Teaching NGSS in Elementary School
Fourth Grade: Energy
January 21, 2015
Introductions

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Co-author, *Project-Based Inquiry Science*
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K-5 Science Coordinator, VT Agency of Education, NGSS Curator
Twitter: @krscienclady
Tracy Lavallee

- Teacher (currently, Underhill ID Elementary School) for 28 years and still love working with and learning from my wonderful students!
- Two years as Science Coordinator K-5 elementary schools
- Two years as Teacher Associate with VISMT.
- Bachelors Degree from UVM and Masters Degree in Education from St. Michael's College.
- I have an 20 year old son who is a sophomore at UVM studying nutrition.
- We have a dog named Orion and enjoy spending time doing many outdoor activities!
Poll: What do you do?

<table>
<thead>
<tr>
<th>4th Grade Teacher</th>
<th>Teacher at Another Grade Level</th>
<th>Preservice Teacher</th>
<th>Science Supervisor</th>
<th>University Faculty</th>
<th>Other</th>
</tr>
</thead>
</table>
Webinar Interactions

- Be an engaged participant.
- Participate by responding to polls and using the CHAT window to share ideas.
- Presume positive intentions!
NGSS for Fourth Grade

- Approaches and tools for supporting NGSS in the classroom
- NGSS topics for fourth grade
- Unpacking Performance Expectation 4-PS3-2
- Physical Science focus: Energy
- Science and Engineering Practices:
  - Planning and Carrying out investigations,
  - Developing and Using Models,
  - Analyze and interpret data
- Video: planning and carrying out an investigation to answer questions about energy transfer
- Resources to support instruction
NGSS for Fourth Grade

- Physical Science: Energy
- Physical Science: Waves
- Life Science: Structure, Function, and Information Processing
- Earth Science: Processes that Shape Earth
Disciplinary Core Idea

PS3: Energy

- The performance expectations in fourth grade help students formulate answers to questions such as: What is energy and how is it related to motion? **How is energy transferred?** How can energy be used to solve a problem?”

- Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions.

NGSS Fourth Grade “Related Content” link

How to read the standards »
Go back to search results
Related Content »

**Students who demonstrate understanding can:**

4-PS3-1. Use evidence to construct an explanation relating the quantitative definition of energy.

4-PS3-2. Make observations to provide evidence that energy can be transferred by sound, light, heat, and electric currents. (Assessment Boundary: Assessment does not include quantitative definition of energy.)

4-PS3-3. Ask questions and predict outcomes about the change in energy. Statement: Emphasis is on the change in the energy of a system. (Assessment Boundary: Assessment does not include quantitative definition of energy.)

4-PS3-4. Apply scientific ideas to design, test, and refine a device to perform specific functions by adding, eliminating, or modifying components and materials. Examples of devices could include electric light, light, or sound; and, a passive solar heater that converts solar energy or use stored energy to cause motion.

The performance expectations above were developed using the following:

**Science and Engineering Practices**

- Asking Questions and Defining Problems
- Planning and Carrying Out Investigations

**Disciplinary Core Ideas**

- PS3.A: Definitions of energy and its role in moving objects or currents.
- PS3.B: Conservation of Energy Transfer
Performance Expectation

PS3: Energy

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

<table>
<thead>
<tr>
<th>Performance Expectation</th>
<th>Description</th>
</tr>
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</table>
| 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.]
| 4-PS3-2.                | Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]
| 4-PS3-3.                | Ask questions and predict outcomes about the changes in energy that occur when objects collide. [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]
| 4-PS3-4.                | Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.* [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.] |
Performance Expectation

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

Three Dimensions

Disciplinary Core Ideas

Science and Engineering Practices

Crosscutting Concepts
Performance Expectation

Disciplinary Core Ideas

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

Energy can be moved from place to place by moving objects or through sound, light, or electric currents.

Energy is present whenever there are moving objects, sound, light or heat. Light also transfers energy from place to place.

Energy can also be transferred from place to place by electric current, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy, because they have different inherited information. (3-LS3-1)
Performance Expectation

Science and Engineering Practices

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

Planning and carrying out investigations

Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
Science and Engineering Practices

1. Asking probing questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations (identified in PE)
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Developing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
Performance Expectation

Crosscutting Concepts

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

Energy can be transferred in various ways and between objects.
Poll: Energy

Which response best reflects how you have taught (or observed being taught) transfer of energy/electric current in the elementary grades?

a. Replicate prepared electric circuits.
b. Observe how common circuits are built - for example, flashlights.
c. Identify tools that use electricity from pictures or everyday objects.
d. Other (please describe briefly).

