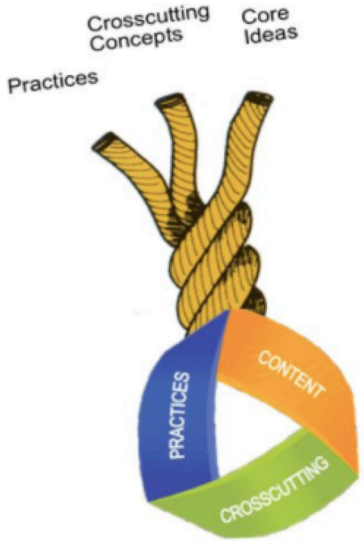
Arizona 3-5 Crosscutting Concept Elements

and

Science and Engineering Practices Elements



3-5 Crosscutting Elements

Patterns – Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

- ☐ Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products.
- ☐ Patterns of change can be used to make predictions.
- ☐ Patterns can be used as evidence to support an explanation.

3-5 Crosscutting Elements

Cause and Effect: Mechanism and Prediction – Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

- ☐ Cause and effect relationships are routinely identified, tested, and used to explain change.
- ☐ Events that occur together with regularity might or might not be a cause and effect relationship.

Scale, Proportion, and Quantity – In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

- ☐ Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods.
- ☐ Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

3-5 Crosscutting Elements

Systems and System Models – A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

- ☐ A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot.
- ☐ A system can be described in terms of its components and their interactions.

3-5 Crosscutting Elements

Energy and Matter: Flows, Cycles, and Conservation – Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

- ☐ Matter is made of particles.
- ☐ Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.
- ☐ Energy can be transferred in various ways and between objects.

3-5 Crosscutting Elements

Structure and Function – The way an object is shaped or structured determines many of its properties and functions.

- ☐ Different materials have different substructures, which can sometimes be observed.
- ☐ Substructures have shapes and parts that serve functions.

Stability and Change – For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

- ☐ Change is measured in terms of differences over time and may occur at different rates.
- ☐ Some systems appear stable, but over long periods of time will eventually change.

3-5 Science & Engineering Practices Elements

Asking Questions and Defining Problems

- ☐ Identify scientific (testable) and non-scientific (non-testable) questions.
- ☐ Ask questions based on careful observations of phenomena and information.
- ☐ Ask questions to clarify ideas or request evidence.
- ☐ Ask questions that relate one variable to another variable.
- ☐ Ask questions to clarify the constraints of solutions to a problem.
- ☐ Use prior knowledge to describe problems that can be solved.
- ☐ Define a simple design problem that can be solved through the development of an object, tool or process and includes several criteria for success and constraints on materials, time, or cost.
- ☐ Formulate questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.

3-5 Science & Engineering Practices Elements

Developing and Using Models

- ☐ Develop and revise models collaboratively to measure and explain frequent and regular events.
- ☐ Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
- ☐ Use simple models to describe or support explanations for phenomena and test cause and effect relationships or interactions concerning the functioning of a natural or designed system.
- ☐ Identify limitations of models.
- ☐ Develop a diagram or simple physical prototype to convey a proposed object, tool or process.
- ☐ Use a simple model to test cause and effect relationships concerning the functioning of a proposed object, tool or process.

3-5 Science & Engineering Practices Elements

Planning and Carrying Out Investigations

- ☐ Design and conduct investigations collaboratively, using fair tests in which variables are controlled and the number of trials considered.
- ☐ Evaluate appropriate methods and tools for collecting data.
- ☐ Make observations and/or measurements, collect appropriate data, and identify patterns that provide evidence for an explanation of a phenomenon or test a design solution.
- ☐ Make measurements of two different models of the same proposed object, tool or process to determine which better meets criteria for success.

3-5 Science & Engineering Practices Elements

Analyzing and Interpreting Data

- ☐ Display data in tables and graphs, using digital tools when feasible, to reveal patterns that indicate relationships.
- ☐ Use data to evaluate claims about cause and effect.
- ☐ Compare data collected by different groups in order to discuss similarities and differences in their findings.
- ☐ Use data to evaluate and refine design solutions.
- ☐ Interpret data to make sense of and explain phenomena, using logical reasoning, mathematics, and/or computation.
- ☐ Analyze data to refine a problem statement or the design of a proposed object, tool or process.

3-5 Science & Engineering Practices Elements

Using Mathematical and Computational Thinking

- ☐ Use mathematical thinking and/or computational outcomes to compare alternative solutions to an engineering problem.
- ☐ Organize simple data sets to reveal patterns that suggest relationships.
- ☐ Describe, measure, estimate, and graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems.
- ☐ Decide if qualitative or quantitative data is best to determine whether a proposed object or tool meets criteria for success.

3-5 Science & Engineering Practices Elements

Constructing Explanations and Designing Solutions

- ☐ Construct explanations of observed quantitative relationships (e.g., the distribution of plants in the back yard).
- ☐ Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or design a solution to a problem.
- ☐ Identify the evidence that supports particular points in an explanation.
- ☐ Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.
- ☐ Apply scientific knowledge to solve design problems.
- ☐ Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the problem.

3-5 Science & Engineering Practices Elements

Engaging in Argument from Evidence

- ☐ Construct and/or support scientific arguments with evidence, data, and/or a model.
- ☐ Compare and refine arguments based on the strengths and weaknesses of the evidence presented.
- ☐ Respectfully provide and receive critiques on scientific arguments with peers by citing relevant evidence and posing specific questions.
- ☐ Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

3-5 Science & Engineering Practices Elements

Obtaining, Evaluating, and Communicating Information

- ☐ Compare and/or combine across complex texts and/or other reliable media to acquire appropriate scientific and/or technical information.
- ☐ Determine the main idea of a scientific text and explain how it is supported by key details; summarize the text.
- ☐ Combine information in written text with that contained in corresponding tables, diagrams, and/or charts.
- ☐ Use multiple sources to generate and communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.
- ☐ Use models to share findings or solutions in oral and/or written presentations, and/or extended discussions.
- ☐ Obtain and combine information from books and/or other reliable media about potential solutions to a specific design problem.