and the University of Minnesota. The unique confluence of these partners in southeast Minnesota presents a tremendous opportunity for Minnesota. The RHEDC recommendations clearly recognize that an expanded University of Minnesota Rochester (UMR) will be the catalyst necessary to bring research and academic programs to our region to support the tremendous innovation occurring here. UMR will take full advantage of our current talent and investments and bring new value to higher education in Minnesota.

IBM stands ready to support your recommendations through our Center for Advanced Studies in the Life Sciences and our Blue Gene supercomputing capacity. We have IBMers prepared to serve as adjunct faculty, opportunities for cooperative education internships and space available for faculty and students to work side-by-side in exciting new areas of technology where IBM Rochester leads the world. Our annual investment of $7M in employee education will also help support our employees as they continue their education at UMR.

The recommendations of the RHEDC will expand higher education in Minnesota. IBM has enjoyed long and successful partnerships with Rochester Community and Technical College and Winona State University, and their missions are important to our region. What is important for Minnesota and for the unique convergence of technology, biology and medicine in southeast Minnesota, is that the University be given the authority and resources necessary to advance the unique programs and research that can thrive in this innovative technology center.

R.L. Knowlton
Chairman

301 N Main Street
Austin MN 55912
Phone 507 437 5357
Fax 507 437 7392

January 18, 2006

Ms. Marilyn Stewart
Edina Realty Inc.
1301 Salem Rd. SW
Rochester, MN 55902

Attn: Rochester Higher Education Development Committee

Dear Marilyn,

The Hormel Foundation was designed to control and assure Hormel Foods Corporation's presence in Austin, Minnesota. With the growth of the Company, the Foundation and the Hormel Institute, the need for development of higher education in southern Minnesota becomes ever more important.

The extraordinary growth of institutions like Mayo Clinic, Hormel Foods (which now has revenues of $5.5 billion/year) and IBM, along with numerous other endeavors, provides a strong case for a four-year higher education campus in this section of the state.

The Hormel Foundation strongly supports the placement of a new campus that would be located in Rochester. The work being accomplished at Mayo, IBM and Hormel is strong evidence of the need and the opportunity for the advancement of technology, research and industry.

The Hormel Institute has grown dramatically in recent years and has been highly successful in its grants from the National Institutes of Health and The Hormel Foundation. A new endeavor is in place that will bring Mayo research to the Hormel Institute along with continued involvement of the University of Minnesota. In the near future, a major addition will double the size of the Hormel Institute and allow greater expansion of our already established cancer research.

All of these impressive developments with the growth of Mayo, IBM and Hormel bring focus to the need for a new four-year extension of the University of Minnesota in Rochester. I would like to thank you in advance for your support to bring a much-needed higher education facility in southern Minnesota. We would like to strongly support the undertaking of a new four-year University of Minnesota at Rochester.

If I can be of further assistance, I would be pleased to act in a supporting role.

Regards,

R. L. KNOWLTON
Chairman of The Hormel Foundation and
former Chairman, President & CEO of Hormel Foods Corporation

kb

Mayor Ardell F. Brede
201 4th Street SE – Room 281
Rochester, MN 55904-3782
Phone: (507) 285-8080 Fax: (507) 287-7979

January 23, 2006

The Honorable Tim Pawlenty
Governor of Minnesota
130 State Capital
75 Rev. Dr. Martin Luther King Jr. Blvd.
Saint Paul, MN 55155

Dear Governor Pawlenty:

The City of Rochester enthusiastically endorses the plan being presented by the Rochester Higher Education Committee, that is, to establish a world-class higher education institution that leverages the unique capabilities of the University of Minnesota in partnership with IBM and Mayo Clinic. This institution will be the University of Minnesota Rochester.

The City has long been among the strongest supporters of efforts to expand higher education facilities and programs in Rochester. We have provided funding to Greater Rochester Area University Center (GRAUC) and championed $28 million in sales tax funding to improve facilities at the University Center. We wholeheartedly support the plan to build signature academic and research programs that complement southeast Minnesota's existing leadership roles in health sciences, biosciences, engineering and technology.

Rochester is committed to the revitalization of downtown and the plan to locate the University of Minnesota Rochester downtown adjacent to Mayo Clinic facilities not only makes sense for shared faculty and facilities but also fits well in our plans.

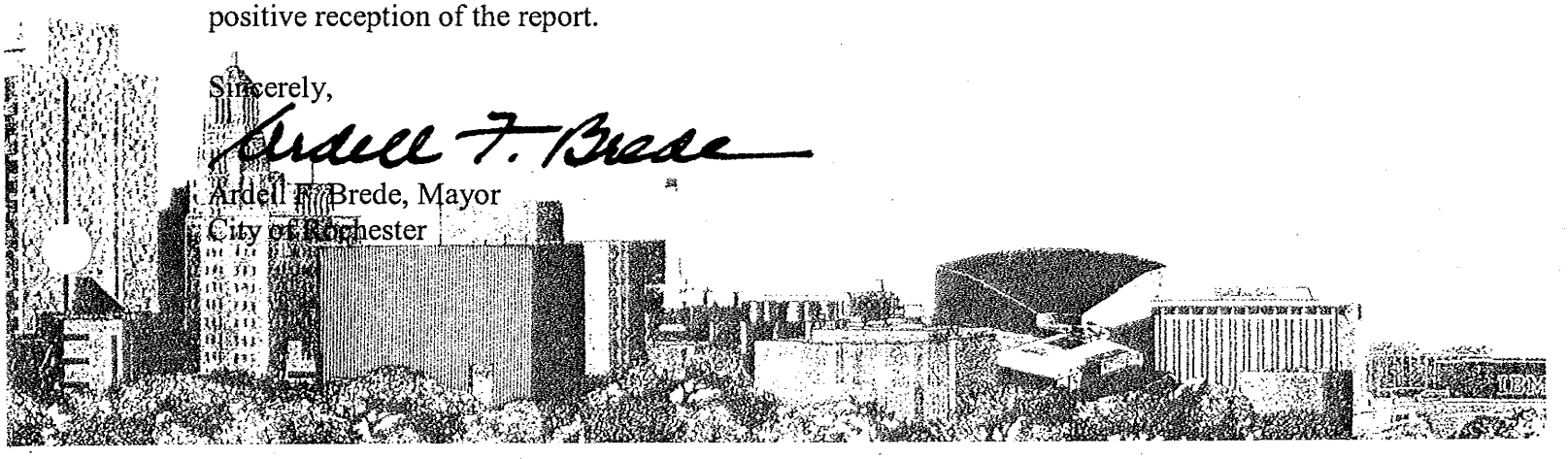
While this proposal for a new University of Minnesota Rochester will directly benefit Rochester, perhaps even more importantly, this will benefit the entire state of Minnesota, not only economically but for its citizens as well.

The City of Rochester stands ready to facilitate this plan becoming a reality. We thank the Rochester Higher Education Committee for their diligence and look forward to a positive reception of the report.

Sincerely,

Ardell F. Brede

Ardell F. Brede, Mayor
City of Rochester



RDA
Rochester Downtown Alliance

January 23, 2006

Governor Tim Pawlenty
130 State Capitol
75 Rev. Martin Luther King Jr. Blvd.
St. Paul, MN 55115

Dear Governor Pawlenty:

I write this letter both as a private citizen who has lived in southeastern Minnesota my entire life and as Executive Director of the Rochester Downtown Alliance (RDA), a non-profit corporation devoted to the continued economic development of one of the most unique cities in America.

Thanks to your efforts, the Rochester Higher Education Development Committee has studied and arrived at a report for you and the Minnesota legislature which I believe, if carried out, will have an enormous impact on the economic, technological, and scientific future of our state. The committee report will become one of the most significant reports of its kind if properly implemented.

Clearly, due to the partnerships between the Mayo Clinic, IBM, and the University of Minnesota, this state is in a position to develop one of the most dynamic biomedical economies in this country. I was deeply impressed by the fact that this new institution, governed by the University of Minnesota, will bring together the immense medical history and knowledge of the Mayo Clinic with the extraordinary research capacities of the University of Minnesota in the dynamic areas of health sciences.

I also agreed with the recommendation that the facility be located in downtown Rochester near the Mayo Clinic/University of Minnesota research facilities. Obviously, we will need your help along with the legislature in funding this start-up. I can assure you we will see to it that there is a substantial local contribution to this effort.

In conclusion, I want to thank you for appointing this remarkable group of men and women who have worked so hard to develop this report. We cannot let it sit on the shelf but must see to it that it is implemented. There is no question in my mind, if properly implemented, this partnership will develop one of most successful biomedical economies in the history of this state and nation.

Warmest personal regards,

ROCHESTER DOWNTOWN ALLIANCE

A.M. Sandy Keith
Executive Director
amkeith@rdowntownalliance.com

AMK:tmb

220 South Broadway • Suite 100 • Rochester, Minnesota 55904
Telephone: (507) 424-4744 • Fax: (507) 282-8960

January 13, 2006

Ms. Marilyn Stewart, Chair
Rochester Higher Education Committee
1301 Salem Road SW
Rochester, MN 55902

Dear Ms. Stewart:

We are writing to thank you and the entire Rochester Higher Education Committee for the work you are doing to plan the future of higher education in the Rochester area. We are extremely pleased you are looking at higher education and how it should be shaped to maximize its contribution to sustaining and growing our area economy.

Your vision is sharp and clear. The signature partnerships and programs you have identified set the right direction for realizing the vision. We are in complete agreement that the University of Minnesota is the institution to carry the ball forward. The development of a downtown campus will assure future investments made in implementing your recommendations are fully leveraged. This location is where the majority of current research, development, and knowledge creation activities take place in Rochester. The Minnesota Partnership for Biotechnology and Medical Genomics, the Mayo Clinic, and the soon-to-be developed Minnesota Bioscience Development Center are all located downtown. This location maximizes the opportunity for human and organizational interaction.

The recommendations contained in your report clearly indicate you understand the importance of doing more than just creating a relevant curriculum. Thank you again for your hard work and vision.

Respectfully,

ROCHESTER AREA ECONOMIC DEVELOPMENT, INC.

Bruce Gudlin
President

ROCHESTER AREA ECONOMIC DEVELOPMENT, INC.

Gary W. Smith, CEcD
Executive Vice President

GWS:tmb

ROCHESTER AREA
CHAMBER OF COMMERCE

January 16, 2005

Marilyn Stewart, Chair
Rochester Higher Education Development Committee
1301 Salem Road SW
Rochester, MN 55902

Dear Chair Stewart:

On behalf of the Membership and Board of the Rochester Area Chamber of Commerce, we would like to first commend you and your committee for your leadership and dedication. Your proposed expansion of higher learning represents an integral piece of Rochester's ongoing contribution to our state and indeed our nation.

Rochester is poised to contribute even more and your proposal, when realized, will help ensure that very objective becomes reality. Rochester's resources are extraordinary and include: the Minnesota Partnership for Biotechnology and Medical Genomics, the realization of the Minnesota Bioscience Development Center in Rochester, and of course the presence of world renowned businesses including Mayo Clinic and IBM.

Clearly, our future contribution to society will require a highly motivated and integrated intellectual partnership. In addition to Rochester Community and Technical College, the growth and expansion of the University of Minnesota in Rochester is vitally important. It is imperative that a university, the University of Minnesota, with a world-class academic reputation be further developed to attract the brightest minds and build world-class relationships that will benefit our region, our state and our nation.

Thank you for your hard work, dedication and your leadership.

Respectfully,

John Wade
President

Paul Grinde
Chair

220 South Broadway • Suite 100 • Rochester, MN 55904 • 507-288-1122 • Fax 507-282-8960
Website: www.rochestermnchamber.com • email: chamber@rochestermnchamber.com
Accredited Chamber of Commerce since 1965

GRAUC

Date: January 19, 2006

To: Marilyn Stewart, Chair
Rochester Higher Education Development Committee

From: Claudia Knowlton-Chike - Chair, GRAUC Board

Subject: Letter of Support to Advance Higher Education in Minnesota

The Greater Rochester Area University Center (GRAUC) Board celebrates its 20th anniversary this year. How fitting it is to see, after twenty years of advocacy for higher education in Southeast Minnesota, the Rochester Higher Education Development Committee advance this effort on behalf of our region and our State.

GRAUC anxiously awaits the formal publication of your recommendations and is fully prepared to advocate on behalf of a world-class research and academic institution. Expanding higher education in Southeast Minnesota with a distinctive, focused baccalaureate and graduate institution will require people to use their imaginations and to work collaboratively. GRAUC is prepared to act as a catalyst to support the recommendations with communications, community awareness, working with lobbyists, legislators and state influencers, along with our Higher Education Systems.

The vision of a research institution with signature programs offered at University of Minnesota Rochester such as Health Sciences, Engineering and Technology and has been a journey. There will be a fundamental shift in the design of the business model, governance and financial model for higher education. We are fortunate to have your leadership on the Rochester Higher Education Development Committee and we applaud the strategic view you have taken with the recommendations.

We are in a fast-moving, competitive and volatile environment. We are ready to build on the previous decade of growth and experimentation and do the tough work to make the changes required to establish a local research institution. We have a window of opportunity. We will preserve the base of Rochester Community and Technical College and Winona State University and grow the University of Minnesota in Rochester. We will excite our leaders and our communities as we advocate for this new model of higher education. You can count on the GRAUC Board to unite with a common voice in supporting the development of a university for the advancement of the biosciences, the future of our region and the State of Minnesota.

Claudia Knowlton-Chike

PEMSTAR

January 23, 2006

To: Rochester Higher Education Development Committee
Marilyn D. Stewart, Chair

From: Greg S. Lea
EVP & CFO
Pemstar Inc.

Subject: Support to Advance Higher Education in Minnesota

Pemstar strongly supports the recommendations of the Rochester Higher Education Development Committee to expand higher education. On behalf of the entire Pemstar family, accept our thanks for all the efforts by the committee.

Pemstar believes these recommendations, when implemented, will effectively advance higher education in our region and state. This advancement is important for the continued vitality of our current and future workforce and will permit companies like ours to stay competitive in this volatile, shifting business environment. We believe these actions will create a more vibrant competitive economy for our community and region.

Pemstar remains committed to supporting the ongoing partnership we have with the Rochester Community and Technical College and Winona State University. We feel that this proposed expansion will enhance this relationship and strengthen their mission in the overall higher education process in our region.

3535 Technology Drive N.W. • Rochester, MN 55901 • Telephone (507)292-6800 • Fax (507) 280-0838

SOUTHERN MINNESOTA INITIATIVE FOUNDATION

Leadership Circle

Charting a course for Southern Minnesota.

525 Florence Avenue PO Box 695 Owatonna, MN 55060 • 507-455-3215 • www.smifoundation.org

January 24, 2006

Marilyn Stewart
Chair
Rochester Higher Education
Development Committee
1301 Salem Rd SW
Rochester, MN 55902

Dear Ms. Stewart:

The Southern Minnesota Leadership Circle supports the report recommendations of the Rochester Higher Education Development Committee to *"establish a world-class higher education institution that leverages the University of Minnesota's research capability, in partnership with IBM, Mayo Clinic, and other industry leaders, to build signature academic and research programs that complement southeast Minnesota's existing leadership roles in health sciences, biosciences, engineering and technology. Educational programs will provide application to economic activities via innovation, translational research, and clinical experiences. This institution will have a distinct identity and one governing entity. This institution will be the University of Minnesota Rochester."*

We believe this plan has been designed to leverage the existing base of collaboration between IBM Rochester, Mayo Clinic and the University of Minnesota; and will enhance regional productivity and innovation. It draws upon the unique knowledge and skills in our region, provides a dynamic synergy to enhance our growing medical industry cluster and more fully integrates the research, education and outreach capacity of the University of Minnesota into regional economic development efforts. We view this as a critical next step in growing southern Minnesota's knowledge economy.

The **Southern Minnesota Leadership Circle,** hosted by the Southern Minnesota Initiative Foundation, is a roundtable of selected CEO's from the area's largest for-profit employers and meets two to three times per year with select public policy and system decision makers to provide high level analysis of regional and state trends, opportunities and challenges.

Sincerely,

Tim Penny
Co-Chair

Tim Lidstrom
Co-Chair

Enclosure: Leadership Circle member roster

08-0034

Report of the MN P-16 Education Partnership Working Group on College and Work Readiness March 13, 2006

Introduction

The essential challenge of defining college and work readiness can be found in the following paragraph from Achieve, Inc.:

> There is substantial evidence that our expectations for what high school students must learn does not reflect the knowledge and skills they will need to succeed in college and work. What it takes to earn a high school diploma is largely disconnected from what it takes for graduates to compete successfully beyond high school – either in the college classroom or in the workplace. Further, because academic standards for high school students do not reflect college admissions and placement requirements, students often get conflicting signals from high schools and colleges about what constitutes adequate preparation. An inextricable link must be built between high school exit expectations and the challenges that graduates will face. (Alignment Guidebook for Institute, Cohorts I and II, February 2006)

The need to remove these disconnects and reach shared, statewide consensus about what constitutes adequate preparation for college and work led the Minnesota P-16 Education Partnership and the Minnesota Legislature to almost simultaneously call for definitions of that preparation. Although each stated its charge slightly differently, both had essentially the same intent: to develop clear and compelling statements to describe the skills and knowledge that high school graduates must have in order to be ready for education and training following graduation, whether in a college or university or in the workplace. Both recognized as well that individuals representing multiple constituencies needed to be actively engaged in the work of defining readiness, including both P-12 and college and university faculty and administrators; parents, employers, and the organizations that represent them; and others committed to quality learning in public and private educational institutions at all levels.

This report describes the work to date of a working group charged with defining college and work readiness in reading, writing, and mathematics. It addresses only some elements of what students need to be successful in college and work (for example, it does not describe the "soft skills" that employers identified as lacking in many high school graduates, nor does it address the creativity, problem-solving, and other skills essential in a highly-skilled workplace), and much remains to be done. It does, however, provide a foundation for additional steps to be taken as Minnesota seeks to align high school and college/work expectations.

Working Group Charge

The Working Group on College and Work Readiness Skills and Knowledge was formed as one of six working groups established by the Minnesota P-16 Education Partnership to carry out targeted work designed to improve college and work readiness and transitions for Minnesota students. Its members were appointed by members of the P-16 Partnership (Appendix B, Members of Working Group) and charged to "identify the reading, writing, and mathematics knowledge and skills needed for entry into postsecondary education and/or into highly skilled occupations at the entry level; to assess the extent to which current high school graduation requirements (credits) align with college and work readiness knowledge and skills; and to recommend any changes in high school requirements needed to improve alignment with college and work readiness."

At approximately the same time that the working group charge was drafted, the Minnesota Legislature passed legislation directing the Higher Education Advisory Council (HEAC) to "convene a working group to develop standards describing the skills and knowledge a high school graduate must have at entry into postsecondary education in order to successfully graduate from college" (Appendix D, Chapter 5, HF 141, Article 2. Section 85, College Readiness). Further, it stated that "The standards must, to the extent possible, be applicable for all postsecondary education but may describe differences in the skills and knowledge necessary for success in different higher education institutions and programs. The standards need not be comprehensive but must, at a minimum, be the essential skills and knowledge that will enable a student to succeed in college."

Because of the alignment between these two tasks, and since the legislation specified consultation with many of the members of the P-16 Partnership and explicitly stated that "The Higher Education Advisory Council and its working group may collaborate with the Minnesota P-16 Education Partnership in developing the college readiness standards," it was determined that the Working Group on College and Work Readiness would be asked to address these charges simultaneously. Senator Steve Kelley, chief author of the college readiness language in HF 141, was consulted about this combined approach.

Working Group Process: Defining College and Work Readiness Knowledge and Skills in Reading, Writing, and Mathematics

Getting Started. The Working Group began by *reviewing and discussing its charge* as drafted by the P-16 Partnership. The group agreed that some language changes could clarify the group's overall charge and references to work readiness. The group reviewed the timelines in the charge and agreed to add brief descriptions of work to be done each month, along with approximate dates for completion of key tasks. Subsequently, the group also agreed to add references to a second phase of work during which the group would define the skills and knowledge needed in science and world languages, given their critical role in the global economy. All of these changes and additions are reflected in the working group charge dated 11.17.05 (Appendix A, Working Group Charge).

Next, a number of *key documents were reviewed* for their value in defining college and work readiness skills and knowledge and assessing their alignment with the Minnesota Academic Standards. The primary documents which the group agreed to use were the *Minnesota Academic Standards in Language Arts and Mathematics*; the *Minnesota State University Preparation Competencies* (which are endorsed by the University of Minnesota); and the *American Diploma Project Benchmarks in English and Mathematics*. In addition, the *College-Ready Writing Rubric* developed by Paul Carney and his college-ready writing project colleagues and the *Joint Mathematics Competencies* developed collaboratively by representatives of the University of Minnesota, the Minnesota State Colleges and Universities, and the Minnesota Private College Council were identified as key sources for subgroups. Finally, members identified other documents relevant to the group's charge and shared "hard copies" or URLs.

Consistent with its charge, the working group discussed the *formation of subgroups to define college and work readiness in reading, writing, and mathematics*. Members were asked to identify the subgroup on which they were willing to serve and/or to identify additional persons who might supplement the expertise already resident in the group. Working group co-chairs Cyndy Crist and Judy Kuechle reviewed the lists, identified co-chairs for each subgroup (one each representing K-12 teachers and postsecondary faculty), and sought their agreement to serve. They also reviewed the names of those who had volunteered for each subgroup and secured several additional participants to bring additional expertise or perspective to the work of two of the subgroups (Appendix C, Subgroup Members Lists).

Meetings/Work of Reading, Writing, and Mathematics Subgroups. Because it was clear that the effective operation of the reading, writing, and mathematics subgroups would be critical to completion of the group's charge, subgroup co-chairs met monthly with the working group co-chairs. Through these monthly meetings, conducted primarily by conference call, the co-chairs were able to identify opportunities, address challenges, and ensure that tasks were being completed in ways that were consistent both with each other and with the group's overall work plan. The primary resources used by each subgroup were those identified above.

Meeting with Employers. Because most members have had more experience considering college readiness than readiness for "entry-level jobs in a highly skilled workplace," the group chose to pay particular attention to the work readiness element of its charge. Following significant discussion about the scope of the task of defining work readiness, it was agreed that the group should meet with several employers. Working group members Bill Blazar and Mike Lehn arranged for four individuals from two Minnesota companies to participate in a January working group meeting and secured written comments from four additional employers. The meeting was held at Lowell, Inc., a precision manufacturing company, and members were invited to participate in a company tour while on-site. The tours, presentations, and discussions added to members' understanding of the demands of a highly-skilled workplace and helped inform their thinking about how to define work readiness.

Participation in Alignment Institute. As the working group neared completion of the first phase of its work, an opportunity to learn from and participate in a national project focused on work and college readiness became available. Minnesota joined the American Diploma Project in 2005; with that membership came an invitation to participate in ADP's Alignment Institute, a project designed to help states "align their high school exit standards with the demands of college and work so that students are able to enter into credit-bearing course work in two- or four-year colleges – without the need for remediation and with a strong chance for earning credit toward their programs or degree, and gain entry-level positions in quality job and career pathways (that often require further education and training)."

In February, several members of the Working Group joined with several additional staff members from the Minnesota Department of Education to participate in the first session of the Alignment Institute. This three-day working meeting provided a valuable opportunity to consider the group's work-to-date within a national context; to discuss with key experts how to address critical aspects of effectively defining college and work readiness; to become familiar with additional sources of information and data that can inform Minnesota's work; and to begin planning for a longer-term process of developing, vetting, finalizing, and communicating about new state definitions of college and work readiness. It also provided an opportunity to do this simultaneously with assessing the extent of alignment of ADP's college and work readiness benchmarks with the Minnesota Academic Standards. The Minnesota Alignment Institute Team agreed to recommend that the Working Group and Alignment Institute tasks be combined into a single process.

Draft Definitions of College and Work Readiness

This section comprises the initial drafts of the reading, writing, and mathematics subgroups. Each offers a short narrative to provide general context, followed by initial definitions of college and work readiness and charts or descriptions addressing the alignment of college and work readiness with Minnesota Academic Standards in language arts and mathematics.

As noted previously, these documents are offered as works in progress, not as final documents. They reflect an initial analysis of key documents and provide a context for further review, development, and the identification of problems, tasks, or other examples that demonstrate college- or work- ready skills and knowledge. It is our hope that they will generate a healthy discussion that will clarify and advance our collective understanding of what high school graduates need to know and be able to do to be successful in colleges or universities and in the highly-skilled workplace.

College and Work Readiness in Reading

Over the past six years, concerns about the literacy skills of adolescents have grown—particularly concerns about whether young people are prepared to exit high school, enter the work force or two- or four-year institutions of higher education, and perform well on tasks that require reading and comprehending a variety of texts for various purposes. Statistics cited in a prominent report (*Every Child a Graduate*, 2001), indicate that approximately six million secondary students are reading "below grade level, impacting their ability to understand what they are required to read in English and language arts classes and in their content or discipline area courses.

Similarly, data from the 2002 National Assessment of Educational Progress exams showed that 25% of eighth graders and 26% of 12th graders were reading at "below basic" levels; international comparisons of reading performance indicated that US students ranked 11th or very close to the bottom of a list of countries (Kamil, 2003). Current NAEP 2005 data (NAEP/NCES, 2006) indicate that the national average reading score for 159,000 eighth-graders was 1 point lower in 2005 than in 2003, but the percentage of eighth graders performing at or above "basic" was higher in 2005 (73%) than in 1992 (69%). However, there was no significant change in the percentage of students scoring at or above "Proficient" between these same years. In Minnesota, 20% of our eighth graders scored at the below basic level on NAEP 2005, 42% scored at the basic level, 34% at the proficient level, and 3% at the advanced level. In addition, an analysis of recent ACT scores (*Reading between the Lines: What the ACT Reveals about College Readiness*, 2006) indicates that only 51% of students tested are ready for the reading requirements of typical credit-bearing first-year college courses.

These results indicate that despite the efforts of excellent teachers and students who are trying to achieve, many adolescents are not succeeding in school. The argument is not solely that students are not taking challenging coursework or aren't motivated to complete reading activities in and out of class. Rather, because teachers doubt their students' abilities to critically read and understand increasingly difficult content texts and are under pressure to cover more and more content, they are likely to give assignments that allow students to read superficially in order to complete tasks. What is required for adolescent readers to succeed is explicit instruction in discipline area classes (e.g., science, mathematics, history) in which teachers model reading strategies, provide guided practice, and create time for independent practice to foster the comprehension of various texts.

