

Essential Concepts and Skill Sets of the Iowa Core Curriculum

The Iowa Core Curriculum (also known as Model Core Curriculum) provides local school districts a guide to delivering instructional content that is challenging and meaningful to students. The curriculum identifies the essential concepts and skill sets for literacy, mathematics, science and social studies, as well as 21st century learning skills (civic literacy, financial literacy, technology literacy, health literacy, and employability).

Below are the identified skills and concepts of the Iowa Core Curriculum for grades K-12 (please note that the skills and concepts for social studies and 21st century skills for grades K-8 will be developed later in 2008).

The Iowa Department of Education and its partners have and will continue to provide guidance and assistance to Iowa's school districts and teachers in incorporating these skills and concepts into their local curriculum.

The goal of the Iowa Core Curriculum is to ensure Iowa students are engaged in rigorous curriculum.

Literacy

Literacy — defined by Meltzer, Smith, and Clark as the ability to read, write, speak, listen, and think effectively — enables students to learn and to communicate clearly about what they know. Being literate gives people the ability to become informed, to inform others, and to make informed decisions (2001). Literacy is synonymous with learning. The integration among reading, writing, speaking, listening, and viewing — connecting with the ever-increasing knowledge base for each content area — provide the means for thinking among and between concepts and ideas. It is an active process.

The Reading, Writing, Speaking, Listening, and Viewing Essential Skills and Concepts found in the Iowa Core Curriculum describe what students should know and be able to do in English language arts at the primary (K–2), intermediate (3–5), middle (6–8), and high school (9–12) levels. The essential skills and concepts described in this document should be considered the focal points for instruction and student learning. The language arts: reading, writing, speaking, listening, and viewing — are different from other content areas because they provide the processes that students use to learn and understand the complex world in which they live. Each discipline has a language and vocabulary of its own. Because of the inclusive nature of language arts, it is critical that these essential literacy concepts and skills be integrated throughout the content areas.

The purpose of this document is to guide school districts in the development of effective literacy curricula. Two fundamental concepts have guided its creation. First, literacy learning is recursive. This means students apply similar language arts skills and concepts at every developmental level as they encounter increasingly complex materials. Therefore, the essential skills and concepts for each level (primary, intermediate, middle, and high school) are very similar. Their implementation at each level will vary by instructional strategies, learning materials, and assessment. As a result, students will build upon and refine their knowledge, and gain sophistication and independence in their use and application of the essential skills and concepts.

Second, although listed separately in the Iowa Core Curriculum, the individual strands of Reading, Writing, Speaking, Listening, and Viewing are intertwined. Each strand links to and supports the other strands. At any time, or at the same time, students may read, write, and view, or speak and listen, to convey meaning. To be learned and used effectively, the processes of reading, writing, speaking, listening, and viewing are best taught in an integrated manner and assessed in the same way.

Primary Elementary Grades

Reading

- Demonstrates an understanding of written language and the relationship of letters and words to the sounds of speech
- Uses multiple decoding strategies to accurately read words in text
- Independently reads a significant number of books and text each year. This reading should include both fiction and nonfiction in a variety of genres
- Reads for a variety of purposes and across content areas
- Uses a variety of skills and strategies to comprehend non-fiction and informational text
- Uses a variety of strategies and skills to comprehend and interpret fiction
- Reads with fluency silently and aloud to support comprehension
- Uses a variety of strategies to develop and expand reading vocabulary

Writing

- Uses an effective writing process
- Uses knowledge of purpose, audience, format and medium in developing written communication
- Applies writing skills and strategies to communicate effectively in a variety of genres with various audiences
- Uses writing as a tool for learning
- Engages in the information literacy process: accesses, evaluates, and communicates information and ideas
- Is able to write on demand
- Adheres to conventions generally established in spelling, punctuation, grammar, usage, syntax and style
- Incorporates technology as a tool to enhance writing

Speaking

- Considers audience and variables in the speaking situation
- Produces a coherent message
- Participates in a variety of communication situations
- Uses appropriate content and conventions for purpose, audience, occasion, and context
- Demonstrates use of presentation skills to communicate
- Participates appropriately in one-on-one situations and group settings
- Recognizes the role of evaluation in oral communication
- Recognizes the role of response in oral communication

Listening

- Listens for information and understanding
- Listens for interpretation, analysis, and evaluation
- Listens to establish, maintain and enhance relationships

Viewing

- Demonstrates an awareness of the effects of visual media on society and culture
- Uses a range of strategies to interpret visual media
- Applies a variety of criteria to evaluate informational media
- Understands how literary forms can be represented in visual narratives

Intermediate Elementary Grades**Reading**

- Uses multiple decoding strategies to accurately read words in text
- Independently reads a significant number of books and text each year. This reading should include both fiction and nonfiction in a variety of genres
- Reads for a variety of purposes and across content areas
- Uses a variety of skills and strategies to comprehend non-fiction and informational text
- Uses a variety of strategies and skills to comprehend and interpret fiction
- Reads with fluency silently and aloud to support comprehension
- Uses a variety of strategies to develop and expand reading vocabulary

Writing

- Uses an effective writing process
- Uses knowledge of purpose, audience, format, and medium in developing written communication
- Applies writing skills and strategies to communicate effectively in a variety of genres with various audiences
- Uses writing as a tool for learning
- Engages in the information literacy process: accesses, evaluates, and communicates information and ideas
- Is able to write on demand
- Adheres to conventions generally established in spelling, punctuation, grammar, usage, syntax, and style
- Incorporates technology as a tool to enhance writing

Speaking

- Considers audience and variables in the speaking situation
- Produces a coherent message
- Participates in a variety of communication situations
- Uses appropriate content and conventions for purpose, audience, occasion, and context
- Demonstrates use of presentation skills to communicate
- Participates appropriately in one-on-one situations and group settings
- Recognizes the role of evaluation in oral communication
- Recognizes the role of response in oral communication

Listening

- Listens for information and understanding
- Listens for interpretation, analysis, and evaluation
- Listens to establish, maintain and enhance relationships

Viewing

- Analyzes the effects of visual media on society and culture
- Uses a range of strategies to interpret visual media
- Applies a variety of criteria to evaluate informational media
- Understands how literary forms can be represented in visual narratives

Middle School Level

Reading

- Independently reads a significant number of books and text each year. This reading should include both fiction and nonfiction in a variety of genres
- Reads for a variety of purposes and across content areas
- Uses a variety of skills and strategies to comprehend non-fiction and informational text
- Uses a variety of strategies and skills to comprehend and interpret fiction
- Reads with fluency silently and aloud to support comprehension
- Uses a variety of strategies to develop and expand reading vocabulary

Writing

- Uses an effective writing process
- Uses knowledge of purpose, audience, format, and medium in developing written communication
- Applies writing skills and strategies to communicate effectively in a variety of genres with various audiences
- Uses writing as a tool for learning
- Engages in the information literacy process: accesses, evaluates, and communicates information and ideas
- Is able to write on demand
- Adheres to conventions generally established in spelling, punctuation, grammar, usage, syntax, and style
- Incorporates technology as a tool to enhance writing

Speaking

- Considers audience and variables in the speaking situation
- Produces a coherent message
- Participates in a variety of communication situations
- Uses appropriate content and conventions for purpose, audience, occasion, and context
- Demonstrates use of presentation skill to communicate
- Participates appropriately in one-on-one situations and group settings
- Recognizes the role of evaluation in oral communication
- Recognizes the role of response in oral communication

Listening

- Listens for information and understanding
- Listens for interpretation, analysis, and evaluation
- Listens to establish, maintain and enhance relationships

Viewing

- Analyzes the effects of visual media on society and culture
- Uses a range of strategies to interpret visual media
- Applies a variety of criteria to evaluate informational media
- Understands how literary forms can be represented in visual narratives

High School Level**Reading**

- Independently reads a significant number of books and texts each year. This reading should include both fiction and nonfiction in a variety of genres.
- Reads for a variety of purposes and across content areas.
- Uses a variety of skills and strategies to comprehend complex non-fiction and informational text.
- Uses a variety of strategies and skills to comprehend and interpret complex literature.
- Reads with fluency silently and aloud to support comprehension.
- Uses a variety of strategies to understand unfamiliar vocabulary found in narrative text, technical reading, and literary text.

Writing

- Uses an effective writing process.
- Uses knowledge of purpose, audience, format, and medium in developing written communication.
- Applies writing skills and strategies to effectively communicate in a variety of genres with various audiences.
- Uses writing as a tool for learning.
- Engages in the information literacy process: accesses, evaluates, and communicates information and ideas.
- Is able to write on demand.
- Adheres to conventions generally established in spelling, punctuation, grammar, usage, syntax, and style.
- Incorporates technology as a tool to enhance writing.

Speaking

- Considers audience and variables in the speaking situation.
- Produces a coherent message.
- Participates in a variety of communication situations.
- Uses appropriate content and conventions for purpose, audience, occasion, and context.
- Demonstrates control of delivery skills.
- Participates appropriately in one-on-one situations and group settings.
- Recognizes the role of evaluation in oral communication.
- Recognizes the role of response in oral communication.

