Topic Arrangements of the Next Generation Science Standards

At the beginning of the NGSS development process, in order to eliminate potential redundancy, seek an appropriate grain size, and seek natural connections among the Disciplinary Core Ideas (DCIs) identified within the Framework for K-12 Science Education, the writers arranged the DCIs into topics around which to develop the standards. This structure provided the original basis of the standards, and is preferred by many states. However, the coding structure of individual performance expectations reflects the DCI arrangement in the Framework.

Due to the fact that the NGSS progress toward end-of-high school core ideas, the standards may be rearranged in any order within a grade level.

Table of Contents

Elementary Introduction ................................................................. 3
Kindergarten Storyline ................................................................. 4
K.Foices and Interactions: Pushes and Pulls .................................. 5
K.Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment .. 6
K.Weather and Climate ................................................................. 7
First Grade Storyline ................................................................. 8
1.Waves: Light and Sound ............................................................ 9
1.Structure, Function, and Information Processing ..................... 10
1.Space Systems: Patterns and Cycles ......................................... 11
Second Grade Storyline .............................................................. 12
2.Structure and Properties of Matter .......................................... 13
2.Interdependent Relationships in Ecosystems ............................. 14
2.Earth’s Systems: Processes that Shape the Earth ..................... 15
3.Inheritance and Variation of Traits: Life Cycles and Traits ........ 20
3.Weather and Climate ............................................................... 21
Third Grade Storyline ............................................................... 17
3.Foices and Interactions ............................................................ 18
3.Interdependent Relationships in Ecosystems ......................... 19
4.Matter and Energy in Organisms and Ecosystems .................. 29
4.Earth’s Systems ............................................................ 26
Fourth Grade Storyline .............................................................. 22
5.Matter and Energy in Organisms and Ecosystems .................. 29
5.Earth’s Systems ............................................................ 30
3-5.Engineering Design ............................................................ 32
Middle School Physical Sciences Storyline ......... 33
Middle School Life Sciences Storyline ................................. 35
Middle School Earth and Space Sciences Storyline ................. 37
Middle School Engineering Design Storyline .......................... 39
MS.Structure and Properties of Matter .................................... 40
MS.Chemical Reactions ............................................................ 42
MS.Foices and Interactions ............................................................ 43
MS.Energy ........................................................................... 45
Elementary Standards

Students in kindergarten through fifth grade begin to develop an understanding of the four disciplinary core ideas: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s). The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain more complex phenomena in the four disciplines as they progress to middle school and high school. While the performance expectations shown in kindergarten through fifth grade couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.
Kindergarten

The performance expectations in kindergarten help students formulate answers to questions such as: “What happens if you push or pull an object harder? Where do animals live and why do they live there? What is the weather like today and how is it different from yesterday?”

Kindergarten performance expectations include PS2, PS3, LS1, ESS2, ESS3, and ETS1 Disciplinary Core Ideas from the NRC Framework. Students are expected to develop understanding of patterns and variations in local weather and the purpose of weather forecasting to prepare for, and respond to, severe weather. Students are able to apply an understanding of the effects of different strengths or different directions of pushes and pulls on the motion of an object to analyze a design solution. Students are also expected to develop understanding of what plants and animals (including humans) need to survive and the relationship between their needs and where they live. The crosscutting concepts of patterns; cause and effect; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the kindergarten performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.
K. Forces and Interactions: Pushes and Pulls

Students who demonstrate understanding can:

K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.]

K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

<table>
<thead>
<tr>
<th>Disciplinary Core Ideas</th>
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</thead>
<tbody>
<tr>
<td>PS2.A: Forces and Motion</td>
</tr>
<tr>
<td>Pushes and pulls can have different strengths and directions. (K-PS2-1), (K-PS2-2)</td>
</tr>
<tr>
<td>Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1), (K-PS2-2)</td>
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<table>
<thead>
<tr>
<th>PS2.B: Types of Interactions</th>
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<tbody>
<tr>
<td>When objects touch or collide, they push on one another and can change motion. (K-PS2-1)</td>
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<tr>
<th>PS3.C: Relationship Between Energy and Forces</th>
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<tbody>
<tr>
<td>A bigger push or pull makes things speed up or slow down more quickly. (Secondary to K-PS2-1)</td>
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<tr>
<th>ETS1.A: Defining Engineering Problems</th>
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<tbody>
<tr>
<td>A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (Secondary to K-PS2-2)</td>
</tr>
</tbody>
</table>