The lack of focus on adolescent reading has developed, in part, due to a focus on early reading, with most Title One budgets allocated towards early intervention and with little money or attention focused on struggling adolescent readers (see the Adolescent Literacy Position Statement of the International Reading Association [IRA], 1999). IRA notes that a good start in reading is critical but not sufficient to produce readers who can comprehend texts that become increasingly complex throughout the grade levels. Adolescent readers "deserve instruction that builds both the skills and desire to read increasingly complex materials" (Moore, Bean, Birdyshaw, & Rycik, 1999, p.5). This includes continued, systematic reading instruction throughout grades K-12, recognizing that the literacy needs of adolescents are very different from those of younger children, that reading development occurs on a continuum, and that the reading demands for adolescents increase as they progress through school. As the American

Diploma Project document, *Ready or Not: Creating a High School Diploma that Works* (2004), noted, the literacy demands of adolescents headed to the workplace after high school, or to college require that individuals be able to "read and interpret a wide range of reference materials...including technical information. They also need to know how to locate, analyze and judge the quality of information presented in a variety of texts including media resources such as the World Wide Web."

Several current reports focus on the state of adolescent literacy (e.g., Donna Alvermann's *Effective Literacy Instruction for Adolescents: JLR*, 2002; *RAND Report*, 2002; *Adolescents and Literacy: Reading for the 21st Century, 2003*; *Reading Next*, 2004). These papers review the concerns educators and policy makers have about adolescents' literacy skills and indicate what we know students at this developmental level need to know and the strategies and program structures most suited to addressing their literacy learning needs. Key ideas focus on the

- developmental nature of reading—one's ability to learn from text changes based on one's life experiences and the educational experiences,
- demands of content area or discipline area texts and reading tasks,
- the need to move away from single textbooks to multiple texts and student choice within content areas,
- the need for highly qualified teachers who can support readers who struggle,
- students' increasing use of media texts digital literacies,
- differing needs of English-language learners and the instructional challenges of supporting these students' literacy development,
- role of technology in supporting students' ability to read and comprehend text,
- infrastructure in schools that supports reading instruction, and
- role of content or discipline area teachers in incorporating reading into their curricula and teaching practices (based on Kamil, 2003).

Key findings also include the critical role of motivation in adolescent readers' development (Guthrie & Wigfield, 1997; O'Brien & Dillon 2002). Struggling readers often do not have the strategies and skills needed to successfully read; this results in continual failure to understand and do well on reading tasks. Students then lose motivation to read or even attempt future reading tasks. A sense of self-efficacy—or the belief that one can accomplish a reading activity—is critical to a student's willingness to expend effort, to continue working when they experience challenges, and to complete a reading assignment.

In conclusion, findings from these national reports and from the research illustrate that literacy is a dynamic process. It involves an interaction or transaction between a learner and a text situated in a particular context. This perspective has framed much of the research on reading and writing at the secondary level–grades seven through twelve–over the last 30 years and, as Moje, Dillon & O'Brien (2000) noted:

> "Studies of secondary literacy have endeavored to understand the cognitive processes involved in reading and writing. Teaching and learning strategies based on those processes were developed to teach secondary learners to use reading and writing to learn information and to think critically in various disciplines (cf. Alvermann & Moore, 1991; Readence, Bean, & Baldwin, 1989; Tierney & Pearson, 1992a). These attempts to understand how features of text and disciplinary or classroom contexts might influence the reader's or writer's cognitive processes have been tremendously influential in the field, as educators have come to understand that learning in the

> secondary disciplines—or content areas—is shaped by the reading and writing learners do in those disciplines. Moreover, reading and writing in the disciplines is shaped by the unique conceptual, textual, and semantic demands of each area; for example, reading and writing historical narrative is different from reading and writing scientific exposition. Thus, the field of secondary literacy has developed with an emphasis on examining how different content areas employ different kinds of texts and make different cognitive demands on learners. . . . The constructs of learner, text, and context remain important, but they have been broadened as secondary literacy scholars have turned increasingly to social and cultural perspectives on literacy" (p. 165).

This framework is important because it allows educators and policy makers to focus on three interrelated areas that impact adolescents' achievement in reading: understanding who readers are—their identities and dispositions towards literacy— and how their literacies are shaped by in- and out-of-school experiences and feelings of self-efficacy; the large variety of texts, both print and non-print, that students are expected to be able to read and comprehend, and; the contexts – discipline areas/events, classrooms/places, social groups, and realms of knowledge – that shape a learner's identity and impact particular interpretations of texts. A consideration of these three factors will be critical as we address what skills and strategies adolescent readers need, and the kinds of instruction they are offered, as they prepare for the workplace and college.

Minnesota Reading ADP/ACT Alignment

MN Academic Standards	American Diploma Project	ACT Expectations
A. Vocabulary Expansion		
A1. The student will apply a variety of strategies to expand vocabulary.		
B. Comprehension **The student will understand the meaning of informational, expository or persuasive texts, using a variety of strategies and will demonstrate literal, interpretive, inferential and evaluative comprehension.**	**F. Informational Text** **E. Logic**	**A. Main idea and author's approach** **B. Sequential, Comparative, and Cause-Effect Relationships**
B1. Monitor comprehension and know when and how to use strategies to clarify the understanding of a selection		
B2. Comprehend and evaluate the purpose, accuracy, comprehensiveness, and usefulness of informational materials		
B3. Analyze and draw accurate conclusions about information contained in warranties, contracts, job descriptions, technical descriptions and other informational sources, selected from labels, warnings, manuals, directions, applications and forms in order to complete specific tasks.		
B4. Analyze a variety of nonfiction materials selected from journals, essays, speeches, biographies and autobiographies.		
B5. Summarize and paraphrase main idea and supporting details.	**F2.** Identify the main ideas of informational text and determine the essential elements that elaborate them. **F4.** Distinguish between a summary and a critique.	A1. Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages A2. Infer the main idea or purpose of straightforward paragraphs in more challenging passages. A3. Summarize basic events and ideas in more challenging passages. A5. Locate important details in more challenging passages. A6. Locate and interpret minor or subtly stated details in uncomplicated passages. A7. Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.

MN Academic Standards	American Diploma Project	ACT Expectations
B6. Trace the logical development of an author's argument, point of view or perspective and evaluate the adequacy, accuracy and appropriateness of the author's evidence in a persuasive text.	**E3.** Describe the structure of a given argument; identify its claims and evidence; and evaluate connections among evidence, inferences and claims. **E4.** Evaluate the range and quality of evidence used to support or oppose an argument.	A4. Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.
B7. Make inferences and draw conclusions based on explicit and implied information from texts	**F8.** Draw conclusions based on evidence from informational and technical texts	
B8. Evaluate clarity and accuracy of information, as well as the credibility of sources.		
B9. Identify, understand and explain the various types of fallacies in logic.	**E2.** Identify false premises in an argument. **E5.** Recognize common logical fallacies, such as the appeal to pity *(argumentum ad misericordiam),* the personal attack *(argumentum ad hominem),* the appeal to common opinion *(argumentum ad populum)* and the false dilemma (assuming only two options when there are more options available); understand why these fallacies do not prove the point being argued.	
B10. Synthesize information from multiple selections in order to draw conclusions, make predictions, and form interpretations.	**F7.** Synthesize information from multiple informational and technical sources. **E8.** Analyze two or more texts addressing the same topic to determine how authors reach similar or different conclusions.	
	F1. Follow instructions in informational or technical texts to perform specific tasks, answer questions or solve problems	
	F5. Interpret and use information in maps, charts, graphs, time lines, tables and diagrams	
	F6. Identify interrelationships between and among ideas and concepts within a text, such as cause-and-effect relationships	B2. Understand relationships between people, ideas, and so on in uncomplicated passages.
	F9. Analyze the ways in which a text's organizational structure supports or confounds its meaning or purpose.	
	F10. Recognize the use or abuse of ambiguity, contradiction, paradox, irony, incongruities, overstatement and understatement in text and explain their effect on the reader.	
	F11. Evaluate informational and technical texts for their clarity, simplicity and coherence and for the appropriateness of their graphics and visual appeal.	
	E1. Distinguish among facts and opinions, evidence and inferences.	

MN Academic Standards	American Diploma Project	ACT Expectations
	E6. Analyze written or oral communications for false assumptions, errors, loaded terms, caricature, sarcasm, leading questions and faulty reasoning.	
	E7. Understand the distinction between a deductive argument (where, if the premises are all true and the argument's form is valid, the conclusion is inescapably true) and inductive reasoning (in which the conclusion provides the best or most probable explanation of the truth of the premises, but is not necessarily true	
		B1. Order sequences of events in uncomplicated passages.
		B3. Understand implied or subtly stated cause-effect relationships in more challenging passages
		C. Meaning of Words
		C1. Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages.
		C2. Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.
C. The student will actively engage in the reading process and read, understand, respond to, analyze, interpret, evaluate and appreciate a wide variety of fiction, poetic and nonfiction texts.	**H. Literature**	**D. Generalizations and Conclusions**
C1. Read, analyze and evaluate traditional, classical and contemporary works of literary merit from American literature.	**H1.** Demonstrate knowledge of 18th and 19th century foundational works of American literature.	
C2. Read, analyze and evaluate traditional, classical and contemporary works of literary merit from British literature.		D1. Draw subtle generalizations and conclusions about characters, ideas, and so on in uncomplicated literary narratives.
C3. Read, analyze and evaluate traditional, classical and contemporary works of literary merit from civilizations and countries around the world.		D2. Draw generalizations and conclusions about people, ideas, and so on in more challenging passages.
C4. Evaluate the impact of an author's decisions regarding word choice, point of view, style and literary elements.		

MN Academic Standards	American Diploma Project	ACT Expectations
C5. Analyze, interpret and evaluate the use of figurative language and imagery in fiction and nonfiction selections, including symbolism, tone, irony and satire.		
C6. Analyze and evaluate the relationship between and among elements of literature: character, setting, plot, tone, symbolism, rising action, climax, falling action, point of view, theme and conflict/resolution	**H4.** Analyze the setting, plot, theme, characterization and narration of classic and contemporary short stories and novels.	
C7. Evaluate a literary selection from several critical perspectives.		
C8. Analyze classic and contemporary poems for poetic devices.	**H5.** Demonstrate knowledge of metrics, rhyme scheme, rhythm, alliteration and other conventions of verse in poetry.	
C9. Analyze the characteristics of literary forms.		
C10. Interpret the effect of literary and structural devices.		
C11. Demonstrate how literary works reflect the historical contexts that shaped them.	**H7.** Analyze works of literature for what they suggest about the historical period in which they were written.	
C12. Synthesize ideas and make thematic connections among literary texts, public discourse, media and other disciplines.	**H9.** Identify and explain the themes found in a single literary work; analyze the ways in which similar themes and ideas are developed in more than one literary work	
C13. Read, analyze, and critique dramatic selections by comparing and contrasting ways in which character, scene, dialogue, and staging contribute to the theme and the dramatic effect.	**H6.** Identify how elements of dramatic literature (for example, dramatic irony, soliloquy, stage direction and dialogue) articulate a playwright's vision.	
C14. Respond to literature using ideas and details from the text to support reactions and make literary connections		
C15. Read from and respond to a variety of fiction, poetic and nonfiction texts of increasing complexity for personal enjoyment		
	H2. Analyze foundational U.S. documents for their historical and literary significance (for example, The Declaration of Independence, the Preamble to the U.S. Constitution, Abraham Lincoln's "Gettysburg Address," Martin Luther King's "Letter from Birmingham Jail").	

MN Academic Standards	American Diploma Project	ACT Expectations
	H3. Interpret significant works from various forms of literature: poetry, novel, biography, short story, essay and dramatic literature; use understanding of genre characteristics to make deeper and subtler	
	H8. Analyze the moral dilemmas in works of literature, as revealed by characters' motivation and behavior.	
D. Media Literacy **The student will critically analyze information found in electronic and print media, and will use a variety of these sources to learn about a topic and represent ideas.**	**D. Research** **E. Logic**	
D1. Evaluate the accuracy and credibility of information found on Internet sites.	**D3.** Make distinctions about the credibility, reliability, consistency, strengths and limitations of resources, including information gathered from Web sites	
D2. Evaluate the logic of reasoning in both print and non-print selections.		
D3. Evaluate the source's point of view, intended audience and authority.		
D4. Determine whether the evidence in a selection is appropriate, adequate and accurate.		
D5. Evaluate the content and effect of persuasive techniques used in print and broadcast media.		
D6. Make informed evaluations about television, radio, film productions, newspapers and magazines with regard to quality of production, accuracy of information, bias, purpose, message and audience.		
D7. Critically analyze the messages and points of view employed in different media, including advertising, news programs, web sites, and documentaries		
D8. Formulate critical, evaluative questions relevant to a print or non-print selection.		
D9. Critically analyze and evaluate the strategies employed in news broadcasts, documentaries, and web sites related to clarity, accuracy, effectiveness, bias and relevance of facts.		

MN Academic Standards	American Diploma Project	ACT Expectations
D10. Demonstrate an understanding of ethics in mass communication and describe the characteristics of ethical and unethical behavior		
	D2. Gather relevant information from a variety of print and electronic sources, as well as from direct observation, interviews and surveys	
	G. Media	
	G2. Examine the intersections and conflicts between the visual (such as media images, painting, film and graphic arts) and the verbal.	

College and Work Readiness in Writing

Preface: This draft report includes three sections. The first is an introduction and an outline of knowledge and skills in writing, language, and research that are built around the general topics of the written product and writing process. The second illustrates some of the ways that readiness can be fleshed out. The third is a chart which places the Minnesota Department of Education standards next to the benchmarks from the American Diploma Project and the freshman composition program outcomes from the University of Minnesota and MnSCU.

Introduction: As the first decade of the new millennium unfolds, high school graduates across the nation seem more challenged by than prepared for entry-level expectations from college and the workplace. Consistent with other states, Minnesota's post-secondary college placement data, as well as employer surveys, indicate a growing trend in under-preparedness among college freshmen and new employees. More than one third of the 2002 state public high school graduates who enrolled in a state public college or university took at least one remedial course during their first two years of college. To ensure preparation for post-secondary success, state agencies—from high school curriculum committees to chambers of commerce—need to promote and coordinate alignment between what students are asked to do and know in high school with what is expected of them in college and/or the workplace.

This document is guided by a fundamental premise that, in addition to adhering to conventions and logical structures, clear writing depends on sound critical thinking skills. It also depends on knowing how and when to communicate information, to persuade, and to express opinions within the context of a given purpose and audience, be it in a college classroom or at a customer service counter. The readiness standards in this report are intended to convey to students, parents, and teachers the levels of academic and workplace writing skills essential for post-secondary success.

Good writing is best learned through frequent practice, coupled with expert coaching, encouragement, and evaluation. When a high- school student does not get regular practice, especially in the junior and senior years, the chance he or she will be ready to write well at work or college is greatly impaired. Thus, as much as possible, students should write in all courses and in all content areas; writing instruction should not only be the responsibility of the language arts teachers. At college, writing takes place in all departments and throughout the years.

In an important sense, the criteria for good writing are roughly the same for students of any age. For example, from Strunk and White's famous *Elements of Style*, "But since writing is communication, clarity can only be a virtue." The issue that is central for high-school students to be prepared for their roles as employees, college freshmen, and citizens is their level of maturity as writers. Sometimes directly and sometimes by inference, mature writers choose what they do; they are purposeful and have control of all the interacting components and processes of writing. Their writing is crafted. They are aware of what they did and *why*. Because of that, their essays, memos, or other texts develop ideas in an orderly way; they have a consistent tone and voice; and they try to understand their audience's interests and needs.

In terms of curriculum, the point of teaching writing as a process is that writers become more conscious of what they are doing without reflection, and what they can do or try to do to improve both the final text and how they get there.

In terms of content, the topic (or the question posed, solution given, argument made) should be complex enough to reflect the thoughts of a young adult writer, and it is interesting, and it gives a sense of the writer's engagement in the task.

P-16 Writing, Language, and Research—Knowledge and Skills

"Products" - What students should practice			
	Links to MDE	**and ADP†**	Sample of criteria used to judge success
Types of writing	*II.A.1*		
• Correspondence – e-mail, letters, brief memos and reports, minutes		C10	In addition to clarity and brevity, adheres to conventions and standard formats.
• Essays to inform, persuade, and present (informed) opinions		C9	Writer's voice and positions are well defined and consistent.
• Formal reports and academic papers – research paper, laboratory reports, arguments		C9	States and sustains an argument; presents information and inferences clearly.
• Communication in media other than the printed page	*II.B.6*	C7, C8	Considers differences in audience and how the communication is used.
Structure			
• Introduction, abstract			Each component is well-constructed, clearly written, and rhetorically effective. The whole piece is consistently focused on a central idea, and gives an overall sense of wholeness and progression of ideas.
• Modes – description, narration, etc. Note: modes are usually mixed	*II.A.1*	C9	
• Conclusion and summary		C9	
Content			
• Details, evidence, backing, illustrations (visual, statistical, quotations and paraphrase)	*II.B.3, II.D.6,*	C4, C9, D5, C10	Details are appropriate and relevant, accurate, substantive, logically related, and focused.
• Diction – formal, informal, technical	*II.C.1*	C2, D3, C10	Control of language is exhibited in word choice and idiomatic usage.
• Paragraph development – central idea, coherence, and focus			Reasoning is clear and persuasively presented.
• Cohesion - links between parts and flow in the whole paper	*II.B.4, II.B.5*	C3, C9	
• Organization at all levels for sequence, and logical, analytical, or persuasive emphasis	*II.B.5, II.D.9*	D5	Claims are backed with evidence, opinions are amplified (and not only expressions of taste and unexamined values).

† MDE = Minnesota Department of Education English Language Arts Standards for Writing, Section II, A (Types), B (Elements of Composition, C (Spelling Grammar, and Usage), and D (Research) in italics. ADP = America Diploma Project Benchmarks, C. Writing and D. Research.

"Process" – How students get there			
Note: Central to the thinking and writing process is to develop ideas by writing them out – taking notes, writing a proposal, preliminary drafts	*II.B.1*	C1	
Sources Other than introspection and personal memory			
• Interviews and surveys, and taking notes		C1	Sources chosen for their relevance to the topic
• Print and graphic resources, whether seen on line or on paper	*II.D.1*	D2	
• Web and other media	*II.D.1*	D2	
• For all of those, evaluate them for their accuracy and credibility	*II.D.5, II.D.7*	D3	
• For all of those, document them precisely, responsibly, and ethically	*II.B.7, II.D.8, II.D.10, II.D.11*	C6, D5	
Audience and Context			
Understand the audience, context, and purpose of the writing	*II.A.1, II.B.8*	C2, C10	
Control and flow of ideas			
• Focus; develop and sustain the thesis	*II.B.2, II.D.3*	C3, C9, D1, D5	
• Expand content to complete the paper as it develops		D4 time manage-ment, deadlines	
• Anticipate possible counter-arguments, reader misunderstanding		C10	
Revising and editing	*II.B.5. II.B.8*	C5	
• Respond to comments from teachers, supervisors, other students		C4	Writing process activities work together to help the writer succeed in her or his efforts to communicate ideas, arguments and opinions with an audience.
• Edit one's own work for content, form, and style	*II.D.12*	C5	
Polishing and proofreading			
• Tidy up syntax and grammar, sharpen diction and be sure it is precise; spell and punctuate according to conventions	*II.C.3*	C5	Exhibit command of standard English conventions.
• Format the pages – headings, white space, etc.		C10	
> Sentence variety	*II.C.2*[*]		

[*] Not included: II.D.2, key terms in research

Notes on Readiness

While the Minnesota State Universities' ***High School Preparation Competencies*** (1993) report thoroughly identifies requisite writing competencies to succeed in college, it does not include levels of preparedness necessary to measure readiness. In fact, the report claims, "Much remains to be done to determine how mastery of these competencies might best be assessed and, perhaps more importantly, to define the level of performance expected of students." The P-16 Writing Subgroup recognizes the need for developing specific readiness standards. Preliminary results from the college-readiness project indicate that, contrary to assumptions in the state universities' report, high school instructors' perceptions of readiness are ***not*** closely aligned with college instructors' expectations. Shooting an arrow with accuracy does not accurately describe the degree to which accuracy must be demonstrated. Does it mean hitting the bull's eye, or can it also mean landing two or three inches from the bull's eye?

"Ready" suggests a level of preparedness for a future experience or task. Being ready means one possesses the skills and knowledge necessary to meet the expectations of a particular task or experience. We know when we're ready to do something when we: a) have done it before; or b) have demonstrated requisite skills that have been observed and verified by an expert. In order for high school teachers to be able to assess readiness skills accurately and to convey them to their students, they must be informed of the post-secondary expectations embedded in each competency. Gauging readiness for college or the workplace requires precise indicators of where **inability (1)** meets **proficiency (3)** and of where **proficiency** meets **mastery (5)**. One approach for establishing this gauge is to develop a proficiency scale and attach it to MDE's ELA standards, recognizing that levels 4 and 5 reach beyond minimum graduation requirements.

1= Inadequate
2= Developing proficiency
3= Proficiency (meets MDE graduation standard)
4= Developing mastery
5= Mastery (meets college/workplace readiness standard)

Another approach would be to create competency statements, or indicators, in which readiness levels are defined according to skill strengths, weaknesses, or omissions. Below are examples from the ***College-Readiness "Fence" Rubric*** for essay development.

Sample College-Readiness "Fence" Rubric for the Essay

CONTENT

COLLEGE-READY

The ideas are focused, well developed, and enhanced by details.

A. The central idea or thesis is clear and concise.
B. The central idea or thesis is strongly supported by well-chosen and integrated details.
C. Ideas are fresh, engaging, or sophisticated.

NOT COLLEGE-READY

The ideas may be focused, but they are only partially developed and may lack necessary details.

A. The central idea or thesis is present; however, it may be too broad or predictable.
B. The central idea or thesis is supported by details, but the details may be general, obvious, or insufficient in number.
C. Ideas are obvious or trite.

The ideas lack focus, are under-developed, and have few details.

A. The central idea or thesis is without direction or not evident.
B. Support for central idea or the thesis is minimal or non-evident; details are sparse, limited or unclear.
C Ideas are obvious, trite, or off topic.

ORGANIZATION

COLLEGE-READY

Organization logically supports the central idea. The order and structure move the reader through the text easily.

A. An interesting introduction draws the reader into the paper, and a satisfying conclusion leaves the reader with a sense of resolution.
B. Smooth, effective transitions exist among all elements (sentences, paragraphs, and ideas).
C. Organizational patterns are effective but unobtrusive. Paragraphing is natural and appropriate

NOT COLLEGE-READY

Organization supports the central idea (thesis). However, the order and structure do not readily move the reader through the text.

A. The introduction and conclusion are present.
B. Transitions are present but commonplace, forced, inappropriate, or excessive.
C. Organizational patterns are present but predictable. Paragraphing is not consistently natural and appropriate.

Organization neither supports nor develops the central idea (thesis). The lack of order and structure detract from the reader's understanding.

A. The introduction and conclusion are not present.
B. Transitions are nonexistent.
C. Organizational patterns are haphazard and disjointed. Paragraphing is not utilized or is misapplied.

CONVENTIONS

COLLEGE-READY

The writer correctly utilizes a wide range of standard writing conventions. Some minor errors may exist, but they do not detract from the overall quality of the paper.

Sentence Level Errors:
___fragments
___comma splices
___run-ons
___other

Punctuation:
___ commas
___ apostrophes
___ semi-colons
___ other

Mechanics:
___capitalization
___abbreviations
___spelling
___other

Grammar:
___pronoun agreement
___pronoun case
___verb agreement
___other

NOT COLLEGE-READY

The writer shows sporadic control over standard writing conventions. A variety of errors or frequent errors detract from the quality of the paper.

Sentence Level Errors:
___fragments
___comma splices
___ run-ons
___ other

Punctuation:
___commas
___apostrophes
___ semi-colons
___ other

Mechanics:
___capitalization
___abbreviations
___spelling
___other

Grammar:
___pronoun agreement
___pronoun case
___verb agreement
___other

SENTENCE FLUENCY

COLLEGE-READY

The writing has a natural flow and rhythm.
A. Varied sentence structure and length demonstrate conscious planning
B. The sentences are rhythmic and graceful.

NOT COLLEGE-READY

The writing moves mechanically.
A. The writer shows control over simple sentence structure, but uses complex sentences infrequently.
B. The sentence rhythm is attempted but inconsistent.

The writing moves awkwardly.
A. The sentences tend to be choppy, incomplete, or rambling.
B. The sentence rhythm is clumsy and jarring.

WORD CHOICE

COLLEGE-READY

The language is rich, natural, and yet succinct.
A. Words are specific, precise, and appropriate.
B. Powerful words provide energy for the paper.

The language is functional, and the message is conveyed.
A. Words are generally correct and appropriate but may be ordinary.
B. Powerful words are occasionally present.
C. Expression is clear but clichés and redundancy may exist.

NOT COLLEGE-READY

The language is awkward and unclear.
A. Words are limited, dull, and abstract.
B. No powerful words are used.
C. The writer uses a limited vocabulary and/or excessive jargon.

P-16 - Writing, Language, and Research

This chart offers a side-by-side comparison of the Minnesota Academic Standards in Language Arts for grades 9-12; American Diploma Project benchmarks, focused on the skills **required** for high school graduates; and goals and competencies for Freshman Composition at the University of Minnesota and MnSCU, which identify writing skills **taught** at the postsecondary level. It was informed by Achieve's "Side-by-Side Comparison of the American Diploma Project (ADP) Benchmarks with Minnesota's *Language Arts Standards*," 2/24/06

Minnesota Academic Standards (italics) and Benchmarks	American Diploma Project Benchmarks	U of M Freshman Comp Goals/**MN Transfer Curr. Communications Competencies**
Preface:	**C. Writing** Strong writing skills have become an increasingly important commodity. High-growth, highly skilled jobs demand that employees can communicate essential information effectively via e-mail, write proposals to obtain new business, communicate key instructions to colleagues or convey policies to customers. Poor writing may easily affect a company's bottom line and even precipitate legal action. The discipline used to create, reshape and polish pieces of high-quality writing prepares students for occasions when they must write quickly and clearly on demand, whether in the workplace or in college classrooms	**Goal: To develop writers and speakers who use the English language effectively and who write, speak and listen critically. As a base, all students should complete introductory communication requirements in their collegiate studies. Writing competency is an ongoing process to be reinforced through writing-intensive courses and writing across the curriculum. Speaking and listening skills need reinforcement through multiple opportunities for interpersonal communication, public speaking, and discussion.**
TYPES OF WRITING *Standard: The student will write in narrative, expository, descriptive, persuasive and critical modes.* II. A.1. Plan, organize and compose narrative, expository, descriptive, persuasive, critical and research writing to address a specific audience and purpose.	**C9.** Write an academic essay (for example, a summary, an explanation, a description, a literary analysis essay) that: * develops a thesis; * creates an organizing structure appropriate to purpose, audience and context; * includes relevant information and excludes extraneous information; * makes valid inferences; * supports judgments with relevant and substantial evidence and well-chosen details; and * provides a coherent conclusion.	Interpret the contexts of your writing, its audiences and purposes. Identify and practice forms of writing most effective for your ideas and audience(s)

MN Academic Standards	ADP Benchmarks	Freshman Comp/**MN Transfer**
ELEMENTS OF COMPOSITION *Standard: The student will engage in a writing process with attention to audience, organization, focus, quality of ideas, and a purpose.* II. B. 1. Generate, gather, and organize ideas for writing.	**C1.** Plan writing by taking notes, writing informal outlines and researching.	
(No exact counterpart)		Practice the activities of writing, including generating ideas, organizing arguments, revising, editing, and creating multiple drafts; **Understand/demonstrate the writing and speaking processes through invention, organization, drafting, revision, editing and presentation.**
II. B. 2. Develop a thesis and clear purpose for writing.	**C3.** Organize ideas in writing with a thesis statement in the introduction, well-constructed paragraphs, a conclusion and transition sentences that connect paragraphs into a coherent whole. *See B4*	Craft a thesis in persuasive and logical ways
II. B. 3. Make generalizations and use supporting details	*See C4, but that includes readers' comments*	Evaluate and present evidence to support your ideas
II. B. 4. Arrange paragraphs into a logical progression.	*See C3*	**Construct logical and coherent arguments.**
	C4. Drawing on readers' comments on working drafts, revise documents to develop or support ideas more clearly, address potential objections, ensure effective transitions between paragraphs and correct errors in logic.	Learn to produce, receive, and integrate constructive feedback in your writing process **Participate effectively in groups with emphasis on listening, critical and reflective thinking, and responding.**
II. B. 5. Revise writing for clarity, coherence, smooth transitions and unity	*See C4*	Rewrite to achieve clarity and grace of expression
		Use authority, point-of-view, and individual voice and style in their writing and speaking.