After you have answered the poll, watch as the results unfold and read the chat box for teacher’s descriptions of other activities.
Introducing Phenomenon

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

How and why does the Energy Ball light up when you touch the sensors?

How does the Energy Ball demonstrate energy transfer?
Anchoring Event

Engaging students in the phenomenon

How does the Energy Ball which lights and buzzes demonstrate energy transfer?
Developing an Initial Model

Engaging students in the phenomenon

Students drew models of their initial ideas in their notebooks.

Then, students drew a collaborative model.
Teaching Video

How does the Energy Ball which lights and buzzes demonstrate energy transfer?

- Northwest Vermont, both rural and suburban
- Learning Experiences from before & after holiday break
- 19 Students (2 IEPs, 1 ELL)
- Teacher with extensive knowledge and experience
- Video edited down from many 50 minute sessions
- Respect for colleagues who share their classrooms
## Talk Moves from What’s Your Evidence?

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<td>How does that help us answer our guiding question, __________?</td>
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<td>What patterns are you beginning to notice in your data?</td>
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<td><strong>Propose a draft claim</strong></td>
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Zembal-Saul et al., 2013, p. 73
Video 1 Link (3.5 minute)

https://psu.box.com/s/jp91urkrzmzelzj0hxp4a
Scientists’ Meeting

Gathering Ideas

**Why?**
- elicit and activate prior knowledge
- generate and share experiences, ideas, questions, and wonderings
- provoke curiosity
- prepare for the investigation at hand

**What?**
- are open-ended
- focus on a science topic or idea
- begin with a statement or productive question
Reflection

How did Tracy use talk moves to scaffold the experience of developing a model?
Talk Moves from What’s Your Evidence?

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Zembal-Saul et al., 2013, p. 73
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<td><em>Is there a different claim that explains the data better? What is similar about the models? What’s different? (Wisdom Walk)</em></td>
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Investigating Phenomenon

- Determining the phenomenon that helps uncover the disciplinary core ideas.
- Crafting question that engages students and encourages investigation.
- Organizing and scaffolding investigations
Second Video 5 minute Video Battery, Bulb Wire

https://psu.box.com/s/n8skoxuimt2oqfif6moj
Video Reflections

- Asked students what questions did they have as they began investigation.
- Highlighted building on the ideas of others.
- Encouraged the use of evidence and arguing from evidence.
- Focus on energy transfer.
- Used talk moves intended to get at students’ ideas and scaffolded constructing a claim from evidence.
Scientists’ Meeting

Making Meaning
Scientists’ Meeting

Making Meaning

Why?

- share claims based on evidence
- consider findings, claims, evidence, and explanations of others
- analyze, question, and debate ideas
- arrive at tentative conclusions
- raise new questions
Scientists’ Meeting

Making Meaning

Characteristics:

- focus on the investigation question
- statements are supported by evidence
- student-to-student debate
- debate and argument based on evidence
- emphasis on synthesis and making generalizations
Science and Engineering Practices

1. Asking probing questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations (identified in PE)
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Developing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
Scientific Explanations

Constructing scientific explanations – the use of observations/data and science ideas to construct evidence-based accounts of natural phenomena
Argument from Evidence

Engaging In Argument from Evidence— the process of reaching agreement about explanations

In Grades 3-5:

• Compare and refine arguments based on an evaluation of the evidence presented

• Respectfully provide and receive critiques from peers about a proposed procedure, explanation or model by citing relevant evidence and posing specific questions

• Construct and/or support an argument with evidence, data, and/or a model
Energy Transfer Storyline

How and why does the Energy Ball light up when you touch the sensors?

How does the Energy Ball demonstrate energy transfer?

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| How is energy transferred between the battery, bulb and wire? (VIDEO)    | Energy is transferred by making a complete circuit. | The bulb lit up when a circuit was completed. | Energy can be transferred from place to place by electric currents. | Students explore material battery, bulb, wire.  
Students participate in a scientists’ meeting. |
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<td>How does the Energy Ball demonstrate the transfer of energy? (Anchoring Event)</td>
<td>The Energy Ball must have a complete circuit inside.</td>
<td>The Energy Ball lights up and buzzes when the circuit is completed</td>
<td>Energy is being transferred through electric currents inside the Energy ball.</td>
<td>Students are shown Energy Ball in scientists’ meeting. Students record their initial thinking in science notebooks. In collaborative groups, students record their ideas of what is happening on chart paper. Wisdom Walk Scientists ‘meeting (initial ideas)</td>
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<tr>
<td>How is energy transferred between the battery, bulb and wire? (Video)</td>
<td>Energy is transferred by making a complete circuit.</td>
<td>The bulb lit up when a circuit was completed.</td>
<td>Energy can be transferred from place to place by electric currents</td>
<td>Students explore material battery, bulb, wire. Students participate in a scientists’ meeting.</td>
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**Energy Transfer Storyline**