Listening

- Listens for information and understanding.
- Listens for interpretation, analysis, and evaluation.
- Listens to establish, maintain, and enhance relationships.

Viewing

- Analyzes the effects of visual media on society and culture.
- Uses a range of strategies to interpret visual media.
- Applies a variety of criteria to evaluate informational media.
- Understands how literary forms can be represented in visual narratives.

Mathematics Introduction

Recent results of national and international tests show that the United States is facing a crisis in mathematics education. American high school students score near the bottom on the international TIMSS and PISA tests, while students in elementary and middle school perform only somewhat better. A common criticism of the U.S. mathematics curriculum is that it is “a mile wide and an inch deep,” trying to cover too many topics in not enough depth. All Iowa students must be better prepared in mathematics to successfully compete in the technology-rich, information-dense, global society. To achieve this we must redesign our mathematics curriculum so that it is focused on providing deep understanding of important mathematics.

In this document we identify the essential characteristics, skills, and content of the world-class mathematics curriculum that Iowa needs. This Iowa Core Curriculum for school mathematics is based on recommendations from the National Council of Teachers of Mathematics (*Principles and Standards for School Mathematics*, 2000, and *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics*, 2006), five years of experience with Iowa’s Every Student Counts mathematics initiative (ESC), and best practices identified from reviews of research conducted by the National Research Council (2001), the International Bureau of Education (Grouws and Cebulla, 2000), the National Council of Teachers of Mathematics (Kilpatrick, 2003), the federal What Works Clearinghouse, and Iowa’s Mathematics Content Network research review project.

In addition, the essential skills and content recommended in this Iowa Core Curriculum document have been informed by a careful review of many background resources, including the *Mathematics Framework for the National Assessment of Educational Progress* (NAEP, 2005 and 2007), *Guidelines for Assessment and Instruction in Statistics Education* (GAISE Report, American Statistical Association, 2005), mathematics standards recommended by Achieve (2007), mathematics standards recommended by the College Board (2007), ACT college readiness standards (2007), the mathematics curricula of Japan and Singapore, the National Center for the Study of Mathematics Curricula,

mathematics standards in other states, and recommendations from the Iowa Core Curriculum Project Lead Team. Additional resources consulted while developing this document are included in the Bibliography.

In order to provide effective guidance and technical assistance for Iowa’s schools, this document has drawn from the above resources to identify the essential skills, content, and characteristics of a world-class school mathematics curriculum.

Essential Characteristics of a World-Class Curriculum in Mathematics

A world-class mathematics curriculum should be built around and focused on:

- Teaching for Understanding
- Problem-Based Instructional Tasks
- Distributed Practice that is Meaningful and Purposeful
- Mathematical Modeling (secondary school emphasis)
- Deep Conceptual and Procedural Knowledge
- Rigor and Relevance
- Effective Use of Technology
- Connected and Coherent Content

Teaching for Understanding

First and foremost, *teaching mathematics for understanding is the basis of the world-class core curriculum in mathematics that all Iowa students deserve. We must shift from a paradigm of “memorize and practice” to one of “understand and apply.”*

Teaching for understanding involves:

- Developing deep conceptual and procedural knowledge of mathematics (See description below.)
- Posing problem-based instructional tasks (See description below.)
- Engaging students in the tasks and providing guidance and support as they develop their own representations and solution strategies
- Promoting discourse among students to share their solution strategies and justify their reasoning
- Summarizing the mathematics and highlighting effective representations and strategies
- Extending students’ thinking by challenging them to apply their knowledge in new situations, especially in real-world settings
- Listening to students and basing instructional decisions on their understanding

Problem-Based Instructional Tasks

Problem-based instructional tasks are at the heart of teaching for understanding. A world-class mathematics curriculum should be built around problem-based instructional tasks focused on important mathematics.

Problem-based instructional tasks:

- Help students develop a deep understanding of important mathematics
- Emphasize connections, especially to the real world
- Are accessible yet challenging to all
- Can be solved in several ways
- Encourage student engagement and communication

- Encourage the use of connected multiple representations
- Encourage appropriate use of intellectual, physical, and technological tools

Distributed Practice that is Meaningful and Purposeful

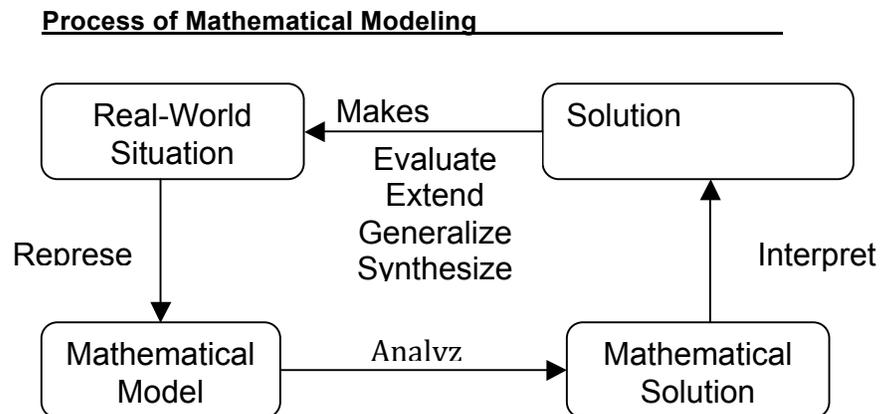
Practice is essential to learn mathematics. However, to be effective in raising student achievement, practice must be meaningful, purposeful, and distributed.

Meaningful Purposeful Distributed Practice:

- Meaningful: Builds on and extends understanding
- Purposeful: Links to curriculum goals and targets an identified need based on multiple data sources
- Distributed: Consists of short periods of systematic practice distributed over a long period of time

Mathematical Modeling (secondary school emphasis)

Mathematical modeling is the process of applying mathematics to solve real-world problems. As such, it is an essential characteristic of a world-class mathematics curriculum. The diagram below summarizes the process of mathematical modeling.



Deep Conceptual and Procedural Knowledge

The goal of a world-class curriculum in mathematics is for all students to develop a deep understanding of important mathematics, which can be applied flexibly and powerfully to solve problems. An ongoing debate in mathematics education revolves around conceptual knowledge (knowledge of mathematical concepts such as function and rate of change) versus procedural knowledge (knowledge of mathematical procedures such as factoring and equation solving). In particular, questions persist about how to teach procedures, when to teach them, how much

time to spend teaching them, and the relation of procedural knowledge to conceptual knowledge.

A common view is that conceptual knowledge is deep knowledge and procedural knowledge is superficial. However, recent research (e.g., Star, 2005) suggests that this view confusingly combines type of knowledge with quality of knowledge. Separating out these two dimensions yields the following table, where XX indicates the goal of deep knowledge for both procedures and concepts.

Type and Quality of Knowledge

	Knowledge of Concepts	Knowledge of Procedures
Superficial Knowledge		
Deep Knowledge	XX	XX

Deep-level knowledge is characterized by comprehension, abstraction, flexibility, critical judgment, and evaluation. It is structured in memory so that it is maximally useful for performance of tasks. This is in contrast to superficial knowledge, which is rote or at best inflexible knowledge.

The debates about conceptual knowledge versus procedural knowledge and about deep versus superficial knowledge are in fact based on false dichotomies. Students must develop deep knowledge of both concepts and procedures. Furthermore, concepts and procedures should be connected.

“As students develop a view of mathematics as a connected and integrated whole, they will have less of a tendency to view mathematical skills and concepts separately. If conceptual understandings are linked to procedures, students will not perceive mathematics as an arbitrary set of rules. This integration of procedures and concepts should be central in school mathematics” (NCTM, 2000, p. 65).

In addition to procedures and concepts, a typical third goal of mathematics instruction is problem solving. One often sees mathematics curricula and assessments discussed and organized in terms of skills, concepts, and problem

solving. The prevalent view is that each of these three tends to be taught in a specific way, as summarized in the left-hand column of the following table. However, in a world-class mathematics curriculum, practice is not just for skills, understanding is not just for concepts, and problem solving is not just for developing the ability of solving problems, as shown in the right-hand column of the table.

	World-Class Mathematics
--	--------------------------------

Prevalent Fragmented View of the Mathematics Curriculum		Curriculum
What to teach:	How to teach and learn:	What to teach: <ul style="list-style-type: none"> • Concepts, Skills, and Problem Solving How to teach: <ul style="list-style-type: none"> • Teach all three for understanding • Problem-based instructional tasks for all three • Meaningful purposeful distributed practice for all three Result: <ul style="list-style-type: none"> • Deep conceptual knowledge • Deep procedural knowledge • Powerful problem solving ability • Increased student achievement in mathematics • Mathematically empowered citizens
Procedures, Skills, Facts	Memorize and Practice	
Concepts	Understand and Apply	
Problem Solving	Heuristics and Solving Problems	

Effective Use of Technology

Technology is an integral part of contemporary life, and as such should be an integral part of mathematics education. Technological tools, such as graphing calculators, computers, and the Internet, should be used to enhance teaching and learning. As stated in NCTM's *Principles and Standards*:

When technological tools are available, students can focus on decision making, reflection, reasoning, and problem solving. Students can learn more mathematics more deeply with the appropriate use of technology (Dunham and Dick 1994; Sheets 1993; Boers-van Oosterum 1990; Rojano 1996; Groves 1994). ...

