Introduction to Next Generation Science Standards

Illinois State Board of Education and Illinois Mathematics and Science Academy
Commonalities Among the Practices in Science, Mathematics, and English Language Arts

Based on work by Tina Chuek at stanford.edu

Math
M1: Make sense of problems and persevere in solving them
M2: Reason abstractly & quantitatively
M6: Attend to precision
M7: Look for & make use of structure
M8: Look for & make use of regularity in repeated reasoning
M4: Models with mathematics
M5: Use appropriate tools strategically

Science
S1: Ask questions and define problems
S2: Develop & use models
S3: Plan & carry out investigations
S4: Analyze & interpret data
S5: Use mathematics & computational thinking
S6: Construct explanations & design solutions
S7: Engage in argument from evidence
S8: Obtain, evaluate, & communicate information

ELA
E1: Demonstrate independence in reading complex texts, and writing and speaking about them
E2: Build a strong base of knowledge through content rich texts
E3: Obtain, synthesize, and report findings clearly and effectively in response to task and purpose
E4: Construct viable arguments and critique reasoning of others
E5: Read, write, and speak grounded in evidence
E6: Use technology & digital media strategically & capably
E7: Come to understand other perspectives and cultures through reading, listening, and collaborations
E8: Observe, evaluate, and communicate information

NGSS@NSTA
www.nsta.org/ngss

IMSA
imsa.edu
https://www.nextgenscience.org/
Click 4-PS3-1 to view details for this Performance Expectation

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**DISCIPLINE**

**CROSSCUTTING CONCEPT**

| Select | Select | SUBMIT | RESET |

### 4-PS3-1 Energy

Use evidence to construct an explanation relating the speed of an object to the energy of that object.

**Performance Expectation** | Grade: 3-5 | 4

### 4-PS3-2 Energy

Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

**Performance Expectation** | Grade: 3-5 | 4

[https://www.nextgenscience.org/search-standards?keys=&tid%5B%5D=104](https://www.nextgenscience.org/search-standards?keys=&tid%5B%5D=104)
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<td><strong>Constructing Explanations and Designing Solutions</strong></td>
<td><strong>PS3.A: Definitions of Energy</strong>&lt;br&gt;• The faster a given object is moving, the more energy it possesses.</td>
<td><strong>Energy and Matter</strong>&lt;br&gt;• Energy can be transferred in various ways and between objects.</td>
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**Connections to other DOKs in fourth grade:** NA

**Articulation of DOKs across grade levels:**

M.5.P.5.A

Common Core State Standards Connections:

- **ELA/Literacy:**
  - RI.4.1 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1)
  - RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1)
- **W.4** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)
- **W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)
- **W.4.3** Follow a sequence of events. (4-PS3-1)
- **W.4.4** Continue a sequence of events. (4-PS3-1)
- **W.4.7** Describe the main points and important details using key details. (4-PS3-1)
- **W.4.8** Recall relevant information from experiences or gather relevant information from print and digital sources, taking notes and categorizing information, and provide a list of sources. (4-PS3-1)
- **W.4.9** Draw logical inferences from literary or informational texts to support analysis, reflection, and research. (4-PS3-1)

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

The section entitled "Disciplinary Core Ideas" is reproduced verbatim from *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Integrated and reprinted with permission from the National Academy of Sciences.

https://www.nextgenscience.org/pe/4-ps3-1-energy
Evidence Statements

- Guide Lesson Development
- Specifics - Details
- What Students are Doing

## Evidence Statements

### Observable features of the student performance by the end of the grade:

#### 1 Articulating the explanation of phenomena

- **a** Students articulate a statement that relates the given phenomenon to a scientific idea, including that the speed of a given object is related to the energy of the object (e.g., the faster an object is moving, the more energy it possesses).
- **b** Students use the evidence and reasoning to construct an explanation for the phenomenon.

#### 2 Evidence

- **a** Students identify and describe* the relevant given evidence for the explanation, including:
  - i. The relative speed of the object (e.g., faster vs. slower objects).
  - ii. Qualitative indicators of the amount of energy of the object, as determined by a transfer of energy from that object (e.g., more or less sound produced in a collision, more or less heat produced when objects rub together, relative speed of a ball that was stationary following a collision with a moving object, more or less distance a stationary object is moved).

