NGSS and Iowa Common Core Connections to:

# Making STEM Connections

Making STEM Connections is a multilevel program that address problem solving and real world application. The newly adopted Next Generation Science Standards bring light to the need for students to engage in critical thinking and engineering practices in addition to academic knowledge. Making STEM Connections works to address many of the Cross Cutting Concepts and Science and Engineering Practices as well as Disciplinary Core Ideas that are brought forth by NGSS for grades K–6.

**Cross Cutting Concepts:**

Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas. — Framework p. 233

1. *Cause and effect: Mechanism and explanation.* Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

2. *Scale, proportion, and quantity.* In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

3. *Systems and system models.* Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

4. *Structure and function.* The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

5. *Stability and change.* For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

**Science and Engineering Practices:**

Standards and performance expectations that are aligned to the framework must take into account that students cannot fully understand scientific and engineering ideas without engaging in the practices of inquiry and the discourses by which such ideas are developed and refined. At the same time, they cannot learn or show competence in practices except in the context of specific content. (NRC Framework, 2012, p. 218)

1. Asking questions (for science) and defining problems (for engineering)

2. Developing and using models

3. Planning and carrying out investigations

4. Analyzing and interpreting data

5. Using mathematics and computational thinking

6. Constructing explanations (for science) and designing solutions (for engineering)

7. Engaging in argument from evidence

8. Obtaining, evaluating, and communicating information

**Engineering Design:**

*We use the term "engineering" in a very broad sense to mean any engagement in a systematic practice of design to achieve solutions to particular human problems. Likewise, we broadly use the term "technology" to include all types of human-made systems and processes—not in the limited sense often used in schools that equates technology with modern computational and communications devices. Technologies result when engineers apply their understanding of the natural world and of human behavior to design ways to satisfy human needs and wants.* (NRC 2012, p. 11-12)

The core idea of engineering design includes three component ideas:

**A. Defining and delimiting engineering problems** involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits.

**B. Designing solutions to engineering problems** begins with generating a number of different possible solutions, then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem.

**C. Optimizing the design solution** involves a process in which solutions are systematically tested and refined and the final design is improved by trading off less important features for those that are more important.

Making STEM Connections promotes 21st Century Skills by providing real tools and learning applications to support academic knowledge. 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).

**Employability Skills:**

The employability essential concepts and skill sets represent universal content. They (1) contribute to outcomes that are valued for individuals and for society; (2) bring benefits in a wide variety of contexts and apply to multiple areas of life; and (3) are of use to all individuals, deemphasizing competencies of use only in a specific trade, occupation or walk of life. (OECD, 2005*).

- Communicate and work productively with others emphasizing collaboration and cultural awareness to produce quality work.
- 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.

**Technology Literacy:**

Although it is important that current technologies be integrated into all teachers’ classroom practices and all students’ experiences, it is also important to understand the broader implications of the transforming influence of technology on society. For example, creativity, innovation and systemic thinking are requirements for success in this environment. Technology is changing the way we think about and do our work. It has changed our relationships with information and given us access to resources, economic and professional, that were unimaginable just a few years ago.

- 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 technology hardware and software system operations and their application.