Technology enhances mathematics learning – Students' engagement with, and ownership of, abstract mathematical ideas can be fostered through technology. Students can examine more examples or representational forms than are feasible by hand, so they can make and explore conjectures easily ... thus allowing more time for conceptualizing and modeling.

Technology supports effective mathematics teaching – The effective use of technology in the mathematics classroom depends on the teacher. Technology is not a panacea. As with any teaching tool, it can be used well or poorly. Teachers should use technology to enhance their students' learning opportunities by selecting or creating mathematical tasks that take advantage of what technology can do efficiently and well—graphing, visualizing, and computing.

Technology influences what mathematics is taught – Technology not

only influences how mathematics is taught and learned but also affects what is taught and when a topic appears in the curriculum. With technology at hand, young children can explore and solve problems involving large numbers, or they can investigate characteristics of shapes using dynamic geometry software. Elementary school students can organize and analyze large sets of data. Middle-grades students can study linear relationships and the ideas of slope and uniform change with computer representations and by performing physical experiments with calculator-based-laboratory systems. High school students can use simulations to study sample distributions, and they can work with computer algebra systems that efficiently perform most of the symbolic manipulation that was the focus of traditional high school mathematics programs. The study of algebra need not be limited to simple situations in which symbolic manipulation is relatively straightforward. Using technological tools, students can reason about more-general issues, such as parameter changes, and they can model and solve complex problems that were heretofore inaccessible to them. Technology also blurs some of the artificial separations among topics in algebra, geometry, and data analysis by allowing students to use ideas from one area of mathematics to better understand another area of mathematics. Technology can help teachers connect the development of skills and procedures to the more general development of mathematical understanding. As some skills that were once considered essential are rendered less necessary by technological tools, students can be asked to work at higher levels of generalization or abstraction. (NCTM, 2000, pp. 24-26)

Rigor and Relevance

A world-class school mathematics curriculum should be rigorous and relevant. These terms, while open to a variety of interpretations, are used in this document with reference to their meaning as given by Daggett (2005). It is insufficient to teach students how to do things by rote; now schools must teach people how to do things with deeper levels of understanding. Daggett recommends levels of cognitive knowledge [rigor] applied to real-world situations [relevance], that is, academic rigor applied in open-ended and unpredictable ways. Daggett advises educators to use the Rigor/Relevance Framework to move beyond the *what of curriculum* to the *how of instruction*.

Connected and Coherent Content

“Mathematics comprises different topical strands, such as algebra and geometry, but the strands are highly interconnected. The interconnections should be displayed prominently in the curriculum A coherent curriculum effectively organizes and integrates important mathematical ideas so that students can see how the ideas build on, or connect with other ideas thus enabling them to

develop new understandings and skills” (NCTM, 2000, Curriculum Principle, p. 15). The school mathematics curriculum, in kindergarten through grade 12, should be connected and coherent.

The United States is virtually the only country in the world in which the high school mathematics curriculum is generally not connected across strands. In particular, the countries that consistently outperform the U.S. on international mathematics achievement tests, including those countries often looked to for solutions such as Singapore and Japan, have a connected high school mathematics curriculum.

What is a connected mathematics curriculum? One can consider the content to be connected and the method of connecting the content. With respect to the content that is connected, the strands of mathematics (such as algebra, geometry, and statistics) might be connected or different disciplines (such as mathematics, science, and social studies) might be connected. Concerning methods of connecting the content, connections might be made through use of thematic units, whereby a particular theme or application is the organizing principle for the unit and targeted mathematics is developed to pursue that theme or application; or connections could be made through use of big-idea strand-dominant units, whereby a big mathematical idea, typically from a specific strand, is the main organizing principle for the unit and a variety of contexts and mathematical connections are utilized to help develop that big idea.

The curriculum content connection prevalent throughout the world is across the strands of mathematics, with courses typically consisting of several connected blocks each focused on a particular mathematical strand. Thus, *mathematics* courses are taught, not separate courses in algebra, geometry, advanced algebra, trigonometry, etc. According to Burkhardt (2001), “Nowhere else in the world would people contemplate the idea of a year of algebra, a year of geometry, another year of algebra, and so on.” The advantages of connected mathematics courses are that “they build essential connections, help make mathematics more usable, avoid long gaps in learning, allow a balanced curriculum, and support equity. I know of no comparable disadvantages, provided that the ‘chunks’ of learning are substantial and coherent.”

As stated in the NCTM Connections Standard, “Mathematics is not a collection of separate strands or standards, even though it is often partitioned and presented in this manner. Rather, mathematics is an integrated field of study. ... When students can connect mathematical ideas, their understanding is deeper and more lasting. ...” (NCTM, 2000, p. 64).

“In a coherent curriculum, mathematical ideas are linked to and build on one another so that students’ understanding and knowledge deepens and their ability to apply mathematics expands” (NCTM, 2000, Curriculum Principle, p. 15).

Thus, the value of a connected and coherent curriculum is that students gain deeper understanding of mathematics and greater ability to apply mathematics. The essential content and skills specified in the Iowa Core Curriculum can be taught in integrated or non-integrated courses, and there is no requirement to restructure schools or adopt any specific materials. It is essential that, whatever courses or materials are chosen, the mathematics content should be connected and coherent.

Essential Skills in a World-Class Curriculum in Mathematics

Students need powerful skills to be successful in the globally competitive workforce of the 21st century. Business and industry demand workers who can solve problems, work in teams, and are able to apply learning to new and changing situations, especially as workers change jobs and careers many times in their lifetimes. Therefore, students must acquire powerful, flexible, and widely-applicable mathematical skills by the time they graduate from high school. Many such skills have been discussed in surveys of businesses (e.g., SCANS 1991, NCEE 2006) and in the NCTM Process Standards (NCTM 2000). The skills identified here are taken substantively from the NCTM Process Standards.

Essential Skills in a World-Class Mathematics Curriculum

- Problem Solving
- Communication
- Reasoning and Proof
- Ability to Recognize, Make, and Apply Connections
- Ability to Construct and Apply Multiple Connected Representations

Problem Solving

All students should be able to:

- Build new mathematical knowledge through problem solving
- Solve problems that arise in mathematics and in other contexts
- Apply and adapt a variety of appropriate strategies to solve problems
- Monitor and reflect on the process of mathematical problem solving

“Problem solving means engaging in a task for which the solution method is not known in advance. In order to find a solution, students must draw on their knowledge, and through this process, they will often develop new mathematical understandings. Solving problems is not only a goal of learning mathematics but also a major means of doing so. Students should have frequent opportunities to formulate, grapple with, and solve complex problems that require a significant amount of effort and should then be encouraged to reflect on their thinking. By learning problem solving in mathematics, students should acquire ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations that will serve them well outside the mathematics classroom. In

everyday life and in the workplace, being a good problem solver can lead to great advantages.” (NCTM, 2000, p. 52)

Implications for Curriculum, Instruction, and Assessment

Problem solving is not just a skill that all students must develop, it is also the means for effectively teaching and learning mathematics. Problem-based instructional tasks should be used in the classroom to teach important mathematics. These tasks should be chosen carefully, addressing real-world problems that allow students to have multiple ways to solve the problems, centered on an important mathematical idea, concept, or skill that is part of a course of study. These tasks should encourage the connection across curricular strands of mathematics. Teachers should choose tasks that require a high level of cognitive demand to promote the development of a deep knowledge of mathematics. Assessments designed to check for understanding should allow for problem solving to be demonstrated. Assessments should focus on the process of solving the problems as well as on correct solutions. (Adapted from *Teaching Mathematics through Problem Solving*, Schoen, NCTM, 2003)

“Problem solving is an integral part of all mathematics learning, and so it should not be an isolated part of the mathematics program. Problem solving in mathematics should involve all [mathematical strands]. The contexts of the problems can vary from familiar experiences involving students’ lives or the school day to applications involving the sciences or the world of work. Good problems will integrate multiple topics and will involve significant mathematics.” (NCTM, 2000, p. 52)

Communication (Reading, Writing, Speaking, Listening, Viewing)

All students should be able to:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

Changes in the workplace increasingly demand teamwork, collaboration, and communication. To be prepared for the future, students must be able to communicate mathematical ideas effectively. As students interact with their classmates, teachers, and others, opportunities arise for exchanging and reflecting on ideas; hence, communication is a fundamental element of mathematics learning. Listening to others’ explanations gives students opportunities to develop their own understandings. Students should be able to formulate ideas to share information or arguments to convince others. As students develop clearer and more-coherent communication (using verbal explanations and appropriate mathematical notation and representations), they will become better mathematical thinkers. (Adapted from NCTM, 2000)

Implications for Curriculum, Instruction, and Assessment

Communication should be addressed throughout curriculum, instruction and assessment. The curriculum materials used in a classroom should reflect this emphasis on communication by providing lessons that promote student-to-student, student-to-teacher, and teacher-to-student communication. Instructional practices should provide opportunities for students to communicate with each other as they study mathematics in the classroom. Teachers should act as facilitators for learning, encouraging student discourse. In doing this, students should be encouraged to explain their thinking and listen to each other as they solve problems.