MN Academic Standards	ADP Benchmarks	Freshman Comp/**MN Transfer**
II. B. 6. Apply available technology to develop, revise and edit writing	**C8.** Present written material using basic software programs (such as Word, Excel and PowerPoint) and graphics (such as charts, ratios and tables) to present information and ideas best understood visually.	
II. B. 7. Generate footnotes, endnotes and bibliographies in a consistent and widely accepted format	*See C6*	
II. B. 8. Revise, edit and prepare final drafts for intended audiences and purposes	**C5.** Edit both one's own and others' work for grammar, style and tone appropriate to audience, purpose and context	
	C7. Determine how, when and whether to employ technologies (such as computer software, photographs and video) in lieu of, or in addition to, written communication.	**Select appropriate communication choices for specific audiences.**
SPELLING, GRAMMAR AND USAGE *Standard: The student will apply standard English conventions when writing.* II. C. 1. Understand the differences between formal and informal language styles and use each appropriately	**C2.** Select and use formal, informal, literary or technical language appropriate for the purpose, audience and context of the communication. *See D3* A6. Recognize nuances in the meanings of words; choose words precisely to enhance communication.	Demonstrate an understanding of grammar and style conventions in standard written American English **Employ syntax and usage appropriate to academic disciplines and the professional world.**
II. C. 2. Use an extensive variety of correctly punctuated sentences for meaning and stylistic effect		
II. C. 3. Edit writing for correct grammar, capitalization, punctuation, spelling, verb tense, sentence structure, and paragraphing to enhance clarity and readability: a. Correctly use reflexive case pronouns and nominative and objective case pronouns, including *who* and *whom*. b. Correctly use punctuation such as the comma, semicolon, colon, hyphen, and dash. c. Correctly use *like/as* if, *any/any other*, *this kind/these kinds*, *who/that*, and *every/many* when they occur in a sentence. d. Correctly use verb forms with attention to subjunctive mood, subject/verb agreement, and active/passive voice. e. Correctly use the possessive	A1. Demonstrate control of standard English through the use of grammar, punctuation, capitalization and spelling.	

pronoun before the gerund		
(Preface)	**D. Research** Research requires the ability to frame, analyze and solve problems, while building on the ideas and contributions of others. Credit-bearing coursework in colleges and universities will require students to identify areas for research, narrow those topics and adjust research methodology as necessary. College students will be asked to consider various interpretations of both primary and secondary resources as they develop and defend their own conclusions. Similarly, in the workplace, employers depend heavily on the ability of employees to evaluate the credibility of existing research to establish, reject or refine products and services.	Find resources to teach you what you don't know or remember
RESEARCH* *Standard: The student will locate and use information in reference materials.* II. D. 1. Use print, electronic databases and online resources to access information, organize ideas, and develop writing	**D2.** Gather relevant information from a variety of print and electronic sources, as well as from direct observation, interviews and surveys	Locate, analyze, document, and integrate potential sources from the library, the Internet, print sources and other media into your writing Recognize differences between popular and scholarly sources. **Locate, evaluate, and synthesize in a responsible manner material from diverse sources and points of view.**
II. D. 2. Identify key terms specific to research tools and processes		
II. D. 3. Narrow the focus of a search by formulating a concise research question or thesis.	**D1.** Define and narrow a problem or research topic.	
II. D. 4. Develop a research plan		

* ADP comments pp. 6-7 suggests sorting this section into process and product; the latter are flagged as *(ADP = Product)*

MN Academic Standards	ADP Benchmarks	Freshman Comp/**MN Transfer**
II. D. 5. Evaluate and organize relevant information from a variety of sources, verifying the accuracy and usefulness of gathered information	**D3.** Make distinctions about the credibility, reliability, consistency, strengths and limitations of resources, including information gathered from Web sites.	Describe, analyze, and synthesize ideas among different readings
II. D. 6. Produce a report with detailed evidence to support a thesis *(ADP = Product)*	**D5.** Write an extended research essay (approximately six to 10 pages), building on primary and secondary sources, that: * marshals evidence in support of a clear thesis statement and related claims; * paraphrases and summarizes with accuracy and fidelity the range of arguments and evidence supporting or refuting the thesis, as appropriate; and * cites sources correctly and documents quotations, paraphrases and other information using a standard format. *(Compare A.1 and D.9)*	
II. D. 7. Distinguish between reliable and questionable Internet sources and apply responsible use of technology	*See D3*	Read and think critically to identify an author's audience, purpose, argument, and assumptions
II. D. 8. Understand plagiarism and its consequences, and identify ethical issues of research and documentation	*See C6*	
II. D. 9. Organize and synthesize information from a variety of sources and present it in a logical manner *(ADP = Product)*	*See D5*	
II. D. 10. Credit sources for both quoted and paraphrased ideas *(ADP = Product)*	**C6.** Cite print or electronic sources properly when paraphrasing or summarizing information, quoting, or using graphics.	
II. D. 11. Cite sources of information using a standard method of documentation, such as a style sheet from the Modern Language Association (MLA) or from the American Psychological Association (APA) *(ADP = Product)*	*See C6*	

MN Academic Standards	ADP Benchmarks	Freshman Comp/**MNTransfer**
II. D. 12. Proofread the final copy, format correctly and prepare the document for publication or submission *(ADP = Product)*	*See C5*	
(No counterpart)	**C10.** Produce work-related texts (for example, memos, e-mails, correspondence, project plans, work orders, proposals, bios) that: * address audience needs, stated purpose and context; * translate technical language into non-technical English; * include relevant information and exclude extraneous information; * use appropriate strategies, such as providing facts and details, describing or analyzing the subject, explaining benefits or limitations, comparing or contrasting, and providing a scenario to illustrate; * anticipate potential problems, mistakes and misunderstandings that might arise for the reader; * create predictable structures through the use of headings, white space and graphics, as appropriate; and * adopt a customary format, including proper salutation, closing and signature, when appropriate.	
(No counterpart)	**D4.** Report findings within prescribed time and/or length requirements, as appropriate.	Use your time and resources efficiently
		Explore cultural functions of literacy

College and Work Readiness in Mathematics

The following report offers a first draft intended to define college and work readiness in mathematics. It is comprised of three documents. The first two (Joint Statement on the Mathematical Competence Expected of All Entering College Students and Use of Technology) are taken from the work of the Joint Committee on Mathematical Competence Expected of All Entering College Students. This document represents the collaborative thinking of a group comprised of faculty and administrators representing the Minnesota Private College Council, the Minnesota State Colleges and Universities, and the University of Minnesota.

The third and most substantive document addresses the four major strands identified in the **American Diploma Project** (ADP) and **Minnesota Academic Standards** documents: Expectations for Number Sense and Numerical Operations; Algebra; Geometry; and Data and Probability. The initial standards and benchmarks are derived primarily from the ADP document, *Ready or Not*, with some additions and word changes made to reflect the Minnesota Academic Standards. In this "strands" document, an asterisk (*) is used to identify standards or benchmarks that are expectations specifically for students intending to pursue math-related majors in a college or university. All other standards or benchmarks set expectations for all high school graduates.

It should be noted that this is the first draft of a subgroup charged to define college and work readiness in mathematics. With additional time and effort, we expect language to be added to address Mathematical Reasoning, provide examples that will clarify expectations for how students can demonstrate achievement of the benchmarks, and add clarity about how this level of readiness connects to the workplace.

Joint Statement on the Mathematical Competence Expected of All Entering College Students

All students enrolled in two-year and four-year colleges or universities, regardless of their field of study, will take courses that require mathematical or quantitative competence. In most colleges, mathematics is necessary to meet general education requirements. In addition, students must understand and be able to apply mathematics in a variety of courses such as economics and biology that are taken outside their major. For these reasons, higher education institutions expect all entering students to be prepared for college-level mathematics. Many require students to demonstrate their readiness on college entrance exams or placement tests.

Achieving the level of competence necessary for college-level work requires that students enroll in a mathematically intensive course in every semester of high school, especially in their senior year. Like a foreign language, mathematical competence is easily lost unless practiced regularly. Many students who take no mathematics in the year before enrolling in college, even if they have completed three or more years of college preparatory mathematics, are unable to succeed in college courses of a quantitative nature without first taking remedial courses that carry no credit toward graduation.

What is mathematical competence? Mathematical competence consists of five interdependent aspects that apply to all areas of mathematics:

- Deep understanding of mathematical concepts, operations, and relations;
- Skill in carrying out procedures accurately, efficiently, and flexibly;
- Ability to formulate, represent, and solve mathematical problems;
- Capacity for logical thought, reflection, explanation, and justification; and
- Seeing mathematics as sensible, unified, useful, and worthwhile.

To succeed in college, all students need to be proficient in these five aspects of mathematical competence in each of the following core content areas:

- *Algebra* (variables, equations, functions, and graphs);
- *Geometry* (axioms, deduction, geometric reasoning, trigonometry, and visualization); and
- *Data Analysis and Probability* (representations of data, probability, and statistics).

To achieve competence in these core content areas, students need to employ *mathematical reasoning.* In particular, students need to:

- Understand the logical structure of mathematics;
- Recognize the roles of definitions, proofs, theorems, and counter-examples;
- Use both inductive and deductive reasoning to arrive at valid conclusions;
- Distinguish relevant from irrelevant information; and
- Employ the special symbols of mathematics correctly and precisely.

How does one acquire mathematical competence? Mathematical competence is achieved by taking challenging high school mathematics courses, by using mathematics in other courses, and by using mathematics frequently in a variety of settings. As with activities such as music or athletics, achieving and maintaining mathematical competence requires constant practice. The more one uses mathematics, the more competent one becomes.

Does every college student need the same mathematical competence? No. While all students require mathematical competence at a level sufficient to succeed in college-level courses, students in mathematically intensive programs require greater mathematical depth and fluency than students in other programs. Although in the past only engineering and physics were considered mathematically intensive, in the twenty-first century fields such as biology, economics, and psychology are becoming mathematically intensive as well. Well over half the majors of Minnesota college graduates are in fields that currently require at least four years of college preparatory mathematics, and in the future many more will expect that level of preparation. As a practical guide, it is always better to take as much mathematics in high school as possible so as not to foreclose possible fields of study.

Is calculus in high school necessary to succeed in college? Absolutely not. It is far better for high school students to acquire depth and competence in a broad variety of mathematical areas than to focus narrowly on completing calculus by the end of twelfth grade. In order to be effective, calculus courses in high school need to be treated as college-level courses and should prepare students to do well on the College Board's Advanced Placement (AP) tests or other comparable external examinations. For many students, other advanced mathematics courses such as statistics or computer science would be preferable to calculus.

Use of Technology

Technology is well engrained in our society today and its development and use continue to grow at a rapid pace. Students entering college should have had experience using many forms of technology, including graphing calculators and computers, all of which can make problems more accessible and deepen students' understanding of functions.
These technologies can enhance student learning opportunities when used to select or create mathematical tasks that take advantage of what technology can do efficiently and well—graphing, visualizing, and computing.

Students should also understand that technology is not a replacement for basic understandings and intuitions; rather, it is best used to foster those understandings and intuitions. Students should be aware of the limitations of technology; recognize calculators and computer programs as tools to assist, but not replace, mathematical reasoning and problem solving; and be able to make appropriate decisions regarding their use.

Different institutions, different instructors, and different courses will require different experiences with calculators, computers, and other forms of technology. Nonetheless, all entering college students should be able to:

Decide when to use technology: Students should be able to determine what preliminary algebraic or geometric manipulations are necessary to make best use of a calculator or computer program. At the same time, they should also be able to determine for themselves when using a calculator or computer might be advantageous in solving a problem.

Deal with data: Students should work on problems posed around real data and involving significant calculations. With related applications requiring computation, they gain skill in estimation, approximation, and the ability to tell if a proposed solution is reasonable. Students should find opportunities to work with data in algebra, geometry, and statistics.

Check calculations: Whenever possible, students should use a calculator with a multi-line screen so that they are able to retrieve the input to the calculator and to determine whether any errors have been made.

Represent problems in multiple ways: Students should be able to use a graphing calculator as a tool to represent functions and to develop a deeper understanding of domain, range, arithmetic operations on functions, inverse functions, and function composition.

Experiment, make conjectures, and find counter examples: Students should be comfortable using technology to check their guesses, to formulate revised guesses, and to make conjectures based on these results. They should also challenge conjectures and find counterexamples. Where possible, they should use tools such as geometric software programs to make and test geometric conjectures and provide counterexamples.

Draft Definitions of College and Work Readiness in Mathematics

EXPECTATIONS FOR NUMBER SENSE AND NUMERICAL OPERATIONS

I. Compute fluently and accurately with rational numbers with and without a calculator.

A. Add, subtract, multiply and divide integers, fractions and decimals.
B. Calculate and apply ratios, proportions, rates and percentages to solve problems.
C. Use the correct order of operations to evaluate arithmetic expressions.
D. Explain and apply basic number theory concepts such as prime number, factor, divisibility, least common multiple and greatest common divisor.
E. Multiply and divide numbers expressed in scientific notation with appropriate attention to the number of significant digits.

II. Recognize and apply absolute value (magnitude) and ordering of real numbers.

A. Locate the position of a number on the number line, know that its distance from the origin is its absolute value and know that the distance between two numbers on the number line is the absolute value of their difference.
B. Determine the relative position on the number line of numbers and the relative magnitude of numbers expressed in fractional form, in decimal form, as roots or in scientific notation.

III. Understand the capabilities and the limitations of technology, such as calculators and computer software, in solving problems.

A. When using technology make estimations regularly to detect potential errors.
B. Understand that the use of a calculator requires appropriate mathematical reasoning and does not replace the need for mental computation.

EXPECTATIONS FOR ALGEBRA

I. Perform basic operations on algebraic expressions fluently and accurately:

A. Understand the properties of integer exponents and roots and apply these properties to simplify algebraic expressions.
B.* Understand the properties of rational exponents and apply these properties to simplify algebraic expressions.
C. Add, subtract, and multiply polynomials; divide a polynomial by a low-degree polynomial.
D. Factor polynomials by removing the greatest common factor; factor quadratic polynomials
E. Add, subtract, multiply, divide and simplify rational expressions.
F. Evaluate polynomial and rational expressions and expressions containing radicals and absolute values at specified values of their variables.
G.* Derive and use the formula for the general term and summation of finite arithmetic and geometric series; find the sum of an infinite geometric series whose common ratio, r, is in the interval (-1,1).

- *Determine the distance between two points and find the midpoint of a segment in a rectangular coordinate system.*
- *Determine the equation of a circle in rectangular coordinate systems.*

II. Understand functions, their representations and their properties:

A. Recognize whether a relationship given in symbolic or graphical form is a function.
B.* Determine the domain of a function represented in either symbolic or graphical form. *Determine the range of a function* (this benchmark is an expectation for all students in the Minnesota document)
C. Understand functional notation and evaluate a function at a specified point in its domain.
D.* Combine functions by composition, as well as by addition, subtraction, multiplication and division.
- *Describe the corresponding effects on their graphs.*
- *Composition is an expectation of students who plan to major in a math-related field*

E.* Identify whether a function has an inverse and when functions are inverses of each other; explain why the graph of a function and its inverse are reflections of one another over the line $y = x$.
F.* Know that the inverse of an exponential function is a logarithm, prove basic properties of a logarithm using properties of its inverse and apply those properties to solve problems.

III. Apply basic algebraic operations to solve equations and inequalities:

A. Solve linear equations and inequalities in one variable including those involving the absolute value of a linear function.
B. Solve an equation involving several variables for one variable in terms of the others.
C. Solve systems of two linear equations in two variables.
D. *Solve systems of three linear equations in three variables.
E. Solve quadratic equations in one variable.
**Understand the correspondence between the roots and the factors of a polynomial.*

IV. Graph a variety of equations and inequalities in two variables, demonstrate understanding of the relationships between the algebraic properties of an equation and the geometric properties of its graph, and interpret a graph:

A. Graph a linear equation demonstrate that it has a constant rate of change.
B. Understand the relationship between the coefficients of a linear equation and the slope and x - and y – intercepts of its graph.
C. Understand the relationship between a solution of a system of two linear equations in two variables and the graphs of the corresponding lines.
D. Graph the solution set of a linear inequality and identify whether the solution set is an open or a closed half-plane; graph the solution set of a system of two or three linear inequalities.
E. Graph a quadratic function and understand the relationship between its real zeros and the x - intercepts of its graph.

F. *Graph ellipses and hyperbolas whose axes are parallel to the x and y axes and demonstrate understanding of the relationship between their stand algebraic form and their graphical characteristics.
G. Graph exponential functions and identify their key characteristics.
H. Read information and draw conclusions from graphs; identify properties of a graph that provide useful information about the original problem.

Graphs of the reciprocals of linear and quadratic functions.
Graphs involving absolute value.
**Graph the trigonometric functions sine, cosine, and tangent and understand the properties of their graphs.*

V. Solve problems by converting the verbal information given into an appropriate mathematical model involving equations or systems of equations; apply appropriate mathematical techniques to analyze these mathematical models; and interpret the solution obtained in written form using appropriate units of measurement.

A. Recognize and solve problems that can be modeled using a linear equation in one variable, such as time/rate/distance problems, percentage of increase or decrease problems, and ratio and proportion problems.
B. Recognize and solve problems that can be modeled using a system of two equations in two variables, such as mixture problems.
C. Recognize and solve problems that can be modeled using a quadratic equation, such as the motion of an object under the force of gravity.
D. Recognize and solve problems that can be modeled using an exponential function, such as compound interest problems.
E. *Recognize and solve problems that can be modeled using an exponential function but whose solution requires facility with logarithms, such as exponential growth and decay problems.
F. Recognize and solve problems that can be modeled using a finite geometric series, such as home mortgage problems and other compound interest problems.

VI. *Understand the binomial theorem and its connections to combinatorics, Pascal's triangle and probability.

EXPECTATIONS FOR GEOMETRY

I. Understand the different roles played by axioms, definitions and theorems in the logical structure of mathematics, especially in geometry.

A. Identify, explain the necessity of and give examples of definitions, axioms and theorems.
B. State and prove basic theorems in geometry such as the Pythagorean Theorem, the sum of the angles of a triangle is 180 degrees, and the line joining the midpoints of two sides of a triangle is parallel to the third side and half its length.
C. Recognize that there are geometries in which the parallel postulate is not true (e.g. in spherical geometry, the longitude lines meet at the poles).

II. Identify the definitions and basic properties of lines, angles, triangles, and circles, and use them to prove theorems in (Euclidean) geometry, solve problems, and perform basic geometric constructions using a straight edge and compass.

A. Identify and apply properties of and theorems about parallel lines and use them to prove theorems such as two lines parallel to a third are parallel to each other and to perform constructions such as a line parallel to a given line through a point not on the line.
B. Identify and apply properties of and theorems about perpendicular lines and use them to prove theorems such as the perpendicular bisectors of line segments are the set of all points equidistant from the two end points and to perform constructions such as the perpendicular bisector of a line segment.
C. Identify and apply properties of and theorems about angles and use them to prove theorems such as two lines are parallel exactly when the alternate interior angles they make with a transversal are equal and to perform constructions such as the bisector of an angle.
D. Know the basic theorems about congruent and similar triangles and use them to prove additional theorems and solve problems.
E. Know the definitions and basic properties of a circle and use them to prove basic theorems and solve problems.
F. Apply the Pythagorean Theorem and its converse and properties of special right triangles to solve problems.

III. Understanding and apply the congruence and similarity of geometric figures to analyze and solve problems.

A. Use rigid motions (compositions of reflections, translations and rotations) to determine whether two geometric figures are congruent and to create and analyze geometric designs.
B. Use the scale factor between similar figures to solve problems.

IV. Know that geometric measurements (length, area, perimeter, volume) depend on the choice of a unit and that measurements made on physical objects are approximations; calculate the measurements of common plane and solid geometric figures.

A. Understand that numerical values associated with measurements of physical quantities must be assigned units of measurement or dimensions; apply such units correctly in expressions, equations and problem solutions that involve measurements; and convert a measurement using one unit of measurement to another unit of measurement.
B. Determine the perimeter of a polygon and the circumference of a circle; the area of a rectangle, a circle, a triangle and a polygon with more than four sides by decomposing it into triangles; the surface area of a prism, a pyramid, a cone and a sphere; and the volume of a rectangular box, a prism, a pyramid, a cone and a sphere.
C. Know that the effect of a scale factor k on length, area and volume is to multiply each by k, k^2 *and* k^3, respectively.

V. Visualize solids and surfaces in three-dimensional space when given two-dimensional representations and create two-dimensional representations for the surfaces of three-dimensional objects.

VI. Represent geometric objects and figures algebraically using coordinates; use algebra to solve geometric problems.

A. Express the intuitive concept of the "slant" of a line in terms of the precise concept of slope, use the coordinates of two points on a line to define its slope, and use slope to express the parallelism and perpendicularity of lines.
B. Given the coordinates of two points, find their midpoint, and using the Pythagorean Theorem, find the distance between them.
C. Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius.
D. Use algebra to solve geometric problems unrelated to coordinate geometry, such as solving for an unknown length in a figure involving similar triangles.

VII. Understand the properties of trigonometric functions and apply them to solve problems.

A. Know the trigonometric functions sine, cosine, tangent (*and cotangent, secant, cosecant) defined for an angle in a right triangle, and apply them to solve problems about right triangles.
B. *Given the xy-coordinates of a point on the terminal side of an angle in standard position, find the values of the six trigonometric functions.
C. *Convert between degrees and radians.
D. *Solve applied problems about triangles using the laws of sines and cosines.
E. *Simplify trigonometric expressions using identities and verify simple trigonometric identities.
F. *Find the solutions of a simple trigonometric equation on various intervals.
G. *Know and be able to use the definitions of the inverse trigonometric functions to solve problems.

EXPECTATIONS FOR DATA AND PROBABILITY

I. Explain and apply quantitative information, and explain and critique alternative ways of presenting and using information.

A. Organize and display data using appropriate methods to detect patterns and departures from patterns.
B. Read and interpret tables, charts, and graphs.
C. Compute and explain summary statistics for distributions of data, including measures of center (mean, median) and spread (range, quartiles, percentiles, variance, standard deviation).
D. Create scatter plots, analyze patterns and describe relationships in paired data. Use technology where appropriate to find the regression line (line of best fit) and correlation coefficient, understand the use of the correlation coefficient, and explain when it is appropriate to use the regression to make predictions.
E. Know the characteristics of the normal distribution (bell-shaped curve).

II. Explain the uses of data and statistical thinking to draw inferences, make predictions and justify conclusions.

A. Evaluate reports based on data published in the media by considering the source of the data, the design of the study, and the way the data are analyzed and displayed.
B. Identify and explain misleading uses of data, and recognize when arguments based on data confuse correlation with causation.
C. Explain the impact of sampling methods, bias, and the phrasing of questions asked during data collection.
D. Design simple experiments or investigations to collect data.

III. Explain and apply probability concepts and calculate simple probabilities.

A. Explain how probability quantifies the likelihood that an event occurs.
B. Explain how the relative frequency of a specified outcome can be used to estimate the probability of the outcome.
C. Understand how the law of large numbers and expected values (means) can be applied in simple examples.
D. Apply probability concepts such as conditional probability, *complements of events*, and independence of events to calculate simple probabilities.
E. Understand the relationship between conditional probabilities and contingency tables.
F. Apply probability concepts to practical situations to carry out calculations of probabilities and to make informed decisions.

Recommendations and Next Steps

Alignment Institute/ADP Benchmarks and MN Academic Standards. As noted earlier, several members of the Working Group participated in the Minnesota team attending the Alignment Institute in February, 2006. Several "take aways" of particular value were identified by team members.

One was the idea that *college and work readiness benchmarks are the same*, rather than parallel but different. As previously noted, the working group grappled regularly with issues about how to define work readiness appropriately. Recognition that *how* readiness is demonstrated may be the primary difference between college and work readiness was very helpful, as were ideas about how to assess college and work readiness periodically throughout high school and about defining college and work readiness in ways that are not restrained by the need to assess each and every benchmark or standard.

A second critical "take-away" from the Institute was recognition of the *need to define skills and knowledge in English/language arts more broadly than the group's original charge* to focus on reading and writing. American Diploma Project benchmarks include attention to skills in oral communications, logic, and research, areas beyond the specific context of reading and writing. The team was pleased to note significant alignment between the ADP benchmarks and the Minnesota Academic Standards in Language Arts and concluded that its definitions of college and work readiness should attend to the full range of language arts addressed in those documents.

Finally, the team was excited about the opportunities provided by the Institute's process to develop effective *processes to seek broad input* within the state regarding the draft definitions of college and work readiness; to gain *external review and validation* of that work; and to develop and implement effective *strategies to communicate the college and work readiness definitions* broadly throughout the state.

Following its return to Minnesota, the team presented recommendations to Commissioner Alice Seagren and several members of her staff. General consensus was reached to, in effect, meld the charge of the Working Group into the Alignment Institute process so that the working group would complete its charge as outlined for September 2005 through March 2006 and then revise some tasks and timelines to be consistent with the Alignment Institute process. In particular, this means adding some key areas of language arts skills and knowledge to the working group charge and then adding expertise accordingly.