Connections to other DCIs in kindergarten: K.ETS1.A (K-PS2-2); K.ETS1.B (K-PS2-2)

Articulation of DCIs across grade levels: 2.ETS1.B (K-PS2-2); 3.PS2.A (K-PS2-1), (K-PS2-2); 3.PS2.B (K-PS2-1); 4.PS3.A (K-PS2-1); 4.ETS1.A (K-PS2-2)

Connections to other DCIs in kindergarten: K.ETS1.A (K-PS2-2); K.ETS1.B (K-PS2-2)

Articulation of DCIs across grade levels: 2.ETS1.B (K-PS2-2); 3.PS2.A (K-PS2-1), (K-PS2-2); 3.PS2.B (K-PS2-1); 4.PS3.A (K-PS2-1); 4.ETS1.A (K-PS2-2)

Common Core State Standards Connections:

- ELA/Literacy –
  - R.I.K.1 With prompting and support, ask and answer questions about key details in a text. (K-PS2-2)
  - W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS2-1)
  - SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-PS2-2)

- Mathematics –
  - MP.2 Reason abstractly and quantitatively. (K-PS2-1)
  - K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-PS2-1)
  - K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has “more of”/ “less of” the attribute, and describe the difference. (K-PS2-1)

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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K. Weather and Climate

Students who demonstrate understanding can:

K-PS3-1. Make observations to determine the effect of sunlight on Earth’s surface. [Clarification Statement: Examples of Earth’s surface could include sand, soil, rocks, and water] [Assessment Boundary: Assessed at grade 1, assessment of properties of matter is limited to relative measures such as warmer/cooler.]

K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.* [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]

K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time. [Clarification Statement: Examples of quantitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [Assessment Boundary: Assessed at grade 1, assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.]

K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.* [Clarification Statement: Emphasis is on local forms of severe weather.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education.

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.
- Ask questions based on observations to find more information about the designed world. (K-ESS3-2)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
- Make observations (firsthand or from media) to collect data that can be used to make comparisons. (K-PS3-1)

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-ESS2-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.
- Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. (K-PS3-2)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
- Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world. (K-ESS3-2)

Disciplinary Core Ideas

PS3.B: Conservation of Energy and Energy Transfer
- Sunlight warms Earth’s surface. (K-PS3-1), (K-PS3-2)

ESS2.D: Weather and Climate
- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. (K-ESS3-2)

ESS3.B: Natural Hazards
- Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K-ESS3-2)

ETS1.A: Defining and Delimiting an Engineering Problem
- Asking questions, making observations, and gathering information are helpful in thinking about problems. (secondary to K-ESS3-2)

Crosscutting Concepts

Patterns
- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (K-ESS2-1)

Cause and Effect
- Events have causes that generate observable patterns. (K-PS3-1), (K-PS3-2), (K-ESS3-2)

Connections to Engineering, Technology, and Applications of Science

Independence of Science, Engineering, and Technology
- People encounter questions about the natural world every day. (K-ESS3-2)

Influence of Engineering, Technology, and Science on Society and the Natural World
- People depend on various technologies in their lives; human life would be very different without technology. (K-ESS3-2)

Connections to other DCIs in kindergarten:
- K.ETS1.A (K-PS3-2), (K-ESS3-2); K.ETS1.B (K-PS3-2)

Articulation of DCIs across grade-levels:
- 1.PS4.B (K-PS3-1), (K-PS3-2); 2.ESS1.C (K-ESS3-2); 2.ESS2.A (K-ESS1-2); 2.ETS1.B (K-PS3-2); 3.ESS2.D (K-PS3-1), (K-ESS3-2); 3.ESS3.B (K-ESS3-2); 4.ESS2.A (K-ESS2-1); 4.ESS3.B (K-ESS3-2); 4.ETS1.A (K-PS3-2)

Common Core State Standards Connections:
- ELA/Literacy – RI.K.1 With prompting and support, ask and answer questions about key details in a text. (K-ESS3-2)
- W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS3-1), (K-PS3-2), (K-ESS3-2)
- SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-ESS3-2)
- Mathematics –
- MP.2 Reason abstractly and quantitatively. (K-ESS2-1)
- MP.3 Model with mathematics. (K-ESS2-1), (K-ESS3-2)
- K.CC Counting and Cardinality (K-ESS3-2)
- K.CC.A Know number names and the count sequence. (K-ESS2-1)
- K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-ESS2-1)
- K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-PS3-1), (K-PS3-2)
- K.MD.B.3 Classify objects into given categories; count the number of objects in each category and sort the categories by count. (K-ESS2-1)

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