#### 3 Reasoning

- **a** Students use reasoning to connect the evidence to support an explanation for the phenomenon. In the explanation, students describe* a chain of reasoning that includes:
  - i. Motion can indicate the energy of an object.
  - ii. The faster a given object is moving, the more observable impact it can have on another object (e.g., a fast-moving ball striking something (a gong, a wall) makes more noise than does the same ball moving slowly and striking the same thing).
  - iii. The observable impact of a moving object interacting with its surroundings reflects how much energy was able to be transferred between objects and therefore relates to the energy of the moving object.
  - iv. Because faster objects have a larger impact on their surroundings than objects moving more slowly, they have more energy due to motion (e.g., a fast-moving ball striking a gong makes more noise than a slow-moving ball doing the same thing because it has more energy that can be transferred to the gong, producing more sound). [Note: This refers only to relative bulk motion energy, not potential energy, to remain within the DCl.]
  - v. Therefore, the speed of an object is related to the energy of the object.

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[Link to Evidence Statements](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/4-PS3-1%20Evidence%20Statements%20June%20202015%20asterisks.pdf)
3 Dimensional Teaching

Science and Engineering Practices

Crosscutting Concepts

Disciplinary Core Ideas
Students who demonstrate understanding can:

**4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.** [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]

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

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<td>Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</td>
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<td>Use evidence (e.g., measurements, observations, patterns) to construct an explanation.</td>
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Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels:

**4-PS3.A**

Common Core State Standards Connections:

**ELA/Literacy -**

| RI.4.1 | Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1) |
| RI.4.3 | Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1) |
| RI.4.9 | Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1) |
| W.4.2 | Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1) |
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[https://www.nextgenscience.org/pe/4-ps3-1-energy](https://www.nextgenscience.org/pe/4-ps3-1-energy)
Performance Expectation (PE)

Students who demonstrate understanding can:

4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]

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Connections to
✓ Other Ideas in Science
✓ CCSS

https://www.nextgenscience.org/pe/4-ps3-1-energy
Three Dimensions of Science Instruction

(Use the bookmark http://stemteachingtools.org/pd/stem-teaching-tools-bookmark)

https://www.nextgenscience.org/pe/4-ps3-1-energy
Science & Engineering Practices (SEP)

- Constructing Explanations and Designing Solutions
  Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.
  - Use evidence (e.g., measurements, observations, patterns) to construct an explanation.

https://www.nextgenscience.org/pe/4-ps3-1-energy
Science and Engineering Practices (SEP) (Active Participation)

- Asking Questions and Defining Problems
- Developing and Using Models
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

http://www.nextgenscience.org/
Appendix F
## Three Dimensions of Science Instruction

(Use the bookmark [http://stemteachingtools.org/pd/stem-teaching-tools-bookmark](http://stemteachingtools.org/pd/stem-teaching-tools-bookmark))

### Science and Engineering Practices

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Use evidence (e.g., measurements, observations, patterns) to construct an explanation.

### Disciplinary Core Ideas

**PS3.A: Definitions of Energy**

- The faster a given object is moving, the more energy it possesses.

### Crosscutting Concepts

**Energy and Matter**

- Energy can be transferred in various ways and between objects.

[https://www.nextgenscience.org/pe/4-ps3-1-energy](https://www.nextgenscience.org/pe/4-ps3-1-energy)
Crosscutting Concepts (CCC)
Connections Among Branches of Science & Engineering

Energy & Matter Applies To
- Life Science
- Physical Science
- Earth and Space Science
- Engineering, Technology and the Application of Science

https://www.nextgenscience.org/pe/4-ps3-1-energy
Crosscutting Concepts (CCC)
(Connections)

- Patterns
- Cause and effect: Mechanism and explanation
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: Flows, cycles, and conservation
- Structure and function
- Stability and change

http://www.nextgenscience.org/
Appendix G
## Three Dimensions of Science Instruction

(Use the bookmark [http://stemteachingtools.org/pd/stem-teaching-tools-bookmark](http://stemteachingtools.org/pd/stem-teaching-tools-bookmark))

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Disciplinary Core Ideas (DCI)

- What Students Need to Know
- Formerly Called Content

https://www.nextgenscience.org/pe/4-ps3-1-energy
Disciplinary Core Ideas (DCI)
(Ideas or Branches)

- PS – Physical Science
- LS – Life Science
- ESS – Earth and Space Science
- ETS – Engineering, Technology and the Application of Science

http://ngss.nsta.org/DisciplinaryCoreIdeasTop.aspx
Appendix E