Work Remaining to Be Done and Recommendations. The working group charge identified the following steps to be completed following the drafting of definitions of college and work readiness in reading, writing, and mathematics:

- Disseminate draft knowledge and skills documents broadly to K-12, higher education, and business contacts for feedback;
- Begin review of alignment of college/work readiness knowledge and skills with high school graduation requirements;
- Review comments on draft readiness documents and subgroup recommendations for improving the alignment of high school graduation and college/work readiness standards;
- Revise draft knowledge and skills document as needed; and
- Present final drafts of college and work readiness knowledge and skills document and alignment recommendations to the P-16 Roundtable for endorsement.

As previously noted, each of the three subgroups has completed first drafts that are ready for review, comment, and further development. However, given the expectations that reading and writing statements will now be included in a broader English/language arts document, **we recommend that the reading and writing subgroup structure be revised to add individuals with the expertise needed to define the broader array of skills and knowledge articulated in the ADP benchmarks**. This broader, more inclusive conversation will contribute to a final document that is complete, coherent, and aligned with Minnesota's Language Arts Standards.

The remaining tasks excerpted above from the working group charge align with or are parallel to steps outlined in the Alignment Institute (AI) process. **We agree with Minnesota's AI team that the P-16 Working Group on College and Work Readiness Skills and Knowledge can complete the tasks and meet the time lines outlined in the AI guidebook and calendar by:**

(1) **adding AI team members** to the College and Work Readiness Working Group;
(2) **adding representatives of other organizations** to the working group as needed to ensure an appropriately broad set of inputs into the group's work;
(3) **broadening the group's college and work readiness definitions** to include other ADP benchmarks in English/language arts (e.g., research, logic, and oral communication) and related items in the Minnesota Academic Standards, as noted above;

(4) **combining the reading and writing sub-groups** and adding to their combined membership in order to better implement the process of defining college and work readiness in English/language arts and aligning it with MN standards;
(5) **revising its timelines** to fit the 11-month plan included in the Alignment Institute and thus providing the working group with the time needed to develop better, more comprehensive definitions of college readiness than is possible under current timelines;
(6) **adding a MN Department of Education representative as a co-chair** of the working group to make clear the shared leadership of P-12 and postsecondary education in this alignment work; and
(7) **including a strong and clear focus on marketing** our college and work readiness efforts, consistent with the expectations of the Alignment Institute work plan and utilizing the expertise of Achieve.

Adopting these revisions to the charge, including timelines, will extend final completion of the process through the end of 2006 and will result in college and work readiness standards that are aligned with the Minnesota Academic Standards in these disciplines, endorsed by all key constituencies, validated by external reviewers, and ready to be broadly and clearly communicated to students, parents, and educators at all levels, as well as employers and other community members.

Added areas for Phase Two Activities. The working group remains committed to the idea that science and world languages readiness for college and work should also be defined, consistent with the needs and demands of an increasingly technological and global economy. To enable completion of an expanded charge incorporated with Minnesota's participation in the Alignment Institute, **we recommend that phase two be undertaken in 2007,** upon completion of the work to define college and work readiness in language arts and mathematics. This timing will enable us to learn from what worked best in the AI project and develop a second set of products that are consistent in style and tone with those currently under development.

Appendixes

A. Working Group Charge
B. Working Group Members List
C. Reading, Writing, and Mathematics Subgroup Members Lists
D. Chapter 5, HF 141, Article 2. Section 85
E. Achieve Summaries and Side-by-Side Documents for Language Arts and Mathematics

Appendix A: Working Group Charge

A. P-16 charge: To identify the reading, writing, and mathematics knowledge and skills needed for entry into postsecondary education and/or into highly skilled occupations at the entry level; to assess the extent to which current high school graduation requirements (credits) align with college and work readiness knowledge and skills; and to recommend any changes in high school requirements needed to improve alignment with college and work readiness.

B. Working group chairs: Judy Kuechle, University of Minnesota-Morris and Cyndy Crist, Minnesota State Colleges and Universities

C. Expected outcomes or products: Four documents are anticipated --
College and work readiness knowledge and skills in (1) reading, (2) writing, and (3) mathematics; and (4) recommendations for changes needed (if any) to student requirements for MN high school graduation in language arts (reading and written composition) and mathematics so that they are aligned with college and work readiness knowledge and skills. With the approval of the P-16 Partnership, the working group will also conduct a phase two activity to define college and work readiness knowledge and skills in science and a world language, given the critical role of each in an increasingly technological and global economy.

D. Expected actions to be requested of Partnership member organizations:

- Decide Partnership's definition of "college and work readiness." (see special notes below)
- Supply names of contacts to coordinate formation of 3 committees (1 for each content area)
- Develop and/or draft skills and endorse final draft readiness documents.
- Suggest revisions to improve college readiness in reading, writing and math for graduation requirements and endorse final draft report.

E. Group's estimated timelines for completion:
(The completion timeline suggested at the June P-16 Partnership meeting was Fall, 2005 to May, 2006. It was also suggested that the group start with math, science, and writing and align with ACT-EPAS, AP-IB, CLEP, math curriculum task force.)

September 2005:	Complete **identification of members** of a College and Work Readiness Knowledge and Skills Working Group, convene **first meeting of full working group**; **determine process** for defining college and work readiness knowledge and skills in each area
October 2005:	**Form 8-15 member subgroups in reading, writing, and math**, select co-chairs for each team, **convene first subgroup meetings.**
November 2005:	Convene **second meeting of full working group**; review initial work of subgroups (general statements of college/work readiness knowledge and skills based on the MN State Universities preparation competencies that have also been endorsed by the University of Minnesota, the standards and benchmarks articulated by the American Diploma Project, and other relevant sets of college readiness standards)
December 2005:	Convene **second meetings of subgroups** to begin defining appropriate levels of college-/work-ready knowledge and skills

January 2006:	Convene **third meeting of full working group**; review subgroup work to date to define levels of performance that indicate college/work readiness.
February 2006:	Convene **third meetings of subgroups** to complete definitions of levels of performance indicating college/work readiness
March 2006:	Convene **fourth meeting of full working group**; complete draft report of college/work readiness for the P-16 Partnership; present report to P-16 Executive Committee and Roundtable and, as appropriate, to legislative committees
April 2006:	**Disseminate draft knowledge and skills documents** broadly to K-12, higher education, and business contacts for feedback; **convene fourth meetings of subgroups** to begin review of alignment of college/work readiness knowledge and skills with high school graduation requirements.
May 2006:	Convene **final meeting of full working group** to review comments on draft readiness documents and subgroup recommendations for improving the alignment of high school graduation and college/work readiness standards.
June 2006:	**Review feedback** from P-16 Roundtable and K-12, higher education and business contacts; **revise draft** knowledge and skills document as needed.
July 2006:	**Present final drafts** of college and work readiness knowledge and skills document and standards/readiness alignment recommendations to the P-16 Roundtable for endorsement.

F. Future Meeting Dates: Specific dates to be set; current plan is to alternate meetings of the full working group (September, November, January, March, and May) with meetings of reading, writing, and mathematics subgroup (October, December, February, and April) to complete the working group's charge by July 2006.

SPECIAL NOTES FROM P-16 PARTNERSHIP CHAIR AND VICE CHAIR:

Knowledge and skills committees should include the following—

- Higher education content area faculty from public and private 2- and 4-year open and selective postsecondary institutions
- Higher education placement and admissions representatives
- High school teachers familiar with the Minnesota Academic Standards for their content area, such as Quality Teaching Network (QTN) teachers
- Representatives from business and industry familiar with the math/reading/writing/science needs of highly skilled workplaces.
- MDE representative from the relevant content area (reading, language arts, mathematics, or career and technical education)

Members of the Partnership should agree on a definition of college and work readiness. We suggest the following — *College and work knowledge and skills readiness*: *Students possess sufficient reading, writing and mathematics skills to be successful in 1) freshman level courses in colleges and universities (i.e., they do not need developmental education) and, 2) highly skilled occupations at the entry level.* Knowledge and skills should be identified for students planning to take "content-intensive" courses (e.g., math-intensive courses required for economics majors), as well skills required for all students who are planning to attend any two-year or four-year public or private college or university.

Appendix B: Members, Working Group on College and Work Readiness Knowledge and Skills

Name	Organization	Contact information
1. *Judy Kuechle, Co-Chair	MACTE	University of MN-Morris 320-589-6413 jkuechle@morris.umn.edu
2. *Cyndy Crist, Co-Chair	MnSCU	651-297-5264 Cyndy.crist@so.mnscu.edu
3. Elona Street Stewart.	MMEP	St. Paul Public Schools 651-767-8149 streetstewart@worldnet.att.net
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5. Mike Miller	MnSCU	MN State University Mankato 507-389-5445 Michael.miller@mnsu.edu
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7. Ginny Karbowski	MnSCU/Anoka STEP Program	763-433-4001 Ginny.karbowski@anoka.k12.mn.us
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13. James Stone, III	U of M	University of MN Twin Cities 612-624-1795 Stone003@umn.edu
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16. Paula Martin	MESPA	Orono Intermediate School (W) 952-449-8475 pmartin@orono.k12.mn.us
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18. Nancy Walters	OHE	651-642-0596 Ex. 3711 Nancy.walters@state.mn.us
19. Jim Russ	Business-Team Industries,Bagley	218-694-3550 jimruss@TEAM-IND.com
20. David Laird	MN Private College Council	651-228-9061 dlaird@mnprivco.org
21. Ron Simmons	MASSP	Bloomington Kennedy High School 952-681-5050 rsimmons@bloomington.k12.mn.us
22. Jerry Williams	MASA	Rochester Public Schools 507-285-8551 jewilliams@rochester.k12.mn.us
23. Michele Ernst	MN Career College Association	ITT Technical Institute 952-914-5300 mernst@itt-tech.edu
24. Bill Blazar	MN Chamber of Commerce	651-292-4658 BBlazar@mnchamber.com
25. Rose Gundacker	Education Minnesota	651-423-7501 Rosemary.gundacker@district196.org
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Appendix C: Subgroup Members Lists

Math:
Larry Gray, faculty/U of M, co-chair
Judy Rohde, teacher, North St. Paul-Maplewood/EdMN, co-chair
Rollie Morud, MDE
Rose Gundacker, EdMN
Tom Muchlinski, MDE
Michael Lehn, MnSCU
Lisa Clarkson, U of M
Ross Taylor, Math Pump

Reading:
Sandy Hayes, teacher, Becker/Ed MN, co-chair
Peggy Ballard, faculty, MSU, Mankato/MnSCU, co-chair
Deborah Dillon, U of M
Bonnie Houck, MDE
Ginny Karbowski, MnSCU
Jim Mecklenberg, MDE

Writing:
Paul Carney, faculty, MN State CTC/ MnSCU, co-chair
Mike Holm, teacher, Eden Prairie/EdMN, co-chair
Paula Martin, MESPA
Charon Tierney, MDE
Donald Ross, U of M

Appendix D: Legislative Reference, College Readiness
Chapter 5, HF 141, Article 2. Section 85

[COLLEGE PREPARATION STANDARDS.]

(a) The Higher Education Advisory Council must convene a working group to develop standards describing the skills and knowledge a high school graduate must have at entry into postsecondary education in order to successfully graduate from college. The standards must, to the extent possible, be applicable for all postsecondary education but may describe differences in the skills and knowledge necessary for success in different higher education institutions and programs. The standards need not be comprehensive but must, at a minimum, be the essential skills and knowledge that will enable a student to succeed in college. The Higher Education Services Office must provide staff for the working group.

(b) The Higher Education Advisory Council must submit the standards to the commissioner of education no later than January 15, 2006. No later than March 15, 2006, the commissioner of education must report, to the chairs of the legislative committees with jurisdiction over kindergarten through grade 12 education policy and finance and higher education policy and finance, its recommendations regarding the changes, if any, that must be made in Minnesota's academic standards in order to ensure that Minnesota high school graduates meet the college readiness standards established by the Higher Education Advisory Council.

(c) The Higher Education Advisory Council must invite the University of Minnesota, Minnesota State Colleges and Universities, representatives of private colleges, and other private postsecondary institutions, to participate in the working group and may invite other individuals or entities to participate. The Higher Education Advisory Council and its working group may collaborate with the Minnesota P-16 Education Partnership in developing the college-readiness standards.

Appendix E, Achieve Summaries and Side-by-Side Documents for Language Arts and Mathematics

As noted in the Working Group report, Minnesota has joined the Alignment Institute, a project of Achieve/American Diploma Project. By virtue of that participation, Achieve content experts have completed an initial comparison of ADP benchmarks, ACT College Readiness Standards, and Minnesota Academic Standards in language arts and mathematics. The results of their review are contained in the four documents that follow. In each discipline, Achieve has provided a summary of their findings and a side-by-side comparison of the three sets of standards/ benchmarks.

Achieve's assessments offer solid evidence that Minnesota is well positioned to align high school and college expectations. In the language arts summary document, the Achieve authors wrote, "Overall, a solid alignment is revealed between the ADP Benchmarks and the Minnesota Language Arts Standards for Grades 9-12." A similar conclusion was reached by the authors of the Achieve math document, who wrote, "In general, there is strong alignment between the ADP mathematics benchmarks and the Minnesota Academic Standards." Clearly, we have a solid foundation in Minnesota on which to build shared expectations for college and work readiness.

The Achieve content experts also identified differences between Minnesota's standards and the ADP benchmarks and/or ACT standards. Their descriptions of these differences will provide a useful context for further discussion and continuing analyses by the P-16 Working Group and its subgroups. Continuing participation in the Alignment Institute will also provide opportunities to review the ADP analysis with the staff who prepared them and to clarify and, as appropriate, correct any errors or omissions in the ADP assessments. These kinds of discussions are expected to contribute significantly to a final outcome that will make clear Minnesota's commitment to high standards for all students.

Summary Points:

Achieve's Side-by-Side Comparison of the American Diploma Project (ADP) Benchmarks with Minnesota's *Language Arts Standards*

For the purposes of this comparison, Achieve staff constructed a side-by-side chart comparing Achieve's American Diploma Project (ADP) Benchmarks to Minnesota's *Language Arts Standards* for grades 9-12. (Please note that Achieve also referenced benchmarks from earlier grade levels as necessary to ensure a complete picture of the alignment between Minnesota's standards and the ADP Benchmarks.)

Overall, a solid alignment is revealed between the ADP Benchmarks and the Minnesota *Language Arts Standards* for Grades 9-12. Many important concepts in the ADP Benchmarks are articulated by the Minnesota Standards. One strength of the Minnesota Standards is an emphasis on informational texts, research, and media literacy. These areas are sometimes overlooked by states with more traditional views of English coursework at the high school level. The state should be recognized for including these many and varied statements. Another strength is that the organization of the Minnesota standards suggests an emphasis on speaking, listening and media literacy, areas which are sometimes neglected in an effort by states to include only those academic standards that can be easily assessed on an on-demand, statewide assessment. Therefore the overall strands identified by ADP align well with the overall strands identified by Minnesota. In addition, Minnesota includes a separate sub-strand on research which adds to the solid alignment with ADP. Although there is not a separate sub-strand on logic, many of these elements from the ADP Benchmarks are reflected within Minnesota's benchmarks in reading, research or media.

It is important to note, however, that not every ADP benchmark is reflected in the Minnesota Standards, particularly in the standards for grades 9-12. Some ADP Benchmarks were not found to align with any Minnesota English Language Arts standard (such as the benchmark on workplace writing); others were found to align with statements from the Minnesota standards, but at the K-8 levels. The state will want to consider the standards that match an ADP Benchmark and that are found at a grade much lower than 9-12. In these cases, Minnesota may want to include this additional content in its 9-12 Standards. Areas of non-alignment or alignment with grades below 9-12 are discussed further in this commentary.

In addition, it is important to note that there are some areas in which the Minnesota Standards include content that is not specified by the ADP Benchmarks. Sometimes this non-aligned content reflects a different emphasis by Minnesota (such as an instructional emphasis as shown by the statement on the use of reading comprehension strategies or a state goal as shown by the statement on reading for pleasure). It is expected that state standards include additional goals not reflected in the ADP Benchmarks, which were written specifically to reflect expectations for work- and college-readiness. Other times this non-alignment may suggest that Minnesota has included some statements that may

have been written too broadly for mapping, or whose intent was unclear to Achieve reviewers.

Finally, a closer look at the alignment reveals some areas in which Minnesota could raise the level of specificity or the rigor expected in its statements. Suggestions for areas for increased specificity or rigor are addressed within this commentary.

What follows is a description of the commonalities and differences found between the two sets of expectations.

Commonalities: Content in Both ADP and the Minnesota Standards
Both the ADP Benchmarks and the Minnesota *Language Arts Standards* at Grades 9-12 expect students to:

- Demonstrate understanding of English grammar and conventions;
- Know and apply various vocabulary/word understanding skills and strategies;
- Make oral presentations;
- Plan, draft and revise various types of academic writing;
- Gather research;
- Evaluate the reliability and validity of sources;
- Identify the main ideas and essential details of informational texts;
- Analyze arguments made in texts and oral presentations;
- Critically analyze and evaluate the subtexts of media;
- Read literature, and consider the historical impact of literature and various literary elements.

Differences: Content in ADP not in the Minnesota Standards
The ADP Benchmarks attempt to describe the English knowledge and skills that high school graduates must master if they expect to succeed in postsecondary education or in high-performance, high-growth jobs. Thus, it is important to consider whether or not the skills not mirrored or fully articulated in the Minnesota Standards represent areas of learning that are crucial to post-secondary success.

ADP expectations not currently found in the state's framework may be absent for a number of reasons, among these may be the fact that the state expects some skills at a level before Grades 9-12. In these cases, it may be appropriate for the state to have some areas of non-alignment with the ADP Benchmarks, as long as secondary educators in the state understand that the expectations for learning are cumulative across the grade levels. This point can be made within the document through language such as that found in New Jersey's grades 9-12 standards: "Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will..." Whether educators will actually refer to earlier grade-level standards when planning their instruction, however, cannot be assured and the state should take this into consideration when considering the comprehensiveness of its Grades 9-12 standards. In addition, in some cases, the examples of non-alignment may suggest an oversight by the state in articulating the important skills that will prepare students for postsecondary education and the world of work. An examination of the

Minnesota Standards for Grades 9-12 reveals some gaps when examined against the ADP Benchmarks.

Language
The alignment is solid between the ADP Benchmarks and the Minnesota document in the ADP Language strand. Most of the ADP Benchmarks are included within the Minnesota benchmarks. Of the last three ADP Benchmarks (A5-A7), however, one is represented only at a much lower grade and the other two are not referenced by Minnesota. Minnesota may want to consider if it wants to add any statements about analogies, idioms, word connotations and denotations or nuances of meaning, or understanding quantitative, technical and mathematical information to its 9-12 benchmarks.

Communication
In the area of Communication, readers of the side-by-side document should note that although it may appear that Minnesota's benchmarks align well with the ADP benchmarks, most of the mapping was done by citing statements from earlier grades in the Minnesota document. Although there is a separate strand in Minnesota's document at Grades 9-12 on Speaking, Listening and Viewing, the state may not have included the most essential benchmarks in this strand. (For more discussion of the statements that Minnesota has included, please see the later section in this commentary.) Minnesota does include the following statement under Speaking and Listening at Grades 9-12:

> 9-12.III.A.1. Distinguish between speaker's opinion and verifiable facts and analyze the credibility of the presentation.

The intent of this statement, however, seemed to have a sufficiently different focus that Achieve reviewers did not align it with the ADP Benchmarks in Communication.

Minnesota should consider if it wants to articulate more fully for educators and students the specific skills required for effective speaking, listening, oral presentations, and group work. The level of specificity present in the ADP Benchmarks is not reflected within the Minnesota standards.

Clearly, effective oral presentation skills and the ability to work successfully within a group are necessary skills for success in higher education and the world of work. As such, the state may want to consider whether it wants to include more specific statements, like those in the ADP Benchmarks, within its high-school course expectations. (Minnesota currently does not reference group work and the requirements for effective group work in its Grades 9-12 statements, although group work is referenced in the Grade 8 benchmarks as shown in the side-by-side document.) Including specific statements such as those found in the following ADP Benchmark can help guide teachers and students in defining classroom expectations and in creating rubrics for scoring and self-evaluation:

> B6. Make oral presentations that:
> - exhibit a logical structure appropriate to the audience, context and purpose;
> - group related ideas and maintain a consistent focus;
> - include smooth transitions

- support judgments with sound evidence and well-chosen details;
- make skillful use of rhetorical devices;
- provide a coherent conclusion;
- employ proper eye contact, speaking rate, volume, enunciation, inflection and gestures to communicate ideas effectively.

B7. Participate productively in self-directed work teams for a particular purpose (for example, to interpret literature, write or critique a proposal, solve a problem, make a decision), including:

- posing relevant questions;
- listening with civility to the ideas of others;
- extracting essential information from others' input;
- building on the ideas of others and contributing relevant information or ideas in group discussions;
- consulting texts as a source of ideas;
- gaining the floor in respectful ways;
- defining individuals' roles and responsibilities and setting clear goals;
- acknowledging the ideas and contributions of individuals in the group;
- understanding the purpose of the team project and the ground rules for decision-making;
- maintaining independence of judgment, offering dissent courteously, ensuring a hearing for the range of positions on an issue and avoiding premature consensus;
- tolerating ambiguity and a lack of consensus; and
- selecting leader /spokesperson when necessary.

Writing

In the area of Writing, Achieve determined that all but one of the statements in the ADP Benchmarks were addressed fully or partially by the Grades 9-12 Minnesota Standards. Only ADP Benchmark C10 on workplace writing was not mapped to a corresponding Minnesota Benchmark. In addition, for ADP Benchmark C9, the corresponding Minnesota statement seems minimal in comparison to the ADP Benchmark. Although some of the criteria for academic writing are reflected in others of Minnesota's benchmarks (such as stating a thesis or placing paragraphs in a logical order), Minnesota may want to consider if it wants to define the criteria for effective academic writing all in one place, as is done in the ADP Benchmarks. As is stated above in the section on oral communication, detailing specific criteria can assist teachers and students in understanding expectations and creating rubrics for teacher scoring and student self-evaluation. Currently, the Minnesota standards seem to fall short of clearly defining the qualities needed for success in academic writing, and they do not address workplace writing at all as an expectation for students in grades 9-12. By not expecting that high school students will produce workplace texts and by not articulating the criteria for writing effective workplace documents, the state has fallen short in an important skill to prepare students for the world of work.

Table 1 below shows the level of specificity within the ADP Benchmarks on these types of writing compared with the more general related statement included in the Minnesota Standards.

Table 1 **Comparison of ADP Writing Benchmarks C9 and C10 with Corresponding Grades 9-12 Minnesota Benchmarks**	
C9.Write an academic essay (for example, a summary, an explanation, a description, a literary analysis essay) that: **• develops a thesis;** **• creates an organizing structure appropriate to purpose, audience and context;** **• includes relevant information and excludes extraneous information;** **• makes valid inferences;** **• supports judgments with relevant and substantial evidence and well-chosen details; and** **• provides a coherent conclusion.**	9-12.II.A.1. Plan, organize and compose narrative, expository, descriptive, persuasive, critical and research writing to address a specific audience and purpose.
C10. Produce work-related texts (for example, memos, e-mails, correspondence, project plans, work orders, proposals, bios) that: **• address audience needs, stated purpose and context;** **• translate technical language into non-technical English;** **• include relevant information and exclude extraneous information;** **• use appropriate strategies, such as providing facts and details, describing or analyzing the subject, explaining benefits or limitations, comparing or contrasting, and providing a scenario to illustrate;** **• anticipate potential problems, mistakes and misunderstandings that might arise for the reader;** **• create predictable structures through the use of headings, white space and graphics, as appropriate; and** **• adopt a customary format, including proper salutation, closing and signature, when appropriate.**	

Research

Minnesota includes many important ideas in articulating the statements of expectations for students in the area of research. However, similar to the Minnesota benchmarks in the area of writing, in the area of research, the Minnesota statements fall short of clearly defining the qualities needed for success in writing an extended research essay. Part of this deficiency may be due to the fact that the benchmarks for the sub-strand of research are grouped with process statements included alongside product statements. The full set of Minnesota's Research benchmarks is provided below as Table 2, with notes about which statements relate to the process of conducting research and which statements refer to the expectations of a product: a research report. Table 3, which follows, shows the ADP Benchmark on producing a research essay. Minnesota may want to consider this

type of organization. As is stated above, this level of detail can guide students in their writing and support teachers in developing standards-based rubrics.

Table 2

Grades 9-12 Minnesota Benchmarks for Sub-Strand on Research with Notes about the Organization of these Benchmarks

1. Use print, electronic databases and online resources to access information, organize ideas, and develop writing.	*Process* of Research
2. Identify key terms specific to research tools and processes.	*Process* of Research
3. Narrow the focus of a search by formulating a concise research question or thesis.	*Process* of Research
4. Develop a research plan.	*Process* of Research
5. Evaluate and organize relevant information from a variety of sources, verifying the accuracy and usefulness of gathered information.	*Process* of Research
6. Produce a report with detailed evidence to support a thesis.	*Product* of Research
7. Distinguish between reliable and questionable Internet sources and apply responsible use of technology.	*Process* of Research
8. Understand plagiarism and its consequences, and identify ethical issues of research and documentation.	*Process* of Research
9. Organize and synthesize information from a variety of sources and present it in a logical manner.	*Product* of Research
10. Credit sources for both quoted and paraphrased ideas.	*Product* of Research
11. Cite sources of information using a standard method of documentation, such as a style sheet from the Modern Language Association (MLA) or from the American Psychological Association (APA).	*Product* of Research
12. Proofread the final copy, format correctly and prepare the document for publication or submission.	*Product* of Research

Table 3

Comparison of ADP Writing Benchmark D5 with Corresponding Grades 9-12 Minnesota Standards

D5.Write an extended research essay (approximately six to 10 pages), building on primary and secondary sources, that: **• marshals evidence in support of a clear thesis statement and related claims;** **• paraphrases and summarizes with accuracy and fidelity the range of arguments and evidence supporting or refuting the thesis, as appropriate; and** **• cites sources correctly and documents quotations, paraphrases and other information using a standard format.**	9-12.II.A.1. Plan, organize and compose narrative, expository, descriptive, persuasive, critical and research writing to address a specific audience and purpose.
	9-12.II.D.6. Produce a report with detailed evidence to support a thesis.
	9-12.II.D.9. Organize and synthesize information from a variety of sources and present it in a logical manner.

Logic

In the area of Logic, Minnesota shows a strong alignment across many of the ADP topics. The state may want to consider the specificity of some statements and consider whether ADP's wording suggests a higher expectation of rigor than is conveyed by the corresponding Minnesota statements.