“Students who have opportunities, encouragement, and support for speaking, writing, reading, and listening in mathematics classes reap dual benefits: they communicate to learn mathematics, and they learn to communicate mathematically. ... Students need to work with mathematical tasks that are worthwhile topics of discussion. Procedural tasks for which students are expected to have well-developed algorithmic approaches are usually not good candidates for such discourse. Interesting problems that ‘go somewhere’ mathematically can often be catalysts for rich conversations.” (NCTM, 2000, p. 60)

The students’ ability to communicate is vital to assessing their mathematical understanding. Students’ understanding should be assessed through the use of good questions that promote the need for communication among students. Assessments in the mathematics classroom should include open-ended questions as well as peer and self-assessment. Assessments should ask students to describe and explain mathematical concepts and methods in multiple ways (with multiple representations) to demonstrate deep understanding.

Reasoning and Proof

All students should be able to:

- Reason in a wide range of mathematical and applied settings
- Recognize reasoning and proof as fundamental aspects of mathematics
- Make and investigate mathematical conjectures
- Develop and evaluate mathematical arguments and proof
- Select and use various types of reasoning and methods of proof

“Being able to reason is essential to understanding mathematics. By developing ideas, exploring phenomena, justifying results, and using mathematical conjectures in all content areas and—with different expectations of sophistication—at all grade levels, students should see and expect that mathematics makes sense. Building on the considerable reasoning skills that children bring to school, teachers can help students learn what mathematical reasoning entails. By the end of secondary school, students should be able to understand and produce mathematical proofs—arguments consisting of logically

rigorous deductions of conclusions from hypotheses—and should appreciate the value of such arguments.” (NCTM, 2000, p. 56)

Implications for Curriculum, Instruction, and Assessment

Reasoning and proof should be addressed throughout curriculum, instruction, and assessment. These skills should be taught as an integral part of classroom instruction in all areas of mathematics. As the context for reasoning and proof, teachers should choose problems rich in mathematical content and accessible and challenging to all students. Students build confidence in their abilities to develop and defend their own arguments as they solve problems in a classroom environment that supports questioning, discussion, and listening. In such a supportive, inquiry-based classroom environment students will use their mathematical knowledge to make conjectures about problems. Students will analyze various approaches to investigate their conjectures. They will develop a carefully reasoned mathematical argument to support their conclusion. This justification of their conjecture will be communicated through interactions with classmates and teacher and validated against conventional arguments.

“Reasoning and proof cannot simply be taught in a single unit on logic, for example, or by “doing proofs” in geometry. Proof is a very difficult area for undergraduate mathematics students. Perhaps students at the postsecondary level find proof so difficult because their only experience in writing proofs has been in a high school geometry course, so they have a limited perspective (Moore 1994). Reasoning and proof should be a consistent part of students’ mathematical experience in prekindergarten through grade 12. Reasoning mathematically is a habit of mind, and like all habits, it must be developed through consistent use in many contexts.” (NCTM, 2000, p. 56)

Connections

All students should be able to:

- Recognize and use connections among mathematical ideas
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics

When students are able to see the connections across different mathematical content areas, they develop a view of mathematics as an integrated whole. As students build on their previous mathematical understandings while learning new concepts, students become increasingly aware of the connections among various

mathematical topics. This focus on connections while learning mathematics develops students’ ability to recognize, make, and apply connections more generally. (Adapted from NCTM, 2000)

Implications for Curriculum, Instruction, and Assessment

“As the Learning Principle [in NCTM’s *Principles and Standards*] emphasizes, understanding involves making connections” (NCTM, 2000, p. 64). A connected and coherent mathematics curriculum helps students make connections across the strands of mathematics. Problem-based instructional tasks provide connections to other disciplines and to the real world. Instruction should emphasize important mathematics across and within the disciplines. Questions should be posed that encourage students to make connections, including connections to their previous mathematical knowledge.

Representation

All students should be able to:

- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems
- Use representations to model and interpret physical, social, and mathematical phenomena

“The ways in which mathematical ideas are represented is fundamental to how people can understand and use those ideas. When students gain access to mathematical representations and the ideas they represent, they have a set of tools that significantly expand their capacity to think mathematically” (NCTM, 2000, p. 67). Students should be able to choose appropriate representations in order to gain particular insights or achieve particular ends. Students should understand that different representations represent different ways of thinking about and manipulating mathematical objects. An object can be better understood when viewed through multiple lenses. As students encounter new representations for mathematical concepts, they need to be able to convert flexibly among those representations. (Adapted from NCTM, 2000)

Implications for Curriculum, Instruction, and Assessment

Teachers should introduce students to multiple connected mathematical representations and help them use those representations effectively. They should highlight ways in which different representations can convey different information and emphasize the importance of selecting representations suited to the particular mathematical tasks at hand. Assessments should allow for students to have choices when representing problems and solutions. Students should be encouraged to evaluate which representation is best to use when solving a problem or investigating a mathematical idea. (Adapted from NCTM, 2000)

“Representations should be treated as essential elements in supporting students’ understanding of mathematical concepts and relationships; in communicating mathematical approaches, arguments, and understandings to one’s self and to others; in recognizing connections among related mathematical concepts; and in

applying mathematics to realistic problem situations through modeling. New forms of representation associated with electronic technology create a need for even greater instructional attention to representation.” (NCTM, 2000, p. 67)

Essential Content in a World-Class Curriculum in Mathematics

All students should acquire a deep and powerful understanding of mathematics. But which areas and topics of mathematics should be included in the school curriculum? In order to provide effective guidance to Iowa schools, this document identifies essential mathematical strands and essential concepts within those strands that all students should study in specified grade spans and in total by the end of high school.

This is the essential content needed by all students to keep all their options open for college and the world of work. Those students intending mathematics-based majors in college should take additional mathematics in high school (not specified here). The recommended content includes *legacy content* and *future content* (Prensky, 2001, as described in the Charge for the Model Core Curriculum Project).

<p>Essential Mathematical Strands in the Iowa Core Curriculum Kindergarten – Grade 8</p> <ul style="list-style-type: none"> • Number and Operations • Algebra • Geometry and Measurement • Data Analysis and Probability 	<p>Essential Mathematical Strands in the Iowa Core Curriculum Grades 9 – 12</p> <ul style="list-style-type: none"> • Algebra • Geometry • Statistics and Probability • Quantitative Literacy <p>(Note: Discrete Mathematics* topics are integrated throughout the above strands.)</p>
---	--

The most telling criticism of the U.S. mathematics curriculum is that it is “a mile wide and an inch deep.” We cannot continue to teach too many topics in too little depth. Long lists of objectives are symptomatic of and serve to exacerbate this problem. At the same time, in order to keep doors open for students and prepare them for the rapidly-changing world they will face as adults, we must provide a rich curriculum.

The need and goal of mathematics education is deep understanding of important mathematics. Thus, this document identifies essential concepts in four essential strands.



Characteristics of Essential Concepts:

- Important mathematics
- Mathematics needed to keep all options open for all students and prepare them for college and the modern world of work
- A foundation for future learning of mathematics
- A focus for curriculum design and instruction
- More than just items in a laundry list of objectives
- Consistent with professional recommendations for mathematics standards
- Consistent with professional experience in mathematics curriculum development and instruction

In addition to an emphasis on essential concepts in each strand, it is also important to weave together general themes of mathematics. Mathematics has been described as a science of patterns, in particular patterns of number, shape, change, chance, and data (cf. Steen, 1990). These themes need to be woven together throughout the study of the mathematical strands.

The topics identified in this document do not all require the same amount of time in the curriculum. For example, at the high school level, the topics of vertex-edge graphs or social decision making may take just a couple weeks or days in the entire high school curriculum, while other topics such as equations and inequalities or geometric properties and relationships will take much longer.

“Discrete mathematics is an important branch of contemporary mathematics that is widely used in business and industry. ... Discrete mathematics is often described by listing the topics it includes, such as vertex-edge graphs, systematic counting, iteration and recursion, matrices, voting methods, and fair division. ... Three key topics of discrete mathematics that are integrated within [NCTM’s] *Principles and Standards* are combinatorics, iteration and recursion, and vertex-edge graphs. ... Other discrete mathematics topics that may be included in the school curriculum include the mathematics of information processing (e.g., error-correcting codes and cryptography), and the mathematics of democratic and social decision making (e.g., voting methods, apportionment, fair division, and game theory)” (*Navigating through Discrete Mathematics in Grades 6–12*, Hart, Kenney, DeBellis, and Rosenstein, NCTM, 2008).