- **Question**: How does the Energy Ball demonstrate the transfer of energy? (Anchoring Event)
  - **Claim**: The Energy Ball must have a complete circuit inside.
  - **Evidence**: The Energy Ball lights up and buzzes when the circuit is completed.
  - **Reasoning**: Energy is being transferred through electric currents inside the Energy ball.
  - **Learning Experiences**: Students are shown Energy Ball in scientists’ meeting. Students record their initial thinking in science notebooks. In collaborative groups, students record their ideas of what is happening on chart paper. Wisdom Walk Scientists ‘meeting (initial ideas)

- **Question**: How is energy transferred between the battery, bulb and wire? (Video)
  - **Claim**: Energy is transferred by making a complete circuit.
  - **Evidence**: The bulb lit up when a circuit was completed.
  - **Reasoning**: Energy can be transferred from place to place by electric currents
  - **Learning Experiences**: Students explore material battery, bulb, wire. Students participate in a scientists’ meeting.
## Energy Transfer Storyline

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<td>Energy can be transferred from place to place by electric currents</td>
<td>Students explore material battery, bulb, wire.</td>
</tr>
<tr>
<td>Why won’t the bulb light up without the battery?</td>
<td></td>
<td></td>
<td></td>
<td>Students participate in a scientists’ meeting.</td>
</tr>
<tr>
<td>How is energy transfer demonstrated flow through the light bulb?</td>
<td></td>
<td></td>
<td></td>
<td>Students given a few more materials and continue working with materials to make complete circuits and light bulb.</td>
</tr>
<tr>
<td>How and why does the Energy Ball light up when you touch the sensors?</td>
<td>There is a circuit inside the Energy Ball that allows the Energy Ball to light up and buzz when it is completed.</td>
<td>The Energy Ball lit up and buzzed when the sensors were touched by the alligator clips allowing the electric current to flow in a complete circuit.</td>
<td>Students engaged with phenomenon.</td>
<td></td>
</tr>
<tr>
<td>How does the Energy Ball demonstrate energy transfer?</td>
<td></td>
<td></td>
<td></td>
<td>Students talked and developed models;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Students investigated and talked.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Students read Electrical Wizard and talked.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Students integrated ALL the experiences into a writing piece that answers driving questions.</td>
</tr>
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</table>
Time for Questions

What would you like to know about how Tracy prepares to teach the energy core idea?
Beyond Activities

❖ Activities (“hands-on”) alone are not enough
❖ Integration of core ideas, scientific practices, and cross-cutting concepts (3D learning) essential for meaningful science learning
❖ Investigations as a vehicle for...
  ● *Engaging* with scientific phenomena
  ● Collecting data from which *to construct* arguments and explanations
  ● *Testing* ideas and explanations
Activities = Box of Chocolates

http://www.tinnedtomatoes.com
Storyline = Well balanced meal

http://esngent.be/significance-munching-healthy-balanced-diet/
Need to know!

- Disciplinary core ideas (and cross-cutting concepts)
- Scientific (and engineering) practices
- Children’s ideas and reasoning
- Learning progressions
- Strategies for rich classroom talk
- Formative assessment approaches
- Interdisciplinary connections
Need to know!

- Disciplinary core ideas (and cross-cutting concepts)
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It’s a lot!
Importance of engaging young children in *meaningful science learning* and scientific discourse and practices

*Foundation* for future learning in science

Opportunity to examine NGSS in early grades and *focus on teaching* particular content and practices

*Connecting* core ideas with ELA and mathematics

Development of a *community of practice* focused on elementary grades

Vehicle to access instructional *resources* for teaching
Action Item!

What is one idea or practice from the webinar that you will take back to your instructional setting and use?

*Please share in the chat window.*
NSTA Learning Center

Accessible Resources

Teacher Learning Journeys: Learn Today...Your Way

Create your personalized learning journey based on your own unique learning needs and preferences where you can plan, track, and assess your progress over time. You can start at “Explore Learning Resources and Opportunities” below or by creating your game plan with the PD Plan and Portfolio tool. You may also review an archived Web Seminar overview of the Learning Center.
Learning Center Collection