In addition, as with the earlier sections of this summary, Minnesota's document again seems to lack the specificity of ADP in articulating the expectations for student-constructed arguments; see Table 4 below.

Table 4

Comparison of ADP Writing Benchmark E9 with Corresponding Grades 9-12 Minnesota Standards

E9. Construct arguments (both orally and in writing) that: **• develop a thesis that demonstrates clear and knowledgeable judgment;** **• structure ideas in a sustained and logical fashion;** **• use a range of strategies to elaborate and persuade, such as descriptions, anecdotes, case studies, analogies and illustrations;** **• clarify and defend positions with precise and relevant evidence, including facts, expert opinions, quotations and/or expressions of commonly accepted beliefs and logical reasoning;** **• anticipate and address the reader's concerns and counterclaims; and** **• provide clear and effective conclusions.**	9-12.II.A.1. Plan, organize and compose narrative, expository, descriptive, persuasive, critical and research writing to address a specific audience and purpose.

Informational Texts

In the area of Informational Texts, Minnesota aligns with all but one of the ADP Benchmarks—a solid alignment. The state may, however, want to pay particular attention to those statements for which the alignment was found at a grade below Grade 8. The following ADP Benchmarks were found to align with Minnesota benchmarks at Grade 8 or below:

> F5. Interpret and use information in maps, charts, graphs, time lines, tables and diagrams.
> F6. Identify interrelationships between and among ideas and concepts within a text, such as cause-and-effect relationships.
> F9. Analyze the ways in which a text's organizational structure supports or confounds its meaning or purpose.

Reading and understanding informational texts often requires attention to the graphic elements in texts, the relationships among ideas, and the organization of the text. Minnesota may want to consider if it wants to address these elements within its high school standards.

Literature

In general, the alignment between ADP and Minnesota in the Literature strand is strong, with most statements aligned. A strength for Minnesota in this area is that the state addresses poetry, drama, and genre characteristics directly.

Overall

A complete listing of those elements included in the ADP Benchmarks, but not evident in the Minnesota *Language Arts Standards* is as follows:

Table 5 **ADP Benchmarks NOT found in the Minnesota *Language Arts Standards***
A. Language
A6. Recognize nuances in the meanings of words; choose words precisely to enhance communication.
A7. Comprehend and communicate quantitative, technical and mathematical information.
B. Communication
B3. Paraphrase information presented orally by others.
B4. Identify the thesis of a speech and determine the essential elements that elaborate it.
B5. Analyze the ways in which the style and structure of a speech support or confound its meaning or purpose.
C. Writing
C10. Produce work-related texts (for example, memos, e-mails, correspondence, project plans, work orders, proposals, bios) that: • address audience needs, stated purpose and context; • translate technical language into non-technical English; • include relevant information and exclude extraneous information; • use appropriate strategies, such as providing facts and details, describing or analyzing the subject, explaining benefits or limitations, comparing or contrasting, and providing a scenario to illustrate; • anticipate potential problems, mistakes and misunderstandings that might arise for the reader; • create predictable structures through the use of headings, white space and graphics, as appropriate; and • adopt a customary format, including proper salutation, closing and signature, when appropriate.
D. Research
D4. Report findings within prescribed time and/or length requirements, as appropriate.
E. Logic
E2. Identify false premises in an argument.
E7. Understand the distinction between a deductive argument (where, if the premises are all true and the argument's form is valid, the conclusion is inescapably true) and inductive argument (in which the conclusion provides the best or most probable explanation of the truth of the premises, but is not necessarily true).
F. Informational Text
F4. Distinguish between a summary and a critique.
G. Media
G2. Examine the intersections and conflicts between the visual (such as media images, painting, film and graphic arts) and the verbal.
G4. Apply and adapt the principles of written composition to create coherent media productions using effective images, text, graphics, music and/or sound effects — if possible — and present a distinctive point of view on a topic (for example, PowerPoint presentations, videos).
H. Literature
H2. Analyze foundational U.S. documents for their historical and literary significance (for

example, The Declaration of Independence, the Preamble to the U.S. Constitution, Abraham Lincoln's "Gettysburg Address, Martin Luther King's "Letter from Birmingham Jail").
H8. Analyze the moral dilemmas in works of literature, as revealed by characters' motivation and behavior.

Differences: Content in the Minnesota Standards Not in ADP

The Minnesota *Language Arts Standards* contain a number of indicators that are not included in the ADP Benchmarks. These are listed in the table below.

Table 6
Elements Included in Minnesota's Grades 9-12 Standards that are NOT in ADP Benchmarks
Strand I: Reading and Literature
9-12.I.B.1. Acquire, understand and use vocabulary by learning words through explicit vocabulary instruction and independent reading, and appropriately use these words in writing.
9-12.I.B.3. Identify and analyze analogies.
9-12.I.C.1. Monitor comprehension and know when and how to use strategies to clarify the understanding of a selection.
9-12.I.C.4. Analyze a variety of nonfiction materials selected from journals, essays, speeches, biographies and autobiographies.
9-12.I.D.2. Read, analyze and evaluate traditional, classical and contemporary works of literary merit from British literature.
9-12.I.D.3. Read, analyze and evaluate traditional, classical and contemporary works of literary merit from civilizations and countries around the world.
9-12.I.D.5. Analyze, interpret and evaluate the use of figurative language and imagery in fiction and nonfiction selections, including symbolism, tone, irony and satire.
9-12.I.D.7. Evaluate a literary selection from several critical perspectives.
9-12.I.D.10. Interpret the effect of literary and structural devices.
9-12.I.D.14. Respond to literature using ideas and details from the text to support reactions and make literary connections.
9-12.I.D.15. Read from and respond to a variety of fiction, poetic and nonfiction texts of increasing complexity for personal enjoyment.
Strand II: Writing
9-12.II.C.2. Use an extensive variety of correctly punctuated sentences for meaning and stylistic effect.
9-12.II.D.2. Identify key terms specific to research tools and processes.
9-12.II.D.4. Develop a research plan.
Strand II: Speaking, Listening and Viewing
9-12.III.A.3. Understand the relationship between nonverbal, interpersonal, and small group communication.
9-12.III.A.4. Describe the role of communication in everyday situations (e.g., advertising, informal social, business, formal social, etc.)
9-12.III.A.6. Identify and understand essential elements, skills and implications of persuasion, argumentation, and debate as essential oral skills.
9-12.III.A.7. Apply assessment criteria to self-evaluation of oral presentations.
9-12.III.C.8. Formulate critical, evaluative questions relevant to a print or non-print selection.
9-12.III.C.10. Demonstrate an understanding of ethics in mass communication and

describe the characteristics of ethical and unethical behavior.

It is important to note that all areas of difference between ADP and the Minnesota Standards do not suggest a weakness in either of the documents. Rather, considering areas of non-alignment is an important task that may illuminate emphases, strengths or weaknesses that should be considered further.

As discussed at the beginning of this summary, some of the statements included in Minnesota but not in ADP reflect an emphasis of Minnesota that is simply not present in the ADP Benchmarks. Minnesota emphasizes some goals and elements of effective language arts instruction, such as monitoring comprehension or reading for enjoyment by including statements such as:

> **9-12.I.C.1.** Monitor comprehension and know when and how to use strategies to clarify the understanding of a selection.
> **9-12.I.D.15.** Read from and respond to a variety of fiction, poetic and nonfiction texts of increasing complexity for personal enjoyment.

This emphasis represents an attempt by the state to focus educators' instruction and goals, and is an appropriate effort by the state, but one that differs from the purpose and intent of the ADP Benchmarks.

In addition, some of the statements Minnesota includes that are not included in ADP may be strengths of the Minnesota Standards and may highlight areas that are important for high-school English classrooms but were not deemed essential for the ADP Benchmarks. For example, the Minnesota Standards at Grades 9-12 include indicators on figurative language and author's style through statements such as:

> **9-12.I.D.5.** Analyze, interpret and evaluate the use of figurative language and imagery in fiction and nonfiction selections, including symbolism, tone, irony and satire.
> **9-12.I.D.10.** Interpret the effect of literary and structural devices.
> **9-12.I.D.14.** Respond to literature using ideas and details from the text to support reactions and make literary connections.

Because of the focus on skills to prepare students for the world of work, the ADP Benchmarks may not focus as explicitly on some of those literary knowledge and analysis skills that may be appropriate and desired in a high-school English class.

Some of the topics that Minnesota includes in indicators that are not included in the ADP Benchmarks may point to weaknesses of the Minnesota Standards. Within the Media benchmarks, there seemed to be too broad a focus. A statement like the following, for example, does not seem to target a skill specific to media literacy:

> **9-12.III.C.8.** Formulate critical, evaluative questions relevant to a print or non-print selection.

The organization of Minnesota's document for the most part is logical – Reading, Writing, Speaking, Listening and Viewing. However, under the Media Sub-Strand in Strand III: Speaking, Listening and Viewing, the state appears to have included several of statements (like the example above) that may fit better in the Reading Strand or should be worded in such a way to better focus on aspects of the skill or knowledge that specifically relate to media. Webster's defines *media* as "Also called **mass media.** The means of communication, as radio, television, newspapers, magazines, etc. that reach very large numbers of people." However, several statements in this section seem general to any text – not specific to media. If they are general to any informational text, for example, perhaps they would fit better under informational text reading. The following statements seemed *not* specific to media:

2. Evaluate the logic of reasoning in both print and non-print selections.
3. Evaluate the source's point of view, intended audience and authority.
4. Determine whether the evidence in a selection is appropriate, adequate and accurate.
8. Formulate critical, evaluative questions relevant to a print or non-print selection.

Another issue within the Minnesota standards was that some statements do not seem to focus appropriately on the essential skill for high-school students. For example, the following statement on research seems overly narrow:

9-12.II.D.2. Identify key terms specific to research tools and processes.

Is the state concerned about students knowing terminology or being able to use research tools and effectively follow a process of research? If the state does want students to "identify key terms" it may be helpful to include some examples within this benchmark.

Similarly, the focus in the strand on Speaking, Listening and Viewing may not be as targeted on essential skills as it could be. Readers of the side-by-side document should note that although it may appear that Minnesota's benchmarks align well with the ADP benchmarks, most of the mapping was done by pulling statements from earlier grades in the Minnesota document. Although there is a separate strand in Minnesota's document at Grades 9-12 on Speaking, Listening and Viewing, the state may not have included the most essential benchmarks in this strand. For example, Minnesota includes the following statements:

9-12.III.A.3. Understand the relationship between nonverbal, interpersonal, and small group communication.
9-12.III.A.4. Describe the role of communication in everyday situations (e.g., advertising, informal social, business, formal social, etc.).
9-12.III.A.6. Identify and understand essential elements, skills and implications of persuasion, argumentation, and debate as essential oral skills.

The state should consider if these define the essential elements of speaking and listening in Grades 9-12. In the first statement, for example, should students understand the relationship or should they effectively use nonverbal elements in making an oral

presentation? Should they demonstrate the ability to work effectively in small groups by listening, taking turns, asking questions, etc.? For the final statement above, if persuasion, argumentation and debate are essential oral skills, should students just identify their essential elements, or should students be expected to deliver effective oral arguments?

Summary

Overall, Minnesota has done a commendable job of developing a set of high-school standards that align well with the ADP Benchmarks and identify many of the essential skills for high-school students planning to pursue jobs or higher education upon graduation. The organizational structure is clean and clear and emphasizes many language arts skills that go beyond a knowledge of literature. With some attention to areas of non-alignment and statements that are not as clear, targeted, or rigorous as desired, the state will have a strong set of high-school language arts standards.

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
Please note that the following coding system is used for the Minnesota Standards. Each benchmark begins with a code, such as 9-12.I.B.1 in which the first set of numbers tells the grade level (such as 9-12 for high school standards, or 8 for 8th grade), the next one-to-three numbers indicate the strand, the letter tells the sub-strand, and the final number tells the benchmark, or performance expectation under each standard. So, for example, 9-12.I.B.1 would be understood as follows: 9-12 = Grades 9-12 I = Strand I: Reading and Literature B = Sub-strand B: Vocabulary Expansion 1 = Benchmark 1 (Acquire, understand and use vocabulary....)		
	A. Language	
Sentence Structure and Formation (13-15) Use conjunctions or punctuation to join simple clauses. Revise shifts in verb tense between simple clauses in a sentence or between simple adjoining sentences.	**A1. Demonstrate control of standard English through the use of grammar, punctuation, capitalization and spelling.**	9-12.II.C.3. Edit writing for correct grammar, capitalization, punctuation, spelling, verb tense, sentence structure, and paragraphing to enhance clarity and readability: a. Correctly use reflexive case pronouns and nominative and objective case pronouns, including who and whom. b. Correctly use punctuation such as the comma, semicolon, colon, hyphen, and dash. c. Correctly use like/as if, any/any other, this kind/these kinds, who/that, and every/many when they occur in a sentence. d. Correctly use verb forms with attention to subjunctive mood, subject/verb agreement, and active/passive voice. e. Correctly use the possessive pronoun before the gerund.
Sentence Structure and Formation (16-19) Determine the need for punctuation and conjunctions to avoid awkward-sounding sentence fragments and fused sentences. Decide the appropriate verb tense and voice by considering the meaning of the entire sentence.		
Sentence Structure and Formation (20-23) Recognize and correct marked disturbances of sentence flow and structure (e.g., participial phrase fragments, missing or incorrect relative pronouns, dangling or misplaced modifiers)		
Sentence Structure and Formation (24-27) Revise to avoid faulty placement of phrases and faulty coordination and subordination of clauses in sentences with subtle structural problems. Maintain consistent verb tense and pronoun person on the basis of the preceding clause or sentence.		
Sentence Structure and Formation (28-32) Use sentence-combining techniques, effectively avoiding problematic comma splices, run-on sentences, and sentence fragments, especially in sentences containing compound subjects or verbs. Maintain a consistent and logical use of verb tense and pronoun person on the basis of information in the paragraph or essay as a whole.		
Sentence Structure and Formation (33-36) Work comfortably with long sentences and complex clausal relationships within sentences, avoiding weak conjunctions between independent clauses and maintaining parallel structure between clauses.		
Conventions of Usage (13-15) Solve such basic grammatical problems as how to form the past and past participle of irregular but commonly used verbs and how to form comparative and superlative adjectives.		
Conventions of Usage (16-19) Solve such grammatical problems as whether to use an adverb or adjective form,		

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
how to ensure straightforward subject-verb and pronoun-antecedent agreement, and which preposition to use in simple contexts. Recognize and use the appropriate word in frequently confused pairs, such as *there* and *their, past* and *passed,* and *led* and *lead.*		
Conventions of Usage (20-23) Use idiomatically appropriate prepositions, especially in combination with verbs (e.g., *long for, appeal to*). Ensure that a verb agrees with its subject when there is some text between the two.		
Conventions of Usage (24-27) Ensure that a pronoun agrees with its antecedent when the two occur in separate clauses or sentences. Identify the correct past and past participle forms of irregular and infrequently used verbs and form present-perfect verbs by using *have* rather than *of.*		
Conventions of Usage (28-32) Correctly use reflexive pronouns, the possessive pronouns *its* and *your,* and the relative pronouns *who* and *whom.* Ensure that a verb agrees with its subject in unusual situations (e.g., when the subject-verb order is inverted or when the subject is an indefinite pronoun).		
Conventions of Usage (33-36) Provide idiomatically and contextually appropriate prepositions following verbs in situations involving sophisticated language or ideas. Ensure that a verb agrees with its subject when a phrase or clause between the two suggests a different number for the verb.		
Conventions of Punctuation (13-15) Delete commas that create basic sense problems (e.g., between verb and direct object)		
Conventions of Punctuation (16-19) Provide appropriate punctuation in straightforward situations (e.g., items in a series). Delete commas that disturb the sentence flow (e.g., between modifier and modified element).		
Conventions of Punctuation (20-23) Use commas to set off simple parenthetical phrases. Delete unnecessary commas when an incorrect reading of the sentence suggests a pause that should be punctuated (e.g., between verb and direct object clause).		
Conventions of Punctuation (24-27) Use punctuation to set off complex parenthetical phrases. Recognize and delete unnecessary commas based on a careful reading of a complicated sentence (e.g., between the elements of a compound subject or compound verb joined by *and*). Use apostrophes to indicate simple possessive nouns. Recognize inappropriate uses of colons and semicolons.		

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
Conventions of Punctuation (28-32) Use commas to set off a nonessential/nonrestrictive appositive or clause. Deal with multiple punctuation problems (e.g., compound sentences containing unnecessary comas and phrases that may or may not be parenthetical). Use an apostrophe to show possession, especially with irregular plural nouns. Use a semicolon to indicate a relationship between closely related independent clauses.		
Conventions of Punctuation (33-36) Use a colon to introduce an example or an elaboration.		
	A2. Use general and specialized dictionaries, thesauruses and glossaries (print and electronic) to determine the definition, pronunciation, etymology, spelling and usage of words.	9-12.I.B.2. Determine the meaning of unfamiliar words and metaphors by using **dictionaries**, context clues and **reference books**.
	A3. Use roots, affixes and cognates to determine the meaning of unfamiliar words.	9-12.I.B.4. Apply knowledge of Greek and Latin roots, prefixes and suffixes to understand content area vocabulary,
		9-12.I.B.5. Understand the meaning of unknown words using derivations, such as word roots and word origins.
Meanings of Words (13-15) Understand the implication of a familiar word or phrase and of simple descriptive language.	**A4. Use context to determine the meaning of unfamiliar words.**	9-12.I.B.2. Determine the meaning of unfamiliar words and metaphors by using dictionaries, **context clues** and reference books.
Meanings of Words (16-19) Use context to understand basic figurative language.		
Meanings of Words (20-23) Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages.		
Meanings of Words (24-27) Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages. Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages.		
Meanings of Words (28-32) Determine the appropriate meaning of words, phrases, or statements from figurative and somewhat technical contexts.		
Meanings of Words (33-36) Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage.		

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
	A5. Identify the meaning of common idioms, as well as literary, classical and biblical allusions; use them in oral and written communication.	5.I.B.2. Use knowledge of root words, derivations, antonyms, synonyms, **idioms**, homonyms and multiple-meaning words to determine word meanings and to understand texts.
	A6. Recognize nuances in the meanings of words; choose words precisely to enhance communication.	
<<Repeated from A4 above>> Meanings of Words (28-32) Determine the appropriate meaning of words, phrases, or statements from figurative and somewhat technical contexts.	**A7. Comprehend and communicate quantitative, technical and mathematical information.**	
	B. Communication	
	B1. Give and follow spoken instructions to perform specific tasks, to answer questions or to solve problems.	3.III.A.3. Follow multi-step oral directions.
	B2. Summarize information presented orally by others.	5.III.A.5. Restate or summarize and organize ideas sequentially using evidence to support opinions and main ideas. *<<Note: Match is not entirely certain. This statement is unclear since suggestion of restating or summarizing is that students are restating or summarizing some information, but statement is unclear as to whether students are summarizing information that has been orally presented or if students are summarizing a text that has been read.>>*
	B3. Paraphrase information presented orally by others.	
	B4. Identify the thesis of a speech and determine the essential elements that elaborate it.	
	B5. Analyze the ways in which the style and structure of a speech support or confound its meaning or purpose.	
	B6. Make oral presentations that: **• exhibit a logical structure appropriate to the audience, context and purpose;** **• group related ideas and maintain a consistent focus;**	9-12.III.A.2. Deliver a speech in a logical manner using grammatically correct language, including vocabulary appropriate to the topic, audience and purpose.

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
	• include smooth transitions • support judgments with sound evidence and well-chosen details; • make skillful use of rhetorical devices; • provide a coherent conclusion; • employ proper eye contact, speaking rate, volume, enunciation, inflection and gestures to communicate ideas effectively.	
	B7. Participate productively in self-directed work teams for a particular purpose (for example, to interpret literature, write or critique a proposal, solve a problem, make a decision), including: • posing relevant questions; • listening with civility to the ideas of others; • extracting essential information from others' input; • building on the ideas of others and contributing relevant information or ideas in group discussions; • consulting texts as a source of ideas; • gaining the floor in respectful ways; • defining individuals' roles and responsibilities and setting clear goals; • acknowledging the ideas and contributions of individuals in the group; • understanding the purpose of the team project and the ground rules for decision-making; • maintaining independence of judgment, offering dissent courteously, ensuring a hearing for the range of positions on an issue and avoiding premature consensus; • tolerating ambiguity and a lack of consensus; and • selecting leader /spokesperson when necessary.	8.III.A.1. Participate in and follow agreed-upon rules for conversation and formal discussions in large and small groups. 8.III.A.7. Participate effectively in group meetings.
	C. Writing	
	C1. Plan writing by taking notes, writing informal outlines and researching.	9-12.II.B.1. Generate, gather, and **organize ideas** for writing.

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
Word Choice in Terms of Style, Tone, Clarity, and Economy (16-19) .... Revise expressions that deviate from the style of an essay.	**C2. Select and use formal, informal, literary or technical language appropriate for the purpose, audience and context of the communication.**	9-12.II.B.2. Develop a thesis and clear purpose for writing.
Word Choice in Terms of Style, Tone, Clarity, and Economy (20-23) Use the word or phrase most consistent with the style and tone of a fairly straightforward essay.		
Word Choice in Terms of Style, Tone, Clarity, and Economy (24-27) ... Use the word or phrase most appropriate in terms of the content of the sentence and tone of the essay.		9-12.II.C.1. Understand the differences between formal and informal language styles and use each appropriately.
Word Choice in Terms of Style, Tone, Clarity, and Economy (28-32) Correct vague or clumsy and confusing writing containing sophisticated language.		
Organization, Unity, and Coherence (13-15) Use conjunctive adverbs or phrases to show time relationships in simple narrative essays (e.g., *then, this time*)	**C3. Organize ideas in writing with a thesis statement in the introduction, well-constructed paragraphs, a conclusion and transition sentences that connect paragraphs into a coherent whole.**	9-12.II.B.2. Develop a thesis and clear purpose for writing.
Organization, Unity, and Coherence (16-19) Select the most logical place to add a sentence in a paragraph.		
Organization, Unity, and Coherence (20-23) Use conjunctive adverbs or phrases to express straightforward logical relationships (e.g., *first, afterward, in response*). Decide the most logical place to add a sentence in an essay. Add a sentence that introduces a simple paragraph.		
Organization, Unity, and Coherence (24-27) Determine the need for conjunctive adverbs or phrases to create subtle logical connections between sentences (e.g., *therefore, however, in addition*). Rearrange the sentences in a fairly uncomplicated paragraph for the sake of logic. Add a sentence to introduce or conclude the essay or to provide a transition between paragraphs when the essay is fairly straightforward.		9-12.II.B.4. Arrange paragraphs into a logical progression.
Organization, Unity, and Coherence (28-32) Make sophisticated distinctions concerning the logical use of conjunctive adverbs or phrases, particularly when signaling a shift between paragraphs. Rearrange sentences to improve the logic and coherence of a complex paragraph. Add a sentence to introduce or conclude a fairly complex paragraph.		
Organization, Unity, and Coherence (33-36) Consider the need for introductory sentences or transitions, basing decisions on a thorough understanding of both the logic and rhetorical effect of the paragraph and essay.		

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
Topic Development in Terms of Purpose and Focus (16-19) ... Delete a clause or sentence because it is obviously irrelevant to the essay.	**C4. Drawing on readers' comments on working drafts, revise documents to develop or support ideas more clearly, address potential objections, ensure effective transitions between paragraphs and correct errors in logic.**	9-12.II.B.3. Make generalizations and use supporting details.
Topic Development in Terms of Purpose and Focus (20-23) ... Determine relevancy when presented with a variety of sentence level details.		
Topic Development in Terms of Purpose and Focus (24-27) Identify the focus of a simple essay, applying that knowledge to add a sentence that sharpens that focus or to determine if an essay has met a specified goal. Delete material primarily because it disturbs the flow and development of the paragraph. Add a sentence to accomplish a fairly straightforward purpose such as illustrating a given statement.		9-12.II.B.5. Revise writing for clarity, coherence, smooth transitions and unity.
Topic Development in Terms of Purpose and Focus (28-32) Apply an awareness of the focus and purpose of a fairly involved essay to determine the rhetorical effect and suitability of an existing phrase or sentence, or to determine the need to delete plausible but irrelevant material. Add a sentence to accomplish a subtle rhetorical purpose such as to emphasize, to add supporting detail, or to express meaning through connotation.		
Topic Development in Terms of Purpose and Focus (33-36) ... Add a phrase or sentence to accomplish a complex purpose, often expressed in terms of the main focus of the essay.		
Word Choice in Terms of Style, Tone, Clarity, and Economy (13-15) Revise sentences to correct awkward and confusing arrangements of sentence elements. Revise vague nouns and pronouns that create obvious logic problems.	**C5. Edit both one's own and others' work for grammar, style and tone appropriate to audience, purpose and context.**	9-12.II.B.8. Revise, edit and prepare final drafts for intended audiences and purposes.
Word Choice in Terms of Style, Tone, Clarity, and Economy (16-19) Delete obviously synonymous and wordy material in a sentence. ...		9-12.II.C.3. Edit writing for correct grammar, capitalization, punctuation, spelling, verb tense, sentence structure, and paragraphing to enhance clarity and readability: a. Correctly use reflexive case pronouns and nominative and objective case pronouns, including who and whom. b. Correctly use punctuation such as the comma, semicolon, colon, hyphen, and dash.
Word Choice in Terms of Style, Tone, Clarity, and Economy (20-23) Delete redundant material when information is repeated in different parts of speech (e.g., "alarmingly started") .... Determine the clearest and most logical conjunction to link clauses.		
Word Choice in Terms of Style, Tone, Clarity, and Economy (24-27) Revise a phrase that is redundant in terms of the meaning and logic of the entire sentence. Identify and correct ambiguous pronoun references.		

