Introduction to Next Generation Science Standards

Illinois State Board of Education and Illinois Mathematics and Science Academy
**Math**
- M1: Make sense of problems and persevere in solving them
- M2: Reason abstractly & quantitatively
- M3: Attend to precision
- M4: Use appropriate tools strategically

**Science**
- S1: Ask questions and define problems
- S2: Develop & use models
- S3: Plan & carry out investigations
- S4: Use mathematics & computational thinking
- S5: Analyze & interpret data
- S6: Construct explanations & design solutions

**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: Read, write, and speak grounded in evidence
- E4: Construct viable arguments and critique reasoning of others
- E5: Engage in argument from evidence
- E6: Obtain, evaluate, & communicate information
- E7: Construct explanations & design solutions

**Commonalities Among the Practices in Science, Mathematics and English Language Arts**

Based on work by Tina Chuek ell.stanford.edu

[NGSS@NSTA](https://www.nsta.org/ngss)
https://www.nextgenscience.org/
Click 4-PS3-1 to view details for this Performance Expectation.
### Science and Engineering Practices

**Conducting Explanations and Designing Solutions**
- Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progressions in 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.

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**Related Evidence Statements**

4-PS3-1 Evidence Statements

**How to Read the Standards**

The standards integrate three dimensions within each standard and have intentional connections across standards. More...

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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: |
|---|---|
| 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. |
| Evidence |
| a | Students identify and describe* the relevant given evidence for the explanation, including: |
| 1 | i. The relative speed of the object (e.g., faster vs. slower objects). |
| 2 | 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). |
| 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: |
| 1 | i. Motion can indicate the energy of an object. |
| 2 | 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). |
| 3 | 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. |
| 4 | 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 DCI.] |
| 5 | v. Therefore, the speed of an object is related to the energy of the object. |

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:*

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
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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>
<td>• The faster a given object is moving, the more energy it possesses.</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:**

**M.S.5PS3.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)
- **W.4.8** Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-1)
- **W.4.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1)

[https://www.nextgenscience.org/pe/4-ps3-1-energy](https://www.nextgenscience.org/pe/4-ps3-1-energy)
Performance Expectation (PE)

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.]

https://www.nextgenscience.org/pe/4-ps3-1-energy
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](http://stemteachingtools.org/pd/stem-teaching-tools-bookmark))

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

What Scientists & Engineers Do

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

http://www.nextgenscience.org/
Three Dimensions of Science Instruction
(Use the bookmark http://stemteachingtools.org/pd/stem-teaching-tools-bookmark)

https://www.nextgenscience.org/pr/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)

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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