Primary Elementary Grades**Number and Operations**

- Count, represent, read, compare, order and conserve whole numbers
- Develop understandings of addition and subtraction and strategies for basic addition facts and related subtraction facts
- Express numbers as equivalent representations to fluently compose and decompose numbers (putting together and taking apart)
- Develop fluency and quick recall of addition facts and related subtraction facts and fluency with multi-digit addition and subtraction
- Estimate the answer to an addition or subtraction problem before computing, and determine whether the computed answer makes sense

- Develop an understanding of whole number relationships, including grouping in tens and ones and apply place-value concepts
- Understand fractional parts are equal shares or equal portions of a whole unit (a unit can be an object or a collection of things)

Algebra

- Recognize, describe, create and extend repeating and growing patterns such as physical, geometric and numeric patterns and translate from one representation to another
- Sort, classify, and order objects by size, number and other properties
- Demonstrate the use of the commutative and associative properties and mathematical reasoning to solve for the unknown quantity in addition and subtraction problems; justify the solution
- Understand equality as meaning “the same as” and use the = symbol appropriately

Geometry

- Recognize and describe shapes and structures in the physical environment
- Compose and decompose geometric shapes, including plane and solid figures to develop a foundation for understanding area, volume, fractions, and proportions
- Identify, name, sort, and describe two- and three- dimensional geometric figures regardless of size or orientation
- Describe and specify space and location with simple relationships and with coordinate systems
- Experience and recognize slides, flips, turns and symmetry to analyze mathematical situations
- Use attributes of geometric figures to solve spatial problems

Measurement

- Identify attributes that are measurable, such as length, weight, time and capacity, and use these attributes to order objects and make direct comparisons
- Estimate, measure and compute measurable attributes while solving problems
- Estimate and measure length using standard (customary and metric) and non-standard units with comprehension

Data Analysis

- Collect, sort, organize, and represent data to ask and answer questions relevant to the K-2 environment
- Compare different representations of the same data using these types of graphs: bar graphs, frequency tables, line plots, and picture graphs
- Use information displayed on graphs to answer questions and make predictions, inferences and generalizations such as likely or unlikely events

Intermediate Elementary Grades

Number and Operations

- Develop an understanding of multiplication and division concepts and strategies for basic multiplication facts and related division facts
- Develop fluency and quick recall of multiplication facts and related division facts and fluency with multi-digit multiplication and division

- Develop the ability to estimate the results of computation with whole numbers, fractions or decimals and be able to judge reasonableness
- Extend place value concepts to represent and compare both whole numbers and decimals
- Use benchmarks to help develop number sense
- Develop an understanding of commonly used fractions, decimals, and percents, including recognizing and generating equivalent representations
- Develop an understanding of and fluency with addition and subtraction of fractions and decimals

Algebra

- Represent and analyze patterns and relationships involving multiplication and division to introduce multiplicative reasoning
- Identify the commutative, associative, and distributive properties and use them to compute with whole numbers
- Understand and apply the idea of a variable as an unknown quantity and express mathematical relationships using equations
- Represent and analyze patterns and functions, using words, tables, and graphs

Geometry and Measurement

- Describe, analyze and classify two-dimensional and three-dimensional shapes
- Explore congruence and similarity
- Predict and describe the results of sliding (translation), flipping (reflection), and turning (rotation) two-dimensional shapes
- Use ordered pairs on a coordinate grid to describe points or paths (first quadrant)
- Use geometric models to solve problems, such as determining perimeter, area, volume, and surface area
- Select and apply appropriate standard (customary and metric) units and tools to measure length, area, volume, weight, time, temperature, and the size of angles
- Select and use benchmarks (1/2 inch, 2 liters, 5 pounds, etc.) to estimate measurements

Data Analysis and Probability

- Represent and analyze data using tallies, pictographs, tables, line plots, bar graphs, circle graphs and line graphs
- Describe the distribution of the data using mean, median, mode or range
- Propose and justify conclusions and predictions based on data
- Predict the probability of simple experiments and test the predictions
- Describe events as likely or unlikely and discuss the degree of likelihood using words like certain, equally likely and impossible

Middle School

Number and Operation

- Understand, apply, and be computationally fluent with multiplication and division of fractions and decimals
- Understand, apply, and be computationally fluent with rational numbers, including negative numbers
- Understand and apply ratio and rate, including percents, and connect ratio and rate to fractions and decimals
- Understand and apply proportional reasoning

- Understand, estimate, and represent real numbers, including common irrational numbers and use of scientific notation

Algebra

- Write, interpret, and use mathematical expressions, find equivalent forms, and relate such symbolic representations to verbal and tabular representations
- Understand and apply proportionality
- Understand, solve, and apply linear equations and inequalities
- Understand and apply linear functions
- Use tables and graphs to analyze systems of linear equations

Geometry and Measurement

- Understand, determine, and apply area of polygons
- Understand and apply similarity, with connections to proportion
- Understand, determine, and apply surface areas and volume of prisms and cylinders and circumference and area of circles
- Analyze two-dimensional space and figures by using distance, angle, coordinates, and transformations
- Visualize, represent, and describe three-dimensional shapes

Data Analysis and Probability

- Understand, interpret, determine, and apply measures of center and graphical representations of data
- Understand and represent simple probabilistic situations
- Use proportions and percentages to analyze data and chance
- Analyze and summarize data sets, including initial analysis of variability
- Understand, compute, and estimate simple probabilities using counting strategies and simulation

High School

Algebra

- Understands, analyzes, represents, and applies functions.
- Understands, analyzes, solves, and applies equations and inequalities.
- Understands, analyzes, transforms, and applies algebraic expressions.
- Understands, analyzes, approximates, and interprets rate of change.
- Understands and applies recursion and iteration*.

**Recursion* and *iteration* are used to represent and solve problems related to sequential change. Sequential change is step-by-step change, such as population change year-by-year. *Recursion* is the method of describing a given step in a sequence in terms of previous steps. *Iteration* is the process of repeating the same procedure or computation over and over again.

Geometry

- Represents and solves geometric problems by specifying locations using coordinates.
- Understands and applies the basic principles of transformational geometry.
- Understands and applies properties and relationships of geometric figures.
- Uses trigonometry based on triangles and circles to solve problems about length and angle measures.
- Uses diagrams consisting of vertices and edges (vertex-edge graphs) to model and solve problems.

Statistics and Probability

- Understands and interprets descriptive statistics.
- Understands and interprets inferential statistics.
- Understands and applies the basic ideas of probability.

Quantitative Literacy

- Understands and applies number operations and properties.
- Understands and applies the basic mathematics of decision making in a democratic society (*social decision making**).
- Understands and applies the basic mathematics of information processing and the Internet (*informatics***).
- Understands and applies the mathematics of systematic counting (*combinatorics***).

*Social decision-making includes the basic mathematics of voting and elections, apportionment, and fair division.

**Definition will be added.

Problem Solving

- Builds new mathematical knowledge through problem solving.
- Applies and adapts a variety of appropriate strategies to solve problems in mathematics and other contexts.
- Monitors and reflects on the process of mathematical problem solving.

Communication (Reading, Writing, Speaking, Listening, Viewing)

- Organizes and consolidates his/her mathematical thinking through communication.

- Communicates his/her mathematical thinking coherently and clearly to peers, teachers, and others.
- Analyzes and evaluates the mathematical thinking and strategies of others.
- Uses the language of mathematics to express mathematical ideas precisely.

Reasoning and Proof

- Recognizes reasoning and proof as fundamental aspects of mathematics.
- Makes and investigates mathematical conjectures.
- Develops and evaluates mathematical arguments and proofs.
- Selects and uses various types of reasoning and methods of proof.

Representation

- Creates and uses representations to organize, record, and communicate mathematical ideas.
- Selects, applies, and translates among mathematical representations to solve problems.
- Uses representations to model and interpret physical, social, and mathematical phenomena.

Connections

- Recognizes and uses connections among mathematical ideas and how they build on one another to produce a coherent whole.
- Recognizes and applies mathematics in contexts outside of mathematics.

Science

The Iowa Science Core Curriculum is a framework of science concepts and skills. This document provides a scaffold upon which each district will develop grade level expectations. The vision is that all Iowa students will have access to this common core and that individual districts will decide how they will extend this core to meet the needs of their students.

The committee used international, national, and state level documents in this process. The final core concepts and skills are drawn from the respected work of the National Research Council's (NRC) National Science Education Standards (NSES). This document is framed upon the four content categories (Science as Inquiry; Physical Science; Earth and Space Science; and Life Science). The remaining categories (Science and Technology; Science in Personal and Social Perspectives; and The History and Nature of Science) address the application of knowledge and should be integrated throughout the content categories.