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
Word Choice in Terms of Style, Tone, Clarity, and Economy (28-32) Correct redundant material that involves sophisticated vocabulary and sounds acceptable as conversational English (e.g., "an aesthetic viewpoint" versus "the outlook of an aesthetic viewpoint).		c. Correctly use like/as if, any/any other, this kind/these kinds, who/that, and every/many when they occur in a sentence. d. Correctly use verb forms with attention to subjunctive mood, subject/verb agreement, and active/passive voice. e. Correctly use the possessive pronoun before the gerund.
Word Choice in Terms of Style, Tone, Clarity, and Economy (33-36) Delete redundant material that involves subtle concepts or that is redundant in terms of the paragraph as a whole.		9-12.II.D. 12. Proofread the final copy, format correctly and prepare the document for publication or submission.
	C6. Cite print or electronic sources properly when paraphrasing or summarizing information, quoting, or using graphics.	9-12.II.B.7. Generate footnotes, endnotes and bibliographies in a consistent and widely accepted format.
		9-12.II.D.8. Understand plagiarism and its consequences, and identify ethical issues of research and documentation.
		9-12.II.D.10. Credit sources for both quoted and paraphrased ideas.
		9-12.II.D.11. Cite sources of information using a standard method of documentation, such as a style sheet from the Modern Language Association (MLA) or from the American Psychological Association (APA).
	C8. Present written material using basic software programs (such as Word, Excel and PowerPoint) and graphics (such as charts, ratios and tables) to present information and ideas best understood visually.	9-12.II.B.6. Apply available technology to develop, revise and edit writing.
(From ACT's Writing Criteria) • Show clear understanding of the persuasive purpose of the task by taking a position on the specific issue in the prompt and offering a critical context for discussion. • Show understanding of the complexity of the issue in the prompt by o Examining different perspectives, and/or o Evaluating implications or complications of the issue, and/or	**C9.Write an academic essay (for example, a summary, an explanation, a description, a literary analysis essay) that:** **• develops a thesis;** **• creates an organizing structure appropriate to purpose, audience and context;** **• includes relevant information and excludes extraneous information;**	9-12.II.A.1. Plan, organize and compose narrative, expository, descriptive, persuasive, critical and research writing to address a specific audience and purpose.

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
○ Posing and fully discussing counterarguments to the writer's position • Maintain a clear focus on discussion of the specific topic and issue in the prompt throughout the essay • Present a critical thesis that clearly establishes the focus of the writer's position on the issue • Develop several ideas fully, using specific and relevant reasons, details, and examples • Show effective movement between general and specific ideas and examples • Provide unity and coherence throughout the essay, often with a logical progression of ideas • Use relevant transitional words, phrases, and sentences to convey logical relationships between ideas • Present a well-developed introduction and conclusion • Show effective use of language to clearly communicate ideas by ○ Correctly employing most conventions of standard English grammar, usage, and mechanics, with just a few, if any, errors ○ Using precise and varied vocabulary Using a variety of kinds of sentence structures to vary pace and to support meaning.	**• makes valid inferences;** **• supports judgments with relevant and substantial evidence and well-chosen details; and** **• provides a coherent conclusion.**	
	C10. Produce work-related texts (for example, memos, e-mails, correspondence, project plans, work orders, proposals, bios) that: **• address audience needs, stated purpose and context;** **• translate technical language into non-technical English;** **• include relevant information and exclude extraneous information;** **• use appropriate strategies, such as providing facts and details, describing or analyzing the subject, explaining benefits or limitations, comparing or contrasting, and providing a scenario to illustrate;** **• anticipate potential problems, mistakes and misunderstandings that might arise for the reader;** **• create predictable structures through the use of headings, white space and graphics, as appropriate; and**	

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
	• adopt a customary format, including proper salutation, closing and signature, when appropriate.	
	D. Research	
	D1. Define and narrow a problem or research topic.	9-12.II.D.3. Narrow the focus of a search by formulating a concise research question or thesis.
	D2. Gather relevant information from a variety of print and electronic sources, as well as from direct observation, interviews and surveys.	9-12.II.D.1. Use print, electronic databases and online resources to access information, organize ideas, and develop writing.
	D3. Make distinctions about the credibility, reliability, consistency, strengths and limitations of resources, including information gathered from Web sites.	9-12.I.C.2. Comprehend and evaluate the purpose, accuracy, comprehensiveness, and usefulness of informational materials.
		9-12.I.C. 8. Evaluate clarity and accuracy of information, as well as the credibility of sources.
		9-12.II.D.5. Evaluate and organize relevant information from a variety of sources, verifying the accuracy and usefulness of gathered information.
		9-12.II.D.7. Distinguish between reliable and questionable Internet sources and apply responsible use of technology.
		9-12.III.C.1. Evaluate the accuracy and credibility of information found on Internet sites.
		9-12.III.C.3. Evaluate the source's point of view, intended audience and authority.
	D4. Report findings within prescribed time and/or length requirements, as appropriate.	
	D5.Write an extended research essay (approximately six to 10 pages), building on primary and secondary sources, that: **• marshals evidence in support of a clear thesis statement and related claims;** **• paraphrases and summarizes with accuracy and fidelity the range of arguments and evidence supporting or refuting the thesis, as appropriate; and**	9-12.II.A.1. Plan, organize and compose narrative, expository, descriptive, persuasive, critical and research writing to address a specific audience and purpose.
		9-12.II.D.6. Produce a report with detailed evidence to support a thesis.
		9-12.II.D.9. Organize and synthesize information from a variety of sources and present it in a logical manner.

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
	• cites sources correctly and documents quotations, paraphrases and other information using a standard format.	
	E. Logic	
	E1. Distinguish among facts and opinions, evidence and inferences.	9-12.III.A.1. Distinguish between speaker's opinion and verifiable facts and analyze the credibility of the presentation. *<<Note that fact/opinion is included in Minnesota's Speaking and Listening Strand at grades 9-12, rather than in the strand on reading print texts.>>*
		7.I.C.7. Distinguish statements of fact from opinion and give examples from text.
	E2. Identify false premises in an argument.	
	E3. Describe the structure of a given argument; identify its claims and evidence; and evaluate connections among evidence, inferences and claims.	9-12.I.C.6. Trace the logical development of an author's argument, point of view or perspective and evaluate the adequacy, accuracy and appropriateness of the author's evidence in a persuasive text.
	E4. Evaluate the range and quality of evidence used to support or oppose an argument.	9-12.I.C.6. Trace the logical development of an author's argument, point of view or perspective and evaluate the adequacy, accuracy and appropriateness of the author's evidence in a persuasive text.
		9-12.III.C.4. Determine whether the evidence in a selection is appropriate, adequate and accurate.
	E5. Recognize common logical fallacies, such as the appeal to pity (argumentum ad misericordiam), the personal attack (argumentum ad hominem), the appeal to common opinion (argumentum ad populum) and the false dilemma (assuming only two options when there are more options available); understand why these fallacies do not prove the point being argued.	9-12.I.C.8. Identify, understand and explain the various types of fallacies in logic.
		9-12.III.C.2. Evaluate the logic of reasoning in both print and non-print selections.

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
	E6. Analyze written or oral communications for false assumptions, errors, loaded terms, caricature, sarcasm, leading questions and faulty reasoning.	9-12.III.C.5. Evaluate the content and effect of persuasive techniques used in print and broadcast media.
		9-12.III.C.9. Critically analyze and evaluate the strategies employed in news broadcasts, documentaries, and web sites related to clarity, accuracy, effectiveness, bias and relevance of facts.
	E7. Understand the distinction between a deductive argument (where, if the premises are all true and the argument's form is valid, the conclusion is inescapably true) and inductive argument (in which the conclusion provides the best or most probable explanation of the truth of the premises, but is not necessarily true).	
	E8. Analyze two or more texts addressing the same topic to determine how authors reach similar or different conclusions.	8.I.C.11. Distinguish fact from opinion in two selections on the same topic and give evidence. *<<Note alignment here is in analyzing across multiple texts. Minnesota statement does not address how authors reach conclusions.>>*
	E9. Construct arguments (both orally and in writing) that: **• develop a thesis that demonstrates clear and knowledgeable judgment;** **• structure ideas in a sustained and logical fashion;** **• use a range of strategies to elaborate and persuade, such as descriptions, anecdotes, case studies, analogies and illustrations;** **• clarify and defend positions with precise and relevant evidence, including facts, expert opinions, quotations and/or expressions of commonly accepted beliefs and logical reasoning;** **• anticipate and address the reader's concerns and counterclaims; and** **• provide clear and effective conclusions.**	9-12.II.A.1. Plan, organize and compose narrative, expository, descriptive, persuasive, critical and research writing to address a specific audience and purpose.

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
	F. Informational Text	
	F1. Follow instructions in informational or technical texts to perform specific tasks, answer questions or solve problems.	9-12.I.C.3. Analyze and draw accurate conclusions about information contained in warranties, contracts, job descriptions, technical descriptions and other informational sources, selected from labels, warnings, manuals, directions, applications and forms in order to complete specific tasks.
Note: Main Ideas and Author's Approach (13-15 through 20-23) refer to literary narratives and are therefore not included here.	**F2. Identify the main ideas of informational text and determine the essential elements that elaborate them.**	9-12.I.C.5. Summarize and paraphrase main idea and supporting details.
Main Ideas and Author's Approach (20-23) Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages.		
Main Ideas and Author's Approach (24-27) Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages. Infer the main idea or purpose of straightforward paragraphs in more challenging passages. ....Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages.		
Main Ideas and Author's Approach (28-32) Infer the main idea or purpose of more challenging passages or their paragraphs. .... Understand the overall approach taken by an author or narrator (e.g., points of view, kinds of evidence used) in virtually any passage.		
Main Ideas and Author's Approach (33-36) Identify clear main ideas or purposes of complex passages or their paragraphs.		
Supporting Details (13-15) Locate basic facts (e.g., names, dates, events) clearly stated in a passage.		
Supporting Details (16-19) Locate simple details at the sentence and paragraph level in uncomplicated passages. Recognize a clear function of a part of an uncomplicated passage.		
Supporting Details (20-23) Locate important details in uncomplicated passages. Make simple inferences about how details are used in passages.		
Supporting Details (24-27) Locate important details in more challenging passages. Locate and interpret minor or subtly stated details in uncomplicated passages. Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages.		

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
Supporting Details (28-32) Locate and interpret minor and subtly stated details in more challenging passages. Use details from different sections of some complex informational passages to support a specific point or argument.		
Supporting Details (33-36) Locate and interpret details in complex passages. Understand the function of a part of a passage when the function is subtle or complex.		
Main Ideas and Author's Approach (24-27) .... Summarize basic events and ideas in more challenging passages ...	**F3. Summarize informational and technical texts and explain the visual components that support them.**	9-12.I.C.5. Summarize and paraphrase main idea and supporting details.
Main Ideas and Author's Approach (28-32) .... Summarize events and ideas in virtually any passage ...		
	F4. Distinguish between a summary and a critique.	
	F5. Interpret and use information in maps, charts, graphs, time lines, tables and diagrams.	2.I.C.3. Analyze text by using pictures, diagrams, titles and headings.
Sequential, Comparative, and Cause-Effect Relationships (13-15) Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages. Recognize clear cause-effect relationships described within a single sentence in a passage.	**F6. Identify interrelationships between and among ideas and concepts within a text, such as cause-and-effect relationships.**	4.I.C.6. Distinguish fact from opinion, determine cause and effect, and draw conclusions.
Sequential, Comparative, and Cause-Effect Relationships (20-23) ..... Identify clear relationships between people, ideas, and so on in uncomplicated passages. Identify clear cause-effect relationships in uncomplicated passages.		
Sequential, Comparative, and Cause-Effect Relationships (24-27) Order sequences of events in uncomplicated passages. Understand relationships between people, ideas, and so on in uncomplicated passages. .... Understand implied or subtly stated cause-effect relationships in uncomplicated passages. Identify clear cause-effect relationships in more challenging passages.		
Sequential, Comparative, and Cause-Effect Relationships (28-32) Order sequences of events in more challenging passages. Understand the dynamics between people, ideas, and so on in more challenging passages. Understand implied or subtly stated cause-effect relationships in more challenging passages.		
Sequential, Comparative, and Cause-Effect Relationships (33-36) Order sequences of events in complex passages. Understand the subtleties of relationships between people, ideas, and so on in virtually any passage. Understand implied, subtle or complex cause-effect relationships in virtually any passage.		

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
	F7. Synthesize information from multiple informational and technical sources.	9-12.I.C.9. Synthesize information from multiple selections in order to draw conclusions, make predictions, and form interpretations.
Generalizations and Conclusions (16-19) Draw simple generalizations and conclusions about people, ideas, and so on in uncomplicated passages.	**F8. Draw conclusions based on evidence from informational and technical texts.**	9-12.I.C.3. Analyze and draw accurate conclusions about information contained in warranties, contracts, job descriptions, technical descriptions and other informational sources, selected from labels, warnings, manuals, directions, applications and forms in order to complete specific tasks.
Generalizations and Conclusions (20-23) Draw generalizations and conclusions about people, ideas, and so on in uncomplicated passages. Draw simple generalizations and conclusions using details that support the main points of more challenging passages.		
Generalizations and Conclusions (24-27) .... Draw generalizations and conclusions about people, ideas, and so on in more challenging passages.		
Generalizations and Conclusions (28-32) Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so on.		9-12.I.C.7. Make inferences and draw conclusions based on explicit and implied information from texts.
Generalizations and Conclusions (33-36) Draw complex or subtle generalizations and conclusions about people, ideas, and so on, often by synthesizing information from different portions of the passage.		
	F9. Analyze the ways in which a text's organizational structure supports or confounds its meaning or purpose.	6.I.C.11. Utilize texts' organizational structures (narrative, expository, chronological, compare and contrast) and generate graphic organizers to organize, recall and summarize content.
	F10. Recognize the use or abuse of ambiguity, contradiction, paradox, irony, incongruities, overstatement and understatement in text and explain their effect on the reader.	9-12.I.D.5. Analyze, interpret and evaluate the use of figurative language and imagery in fiction and nonfiction selections, including symbolism, tone, irony and satire.
	F11. Evaluate informational and technical texts for their clarity, simplicity and coherence and for the appropriateness of their graphics and visual appeal.	9-12.I.C.8. Evaluate clarity and accuracy of information, as well as the credibility of sources.
	G. Media	
	G1. Evaluate the aural, visual and written images and other special effects used in television, radio, film and the Internet for their ability to inform, persuade and entertain (for example, anecdote, expert witness, vivid detail, tearful testimony and humor).	9-12.III.A.5. Understand the effects of media on society and culture. *<<Note: Unclear why benchmark above appears under Minnesota's Sub-Strand on "Speaking and Listening" rather than under "Media Literacy.">>*

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
		9-12.III.C.6. Make informed evaluations about television, radio, film productions, newspapers and magazines with regard to quality of production, accuracy of information, bias, purpose, message and audience.
		9-12.III.C.7. Critically analyze the messages and points of view employed in different media, including advertising, news programs, web sites, and documentaries.
		9-12.III.C.9. Critically analyze and evaluate the strategies employed in news broadcasts, documentaries, and web sites related to clarity, accuracy, effectiveness, bias and relevance of facts.
	G2. Examine the intersections and conflicts between the visual (such as media images, painting, film and graphic arts) and the verbal.	
	G3. Recognize how visual and sound techniques or design (such as special effects, camera angles and music) carry or influence messages in various media.	9-12.III.C.7. Critically analyze the messages and points of view employed in different media, including advertising, news programs, web sites, and documentaries.
	G4. Apply and adapt the principles of written composition to create coherent media productions using effective images, text, graphics, music and/or sound effects — if possible — and present a distinctive point of view on a topic (for example, PowerPoint presentations, videos).	
	H. Literature	
	H1. Demonstrate knowledge of 18th and 19th century foundational works of American literature.	9-12.I.D.1. Read, analyze and evaluate traditional, classical and contemporary works of literary merit from American literature.
	H2. Analyze foundational U.S. documents for their historical and literary significance (for example, The Declaration of Independence, the Preamble to the U.S. Constitution, Abraham Lincoln's "Gettysburg Address, Martin Luther King's "Letter from Birmingham Jail").	

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
	H3. Interpret significant works from various forms of literature: poetry, novel, biography, short story, essay and dramatic literature; use understanding of genre characteristics to make deeper and subtler interpretations of the meaning of the text.	9-12.I.D.9. Analyze the characteristics of literary forms.
Generalizations and Conclusions (13-15) Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.	**H4. Analyze the setting, plot, theme, characterization and narration of classic and contemporary short stories and novels.**	9-12.I.D.4. Evaluate the impact of an author's decisions regarding word choice, point of view, style and literary elements.
Generalizations and Conclusions (24-27) Draw subtle generalizations and conclusions about characters, ideas, and so on in uncomplicated literary narratives. ...		
Generalizations and Conclusions (33-36) .... Understand and generalize about portions of a complex literary narrative.		
Sequential, Comparative, and Cause-Effect Relationships (13-15) Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages. Recognize clear cause-effect relationships described within a single sentence in a passage.		9-12.I.D.6. Analyze and evaluate the relationship between and among elements of literature: character, setting, plot, tone, symbolism, rising action, climax, falling action, point of view, theme and conflict/resolution.
Sequential, Comparative, and Cause-Effect Relationships (16-19) Identify relationships between main characters in uncomplicated literary narratives. Recognize clear cause-effect relationships within a single paragraph in uncomplicated literary narratives.		
Sequential, Comparative, and Cause-Effect Relationships (20-23) Order simple sequences of events in uncomplicated literary narratives. Identify clear relationships between people, ideas, and so on in uncomplicated passages. Identify clear cause-effect relationships in uncomplicated passages.		
Sequential, Comparative, and Cause-Effect Relationships (24-27) Order sequences of events in uncomplicated passages. Understand relationships between people, ideas, and so on in uncomplicated passages. Identify clear relationships between characters, ideas, and so on in more challenging literary narratives. Understand implied or subtly stated cause-effect relationships in uncomplicated passages. Identify clear cause-effect relationships in more challenging passages.		
Sequential, Comparative, and Cause-Effect Relationships (28-32) Order sequences of events in more challenging passages. Understand the dynamics between people, ideas, and so on in more challenging passages. Understand implied or subtly stated cause-effect relationships in more challenging passages.		

ACT: College Readiness Standards	American Diploma Project	Minnesota Language Arts Standards Grades 9-12
Sequential, Comparative, and Cause-Effect Relationships (33-36) Order sequences of events in complex passages. Understand the subtleties of relationships between people, ideas, and so on in virtually any passage. Understand implied, subtle or complex cause-effect relationships in virtually any passage.		
	H5. Demonstrate knowledge of metrics, rhyme scheme, rhythm, alliteration and other conventions of verse in poetry.	9-12.I.D.8. Analyze classic and contemporary poems for poetic devices.
	H6. Identify how elements of dramatic literature (for example, dramatic irony, soliloquy, stage direction and dialogue) articulate a playwright's vision.	9-12.I.D.13. Read, analyze, and critique dramatic selections by comparing and contrasting ways in which character, scene, dialogue, and staging contribute to the theme and the dramatic effect.
	H7. Analyze works of literature for what they suggest about the historical period in which they were written.	9-12.I.D.11. Demonstrate how literary works reflect the historical contexts that shaped them.
	H8. Analyze the moral dilemmas in works of literature, as revealed by characters' motivation and behavior.	
Main Ideas and Author's Approach (13-15) Recognize a clear intent of an author or narrator in uncomplicated literary narratives. (NOTE: This progresses to become at levels 33-36: Identify clear main ideas or purposes of complex passages...)	**H9. Identify and explain the themes found in a single literary work; analyze the ways in which similar themes and ideas are developed in more than one literary work.**	9-12.I.D.12. Synthesize ideas and make thematic connections among literary texts, public discourse, media and other disciplines.

Summary Points
Achieve's Side-by-Side Comparison of the American Diploma Project (ADP) Mathematics Benchmarks with the Minnesota Academic Standards – Mathematics K-12 (May 19, 2003) and the ACT College Readiness Standards

For purposes of this analysis, Achieve staff constructed a side-by-side chart comparing Achieve's American Diploma Project (ADP) mathematics benchmarks with the Minnesota Academic Standards – Mathematics K-12 (May 19, 2003) and ACT's College Readiness Standards. The Achieve study focused on the Minnesota standards identified for grades 9 through 12. Since the ADP benchmarks are cumulative in nature, in select instances content from lower grades was used to complete the chart.

Since the ACT assessment program is of interest to the state, the side-by-side chart developed as a tool for this analysis also includes ACT's recently completed College Readiness Standards. These standards consist of statements that are intended to help students who have taken the ACT assessment make a connection between their test scores and what they have learned and are ready to learn next. The three-column side-by-side chart shows alignment of the ACT College Readiness standards—along with Minnesota's Academic Standards—to the ADP benchmarks, with the ADP benchmarks being the organizing structure for the analysis. To facilitate this work, the ADP benchmarks are located in the center column, allowing both the Minnesota Academic Standards (in the first column) and the ACT College Readiness Standards (in the third column) to be directly compared with ADP. There is no direct comparison made between the Minnesota Academic Standards and the ACT College Readiness Standards although this can easily be determined by analysis of the side-by-side chart. The emphasis in this summary report will be on the ADP benchmarks, the Minnesota Academic Standards, and how the two documents compare.

The ADP benchmarks include expectations that are roughly equivalent to what students should encounter in a 4-year high school mathematics program that includes Algebra I, Geometry, Algebra II, and at least a portion of a pre-calculus course. The ADP benchmarks define what students need to know and be able to do if they are to be ready for college or work. Certain ADP mathematics benchmarks are marked with an asterisk (*). These asterisked benchmarks represent content that is recommended for all students, but is required for those students who plan to study calculus in college—a requisite for mathematics majors and many mathematics-intensive majors.

In general, there is strong alignment between the ADP mathematics benchmarks and the Minnesota Academic Standards. In some cases, the alignment required use of standards from grade 8 or below. Most of the ADP benchmarks have at least one Minnesota benchmark that aligns with them, and the majority of Minnesota standards can also be found in ADP. There are often times differences in the nuances of the standards language—and hence in the perceived intent of the two sets of expectations—and these differences will be described in this summary report. There are some Minnesota expectations that do not appear to have a clear match with any of the ADP benchmarks,

and these too are noted—both at the end of the side-by-side chart and in this summary report.

What follows is a description of commonalities and differences found between the two sets of standards.

- Both the ADP benchmarks and the MN Academic Standards clearly expect students to use appropriate technology—including calculators and computerized application software such as spreadsheets—in the classroom to further their mathematical understandings. Minnesota cites technology throughout its standards with references to the application of various types of technology and to the intelligent use of technology, including its limitations. This is similar to the strategy employed by ADP where students are called upon to not only use technology—including graphing calculators and spreadsheets—but also to understand the capabilities and limitations of calculators and computers in solving problems.

- Both ADP and Minnesota clearly articulate the types and levels of mathematical reasoning they expect of students. ADP does this through nine statements that define—in a manner that overarches the content strands—what is expected of students with respect to mathematical reasoning when they graduate from high school. Minnesota has a more expanded approach, beginning each grade level or grade-level cluster with a Mathematical Reasoning strand that includes numerous benchmarks.

- ADP is more explicit and rigorous in its expectations with respect to geometric proof than Minnesota. In 11.V.B.1 and 11.V.B.2 Minnesota students are expected to know and use theorems about triangles, parallel lines, and circles. However, there are no instances where students are required to prove a theorem or to use a formal or informal system of logic. MN states that students are to be able to use theorems to justify facts and solve problems, but it is not clear what justification entails. The only direct reference to proof is in MN 12.III.A (for 11^{th} and 12^{th} grade students), which states that students are expected to "develop increased mastery of geometric proof methodology." ADP is quite specific that students are to be able to prove theorems related to such constructs as lines, angles, parallel lines, perpendicular lines, congruence, similarity, and circles. Specific examples of the types of theorems students are expected to prove are cited in the ADP benchmarks to give readers a sense of the level of rigor expected. (e.g., K1.2, K2.1, K2.2, K2.3, K3, K4)

- Both ADP and MN include expectations with respect to geometric construction. MN tends to address geometric constructions rather generically by stating that students should be able to "perform basic constructions with a straightedge and compass" and "draw accurate representations of planar figures using a variety of tools." ADP links its expectations with respect to construction to content-specific

benchmarks, resulting in greater clarity than the MN Academic Standards as to the types of constructions students should be able to perform.

- There are instances where content expectations are defined in the ADP benchmarks but not clearly or explicitly found in the MN standards:

  - Functions. No reference is included in the MN standards to general function information like domain and range (ADP J2.2), function notation (ADP J2.3), and evaluation of functions (ADP J1.6, J2.3). MN makes limited reference to evaluation of a function at a given value of x, which is included at a conceptual level for all students in the ADP benchmarks. In grade 8 (8.III.A.3), Minnesota students are asked to complete a table of values, which would require that they use given inputs to find the related outputs. This requirement does not assume facility with more complex functions like polynomial, rational, and absolute value expressions, as are included in ADP J1.6.
  - Equations. The Minnesota benchmark (11.III.B.4) refers to translation among equivalent forms of linear equations. Although this aligns generally with ADP it does not go far enough to match the scope of the ADP benchmark that expects students to solve an equation in several variables for one of the variables (ADP J3.2)
  - Similarity and scale factor. A brief reference to similarity of triangles in 11.V.B.1 and an expectation at grade 8 (8.V.B.2) do not go far enough to align to the ADP expectation calling for knowledge and application of the properties of similar figures (ADP K7) and the use of scale factors in problem solving (ADP K8.3).
  - Perpendicular lines. Properties and theorems related to perpendicular lines are specifically defined in the ADP benchmarks (ADP K2.2). No MN benchmark aligns to this standard.
  - Proof. No specific reference is made in the MN standards to the structure of the system of mathematical logic, including definitions, axioms, and theorems. While there are general references to theorems in the MN standards (11.V.B.7 and 11.V.B.8), it appears that the level of expectation for use of formal logic is quite different from that articulated in the ADP benchmarks (ADP K1, K1.1, K1.2, K1.3).
  - Circles. Finding the equation of a circle given its center and radius—and finding the center and radius given the equation—are defined with asterisks in the ADP benchmarks (ADP K10.4*). This is not an expectation in the MN standards, even at the grade 11-12 level.
  - Other Geometries. No MN benchmark expects students to recognize geometries other than Euclidean (ADP K1.3).
  - Binomial Theorem. No mention is made in the MN benchmarks of study of the Binomial Theorem and its connection to Pascal's triangle and probability (ADP J6).
  - Trigonometry. While trigonometry is addressed in the MN standards in some detail, ADP extends its expectations with respect to trigonometry for students

who anticipate taking calculus in college to include applications, periodic functions, and the unit circle. There is mention in the MN Academic Standards of trigonometric functions (12.III.A), use of trigonometric laws and identities (12.III.A.4, 12.III.A.5, 12.III.A.7), and degree/radian angle measure (12.III.A.3). However trigonometric applications and extensions to periodic functions and the unit circle (ADP K11.3, K12.1) are not clearly articulated in the MN standards.

- Sequences and Series. The MN benchmarks include only knowledge of formal notation for sequences and series (11.III.B.1) but do not go far enough to align with the ADP expectation for deriving and using formulas for the general term and finding finite arithmetic and infinite geometric sums (ADP J1.7).
- Data Analysis. While MN is generally comprehensive in its treatment of data analysis and statistics, there appears to be no reference to the differences between randomized experiments and observational studies (ADP L3.3). There is also no clear expectation that students need to be able to design and conduct simple statistical experiments (ADP L3.2). MN benchmarks include comparison of voting methods (11.IV.A.7), which may be an example of an instance where evaluation of a data-based report is addressed, but MN makes no general reference to evaluation of statistical information provided in the media (ADP L2.1).
- Probability. ADP (ADP L4.3) requires an understanding of how the law of large numbers can be applied while MN asks that students know the effect of sample size on probability situations (11.IV.B.5). It is not clear if the two benchmarks are setting the same expectation.

