Iowa Core – Davenport Schools
Priority Essential Concepts and Skills for Grade 8 Science

We believe that the scientifically literate person is one who is aware that science, mathematics, and technology are interdependent human enterprises with strengths and limitations; understands key concepts and principles of science; is familiar with the natural world and recognizes both its diversity and unity; and uses scientific knowledge and scientific ways of thinking for individual and social purposes.

Science for All Americans, 1990

Introduction

The need for scientific literacy in today's increasingly technological world, for fundamental reforms in how science is taught, and for well-validated models that districts might emulate are by now well-known and documented. Expressions of concern from business leaders, scientists, and educators have led to national, state, and local initiatives. The Iowa Core Curriculum rose from those concerns. It has been a two-decade process in which the Department of Education initiated conversations and produced a body of work that laid the groundwork for this effort. Each of those early efforts led us closer to the design that would produce the clearest picture and become the most useful. This committee used both national and state level documents in this process. The final standards are drawn from the respected work of the National Research Council's (NRC) National Science Education Standards (NSES). The Iowa Core Curriculum is a common set of expectations designed to clarify and raise expectations for all students. It is a tool for Iowa educators to use to assure that essential subject matter is being taught and essential knowledge and skills are being learned.

As the amount of scientific knowledge expands, the need for ALL students to have a deep understanding of essential concepts increases. Technological advances have made information more readily available and decreased the need to memorize vocabulary and formulas. The scientific community agrees that we should teach fewer concepts at greater depth. The Iowa Core Curriculum of essential concepts and abilities in Science is a rich, yet manageable, set that will give each district a comprehensive model to evaluate local curricula. It moves beyond, as stated in the research report, Taking Science to School (National Research Council, The National Academies. Washington, D.C. 2007) "a focus on the dichotomy between either content knowledge or process skills because content and process are inextricably linked in science. Students who are proficient in science:

1. Know, use, and interpret scientific explanations of the natural world;
2. Generate and evaluate scientific evidence and explanations;
3. Understand the nature and development of scientific knowledge; and
4. Participate productively in scientific practices and discourse.

These strands of proficiency represent learning goals for students as well as a broad framework for curriculum design. They address the knowledge and reasoning skills that students must acquire to be proficient in science and, ultimately, able to participate in society as educated citizens."

The Iowa Core Curriculum for Science reflects the belief that ALL students should experience science through a curriculum that is rigorous, relevant, global in its perspective, collaborative in nature, and connected by strong visible links to other areas of study. This document follows the format and content of NSES in which there are eight categories of standards. Four of the categories — Science as Inquiry, Physical Science, Earth and Space Science, and Life Science — are content specific, while the remaining categories — Science and Technology, Science in Personal and Social Perspectives, and the History and Nature of Science — address the application of knowledge. These remaining standards sets call for students to develop abilities to identify and state a problem, design, implement and evaluate a solution, and they complement the abilities developed in the Science as Inquiry Standards. They also help students develop decision-making skills and understand that science reflects its history and is an ongoing, changing enterprise. As such, these standards should be integrated throughout the four content specific categories stated above. These sets include the following at the 9 – 12 level: Science and Technology — abilities of technological design, and understanding about science and technology; Science in Personal and Social Perspectives — personal and community health, population growth, natural resources, environmental quality, natural and human-induced hazards, and science and technology in local, national, and global changes; History and Nature of Science — science as a human endeavor, nature of scientific knowledge, and historical perspectives (see appendix). Science as Inquiry and the

application standards from the NSES are integrated into the knowledge base by design. The content category of Unifying Concepts and Processes complements the other standards. The concepts and procedures in this category provide students with productive and insightful ways of thinking about and integrating basic ideas that explain the natural and designed world (see appendix for details). These concepts and processes include:

- Systems, order, and organization
- Evidence, models, and explanation
- Constancy, change, and measurement
- Evolution and equilibrium
- Form and function

Science is more than a body of knowledge. It is a way of thinking and a way of investigating. Students must have the opportunity to examine the impact science has had, and will continue to have, on the environment and society. These opportunities are the focus of the integrated standards.

The Iowa Core Curriculum for Science emphasizes student inquiry. The depth of understanding required of our students is not possible with lectures, readings, cookbook labs, and plug-and-chug problem solving. Students must be actively investigating: designing experiments, observing, questioning, exploring, making and testing hypotheses, making and comparing predictions, evaluating data, and communicating and defending conclusions. A district's science curriculum cannot align to the Iowa Core Curriculum for Science without including inquiry as a guaranteed and viable, testable component in every science course. The science

instruction should be engaging and relevant for the students. Strong connections between the lessons and the students' daily lives must be made. This core curriculum reflects high standards of science achievement for ALL students and not just those who have traditionally succeeded in science classes.

