Arizona Science Standards Science and Engineering Practices for K-2 | For use with Arizona Science Standards

Asking Questions and Defining Problems

A science practice is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.

- Ask questions based on observations of the natural and/or designed world.
- Define a simple problem that can be solved through the development of a new or improved object or tool.

Developing and Using Models

A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations.

- Distinguish between a model and the actual object, process, and/or events the model represents.
- Compare models to identify common features and differences.
- Develop and/or use models (i.e., diagrams, drawings, physical replicas, dioramas, dramatizations, or storyboards) that represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed worlds.
- Develop a simple model that represents a proposed object or tool.

Engaging in Argument from Evidence

Reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem in science and engineering.

- Identify arguments that are supported by evidence.
- Listen actively to others' explanations and arguments and ask questions for clarification.
- Make a claim about the effectiveness of an object, tool, or solution that is based on relevant evidence.

Analyzing and Interpreting Data

Scientific investigations produce data that must be analyzed in order to derive meaning. Engineering investigations include analysis of data collected in the tests of designs.

- Use and share pictures, drawings, and/or writings of observations.
- Use observations to describe patterns and/or relationships in the natural and designed worlds in order to answer scientific questions and solve problems. Make measurements of length to quantify data.
- Analyze data from tests of an object or tool to determine if a proposed object or tool functions as intended.

Using Mathematics and Computational Thinking

Mathematics and computation are fundamental tools for representing physical variables and their relationships in both science and engineering,

- Decide when to use qualitative vs. quantitative data.
- Use counting and numbers to identify and describe patterns in the natural and designed worlds.
- Describe, measure, and compare quantitative attributes of different objects and display the data using simple graphs.
- Use quantitative data to compare two alternative solutions to a problem.

Obtaining, Evaluating, and Communicating Information

Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate.

- Read and comprehend grade appropriate texts and media to acquire scientific and/or technical information.
- Critique and/or communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers.
- Record observations, thoughts, and ideas.
- Explain how specific images (e.g., a diagram showing how a machine works) contribute to and clarify a text.
- Obtain information by using various text features (e.g., headings, tables of contents, glossaries, electronic menus, icons).

Constructing Explanations and Designing Solutions

The goal of science is the construction of theories that provide explanatory accounts of the world. The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world.

- Use information from direct or indirect observations to construct explanations.
- Use tools and materials provided to design a device or solution to a specific problem.
- Distinguish between opinions and evidence in one's own explanations.
- Generate and compare multiple solutions to a problem.

The elements are not to be used as a check-off list, but rather a useful tool to help educators identify the specific pieces of knowledge and skill that make up the practice, crosscutting concept, or core idea at that grade-band.

ARIZONA Department of Education

Published 02/24/23

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Planning and Carrying Out Investigations

Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually.

- With guidance, design and conduct investigations in collaboration with peers.
- Design and conduct investigations collaboratively.
- Evaluate different ways of observing and/or measuring an attribute of interest.
- Make direct or indirect observations and/or measurements to collect data, which can be used to make comparisons.
- Identify questions and make predictions based on prior experiences.
- Make direct or indirect observations and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.

Arizona Science Standards Crosscutting Concepts for K-2 | For use with Arizona Science Standards

Patterns

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

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.
  - What do you observe?
  - Is there a pattern?
  - What pattern do you notice?
  - Can you describe the pattern?
  - What predictions are possible based on the pattern?
  - What is the same? What is different?
  - How often does this happen?
  - The pattern I notice is _____.
  - From the pattern _____ I predict that _____ because _____ .

Structure and Function

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

- The shape and stability of structures of natural and designed objects are related to their function(s).
  - How does the shape (or structure) of ... make it work better?
  - What material is best to ...? Why?
  - What is the function of ...?
  - How can this structure be improved?
  - What shape is best to ...?
  - How does this work?
  - What is the purpose of ...?
  - How is the structure related to the function?
  - The important structures of _____ are _____ , _____ , _____.
  - The _____ (structure) of a _____ is for _____ (function).

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.

- Objects and organisms can be described in terms of their parts.
- Systems in the natural and designed world have parts that work together.
  - What are the parts that make this up?
  - What does each part do?
  - How do the parts work together?
  - Can you draw a picture (or diagram) of the system?
  - What is the system?
  - How do the parts of the system interact?
  - What process is occurring? Can you describe it?
  - The parts of the system are _____ , _____ , _____.
  - In this system _____ interacts with _____ to cause _____.

Energy and Matter

Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

- Objects may break into smaller pieces, be put together into larger pieces, or change shapes.
  - What are the properties of ...?
  - Do the properties stay the same? Are they different?
  - Can you break this up into smaller pieces?
  - Can you put it back together again? How?
  - What is the weight before and after?
  - What happened to the energy? Where did it go?
  - How was the energy transferred?
  - How is the energy moving in/out/within/between an object(s)?
  - I claim that _____ (matter) changed because _____.
  - I noticed evidence of energy when _____ happened.

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.

- Some things stay the same while other things change.
- Things may change slowly or rapidly.
  - What is changing or staying the same?
  - Describe if this happens slow or fast.
  - How does this change over a long period of time?
  - How often does this change?
  - Does this have a repeating cycle or pattern?
  - What could you change to make this better?
  - Is that stable?
  - I claim ____ is changing/staying the same, because our evidence shows ____.
  - Over a long period of time, _____ stays the same/changes, because _____.

Cause and Effect

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.

- Events have causes that generate observable patterns.
- Simple tests can be designed to gather evidence to support or refute student ideas about causes.
  - How/Why did that happen?
  - What is causing this to happen?
  - When will it happen again? Can you make it happen again?
  - What is the effect from the change?
  - Can you identify the cause and the effect?
  - What do you predict will happen if...?
  - How do you know that the cause and effect are connected?
  - One cause of _____ (effect) might be _____.
  - From the cause-effect relationship, I would claim that _____.

Scale, Proportion, and Quantity

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 when considering phenomena,

- Relative scales allow objects and events to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower).
- Standard units are used to measure length.
  - Which is hotter/cooler? What is the difference in temperature?
  - Which is bigger/smaller? How much larger/smaller?
  - Which happens faster/slower? What is the difference in time?
  - How long does that take?
  - How can you measure that? What measurement could you take?
  - What tool and units will you use?
  - When comparing _____ to _____ , I noticed _____.
  - I used _____ units to measure because _____.

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Adapted from: REGIONAL EDUCATIONAL SERVICE AGENCY www.sccresa.org to support K-12 Crosscutting Concepts

Published 02/24/23

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