- The following aspects of content aligning with the ADP benchmarks were emphasized—not in MN's high school standards—but rather in expectations from an earlier grade.

  - Number Sense and Operations. Benchmarks from grades 6-8 standards were used to align with most of the early number sense benchmarks in ADP. It is implied that the work done in earlier grades in this area will be reinforced in grades 9-12.
  - Number Theory. Factors, multiples, and prime number concepts are found in MN's standards for grade 6.
  - Measurement. Measurement concepts—such as converting from one unit of measure to another—are covered extensively in the middle grades in MN.
  - Problem Solving Strategies. Grade 8 benchmarks from MN were used to align with many of ADP's benchmarks dealing with problem solving strategies (ADP MR8).

- Some of the MN high school standards are connected to, but go beyond the scope of, ADP benchmarks. The table providing standard-specific feedback that appears later in this report also offers feedback in this regard.

- Parametrics. In solving systems of linear equations (12.II.A.1) and quadratic equations (12.II.A.2) reference is made in the MN standards to parametric descriptions which goes beyond the ADP requirements (ADP J3.4* and ADP J3.5).
- Normal Distribution. While ADP expects students to know the characteristics of the Gaussian distribution (ADPL1.6), MN expects its students to be able to calculate confidence intervals (12.I.A.2).
- Probability. The ADP expectation for students to apply probability concepts (ADP L4.5) does not go as far as the MN benchmarks that indicate students should be able to also use area and binomial models (11.IV.B.3) and to determine expected values (11.IV.B.4). Also, while ADP sets the expectation that students be able to use inductive and deductive reasoning (ADP MR1), MN extends its reasoning expectations to include formal logic, e.g., inverse, converse, and contrapositive statements (MN 11.I.A.6)
- Complex Numbers. While ADP expects students to be familiar with the need for extending the number system to include the set of complex numbers (ADP I3), the MN benchmarks set the expectation that students in grades 11-12 be able to compute with and interpret complex solutions (12.II.A.13).

- There are expectations included in the MN high school benchmarks that go beyond the scope of the ADP benchmarks. These benchmarks (12.II.A.9 and 12.II.A.9) address rational functions.

More standard-specific variations between the ADP benchmarks and the Minnesota Academic Standards are noted below:

ADP	MN	Comments
I1.1	6.II.B.3 7.II.B.1	MN makes no explicit reference to operations with integers.
I1.2	7.V.B.3	While MN references ratio and proportion in middle school in the context of map reading and scale drawing, broader applications of proportional reasoning are not apparent.
I2.1	11.III.B.2	The MN expectation for graphing simple absolute value expressions extends beyond the ADP benchmark.
I2.2	8.II.A.1	ADP is specific with respect to the form of the numbers students are expected to order.
I3	12.II.A.13	ADP expects recognition of the set of complex numbers as an essential part of the number system. MN expects that students be able to calculate with complex numbers and interpret complex results.
I4.1	11.I.B.3 11.II.B.4 11.II.B	The first two of these MN benchmarks imply calculator use but are very specific to certain aspects of content. The last MN benchmark listed here specifies calculator use but does not specifically mention graphing calculators as ADP does.
J1.1	11.III.B.6	MN constrains its expectation to expressions with integer roots.
J1.2*	12.II.A.5	ADP references rational exponents, while MN references fractional

ADP	MN	Comments
		exponents. It is not clear if MN intends negative exponents.
J1.4	12.II.A.10	MN is more specific than ADP with respect to the strategies students should be able to use when factoring quadratic polynomials.
J1.6, J2.3	8.III.A.3	Evaluation of a function for a given domain value is not specifically included in the MN high school benchmarks. The aligned benchmark from grade 8 refers to generating a table of values and does not assume the same level of rigor as in ADP.
J1.7*	12.II.A.16	The level of expectation with respect to sequences and series in this ADP asterisked benchmark exceeds that articulated in the MN document.
J2.2		MN high school benchmarks do not include determination of the domain of a function.
J2.3		ADP expects students to demonstrate an understanding of function notation, and this is not clearly articulated in MN.
J2.4	12.II.A.15	MN makes no reference to adding, subtracting, multiplying, and dividing functions.
J2.6*	12.II.A.6	MN does not expect proofs of basic properties of logarithms.
J3.1	11.III.B.7	MN makes no mention of solving equations involving absolute value. They do, however, specify what solution techniques students should be able to use—which ADP does not.
J3.2	11.III.B.4	ADP requires students to solve an equation in several variables for one of them. MN asks that students translate among forms of linear equations. These are related but ADP appears to go further.
J3.3	11.III.B.11	MN is specific with respect to solution techniques, which ADP is not. MN also includes inequalities in its expectation, which ADP does not.
J3.4	12.II.A.1	ADP does not include parametric descriptions in solving linear systems. MN also extends its expectations to more than three equations and references inequalities, which are not in the ADP benchmark.
J3.5, J5.3	12.II.A.2	ADP requires students to be able to solve quadratic equations. MN goes further for 11^{th} and 12^{th} grade students, requiring problem solving using quadratic functions that may have coefficients expressed in terms of parameters.
J4.2	11.III.A.3	MN extends its expectation beyond linear to include quadratic functions and their graphs.
J4.3	11.III.B.11	MN extends its expectation to include inequalities.
J5	11.III.B.10	MN explicitly references recursive formulas, which appears to extend beyond the ADP expectation.
J5.2	11.III.B.11	ADP clearly expects modeling, while the MN expectation appears to be more procedural.
J5.6	12.II.A.16	The wording of the MN expectation is not as clear and explicit as that in ADP.
J6		The MN high school benchmarks do not include the binomial theorem or its connections to combinatorics.

ADP	MN	Comments
K1, K1.1, K1.2		The logical structure of mathematics is not addressed in the MN benchmarks, as it is in ADP.
K1.3		The MN high school benchmarks do not include recognition of studies of geometries other than Euclidean.
K1.2, K2.1, K2.2, K2.3, K3, K4		Reference to a system of logic or formal or informal proof is not clearly defined in the MN benchmarks. MN expects students to "justify," and it is not clear what level of rigor this involves.
K2, K2.1, K2.2, K2.3	11.V.B.7 11.V.B.8	MN includes general references to construction and representation, while ADP provides specific examples of the types of constructions students should be able to perform.
K2.2		MN high school benchmarks do not refer specifically to theorems and properties of perpendicular lines. Perpendicular lines are addressed in middle school but not at the level of rigor defined in ADP.
K3, K7, K8.3	11.V.B.1 8.V.B.2	Similarity of figures is addressed in the MN high school benchmarks only in reference to criteria for triangles to be similar. ADP asks students to know, use, and prove theorems about similar figures and scale factor and to use scale factor to solve problems of length, area, and volume.
K6	11.V.B.6	MN makes no explicit connection between transformation and congruence, although it does reference various types of representations of transformations—which ADP does not.
K8.2	11.V.B.3	There is good alignment here but it should be noted that MN provides greater specificity in the earlier grades with respect to the geometric figures students are to be able to work with in determining perimeter, area, volume, and surface area.
K10.2	11.III.B.3	MN is more specific than ADP.
K10.3	11.V.B.5	MN does not make explicit the relationship between the distance formula and the Pythagorean Theorem.
K10.4*		The MN high school benchmarks do not include finding the equation of a circle.
K11.3		MN does not make the connection between the formula for the area of a triangle and the area formula expressed trigonometrically.
K12*, K12.1*	12.III.A.3	The MN high school benchmarks do not include trigonometric study of the unit circle. What treatment there is (conversion between degrees and radians) is of a procedural nature.
L2.1	11.IV.A.7	MN includes a benchmark regarding comparison of voting methods. This was aligned with evaluation of media reports but is much more specific than the ADP benchmark.
L3.2		MN high school benchmarks do not expect students to design a simple statistical experiment.
L3.3		MN high school benchmarks do not include knowledge of the difference between randomized experiments and observational studies.
L3.4	11.IV.A.3	ADP expects students to construct scatter plots and to understand correlation coefficients. This is lacking in MN. In addition, ADP

ADP	MN	Comments
		makes specific reference to the use of graphing calculators.
L4.3	11.IV.B.5	ADP requires students to understand applications of the law of large numbers while the MN high school standards address only the effect of sample size on probability situations.
L4.5	11.IV.B.3	MN expects students to use binomial models in their work with probability.
L4.5	11.IV.B.4	MN expects students to find expected values in their work with probability.
MR1	11.I.A.6	ADP expects that students use inductive an deductive reasoning while MN extends that to require that students use formal logic, including inverse, converse, and contrapositive statements.
MR3	11.I.A.2	ADP is explicit with respect to the construction of proofs—both in its content and reasoning expectations. MN is much less explicit with respect to proof.
	12.I.A.2	MN requires students to find confidence intervals in their statistical work, which somewhat aligns with the ADP expectation on the normal distribution—but extends beyond it.
	12.II.A.8, 12.II.A.9	MN includes knowledge, analysis, and use of rational functions.

ADP Benchmarks With Minnesota Academic Standards and ACT College Readiness Standards		
Organizing Structure: ADP Benchmarks for College and Work Readiness (located in Column 2)		
Minnesota Academic Standards	**ADP Benchmarks: Mathematics**	**ACT College Readiness Standards**
All standards and benchmarks from the high school components of the MN Academic Standards (May 19, 2003) are included in this analysis. In addition, it was necessary to sometimes use standards from earlier grades to align with the ADP benchmarks--given their cumulative nature. MN high school benchmarks that do not align with an ADP benchmark are noted at the end of the table. **Bold type** is used in this chart to indicate words that are important to the alignment to all or part of an ADP benchmark; *italics* indicate a comment inserted by Achieve staff. A coding schema was devised corresponding to the MN Academic Standards (e.g.,11.II.B.5) with the first digit representing the Grade level, followed by a Roman numeral representing the Strand, a letter representing the Sub-strand, and lastly the number of the Benchmark. If only one sub-strand is included in the MN document, an A has been added to the code's third position. The grade 9-11 expectations are denoted as "11," while those for grades 11-12 are denoted as "12." Gaps/weaknesses in comparison to ADP are highlighted in yellow .	Certain mathematics benchmarks are marked with an **asterisk (*).** These asterisked benchmarks represent **content that is recommended for all students, but is required for those students who plan to take calculus** in college, a requisite for mathematics and many mathematics intensive majors.	The coding schema corresponds to content domains and score ranges on ACT's 3 curriculum-based assessment programs: EXPLORE, PLAN, and ACT. The system works as follows: 200-level statements: score range 13-15; 300-level statements: score range 16-19; 400-level statements: score range 20-23; 500-level statements: score range 24-27; 600-level statements: score range 28-32; and 700-level statements: score range 33-36. Those statements noted as 700-level expectations or identified with a † are applicable to the ACT only. Statements identified as 600-level expectations or identfied with an * apply to PLAN and ACT only. Subsets of content are sometimes **bolded** to indicate alignment of a portion of an ACT standard with a given ADP benchmark.
	I. Number Sense and Numerical Operations - The high school graduate can:	
	I1. Compute with rational numbers fluently and accurately without a calculator:	
7.II.B.1. Add, subtract, multiply and divide fractions and mixed numbers.	**I1.1.** Add, subtract, multiply and divide integers, fractions and decimals.	BOA 201. Perform one-operation computation with whole numbers and decimals
6.II.B.3 Use addition, subtraction, multiplication and division of multi-digit whole and decimal numbers to solve multi-step real-world and mathematical problems.		BOA 202 Solve problems in one or two steps using whole numbers
		BOA 301 Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent
		BOA 302. Solve some routine two-step arithmetic problems

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
		NCP 603 Apply number properties involving positive/negative numbers
7.II.B.4. Convert among fractions, decimals and percents and use these representations for estimations and computations in real-world and mathematical problems.	**I1.2.** Calculate and apply ratios, proportions, rates and percentages to solve problems.	BOA 401. Solve routine two-step or three-step arithmetic problems involving concepts such as **rate and proportion, tax added, percentage off**, and computing with a given average
6.II.B.8 Find, represent and use percentages in real-world and mathematical problems, including percentages greater than 100% and less than 1%.		BOA 601. Solve word problems containing several rates, proportions, or percentages
7.II.B.3 Calculate the percentage of increase and decrease of a quantity in real-world and mathematical problems.		BOA 701 Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings
7.V.B.3 Use ratios and proportions to interpret map scles and scale drawings.		XEI 502 Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)
11.II.B.1. Apply the correct order of operations and grouping symbols when using calculators and other technologies.	**I1.3.** Use the correct order of operations to evaluate arithmetic expressions, including those containing parentheses.	
6.II.B.1. Determine the prime factorization of positive integers. 6.II.B.2. Determine the least common multiple and the greatest common divisor of whole numbers.	**I1.4.** Explain and apply basic number theory concepts such as prime number, factor, divisibility, least common multiple and greatest common divisor.	NCP 301 Recognize one-digit factors of a number
		NCP 401. Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, **primes, and greatest common factor**
		NCP 501. Find and use the least common multiple
		NCP 503. Work with numerical factors
		NCP 601. Apply number properties involving prime factorization
		NCP 602 Apply number properties involving even/odd numbers and factors/multiples

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
8.II.A.3. Use scientific notation with positive and negative powers of 10, with appropriate treatment of significant digits, to solve real-world and mathematical problems. **Goes beyond the scope of this ADP benchmark.*	**I1.5.** Multiply and divide numbers expressed in scientific notation.	NCP 504. Work with scientific notation
	I2. Recognize and apply magnitude (absolute value) and ordering of real numbers:	
11.III.B.2. Understand the relationship between absolute value and distance on the number line and graph simple expressions involving absolute value such as, $\|x - 3\| = 6$ or $\|x + 2\| < 5$.	**I2.1.** Locate the position of a number on the number line, know that its distance from the origin is its absolute value and know that the distance between two numbers on the number line is the absolute value of their difference.	NCP 401. Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, **absolute value,** primes, and greatest common factor
		GRE 201. Identify the location of a point with a positive coordinate on the number line
		GRE 301. Locate points on the number line and in the first quadrant
		GRE 402. Comprehend the concept of length on the number line*
8.II.A.1. Represent and compare rational and irrational numbers symbolically and on a number line.	**I2.2.** Determine the relative position on the number line of numbers and the relative magnitude of numbers expressed in fractional form, in decimal form, as roots or in scientific notation.	GRE 201. Identify the location of a point with a positive coordinate on the number line
		GRE 301. Locate points on the number line and in the first quadrant
		GRE 402. Comprehend the concept of length on the number line*
		NCP 502 Order fractions
11.II.A Use real numbers, represented in a variety of ways, to quantify information and to solve real-world and mathematical problems.	**I3. Understand that to solve certain problems and equations, number systems need to be extended from whole numbers to the set of all integers (positive, negative and zero), from integers to rational numbers, from rational numbers to real numbers (rational and irrational numbers) and from real numbers to complex numbers; define and give examples of each of these types of numbers.**	NCP 509. Exhibit some knowledge of the complex numbers†

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
12.II.A.13. **Add, subtract, multiply and divide complex numbers,** interpret sums geometrically, and find complex solutions of quadratic equations. **Goes beyond the scope of this ADP benchmark.*		NCP 605. Multiply two complex numbers†
		NCP 703. Apply properties of complex numbers
11.II.B.5. Understand the limitations of calculators such as missing or additional features on graphs due to viewing parameters or misleading representations of zero or very large numbers.	**I4. Understand the capabilities and the limitations of calculators and computers in solving problems:**	
11.II.B.3. Recognize the impact of units such as degrees and radians on calculations.	**I4.1.** Use calculators appropriately and make estimations without a calculator regularly to detect potential errors.	
11.II.B.4. Recognize that applying an inverse function with a calculator may lead to **extraneous or incomplete solutions.**		
11.II.B.6. Understand that use of a calculator requires appropriate mathematical reasoning and does not replace the need for **mental computation.**		
11.II.B Appropriately use calculators and other technologies to solve algebraic, geometric, probabilistic and statistical problems.	**I4.2.** Use graphing calculators and computer spreadsheets.	
11.III.B.5. Use a variety of models such as equations, inequalities, algebraic formulas, written statements, tables and graphs or **spreadsheets** to represent functions and patterns in real-world and mathematical problems.		
	J. Algebra - The high school graduate can:	
	J1. Perform basic operations on algebraic expressions fluently and accurately:	XEI 201 Exhibit knowledge of basic expressions (e.g., identify an expression for a total as b + g)
		NCP 508 Determine when an expression is undefined*
11.III.B.6. Apply the laws of exponents to perform operations on expressions with integer exponents.	**J1.1.** Understand the properties of integer exponents and roots and apply these properties to simplify algebraic expressions.	NCP 505 Work with squares and square roots of numbers
12.II.A.4. Simplify a wide variety of algebraic expressions, including those in which numerator or denominator needs to be **rationalized**.		NCP 506 Work problems involving positive integer exponents*

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
		NCP 507 Work with cubes and cube roots of numbers*
		NCP 604 Apply rules of exponents
12.II.A.5. Apply the laws of exponents to perform operations on expressions with fractional exponents.	**J1.2.** * Understand the properties of rational exponents and apply these properties to simplify algebraic expressions.	NCP 604 Apply rules of exponents
12.II.A.3. Perform the four arithmetic operations with polynomials, except that division is restricted to division by monomials and linear binomials.	**J1.3.** Add, subtract and multiply polynomials; divide a polynomial by a low degree polynomial.	XEI 303. Combine like terms (e.g., 2x + 5x)
		XEI 402. Add and subtract simple algebraic expressions
		XEI 405. Multiply two binomials*
		XEI 504. Add, subtract, and multiply polynomials*
11.III.B.1. Translate among equivalent forms of expressions, such as, simplify algebraic expressions involving nested pairs of parentheses and brackets, simplify rational expressions, **factor a common term** from an expression and apply associative, commutative and distributive laws.	**J1.4.** Factor polynomials by removing the greatest common factor; factor quadratic polynomials.	XEI 505. Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)*
12.II.A.10. Factor polynomials representing the difference of squares, perfect square trinomials and quadratics with rational factors. **Goes beyond the scope of this ADP benchmark.*		
12.II.A.14. Know and use the Factor and Remainder Theorems. **Goes beyond the scope of this ADP benchmark.*		
11.III.B.1. Translate among equivalent forms of expressions, such as, simplify algebraic expressions involving nested pairs of parentheses and brackets, **simplify rational expressions**, factor a common term from an expression and apply associative, commutative and distributive laws.	**J1.5.** Add, subtract, multiply, divide and simplify rational expressions.	NCP 508 Determine when an expression is undefined*
	J1.6. Evaluate polynomial and rational expressions and expressions containing radicals and absolute values at specified values of their variables.	XEI 301 Substitute whole numbers for unknown quantities to evaluate expressions
		XEI 401. Evaluate algebraic expressions by substituting integers for unknown quantities

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
12.II.A.16. Know and use formal notation for sequences and series to solve related problems.	**J1.7.** * Derive and use the formulas for the general term and summation of finite arithmetic and geometric series; find the sum of an infinite geometric series whose common ratio, r, is in the interval (-1, 1).	
	J2 Understand functions, their representations and their properties:	
11.III.A.5. Distinguish functions from other relations using graphic and symbolic methods.	**J2.1** Recognize whether a relationship given in symbolic or graphical form is a function	
	J2.2. * Determine the domain of a function represented in either symbolic or graphical form.	
8.III.A.3. Generate a table of values from a formula and graph the resulting ordered pairs on a grid.	**J2.3.** Understand functional notation and evaluate a function at a specified point in its domain.	FUN 401. Evaluate quadratic functions, expressed in function notation, at integer values
		FUN 501. Evaluate polynomial functions, expressed in function notation, at integer values
		FUN 601. Evaluate composite functions at integer values
12.II.A.15. Find the inverse of a function and the **composition** of functions by numeric and symbolic methods. Know the relationship between the graphs of a function and its inverse.	**J2.4.** * Combine functions by composition, as well as by addition, subtraction, multiplication and division.	FUN 701 . Write an expression for the composite of two simple functions
		FUN 601. Evaluate composite functions at integer values
12.II.A.15. Find the **inverse** of a function and the composition of functions by numeric and symbolic methods. Know the relationship between the graphs of a function and its inverse.	**J2.5.** * Identify whether a function has an inverse and when functions are inverses of each other; explain why the graph of a function and its inverse are reflections of one another over the line y = x.	
12.II.A.6. Know the numeric, graphic and symbolic properties of power, **logarithmic** and exponential functions.	**J2.6.** * Know the inverse of an exponential function is a logarithm, prove basic properties of a logarithm using properties of its inverse and apply those properties to solve problems.	NCP 702 . Exhibit knowledge of **logarithms** and geometric sequences
11.III.B Solve simple equations and ieequalities numerically, graphically, and symbolically. Use recursion to model and solve real-world and mathematical problems.	**J3. Apply basic algebraic operations to solve equations and inequalities:**	
11.III.B.7. Solve linear equations and inequalities in one variable with numeric, graphic and symbolic methods.	**J3.1.** Solve linear equations and inequalities in one variable including those involving the absolute value of a linear function.	XEI 202 Solve equations in the form x + a = b, where a and b are whole numbers or decimals
		XEI 302 Solve one-step equations having integer or decimal answers

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
		XEI 403. Solve routine first-degree equations
		XEI 506. Solve first-degree inequalities that do not require reversing the inequality sign*
		XEI 603. Solve linear inequalities that require reversing the inequality sign
		XEI 604. Solve absolute value equations
		XEI 703 . Solve simple absolute value inequalities
11.III.B.4. Translate among equivalent forms of linear equations and inequalities.	**J3.2.** Solve an equation involving several variables for one variable in terms of the others.	XEI 601. Manipulate expressions and equations
11.III.B.11. Solve systems of two linear equations and inequalities with two variables using numeric, graphic and symbolic methods.	**J3.3.** Solve systems of two linear equations in two variables.	XEI 606. Find solutions to systems of linear equations
12.II.A.1. Solve systems of two, **three** or more simultaneous linear equations or inequalities, in particular, deciding whether a given system of equations has one solution, no solution or infinitely many solutions and, in this latter case, describing them parametrically. **Goes beyond the scope of this ADP benchmark.*	**J3.4. *** Solve systems of three linear equations in three variables.	XEI 606. Find solutions to systems of linear equations
12.II.A.2. Solve problems with quadratic functions and equations, where some of the coefficients may be expressed in terms of parameters. **Goes beyond the scope of this ADP benchmark.*	**J3.5.** Solve quadratic equations in one variable.	XEI 503. Identify solutions to simple quadratic equations
11.III.B.8. Find real solutions to quadratic equations in one variable with numeric, graphic and symbolic methods.		XEI 605. Solve quadratic equations
12.II.A Demonstrate facility with a wide range of algebraic operations and use the relationship between coordinate geometry and algebraic equations to solve real-world and mathematical problems.	**J4. Graph a variety of equations and inequalities in two variables, demonstrate understanding of the relationships between the algebraic properties of an equation and the geometric properties of its graph, and interpret a graph:**	GRE 401 Locate points in the coordinate plane
11.III.A.1. Know the numeric, **graphic** and symbolic properties of **linear,** step, absolute value and quadratic functions. **Graphic properties may include rates of change**, intercepts, maxima and minima.	**J4.1.** Graph a linear equation and demonstrate that it has a constant rate of change.	GRE 403 Exhibit knowledge of slope*
11.III.A.3. Analyze the effects of coefficient changes on linear and quadratic functions and their graphs.	**J4.2.** Understand the relationship between the coefficients of a linear equation and the slope and x- and y-intercepts of its graph.	GRE 503 Match linear graphs with their equations*

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
11.III.B.11. Solve systems of two linear equations and inequalities with two variables using numeric, **graphic** and symbolic methods.	**J4.3.** Understand the relationship between a solution of a system of two linear equations in two variables and the graphs of the corresponding lines.	
11.III.B.11. Solve systems of two linear equations and **inequalities** with two variables using numeric, **graphic** and symbolic methods.	**J4.4.** Graph the solution set of a linear inequality and identify whether the solution set is an open or a closed half-plane; graph the solution set of a system of two or three linear inequalities.	GRE 501. Identify the graph of a linear inequality on the number line*
		GRE 602 Match number line graphs with solution sets of linear inequalities
11.III.A.4. Apply basic concepts of linear, **quadratic** and exponential expressions or equations in real-world problems such as loans, investments and the path of a projectile.	**J4.5.** Graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of its graph.	GRE 701 . Match number line graphs with solution sets of simple quadratic inequalities
11.III.B.8. Find real solutions to quadratic equations in one variable with numeric, **graphic** and symbolic methods.		GRE 702 . Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$
11.III.A.1. Know the numeric, graphic and symbolic properties of linear, step, absolute value and **quadratic** functions. Graphic properties may include rates of change, **intercepts,** maxima and minima.		
12.II.A.11. Make sketches including axes, centers, asymptotes, vertices of parabola, ellipses (including circles) and hyperbolas with axes parallel to the coordinate axes, given their equations, and completing the square if necessary.	**J4.6.** * Graph ellipses and hyperbolas whose axes are parallel to the x and y axes and demonstrate understanding of the relationship between their standard algebraic form and their graphical characteristics.	
12.II.A.12. Find equations of parabolas, ellipses and hyperbolas when presented with their graphs having axes parallel to the coordinate axes.		
11.III.A.2. Model exponential growth and decay, numerically, **graphically** and symbolically, using exponential functions with integer inputs.	**J4.7.** Graph exponential functions and identify their key characteristics.	
12.II.A.6. Know the numeric, **graphic** and symbolic properties of power, logarithmic and **exponential** functions.		
11.III.A Represent and analyze real-world and mathematical problems using numeric, **graphic** and symbolic methods for a variety of functions.	**J4.8.** Read information and draw conclusions from graphs; identify properties of a graph that provide useful information about the original problem.	GRE 601. Interpret and use information from graphs in the coordinate plane

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
		GRE 704 . Analyze and draw conclusions based on information from graphs in the coordinate plane
11.III.B.5. Use a variety of models such as equations, inequalities, algebraic formulas, written statements, tables and graphs or spreadsheets to represent functions and patterns in **real-world and mathematical problems.**	**J5. Solve problems by converting the verbal information given into an appropriate mathematical model involving equations or systems of equations; apply appropriate mathematical techniques to analyze these mathematical models; and interpret the solution obtained in written form using appropriate units of measurement:**	XEI 602 Write expressions, equations, and inequalities for common algebra settings
11.III.B.10. Create and use recursive formulas to model and solve **real-world and mathematical problems**. **Goes beyond the scope of this ADP benchmark.*		
12.II.A.7. Solve a wide variety of mathematical and **real-world problems** involving power, exponential and logarithmic functions and equations, discard extraneous solutions and present results graphically.		
11.III.A.4. Apply basic concepts of **linear**, quadratic and exponential expressions or equations in real-world problems such as loans, investments and the path of a projectile.	**J5.1.** Recognize and solve problems that can be modeled using a linear equation in one variable, such as time/rate/distance problems, percentage increase or decrease problems, and ratio and proportion problems.	XEI 404 Perform straightforward word -to-symbol translations
11.III.B.7. Solve linear equations and inequalities in one variable with numeric, graphic and symbolic methods.		XEI 501 Solve real-world problems using first-degree equations
		XEI 502 Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)
11.III.B.11. Solve **systems of two linear equations** and inequalities with two variables using numeric, graphic and symbolic methods.	**J5.2.** Recognize and solve problems that can be modeled using a system of two equations in two variables, such as mixture problems.	
11.III.A.4. Apply basic concepts of linear, **quadratic** and exponential expressions or equations in real-world problems such as loans, investments and the path of a projectile.	**J5.3.** Recognize and solve problems that can be modeled using a quadratic equation, such as the motion of an object under the force of gravity.	
11.III.B.8. Find real solutions to **quadratic** equations in one variable with numeric, graphic and symbolic methods.		