For this core to become viable, teachers will need to be aware of and effectively use research based, best practice instructional strategies. The Iowa Content Network –

<http://www.iowa.gov/educate/prodev/main.html> scrutinizes research in instruction and learning. This research base provided the impetus for the Every Learner Inquires (ELI) initiative. The purpose of ELI is to establish a learning community among Iowa teachers as they utilize best practices (such as learning cycles) to help students become more scientifically literate. ELI is a state-wide teaching and learning initiative that will improve Iowa students' access to this core of science concepts and skills. These two Department of Education programs should work hand-in-hand to help students attain the scientific literacy necessary for success in the 21st century.

Primary Elementary Grades

Science as Inquiry

- Ask questions about objects, organisms, and events in the environment
- Plan and conduct simple investigations
- Use tools to gather data and extend the senses
- Use mathematics in scientific inquiry
- Use data to construct reasonable explanations
- Communicate investigations and explanations orally, in writing or through drawings
- Follow appropriate safety procedures when conducting investigations

Earth and Space Science

- Apply and understand properties of earth materials
- Apply and understand observable information about daily and seasonal weather conditions
- Apply and understand events around us that have repeating patterns including the seasons of the year, day and night

Life Science

- Apply and understand the characteristics of living things and how living things are both similar to and different from each other and from non-living things
- Apply and understand life cycles of plants and animals
- Apply and understand the basic needs of plants and animals and how they interact with each other and their physical environment
- Apply and understand ways to help take care for the environment
- Apply and understand fundamental human body parts and their functions
- Apply and understand good health habits

Physical Science

- Understand and apply observable and measurable properties of objects
- Understand and apply characteristics of liquids and solids
- Understand and apply the positions and motions of objects

Intermediate Elementary Grades

Science as Inquiry

- Generate questions that can be answered through scientific investigations
- Recognize that scientists perform different kinds of investigations
- Plan and conduct scientific investigations
- Use appropriate tools and techniques to gather, process, and analyze data
- Incorporate mathematics in science inquiries
- Use evidence to develop reasonable explanations
- Communicate scientific procedures and explanations
- Follow appropriate safety procedures when conducting investigations

Earth and Space Science

- Understand and demonstrate knowledge of properties and uses of earth materials
- Understand and demonstrate knowledge of processes and changes on or in the earth's land, oceans, and atmosphere

- Understand and demonstrate knowledge of fossils and the evidence they provide of past life on earth
- Understand and demonstrate knowledge of weather and weather patterns
- Understand and demonstrate knowledge of the properties, movements, and locations of objects in our solar system

Life Science

- Understand and demonstrate knowledge of structures, characteristics, and adaptations of organisms that allow them to function and survive within their habitats
- Understand and demonstrate knowledge of how individual organisms are influenced by internal and external factors
- Understand and demonstrate knowledge of the relationships among living and non-living factors in terrestrial and aquatic ecosystems
- Understand and demonstrate knowledge of environmental stewardship
- Understand and demonstrate knowledge of basic human body systems and how they work together
- Understand and demonstrate knowledge of personal health and wellness issues

Physical Science

- Understand and demonstrate knowledge of how to describe and identify substances based on characteristic properties
- Understand and demonstrate knowledge of states of matter and changes in states of matter
- Understand and demonstrate knowledge of the concept of conservation of mass/matter
- Understand and demonstrate knowledge of the characteristic properties of sound, light, electricity, magnetism, and heat
- Understand and demonstrate knowledge of how forces are related to an object's motion

Middle School

Science as Inquiry

- Generate questions that can be answered through scientific investigations
- Design and conduct different kinds of scientific investigations
- Understand that different kinds of questions suggest different kinds of scientific investigations
- Select and use appropriate tools and techniques to gather, analyze and interpret data
- Incorporate mathematics in scientific inquiry
- Use evidence to develop descriptions, explanations, predictions, and models
- Think critically and logically to make the relationships between evidence and explanations
- Recognize and analyze alternative explanations and predictions
- Communicate and defend procedures and explanations
- Use appropriate safety procedures when conducting investigations

Earth and Space Science

- Understand and demonstrate knowledge of the structure of the earth system and the processes that change the earth and its surface
- Understand and demonstrate knowledge of the water cycle, including consideration of events that impact groundwater quality
- Understand and demonstrate knowledge of our earth's history based on physical evidence
- Understand and demonstrate knowledge of the earth's atmospheric properties and how they influence weather and climate
- Understand and demonstrate knowledge of the components and predictable patterns of our solar system

Life Science

- Understand and demonstrate knowledge of the basic components and functions of cells, tissues, organs, and organ systems
- Understand and demonstrate knowledge of how different organisms pass on traits
- Understand and demonstrate knowledge of the complementary nature of structure and function and the commonalities among diverse organisms
- Understand and demonstrate knowledge of the interdependency of organisms, changes in environmental conditions, and survival of individuals and species
- Understand and demonstrate knowledge of the cycling of matter and energy through ecosystems
- Understand and demonstrate knowledge of the social and personal implications of environmental issues
- Understand and demonstrate knowledge of the functions and interconnections of the major human body systems including the breakdown in structure or function that disease causes

Physical Science

- Understand and demonstrate knowledge of elements, compounds, mixtures, and solutions based on the nature of their physical and chemical properties
- Understand and demonstrate knowledge of physical and chemical changes and their relationship to the conservation of matter and energy
- Understand and demonstrate knowledge of forms of energy and energy transfer
- Understand and demonstrate knowledge of motions and forces

High School

Science as Inquiry

- Identifies questions and concepts that guide scientific investigations.
- Designs and conducts scientific investigations.
- Uses technology and mathematics to improve investigations and communications.
- Formulates and revises scientific explanations and models using logic and evidence.
- Recognizes and analyzes alternative explanations and models.
- Communicates and defends a scientific argument.
- Understands about scientific inquiry.

Earth and Space

- Understands and applies knowledge of energy in the earth system.
- Understands and applies knowledge of Geochemical cycles.
- Understands and applies knowledge of the origin and evolution of the earth system.
- Understands and applies knowledge of the origin and evolution of the universe.

Life Science

- Understands and applies knowledge of the cell.
- Understands and applies knowledge of the molecular basis of heredity.
- Understands and applies knowledge of biological evolution.
- Understands and applies knowledge of the inter-dependence of organisms.
- Understands and applies knowledge of matter, energy, and organization in living systems.
- Understands and applies knowledge of the behavior of organisms.

Physical Science

- Understands and applies knowledge of the structure of atoms.
- Understands and applies knowledge of the structure and properties of matter.
- Understands and applies knowledge of chemical reactions.
- Understands and applies knowledge of motions and forces.
- Understands and applies knowledge of conservation of energy and increase in disorder.
- Understands and applies knowledge of interactions of energy and matter.

Social Studies

Social studies is the integrated study of the social sciences and humanities to promote civic competence. Within the school program, social studies provides coordinated, systematic study drawing upon such disciplines as anthropology, archaeology, economics, geography, history, law, philosophy, political science, psychology, religion, and sociology, as well as appropriate content from the humanities, mathematics, and natural sciences. The primary purpose of social studies is to help young people develop the ability to make informed and reasoned decisions for the public good as citizens of a culturally diverse, democratic society in an interdependent world.

Definition of Social Studies

National Council for the Social Studies (NCSS)

The founders of our country emphasized that the vitality and security of a democracy depends upon the education and willingness of its citizens to participate actively in society. This level of participation requires civic competence. In other words, it is imperative that our future generations gain an understanding of the core concepts of Social Studies. The United States and its democratic system are continually changing which creates varying social circumstances. As a result, citizens need to adapt to such changes in order to sustain vital democratic traditions. Meeting this need is the mission of the social studies.

In social studies, students develop knowledge, skills and dispositions including but not limited to:

- basic knowledge and ways of thinking drawn from many academic disciplines
- expressing ideas in written form
- reading reflectively and critically
- analyzing their own and others' opinions on social issues
- becoming motivated to participate in civic and community life as active and informed citizens

As we work to carry on the ideals of the founders we are compelled to revisit our fundamental beliefs and institutions and to construct new social contexts and relationships. The Iowa Social Studies Core Curriculum reflects the belief that the informed social studies student comprehends and applies to personal and public experiences the core content perspectives of the many academic fields of the social studies. Our entire social experiences, as well as our republic, are established upon the principles of individual citizenship. Therefore, it is necessary that attention be paid to the education of those future citizens.

For that reason, the Iowa Social Studies Core Curriculum has been structured around five core social studies content areas. They are:

- Behavioral Sciences
- Economics
- Geography
- History
- Political Science/Civic Literacy

For each area, knowledge and skills have been identified and defined in terms of detailed understandings that students should be able to apply. It is of key importance that students possess the knowledge and skills associated with the economic, political, and social forces that make up the human systems in which they live. In addition, they must possess the historical knowledge, which created the spatial, temporal and cultural perspectives present in our world. This document is premised upon a rigorous and relevant K-12 social studies program. Engaging students in the pursuit of active informed citizenship will require a broad range of understandings and skills. It will also require an articulated curriculum which connects students to the social world through informed instructional experiences led by teachers who are committed to active civic participation. This document represents a bold step toward a vision of social and civic literacy for all of Iowa's students.