The challenge is to create an educational system that connects students to the scientific world. The broad range of understandings and skills possessed by students when they enter 9th grade will require a system that is clearly articulated and masterfully implemented from kindergarten through grade 12. Teachers will need support and time to prepare for this challenge. This is a first bold step toward a vision of scientific literacy for all.

Science as Inquiry

Essential Concept and/or Skill: ***Identify and generate questions that can be answered through scientific investigations.***
Students should develop the ability to refine and refocus broad and ill-defined questions. An important aspect of this ability consists of clarifying questions and inquiries and directing them toward objects and phenomena that can be described, explained, or predicted by scientific investigations.

Students should develop the ability to connect their questions with scientific ideas, concepts, and quantitative relationships that guide investigations.

Essential Concept and/or Skill: ***Design and conduct different kinds of scientific investigations.***
Students understand that different kinds of questions suggest different kinds of scientific investigations.

Students should develop general abilities such as making systematic observations, taking accurate measurements, and identifying and controlling variables.

Students should develop the ability to clarify ideas that are influencing and guiding their inquiry, and to understand how those ideas compare with current scientific knowledge.

Students formulate questions, design investigations, execute investigations, interpret data, use evidence to generate explanations, propose alternative explanations, and critique explanations and procedures.

Students use appropriate safety procedures when conducting investigations.

Essential Concept and/or Skill: ***Understand that different kinds of questions suggest different kinds of scientific investigations.***
Some investigations involve observing and describing objects, organisms and events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models.

Essential Concept and/or Skill: ***Select and use appropriate tools and techniques to gather, analyze and interpret data.***
The use of tools and techniques, including computers, will be guided by the questions asked and the investigations students design. Students should be able to access, gather, store, retrieve, and organize data, using computer hardware and software designed for these purposes.

Essential Concept and/or Skill: ***Incorporate mathematics in scientific inquiry.***
Mathematics is used to gather, organize and present data and to construct convincing explanations.

Essential Concept and/or Skill: ***Use evidence to develop descriptions, explanations, predictions, and models.***
Students should base their explanations on observations and they should be able to differentiate between description and explanation.

Developing explanations establishes connections between the content of science and the contexts in which students develop new knowledge.

Models are often used to think about processes that happen too slowly, too quickly, or on too small a scale to observe directly, or are too vast to be changed deliberately, or are potentially dangerous.

Different models can be used to represent the same thing.

Essential Concept and/or Skill: ***Think critically and logically to make the relationships between evidence and explanations.***
Students decide what evidence should be used and develop the ability to account for anomalous data.

Students should be able to review data from an experiment, summarize the data, and form a logical argument between cause and effect relationships.

Students should begin to state some explanations in terms of relationships between two or more variables.

Essential Concept and/or Skill: ***Recognize and analyze alternative explanations and predictions.***
Students should develop the ability to listen to and respect the explanations proposed by other students. They should remain open to and acknowledge different ideas and explanations, be able to accept the skepticism of others, and consider alternative explanations.

Essential Concept and/or Skill: ***Communicate and defend procedures and explanations.***
Students should become competent in communicating experimental methods, describing observations and summarizing the results of investigations. Explanations can be communicated through various methods.

Essential Concept and/or Skill: ***Use appropriate safety procedures when conducting investigations.***

Physical Science

Essential Concept and/or Skill: ***Understand and apply knowledge of:***

- ***elements, compounds, mixtures, and solutions based on the nature of their physical and chemical properties.***
- ***physical and chemical changes and their relationship to the conservation of matter and energy.***

Examples:

- A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.
- Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. Substances often are placed in categories or groups if they react in similar ways; metals is an example of such a group.
- Chemical elements do not break down during normal laboratory reactions involving such treatments as heating, exposure to electric current, or reaction with acids. There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances that we encounter.

Essential Concept and/or Skill: ***Understand and apply knowledge of forms of energy and energy transfer.***

Examples:

- Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.
- Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.
- Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object- emitted by or scattered from it- must enter the eye.
- Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced.
- In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers.
- The sun is a major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches the earth, transferring energy form the sun to the earth. The sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation.

Essential Concept and/or Skill: ***Understand and apply knowledge of motions and forces.***

Examples:

- The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.
- An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.

- If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in speed or direction of an object's motion.