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
11.III.A.4. Apply basic concepts of linear, quadratic and **exponential** expressions or equations in real-world problems such as loans, investments and the path of a projectile.	**J5.4.** Recognize and solve problems that can be modeled using an exponential function, such as compound interest problems.	
12.II.A.7. Solve a wide variety of mathematical and real-world problems involving power, **exponential and logarithmic** functions and equations, discard extraneous solutions and present results graphically.	**J5.5.** * Recognize and solve problems that can be modeled using an exponential function but whose solution requires facility with logarithms, such as exponential growth and decay problems.	
12.II.A.16. Know and use formal notation for sequences and series to solve related problems.	**J5.6.** Recognize and solve problems that can be modeled using a finite geometric series, such as home mortgage problems and other compound interest problems.	NCP 702 . Exhibit knowledge of logarithms and **geometric sequences**
	J6. * Understand the binomial theorem and its connections to combinatorics, Pascal's triangle and probability.	
11.V.B. Apply basic theorems of plane geometry, right triangle trigonometry, coordinate geometry and a variety of visualization tools to solve real-world and mathematical problems.	**K. Geometry** - The high school graduate can:	
	K1. Understand the different roles played by axioms, definitions and theorems in the logical structure of mathematics, especially in geometry:	
	K1.1. Identify, explain the necessity of and give examples of definitions, axioms and theorems.	
	K1.2. State and prove key basic theorems in geometry such as the Pythagorean theorem, the sum of the angles of a triangle is 180 degrees, and the line joining the midpoints of two sides of a triangle is parallel to the third side and half its length.	
	K1.3. Recognize that there are geometries, other than Euclidean geometry, in which the parallel postulate is not true.	
	K2. Identify and apply the definitions related to lines and angles and use them to prove theorems in (Euclidean) geometry, solve problems, and perform basic geometric constructions using a straight edge and compass:	

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
11.V.B.1. Know and use theorems about triangles and **parallel lines** in elementary geometry to justify facts about various geometrical figures and solve real-world and mathematical problems. These theorems include criteria for two triangles to be congruent or similar and facts about parallel lines cut by a transversal.	**K2.1.** Identify and apply properties of and theorems about parallel lines and use them to prove theorems such as two lines parallel to a third are parallel to each other and to perform constructions such as a line parallel to a given line through a point not on the line.	PPF 301. Exhibit some knowledge of the angles associated with parallel lines
		PPF 401. Find the measure of an angle using properties of parallel lines
11.V.B.7. Perform basic **constructions** with a straightedge and compass.		
11.V.B.8. Draw accurate **representations** of planar figures using a variety of tools.		
	K2.2. Identify and apply properties of and theorems about perpendicular lines and use them to prove theorems such as the perpendicular bisectors of line segments are the set of all points equidistant from the two end points and to perform constructions such as the perpendicular bisector of a line segment.	
11.V.B.7. Perform basic **constructions** with a straightedge and compass.		
11.V.B.1. Know and use theorems about triangles and parallel lines in elementary geometry to justify facts about various geometrical figures and solve real-world and mathematical problems. These theorems include criteria for two triangles to be congruent or similar and facts about **parallel lines cut by a transversal**.	**K2.3.** Identify and apply properties of and theorems about angles and use them to prove theorems such as two lines are parallel exactly when the alternate interior angles they make with a transversal are equal and to perform constructions such as the bisector of an angle	PPF 301. Exhibit some knowledge of the angles associated with parallel lines
11.V.B.7. Perform basic **constructions** with a straightedge and compass.		PPF 401. Find the measure of an angle using properties of parallel lines
11.V.B.8. Draw accurate **representations** of planar figures using a variety of tools.		PPF 402. Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)
6.V.B.1 Use facts about angles including the relationship between complementary angles, supplementary angles and the angles within triangles to solve real-world and mathematical problems.		PPF 501 Use several angle properties to find an unknown angle measure

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
11.V.B.1. Know and use theorems about triangles and parallel lines in elementary geometry to justify facts about various geometrical figures and solve real-world and mathematical problems. These theorems include criteria for two **triangles** to be **congruent or similar** and facts about parallel lines cut by a transversal.	**K3. Know the basic theorems about congruent and similar triangles and use them to prove additional theorems and solve problems.**	MEA 201. Estimate or calculate the length of a line segment based on other lengths given on a geometric figure
		PPF 503. Use properties of isosceles triangles*
		PPF 601. Apply properties of 30°-60°-90°, 45°-45°-90°,**similar, and congruent triangles**
11.V.B.2. Know and use theorems about circles to justify geometrical facts and solve real-world and mathematical problems. These theorems include the relationships involving tangent lines and radii, the relationship between inscribed and central angles and the relationship between the measure of a central angle and arc length.	**K4. Know the definitions and basic properties of a circle and use them to prove basic theorems and solve problems.**	GRE 605. Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)†
		PPF 703 . Use relationships among angles, arcs, and distances in a circle
11.V.B.3. Know and use properties of two- and three-dimensional figures to solve real-world and mathematical problems such as: finding area, perimeter, volume and surface area; applying direct or indirect methods of measurement; **the Pythagorean theorem and its converse; and properties of 45°-45°-90° and 30°-60°-90° triangles.**	**K5. Apply the Pythagorean theorem, its converse and properties of special right triangles to solve problems.**	PPF 502 Recognize Pythagorean triples*
		PPF 601. Apply properties of **-30°-60°-90°, 45°-45°-90**, similar, and congruent triangles
		PPF 602. Use the Pythagorean theorem
11.V.B.6. Use numeric, graphic and symbolic representations of transformations such as reflections, translations and change of scale in one, two and three dimensions to solve real-world and mathematical problems.	**K6. Use rigid motions (compositions of reflections, translations and rotations) to determine whether two geometric figures are congruent and to create and analyze geometric designs.**	
8.V.B.2 Use the concept of similarity in simple two-dimensional figures to solve real-world and mathematical problems involving proportionality.	**K7. Know about the similarity of figures and use the scale factor to solve problems.**	PPF 601. Apply properties of 30°-60°-90°, 45°-45°-90°, **similar,** and congruent triangles
		MEA 701 . Use scale factors to determine the magnitude of a size change

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
11.V.C Use the interconnectedness of geometry, algebra and **measurement** to explore real-world and mathematical problems.	**K8. Know that geometric measurements (length, area, perimeter, volume) depend on the choice of a unit and that measurements made on physical objects are approximations; calculate the measurements of common plane and solid geometric figures:**	
7.V.C.1 Choose appropriate units to calculate, measure, and record length, weight, area and volume in both U.S. customary and metric systems.		
11.V.C Use the interconnectedness of geometry, algebra and **measurement** to explore real-world and mathematical problems.	**K8.1.** Understand that numerical values associated with measurements of physical quantities must be assigned units of measurement or dimensions; apply such units correctly in expressions, equations and problem solutions that involve measurements; and convert a measurement using one unit of measurement to another unit of measurement.	BOA 203. Perform common conversions (e.g., inches to feet or hours to minutes)
8.V.C.1 Find approximate equivalent measures of length, temperature and weight for common units in U.S. customary and metric measuring systems.		BOA 501. Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour)
8.V.C.2 Use arithmetic to solve simple real-world and mathematical problems involving mixed units such as minutes and hours in elapsed time, degrees and minutes in latitude and longitude and feet and inches in distance.		
6.V.C.1 Solve problems requiring conversion of units within the U.S. customary system, and within the metric system.		
11.V.B.3. Know and use properties of two- and three-dimensional figures to solve real-world and mathematical problems such as: finding area, perimeter, volume and surface area; applying direct or indirect methods of measurement; the Pythagorean theorem and its converse; and properties of 45°-45°-90° and 30°-60°-90° triangles.	**K8.2.** Determine the perimeter of a polygon and the circumference of a circle; the area of a rectangle, a circle, a triangle and a polygon with more than four sides by decomposing it into triangles; the surface area of a prism, a pyramid, a cone and a sphere; and the volume of a rectangular box, a prism, a pyramid, a cone and a sphere.	MEA 301. Compute the perimeter of polygons when all side lengths are given
		MEA 302. Compute the area of rectangles when whole number dimensions are given
		MEA 401. Compute the area and perimeter of triangles and rectangles in simple problems

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
		MEA 402. Use geometric formulas when all necessary information is given
		MEA 501. Compute the area of triangles and rectangles when one or more additional simple steps are required
		MEA 502. Compute the area and circumference of circles after identifying necessary information
		MEA 503. Compute the perimeter of simple composite geometric figures with unknown side lengths*
		MEA 601. Use relationships involving area, perimeter, and volume of geometric figures to compute another measure
		MEA 702 Compute the area of composite geometric figures when planning or visualization is required
	K8.3. Know that the effect of a scale factor k on length, area and volume is to multiply each by k, k^2 and k^3, respectively.	MEA 701 . Use scale factors to determine the magnitude of a size change
11.V.A.1. Use models and visualization to understand and represent three-dimensional objects and their cross sections from different perspectives.	**K9. Visualize solids and surfaces in three-dimensional space when given two-dimensional representations (e.g., nets, multiple views) and create two-dimensional representations for the surfaces of three-dimensional objects.**	
11.V.A Use models to represent and understand two- and three-dimensional shapes and how various motions affect them. Recognize the relationship between different representations of the same shape.		
8.V.A.1 Use models and visualization to understand and create various two-dimensional diagrams of three-dimensional shapes.		
6.V.A.1 Create models of three-dimensional geometric shapes from two-dimensional representations.		
11.V.B.5. Use **coordinate geometry** to represent and examine geometric concepts such as the distance between two points, the midpoint of a line segment, the slope of a line and the slopes of parallel and perpendicular lines.	**K10. Represent geometric objects and figures algebraically using coordinates; use algebra to solve geometric problems:**	GRE 703 Solve problems integrating multiple algebraic and/or geometric concepts

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
11.V.B.5. Use coordinate geometry to represent and examine geometric concepts such as the distance between two points, the midpoint of a line segment, the **slope of a line and the slopes of parallel and perpendicular lines.**	**K10.1.** Express the intuitive concept of the "slant" of a line in terms of the precise concept of slope, use the coordinates of two points on a line to define its slope, and use slope to express the parallelism and perpendicularity of lines.	GRE 403. Exhibit knowledge of slope*
11.III.B.12. Understand how slopes can be used to determine whether lines are **parallel or perpendicular.** Given a line and a point not on the line, find the equations for the lines passing through that point and parallel or perpendicular to the given line.		GRE 502 Determine the slope of a line from points or equations*
		GRE 604. Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point
11.III.B.3. Find equations of a line given two points on the line, a point and the slope of the line or the slope and the y-intercept of the line.	**K10.2.** Describe a line by a linear equation.	GRE 503. Match linear graphs with their equations
11.V.B.5. Use coordinate geometry to represent and examine geometric concepts such as the **distance between two points,** the midpoint of a line segment, the slope of a line and the slopes of parallel and perpendicular lines.	**K10.3.** Find the distance between two points using their coordinates and the Pythagorean theorem.	GRE 603. Use the distance formula
	K10.4. * Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius.	
12.III.A. **Understand the properties of the standard trigonometric functions and apply them to real-world and mathematical problems, especially geometrical problems. Develop increased mastery of geometric proof methodology.**	**K11. Understand basic right-triangle trigonometry and apply it to solve problems:**	
12.III.A.1. Know the six trigonometric functions defined for an angle in a right triangle.	**K11.1.** Understand how similarity of right triangles allows the trigonometric functions sine, cosine and tangent to be defined as ratios of sides and be able to use these functions to solve problems.	FUN 502. Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths
12.III.A.2. Given the coordinates of a point on the terminal side of an angle in standard position in the xy-plane, find the values of the trigonometric functions.		FUN 602. Apply basic trigonometric ratios to solve right-triangle problems

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
11.V.B.4. Apply the basic concepts of right triangle trigonometry including sine, cosine and tangent to solve real-world and mathematical problems.	**K11.2.** Apply the trigonometric functions sine, cosine and tangent to solve for an unknown length of a side of a right triangle, given one of the acute angles and the length of another side.	FUN 602. Apply basic trigonometric ratios to solve right-triangle problems
	K11.3. Use the standard formula for the area of a triangle, $A = \frac{1}{2}bh$, to explain the area formula, $A = \frac{1}{2}absinC$ where a and b are the lengths of two sides of a triangle and C is the measure of the included angle formed by these two sides, and use it to find the area of a triangle when given the lengths of two of its sides and the included angle.	
12.III.A.8. Find all the solutions of a trigonometric equation on various intervals.	**K12. * Know how the trigonometric functions can be extended to periodic functions on the real line, derive basic formulas involving these functions, and use these functions and formulas to solve problems:**	
12.III.A.3. Convert between degrees and radian measures.	**K12.1. *** Know that the trigonometric functions sine and cosine, and thus all trigonometric functions, can be extended to periodic functions on the real line by defining them as functions on the unit circle, that radian measure of an angle between 0 and 360 degrees is the arc length of the unit circle subtended by that central angle, and that by similarity, the arc length s of a circle of radius r subtended by a central angle of measure t radians is s = rt.	FUN 703 Exhibit knowledge of unit circle trigonometry
12.III.A.9. Know and be able to use the definitions of the inverse trigonometric functions and related methods to solve problems such as find cos(x) and tan(x) given the value of sin x and the quadrant containing the terminal side. **Goes beyond the scope of this ADP benchmark.*		
12.III.A.7. Simplify trigonometric expressions using identities and verify simple trigonometric identities including $\sin^2 x + \cos^2 x = 1$, sum, difference, double angle and half-angle formulas for sine and cosine.	**K12.2. *** Know and use the basic identities, such as $\sin^2(x) + \cos^2(x) = 1$ and $\cos(\Pi/2-x) = \sin(x)$ and formulas for sine and cosine, such as addition and double angle formulas.	FUN 702 Use trigonometric concepts and basic identities to solve problems
12.III.A.6. Graph the functions of the form Asin (Bt + C), Acos (Bt + C), and Atan (Bt + C) and know the meaning of the terms frequency, amplitude, phase shift and period.	**K12.3. *** Graph sine, cosine and tangent as well as their reciprocals, secant, cosecant and cotangent; identify key characteristics.	FUN 704 Match graphs of basic trigonometric functions with their equations

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
12.III.A.4. Solve applied problems about triangles using the **law of sines** including the ambiguous case.	**K12.4. * Know** and use the law of cosines and the law of sines to find missing sides and angles of a triangle.	
12.III.A.5. Solve applied problems about triangles using the **law of cosines**.		
	L. Data Interpretation, Statistics and Probability The high school graduate can:	
11.IV.A **Represent data and use various measures associated with data to draw conclusions and identify trends. Understand the effects of display distortion and measurement error on the interpretation of data.**	**L1. Explain and apply quantitative information:**	
11.IV.A.4. Know the **influence of outliers** on various measures and representations of data about real-world and mathematical problems.	**L1.1.** Organize and display data using appropriate methods (including spreadsheets) to detect patterns and departures from patterns.	PSD 402 Translate from one representation of data to another (e.g., a bar graph to a circle graph)
11.II.B Appropriately use calculators and other technologies to solve algebraic, geometric, **probabilistic and statistical problems.**		
11.III.B.5. Use a variety of models such as equations, inequalities, algebraic formulas, written statements, **tables and graphs or spreadsheets** to represent functions and patterns in real-world and mathematical problems.		
11.IV.A.1. **Construct** and analyze circle graphs, bar graphs, histograms, box-and-whisker plots, scatter plots and tables, and demonstrate the strengths and weaknesses of each format by choosing appropriately among them for a given situation.		
11.IV.A.1. Construct and **analyze** circle graphs, bar graphs, histograms, box-and-whisker plots, scatter plots and tables, and demonstrate the strengths and weaknesses of each format by choosing appropriately among them for a given situation.	**L1.2.** Read and interpret tables, charts and graphs.	PSD 202. Perform a single computation using information from a table or chart
		PSD 303. Read tables and graphs
		PSD 502 Manipulate data from tables and graphs
		PSD 602. Interpret and use information from figures, tables, and graphs

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
		PSD 702 Analyze and draw conclusions based on information from figures, tables, and graphs
11.IV.A.2. Use measures of central tendency and variability, such as, mean, median, maximum, minimum, range, standard deviation, quartile and percentile, to describe, compare and draw conclusions about sets of data.	**L1.3.** Compute and explain summary statistics for distributions of data including measures of center (mean, median) and spread (range, percentiles, variance, standard deviation).	PSD 201. Calculate the average of a list of positive whole numbers
		PSD 301 Calculate the average of a list of numbers
		PSD 302 Calculate the average, given the number of data values and the sum of the data values
		PSD 304. Perform computations on data from tables and graphs
		PSD 401 Calculate the missing data value, given the average and all data values but one
		PSD 501. Calculate the average, given the frequency counts of all the data values
		PSD 601 Calculate or use a weighted average
		PSD 701 Distinguish between mean, median, and mode for a list of numbers
11.IV.A.1. Construct and analyze circle graphs, bar graphs, histograms, box-and-whisker plots, scatter plots and tables, and demonstrate the strengths and weaknesses of each format by choosing appropriately among them for a given situation.	**L1.4.** Compare data sets using graphs and summary statistics.	PSD 303. Read tables and graphs
11.IV.A.2. Use measures of central tendency and variability, such as, mean, median, maximum, minimum, range, standard deviation, quartile and percentile, to describe, **compare** and draw conclusions about **sets of data**.		
11.IV.A.3. Determine an approximate best-fit line from a given scatter plot and use the line to draw conclusions.	**L1.5.** Create scatter plots, analyze patterns and describe relationships in paired data.	
12.I.A Use tables of the normal distribution and properties of that distribution to make judgments about populations based on random samples from these populations.	**L1.6.** Know the characteristics of the Gaussian normal distribution (bell-shaped curve).	

Minnesota Academic Standards	ADP Benchmarks, Mathematics	ACT College Readiness Standards
12.I.A.1. Use the concept of normal distribution and its properties to answer questions about sets of data.		
12.I.A.2. Describe and use sampling distributions and the central limit theorem. Calculate **confidence intervals** when appropriate. **Goes beyond the scope of this ADP benchmark.*		
11.IV.A.1. Construct and analyze circle graphs, bar graphs, histograms, box-and-whisker plots, scatter plots and tables, and demonstrate the strengths and weaknesses of each format by choosing appropriately among them for a given situation.	**L2. Explain and critique alternative ways of presenting and using information:**	
11.IV.A.7. Compare outcomes of voting methods such as majority, plurality, ranked by preference, run-off and pair-wise comparison. **Relates to this ADP benchmark but is more specific.*	**L2.1.** Evaluate reports based on data published in the media by considering the source of the data, the design of the study, and the way the data are analyzed and displayed.	
11.IV.A.6. Interpret data credibility in the context of measurement error and display distortion.	**L2.2.** Identify and explain misleading uses of data.	
11.IV.A.5. Understand the relationship between correlation and causation.	**L2.3.** Recognize when arguments based on data confuse correlation with causation.	
	L3. Explain the use of data and statistical thinking to draw inferences, make predictions and justify conclusions:	
12.I.A.3. Understand the importance of appropriate sampling methods. For instance, the time of day of a survey could lead to inaccuracies in the outcome.	**L3.1.** Explain the impact of sampling methods, bias and the phrasing of questions asked during data collection and the conclusions that can rightfully be made.	
	L3.2. Design simple experiments or investigations to collect data to answer questions of interest.	
	L3.3. Explain the differences between randomized experiments and observational studies.	
11.IV.A.3. Determine an approximate best-fit line from a given scatter plot and use the line to draw conclusions.	**L3.4.** Construct a scatter plot of a set of paired data, and if it demonstrates a linear trend, use a graphing calculator to find the regression line that best fits this data; recognize that the correlation coefficient measures goodness of fit and explain when it is appropriate to use the regression line to make predictions	

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
	L4. Explain and apply probability concepts and calculate simple probabilities:	
11.IV.B.1. Select and apply appropriate counting procedures to solve real-world and mathematical problems, including probability problems.	**L4.1.** Explain how probability quantifies the likelihood that an event occurs in terms of numbers.	PSD 305. Use the relationship between the probability of an event and the probability of its complement
11.IV.B Use appropriate counting procedures, calculate probabilities in various ways and apply theoretical probability concepts to solve real-world and mathematical problems.	**L4.2.** Explain how the relative frequency of a specified outcome of an event can be used to estimate the probability of the outcome.	PSD 404. Exhibit knowledge of simple counting techniques*
		PSD 603. Apply counting techniques
11.IV.B.5. Know the effect of sample size on experimental and simulation probabilities.	**L4.3.** Explain how the law of large numbers can be applied in simple examples.	
11.IV.B.2. Use area, trees, unions and intersections to calculate probabilities and relate the results to mutual exclusiveness, **independence and conditional** probabilities, in real-world and mathematical problems.	**L4.4.** Apply probability concepts such as conditional probability and independent events to calculate simple probabilities.	PSD 403. Determine the probability of a simple event
11.IV.B.6. Use a variety of experimental, simulation and theoretical methods to calculate probabilities.		PSD 703 Exhibit knowledge of conditional and joint probability
11.IV.B.3. Use probability models, including area and binomial models, in real-world and mathematical problems.	**L4.5.** Apply probability concepts to practical situations to make informed decisions.	PSD 503. Compute straightforward probabilities for common situations
11.IV.B Use appropriate counting procedures, calculate probabilities in various ways and apply theoretical probability concepts to solve real-world and mathematical problems.		PSD 604. Compute a probability when the event and/or sample space are not given or obvious
11.IV.B.4. For simple probability models, determine the expected values of random variables. **Goes beyond the scope of this ADP benchmark.*		
11.I.A MATHEMATICAL REASONING **Apply skills of mathematical representation, communication and reasoning throughout the remaining three content strands.**	**Mathematical Reasoning:** Woven throughout the four domains of mathematics — Number Sense and Numerical Operations, Algebra, Geometry, and Data Interpretation, Statistics and Probability — are the following mathematical reasoning skills:	
11.I.A.4. Support mathematical results by explaining why the steps in a solution are valid and why a particular solution method is appropriate.	**MR1.** Using inductive and deductive reasoning to arrive at valid conclusions.	PPF 701 Draw conclusions based on a set of conditions
11.I.A.6. Know and use the relationship that exists among a logical implication of the form "if A, then B," its converse "if B, then A," its inverse "if not A, then not B," and its contrapositive "if not B, then not A." **Goes beyond the scope of this ADP benchmark.*		NCP 701 Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers

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11.I.A.3. Translate a problem described verbally or by tables, diagrams or graphs, into suitable mathematical language, solve the problem mathematically and interpret the result in the original context.	**MR2.** Using multiple representations (literal, symbolic, graphic) to represent problems and solutions.	
11.I.A.2. Appropriately use examples and counterexamples to make and test conjectures, justify solutions, and explain results.	**MR3.** Understanding the role of definitions, proofs and counterexamples in mathematical reasoning; constructing simple proofs.	
11.III.B.9. Use appropriate terminology and mathematical **notation** to define and represent recursion.	**MR4.** Using the special symbols of mathematics correctly and precisely.	
11.II.B.2. Know, use and translate calculator **notational conventions** to mathematical notation.		
12.II.A.16. Know and use **formal notation** for sequences and series to solve related problems.		
11.I.A.1. Assess the reasonableness of a solution by comparing the solution to appropriate graphical or numerical estimates or by recognizing the feasibility of solutions in a given context and rejecting extraneous solutions.	**MR5.** Recognizing when an estimate or approximation is more appropriate than an exact answer and understanding the limits on precision of approximations.	
11.I.A.5. Determine whether or not relevant information is missing from a problem and if so, decide how to best express the results that can be obtained without that information.	**MR6.** Distinguishing relevant from irrelevant information, identifying missing information and either finding what is needed or making appropriate estimates.	
11.III.B.5. Use a variety of models such as equations, inequalities, algebraic formulas, written statements, tables and graphs or spreadsheets to represent functions and patterns in real-world and mathematical problems.	**MR7.** Recognizing and using the process of mathematical modeling: recognizing and clarifying mathematical structures that are embedded in other contexts, formulating a problem in mathematical terms, using mathematical strategies to reach a solution, and interpreting the solution in the context of the original problem.	XEI 701 Write expressions that require planning and/or manipulating to accurately model a situation
		XEI 702 Write equations and inequalities that require planning, manipulating, and/or solving
		PPF 702 . Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas

Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
8.I.A.1. Assess the reasonableness of a solution by comparing the solution to appropriate graphical or numerical estimates or by recognizing the feasibility of a solution in a given context.	**MR8.** When solving problems, thinking ahead about strategy, testing ideas with special cases, trying different approaches, checking for errors and reasonableness of solutions as a regular part of routine work, and devising independent ways to verify results.	
8.I.A.2. Appropriately use examples and counterexamples to make and test conjectures, justify solutions and explain results.		
8.I.A.2 Appropriately use examples and counterexamples to make and test conjectures, justify solutions and explain results.	**MR9.** Shifting regularly between the specific and the general, using examples to understand general ideas, and extending specific results to more general cases to gain insight.	
12.II.A.8. Know the numeric, graphic and symbolic properties of rational functions.	**X Rational Functions**	
12.II.A.9. Solve a wide variety of mathematical and real-world problems involving rational functions, discard extraneous solutions and present results graphically.	**X Rational Functions**	
		NCP 201 Recognize equivalent fractions and fractions in lowest terms
		NCP 302 Identify a digit's place value
		GRE 504 Find the midpoint of a line segment
		PSD 504 Use Venn Diagrams in counting*