Primary Elementary Grades

Behavioral Sciences

- Understand the changing nature of society.
- Understand all people have individual traits.
- Understand interactions between self and peer group.
- Understand the relationship of the individual to the components of society and culture.

Economics

- Understand the role of scarcity and economic trade-offs and how economic conditions impact people's lives.
- Understand that the basic nature of economics is an exchange of resources.
- Understand how governments throughout the world influence economic behavior.
- Understand people in all parts of the world trade with one another.
- Understand that changes in technology impact individuals and society.
- Understand the universal economic concept of wants and needs.

Geography

- Understand the use of geographic tools to locate and analyze information about people, places and environments.
- Understand how geographic and human characteristics create culture and define regions.
- Understand how human factors and the distribution of resources affect the development of communities and the movement of population.
- Understand how geographic processes and human actions modify the environment affects humans.

History

- Understand people construct knowledge of the past from multiple and various types of sources.
- Understand how and why people create and participate in governance.
- Understand culture and cultural diffusion affects the development and maintenance of societies.
- Understand individuals and groups within a society may promote change or the status quo.
- Understand economic needs and wants affect individual and group decisions.
- Understand relationships between geography and historical events.

- Understand cause and effect relationships and other historical thinking skills in order to interpret events and issues.

Political Science/Civic Literacy

- Understand the basic concepts of government and democracy and that the U.S. Constitution defines the rights and responsibilities of citizens.
- Understand how government affects citizens and how citizens affect government.
- Understand the United States has a role in current world affairs.

Intermediate Elementary Grades

Behavioral Sciences

- Understand the changing nature of society.
- Understand the influences on individual and group behavior and group decision making.
- Understand how personality and socialization impact the individual.
- Understand the process of how humans develop, learn, adapt to the environment, and internalize their culture.
- Understand current social issues to determine how the individual formulates opinions and responds to issues.
- Understand how to evaluate social research and information.

Economics

- Understand the role of scarcity and economic trade-offs and how economic conditions impact people's lives.
- Understand the functions of economic institutions.
- Understand how governments throughout the world influence economic behavior.
- Understand factors that create patterns of interdependence in the world economy.
- Understand that advancing technologies impact the global economy.
- Understand that all economies throughout the world rely upon universal concepts.

Geography

- Understand the use of geographic tools to locate and analyze information about people, places and environments.
- Understand how geographic and human characteristics create culture and define regions.
- Understand how human factors and the distribution of resources affect the development of society and the movement of populations.
- Understand how physical processes and human actions modify the environment and how the environment affects humans.

History

- Understand historical patterns, periods of time, and the relationships among these elements.
- Understand how and why people create, maintain, or change systems of power, authority, and governance.
- Understand the role of culture and cultural diffusion on the development and maintenance of societies.
- Understand the role of individuals and groups within a society as promoters of change or the status quo.

- Understand the effect of economic needs and wants on individual and group decisions.
- Understand the effects of geographic factors on historical events.
- Understand the role of innovation on the development and interaction of societies.
- Understand cause and effect relationships and other historical thinking skills in order to interpret events and issues.

Political Science/Civic Literacy

- Understand the rights and responsibilities of each citizen and demonstrate the value of lifelong civic action.
- Understand how the government established by the Constitution embodies the enduring values and principles of democracy and republicanism.
- Understand the purpose and function of each of each of the three branches of government established by the U.S. Constitution.
- Understand the differences among local, state, and national government.
- Understand the role of the United States in current world affairs.

Middle School

Behavioral Sciences

- Understand the changing nature of society.
- Understand how personality and external social forces impact the individual.
- Understand the influences on individual and group behavior and group decision making.
- Understand the process of how humans develop, learn, adapt to the environment, and internalize their culture.
- Understand current social issues to determine how the individual is able to formulate opinions and respond to those issues.
- Understand how to evaluate social research and information.

Economics

- Understand the role of scarcity and economic trade-offs and how economic conditions impact people's lives.
- Understand the function of economic institutions.
- Understand how governments throughout the world influence economic behavior.
- Understand factors that create patterns of interdependence in the world economy.
- Understand the impact of advancing technologies on the global economy.
- Understand how universal economic concepts present themselves in various types of economies throughout the world.
- Understand the function of common financial instruments.

Geography

- Understand the use of geographic tools to locate and analyze information about people, places and environments.
- Understand how geographic and human characteristics create culture and define regions.
- Understand how human factors and the distribution of resources affect the development of society and the movement of populations.

- Understand how physical processes and human actions modify the environment and how the environment affects humans.

History

- Understand historical patterns, periods of time, and the relationships among these elements.
- Understand how and why people create, maintain, or change systems of power, authority, and governance.
- Understand the role of culture and cultural diffusion on the development and maintenance of societies.
- Understand the role of individuals and groups within a society as promoters of change of the status quo.
- Understand the effect of economic needs and wants on individual and group decisions.
- Understand the effects of geographic factors on historical events.
- Understand the role of innovation on the development and interaction of societies.
- Understand cause and effect relationships and other historical thinking skills in order to interpret events and issues.

Political Science/Civic Literacy

- Understand the rights and responsibilities of each citizen and demonstrate the value of lifelong civic action.
- Understand how the government established by the Constitution embodies the principles of democracy.
- Understand the purpose and function of each of the three branches of government established by the U.S. Constitution.
- Understand the similarities and differences among the complex levels of local, state, and national government.
- Understand strategies for effective political action that impacts local, state, and national government.
- Understand how laws are established at the local, state, and national levels.
- Understand how various political systems throughout the world define the rights and responsibilities of the individual.
- Understand the role of the United States in current world affairs.

High School

Behavioral Sciences

- Understand the historical development of the behavioral sciences and the changing nature of society.
- Understand the influences on individual and group behavior and group decision making.
- Understand the appropriate research procedures and skills of the behavioral scientist.
- Understand current social issues to determine how the individual is able to formulate opinions and responds to those issues.
- Understand how social status, social groups, social change and social institutions influence individual and group behaviors.
- Understand the process of how humans develop, learn, adapt to their environment, and internalize their culture.
- Understand how personality and agents of socialization impact the individual.

Economics

- Understand the function of common financial instruments.
- Understand the role of scarcity and economic trade-offs.
- Understand the functions of economic institutions.
- Understand how governments influence economic behavior.
- Understand how universal economic concepts present themselves in various types of economies.
- Understand the local, state, regional, national and international factors that create patterns of interdependence in the global economy.
- Understand the impact of advancing technologies on the global economy.

Geography

- Understand the use of geographic tools to locate and analyze information about people, places, and environments.
- Understand how physical and human characteristics create and define regions.
- Understand how human factors and the distribution of resources affect the development of society and the movement of populations.
- Understand how physical and human processes shape the earth's surface and major ecosystems.
- Understand how human actions modify the environment and how the environment affects humans.
- Understand how culture affects the interaction of human populations through time and space.
- Understand how cultural factors influence the design of human communities.

History

- Understand historical patterns, periods of time and the relationships among these elements.
- Understand how and why people create, maintain or change systems of power, authority, and governance.
- Understand the role of culture and cultural diffusion on the development and maintenance of societies.
- Understand the role of individuals and groups within a society as promoters of change or the status quo.
- Understand the effect of economic needs and wants on individual and group decisions.
- Understand the effects of geographic factors on historical events.
- Understand the role of innovation on the development and interaction of societies.
- Understand cause and effect relationships and other historical thinking skills in order to interpret events and issues.

Political Science/Civic Literacy

- Understand the rights and responsibilities of each citizen and demonstrate the value of lifelong civic action.
- Understand how the government established by the Constitution embodies the enduring values and principles of democracy and republicanism.
- Understand the purpose and function of each of the three branches of government established by the Constitution.
- Understand the differences among the complex levels of local, state and national government and their inherent, expressed and implied powers.

- Understand strategies for effective political action that impacts local, state and national governance.
- Understand how law and public policy are established at the local, state and national levels.
- Understand how various political systems throughout the world define the rights and responsibilities of the individual.
- Understand the role of the United States in current world affairs.

21st Century Skills

As each Iowa student is provided access to essential concepts and meaningful learning experiences in the core academic content areas, it is imperative that we also look to 21st century skills to build capacity in students so they are prepared to lead productive, satisfying lives. According to Ken Kay, president of the Partnership for 21st Century Skills, the 21st century skills set “is the ticket to economic upward mobility in the new economy” (Gewertz, 2007). Business and industry is providing a very clear message that students need the skills to “work comfortably with people from other cultures, solve problems creatively, write and speak well, think in a multidisciplinary way, and evaluate information critically. And they need to be punctual, dependable, and industrious.” (Gewertz, 2007).

The Framework for 21st Century Learning stated, “We believe schools must move beyond a focus on basic competency in core subjects to promoting understanding of academic content at much higher levels by weaving 21st century interdisciplinary themes into core subjects” (2007). 21st century skills bridge the knowledge, skills, and dispositions of students from the core academic areas to real life application.

