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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.

<u>Participation in Alignment Institute</u>. 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.

"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*[*]		

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

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		

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[*] 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

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
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Tom Muchlinski, MDE
Michael Lehn, MnSCU
Lisa Clarkson, U of M
Ross Taylor, Math Pump

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Peggy Ballard, faculty, MSU, Mankato/MnSCU, co-chair
Deborah Dillon, U of M
Bonnie Houck, MDE
Ginny Karbowski, MnSCU
Jim Mecklenberg, MDE

Writing:
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Mike Holm, teacher, Eden Prairie/EdMN, co-chair
Paula Martin, MESPA
Charon Tierney, MDE
Donald Ross, U of M

[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.

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 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.
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.		a. Correctly use reflexive case pronouns and nominative and objective case pronouns, including who and whom.
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)		b. Correctly use punctuation such as the comma, semicolon, colon, hyphen, and dash.
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 a consistent verb tense and pronoun person on the basis of the preceding clause or sentence.		c. Correctly use like/as if, any/any other, this kind/these kinds, who/that, and every/many when they occur in a 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.		d. Correctly use verb forms with attention to subjunctive mood, subject/verb agreement, and active/passive voice.
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.		e. Correctly use the possessive pronoun before the gerund.
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 commas 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. 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.	**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.

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.
<<Repeated from A4 above>> Meanings of Words (28-32) Determine the appropriate meaning of words, phrases, or statements from figurative and somewhat technical contexts.	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	
	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.	8.III.A.1. Participate in and follow agreed-upon rules for conversation and formal discussions in large and small groups.
	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.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.		9-12.II.B.5. Revise writing for clarity, coherence, smooth transitions and unity.
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.		
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

o 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
  o Correctly employing most conventions of standard English grammar, usage, and mechanics, with just a few, if any, errors
  o 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.		9-12.I.C.7. Make inferences and draw conclusions based on explicit and implied information from texts.
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.		
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.
	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 (13-15) Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives.		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.
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.		
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 11th and 12th 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 11th and 12th 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: Mathematics
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 identified 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
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.	NCP 603 Apply number properties involving positive/negative numbers 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 scales 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

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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*

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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.II.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*

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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 = ax² + 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, exponential functions with integer inputs.	J4.7. Graph exponential functions and identify their using 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

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Minnesota Academic Standards	ADP Benchmarks: Mathematics	ACT College Readiness Standards
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:	GRE 704 . Analyze and draw conclusions based on information from graphs in the coordinate plane 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 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.		

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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**, **logarithmic** functions and equations, 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 parallel lines 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 parallel lines 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

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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 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

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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, $A = \frac{1}{2}ab\sin C$ 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 (Π/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

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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

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		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 and (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).	

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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	

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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*
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.	PSD 603. Apply counting techniques
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
		PSD 703 Exhibit knowledge of conditional and joint probability
11.IV.B.6. Use a variety of experimental, simulation and theoretical methods to calculate probabilities.		
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**	
MR1. Using inductive and deductive reasoning to arrive at valid conclusions.	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.	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*

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