“The primary aim of education is not to enable students to do well in school, but to help them do well in the lives they lead outside of the school.”

-Ray McNulty, ICLE

Iowa High School Summit, December 10, 2007

Descriptions of the new global reality are plentiful, and the need for new, 21st century skills in an increasingly complex environment is well documented. In one form or another, authors cite (1) the globalization of economics; (2) the explosion of scientific and technological knowledge; (3) the increasingly international dimensions of the issues we face, i.e. global warming and pandemic diseases; and (4) changing demographic as the major trends that have resulted in a future world much different from the one that many of us faced when we graduated from high school (Friedman, 2005 and Stewart, 2007). The trends are very clear that each Iowa students will need essential 21st century skills to lead satisfying lives in this current reality.

Descriptions of what constitute essential 21st century skills are plentiful as well. In the 2007 session, the Iowa Legislature established the Iowa 21st century framework as:

1. employability skills
2. financial literacy
3. health literacy
4. technology literacy

Within this 21st century skill framework are the common strands of learning and innovation; communication, information, and technology; and, life and career skills. The development of the Iowa 21st century essential concepts and skills was a collaborative process engaging the expertise of p – 16 educators, business, and industry representatives.

Sources used for this work included the 1991 SCANS report, What Work Requires of Schools, and Framework for 21st Century Learning, from the Partnership for 21st Century Skills. The committee surveyed the literature and endeavored to bring together the common elements of these frameworks. The members have outlined the concepts, dispositions and habits of mind believed essential for success in the 21st century.

The reality of building capacity for the 21st century is that we do not know what the work of the future will be like (Darling-Hammond, 2007) or how technology will influence health and financial issues. The challenge is to prepare students to think critically, to engage in mental activity, or habits of mind, that "...use facts to plan, order, and work toward an end; seek meaning or explanations; are self-reflective; and use reason to question claims and make judgments..."(Noddings, 2008). It may be that our task is not only to prepare students to "fit into the future" but to shape it. "...If the complex questions of the future are to be determined... by human beings...making one choice rather than another, we should educate youths - all of them - to join in the conversation about those choices and to influence that future..." (Meier, 2008)

Primary Elementary Grades

Financial Literacy

- Demonstrate the ability to set goals based on wants and needs.
- Identify monetary resources and distribution options for those resources.
- Demonstrate an understanding of the concept of credit.
- Develop awareness that each person has an identity.
- Recognize various ways to save and the reasons individuals decide to save.
- Distinguish between appropriate spending choices.

Health Literacy

- Understand and use basic health concepts to enhance personal, family, and community health.
- Understand and use interactive literacy and social skills to enhance personal, family and community health.
- Recognize critical literacy/thinking skills related to personal, family, and community wellness.
- Identify influences that affect personal health and the health of others.
- Demonstrate behaviors that foster healthy, active lifestyles for individuals and the benefit of society.

Technology Literacy

- Use technology to create projects, identify patterns, and make predictions.
- Use a variety of technology tools and media-rich resources to work collaboratively with others.
- Utilize predetermined digital resources and tools to answer questions or solve problems.
- Use technological resources to investigate given questions or problems.
- Understand and practice appropriate and safe uses of technology.
- Understand basic technology hardware and software and their application.

Employability

- Communicate and work appropriately with others to complete tasks.
- Recognizes different roles and responsibilities and is open to change.
- Learn leadership skills and demonstrate integrity, ethical behavior, and social responsibility.
- Develop initiative and demonstrate self-direction in activities.
- Work productively and are accountable for their actions.

Intermediate Elementary Grades

Financial Literacy

- Create long and short term goals based on prioritization of wants and needs.
- Recognize how one's personal career choice and attitude can impact financial planning decisions.
- Identify the concept of debt and an individual's responsibility for that debt.
- Recognize common risks to one's identity and demonstrate the ability to protect that identity.
- Determine the importance of saving/investing in relation to future needs.
- Recognize that spending choices differ between groups of people and settings.

Health Literacy

- Obtain, interpret, understand and use basic health concepts to enhance personal, family and community health.
- Utilize interactive literacy and social skills to establish personal, family, and community wellness.
- Demonstrate critical literacy/thinking skills related to personal, family, and community wellness.
- Recognize that media and other influences affect personal, family, and community health.
- Demonstrate behaviors that foster healthy, active lifestyles for individuals and the benefit of society.

Technology Literacy

- Use technology resources to create original products, identify patterns and problems, make predictions, and propose solutions.
- Use interactive technologies in a collaborative group to produce digital presentations or products in a curricular area.
- Utilize digital tools and resources to investigate real-world issues, answer questions or solve problems.
- Understand and practice appropriate, legal and safe uses of technology for lifelong learning.
- Understand technology hardware and software system operations and their application.

Employability

- Communicate and work productively with others emphasizing collaboration and cultural awareness to produce quality work.
- Adjust to various roles and responsibilities and understand the need to be flexible to change.
- Practice leadership skills, and demonstrate integrity, ethical behavior and social responsibility in all activities.
- Demonstrate initiative, creativity, self-direction, and entrepreneurial thinking to produce successful outcomes.
- Demonstrate productivity and accountability by producing quality work.

Middle School

Financial Literacy

- Model the process of financial planning based on personal prioritization of wants and needs.
- Create an effective spending plan using informed decision-making skills.
- Recognize appropriate uses of credit and its impact on an individual's financial security.
- Evaluate various risks to personal identity and create a plan for ongoing protection.
- Evaluate possible options for investing as a means to attain one's goals.
- Demonstrate ethical financial decision making skills and assess how these decisions might impact the broader community.

Health Literacy

- Demonstrate functional health literacy skills to obtain, interpret, understand, and use basic concepts to enhance personal, family, and community health.
- Utilize interactive literacy and social skills to establish personal, family, and community health goals.
- Apply critical literacy/thinking skills related to personal, family, and community wellness.
- Employ media literacy skills to analyze media and other influences for effectively manage personal, family, and community health situations.
- Demonstrate behaviors that foster health, active lifestyles for individuals and the benefit of society.

Technology Literacy

- Demonstrate creative thinking in the design and development of innovative technology products and problem solving.
- Collaborate with peers, experts, and others using interactive technology.
- Plan strategies utilizing digital tools to gather, evaluate, and use information.
- Use critical thinking skills to conduct research, solve problems, and make informed decisions using appropriate technological tools and resources.
- Understand the legal and ethical issues of technology as related to individuals, cultures, and societies.
- Understand the underlying structure and application of technology systems.

Employability

- Communicate and work productively with others considering different perspectives, and cultural views to increase the quality of work.
- Adapts and adjusts to various roles and responsibilities in an environment of change.
- Demonstrate leadership, integrity, ethical behavior and social responsibility in all environments,
- Demonstrate initiative, self-direction, creativity, and entrepreneurial thinking while exploring individual talents and skills necessary to be successful.
- Demonstrate productivity and accountability while aspiring to meet high expectations.

High School

Financial Literacy

- Demonstrate financial responsibility and planning skills to achieve financial goals for a lifetime of financial health
- Manage money effectively by developing spending plans and selecting appropriate financial instruments to maintain positive cash flow
- Make informed and responsible decisions about incurring and repaying debt to remain both creditworthy and financially secure
- Evaluate and identify appropriate risk management options, including types of insurance, non-insurance, and identity protection
- Assess the value, features, and planning processes associated with savings, investing, and asset building, and apply this knowledge to achieve long-term financial security with personal and entrepreneurial goals in a global market
- Understand human, cultural, and societal issues related to financial literacy, and practice legal and ethical behavior

Health Literacy

- Demonstrate functional health literacy skills to obtain, interpret, understand and use basic health concepts to enhance personal, family, and community health
- Synthesize interactive literacy and social skills to establish and monitor personal, family and community goals related to all aspects of health
- Apply critical literacy/thinking skills related to personal, family and community wellness
- Use media literacy skills to analyze media and other influences to effectively manage health risk situations and advocate for self and others
- Demonstrate behaviors that foster healthy, active lifestyles for individuals and the benefit of society

Technology Literacy

- Demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology
- Use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others
- Apply digital tools to gather, evaluate, and use information
- Demonstrate critical thinking skills using appropriate tools and resources to plan and conduct research, manage projects, solve problems and make informed decisions
- Understand human, cultural, and societal issues related to technology, and practice legal and ethical behavior
- Demonstrate a sound understanding of technology concepts, systems and operations

Employability

- Communicate and work productively with others, incorporating different perspectives and cross cultural understanding, to increase innovation and the quality of work
- Adapt to various roles and responsibilities and work flexibly in climates of ambiguity and changing priorities

- Demonstrate leadership skills, integrity, ethical behavior, and social responsibility while collaborating to achieve common goals
- Demonstrate initiative and self-direction through high achievement and lifelong learning while exploring the ways individual talents and skills can be used for productive outcomes in personal and professional life
- Demonstrate productivity and accountability by meeting high expectations