Professional Development Documents: Developing Learning Progressions

In this packet you will find a set of handouts and support materials for the Developing Learning Progressions professional development module. These documents represent the work of the leadership of the Assessing with Learning Progressions in Science Project, a Math Science Partnership through the Northwest Educational Service District in Washington State. We encourage others to use these materials as part of their own professional development programs. The PowerPoint which contains presentation notes and instructions for use of these materials can be found on the professional development tools section of the ALPS project web page www.nwesd.org/nwalps. For access to editable versions of these documents please contact Nancy Menard nmenard@nwesd.org.

Description of the Enclosed Documents

Learning Progression Template
Blank learning progression template for use in the creation of new learning progressions. Poster sized copied of the templates it can be very helpful for teams building progressions collaboratively If you have the ability to also print.

Formative Assessment Learning Progression
This learning progression describes a pathway to developing an understanding of formative assessment

Building a Learning Progression
This document details a step by step process for creating learning progression

Peer Assessment Sheet
This form can be used by participants to provide peer assessment feedback on learning progressions

Rubric for Learning Progression
This rubric can be used for peer and self assessment of learning progressions

Learning progression self assessment
This document provides guiding questions that can be used to self assess the strength of a learning progression

Sample Learning Progression with Step-by-Step Creation Description
This document provides an example of the steps of learning progression creation using a commonly used instructional material FOSS: Matter and Energy

Assessing with Learning Progressions In Science
Math Science Partnership
File Name: Learning Progression PD documents cover page.docx

Funding information:
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B
Learning Progression

Materials: ____________________________ Grade level: ____________

Prerequisite skill:

Learning Target:

Success Criteria: I can...

Formative Assessment:

Success Criteria: I can...

Formative Assessment:

Later big ideas that build on this big idea include:

Learning Target:

Success Criteria: I can...

Formative Assessment:

Success Criteria: I can...

Formative Assessment:

Learning Target:

Success Criteria: I can...

Formative Assessment:

Learning Target:

Success Criteria: I can...

Formative Assessment:

Big Idea:

Later big ideas that build on this big idea include:

Prepared by: ____________________________
Review by: ____________________________

Assessing with Learning Progressions in Science
Math Science Partnership
File Name: LP Blank Template

Funding Information:
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B
<table>
<thead>
<tr>
<th>Building a Learning Progression for a Curriculum Unit</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify 3 to 4 big ideas.</td>
<td>Match the state science standards’ big ideas and core content to the content of your teacher’s guide. Select three to four big ideas from the state standards that best fit the content of your teacher’s guide. Record each big idea on a sticky note.</td>
</tr>
<tr>
<td></td>
<td>State Science Standards Big Idea: Energy Transfer, transformation, and Conservation</td>
</tr>
<tr>
<td></td>
<td>FOSS Matter and Energy; Investigation 1 Big Idea Energy has many forms that can be transformed (changed) and transferred (moved). Etc.</td>
</tr>
<tr>
<td>2. Identify concepts.</td>
<td>Find the concepts listed in the overview section of your teacher’s guide. Write each concept at the top of a sticky note. Post each concept with its overarching big idea.</td>
</tr>
<tr>
<td></td>
<td>FOSS Inv. 1, part 1</td>
</tr>
<tr>
<td></td>
<td>• Energy takes many forms.</td>
</tr>
<tr>
<td></td>
<td>• Energy can be carried from one place to another by waves, electric current, and moving objects.</td>
</tr>
<tr>
<td></td>
<td>• Energy can be converted to other forms of energy.</td>
</tr>
<tr>
<td></td>
<td>• Etc.</td>
</tr>
<tr>
<td>3. Meld state curriculum with state big ideas.</td>
<td>Find the state standards that correlate with concepts from the teacher’s guide. Record state standards on the sticky notes with correlating concepts from the teacher’s guide.</td>
</tr>
<tr>
<td></td>
<td>For instance, FOSS Inv. 1, part 2: “Energy can be converted to other forms of energy,” correlates with&gt;&gt;&gt; State science standard: 4-S PS3B: “Energy can be transformed from one form to another.”</td>
</tr>
<tr>
<td>4. Find state standards lurking in lessons.</td>
<td>Search the lessons in your teacher’s guide for state standards that are not listed in the teacher’s guide overview. Record each standard you find on a sticky note and post it with the appropriate big idea.</td>
</tr>
<tr>
<td></td>
<td>For instance, standard 4-S PS3D: “Sound energy can be generated by vibrations” [kinetic (movement) energy], is a state standard. This concept is in FOSS Matter and Energy, Inv. 1, Part 3; but it is not listed as a concept in the overview of the teacher’s guide.</td>
</tr>
<tr>
<td>5. Organize the concepts.</td>
<td>Group the concepts/standards for each big idea with like concepts.</td>
</tr>
<tr>
<td></td>
<td>• FOSS Inv. 1, part 1 and 2: Machines and living things can convert energy into motion and heat.</td>
</tr>
<tr>
<td></td>
<td>• 4-S PS3Ca: Heat energy can be generated a number of ways.</td>
</tr>
<tr>
<td></td>
<td>• FOSS Inv. 1, part 2: Energy can be converted to other forms of energy.</td>
</tr>
<tr>
<td></td>
<td>• 4-S PS3B: Energy can be transformed from one form to another.</td>
</tr>
<tr>
<td></td>
<td>• Etc.</td>
</tr>
<tr>
<td>6. Establish progressive learning targets.</td>
<td>Arrange the groups in a hierarchy that builds to the big idea. Synthesize each group of concepts into a learning target Post the learning targets in a progression that builds to the big idea.</td>
</tr>
<tr>
<td></td>
<td>Learning Target 1 Energy has many forms. Inv. 1, Part 1 3 sessions</td>
</tr>
<tr>
<td></td>
<td>Learning Target 2 Energy can be changed from one form to another form. Inv. 1, Part 2 3 sessions</td>
</tr>
<tr>
<td></td>
<td>Learning Target 3 Energy can move from one place to another. Inv. 1, Part 3 3 sessions</td>
</tr>
<tr>
<td>7. Identify prerequisite skills and later big ideas.</td>
<td>Look at the state standards’ big ideas and core content for the previous grade band Post this content as the prerequisite skill. Look at the state standards’ big ideas and core content for the following grade band. Post this content as the later big ideas.</td>
</tr>
<tr>
<td></td>
<td>Prerequisite skill: Different forms of energy are used in everyday activities. Grades 2-3</td>
</tr>
<tr>
<td></td>
<td>Later big ideas that build on this big idea include:</td>
</tr>
<tr>
<td></td>
<td>• Heat energy (thermal) always moves from a warmer to a cooler place.</td>
</tr>
<tr>
<td></td>
<td>• Electrical energy is a convenient way to transfer energy.</td>
</tr>
<tr>
<td></td>
<td>• Sound energy is produced by a vibrating object. Grades 6-8</td>
</tr>
<tr>
<td>8. Establish success criteria and plan formative assessment.</td>
<td>Establish success criteria that provide evidence of student mastery of each learning target. Turn the success criteria into student friendly statements. Plan formative assessments that apply to the success criteria for each learning target</td>
</tr>
<tr>
<td></td>
<td>Success Criteria: I can identify different forms of energy in a system.</td>
</tr>
<tr>
<td></td>
<td>Formative Assessment: Exit ticket: Students identify the forms of energy in a given system and note them on a card.</td>
</tr>
</tbody>
</table>

Assessing with Learning Progressions in Science
Math Science Partnership
File Name: Build_Learn_Prog

Funding Information:
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B
<table>
<thead>
<tr>
<th>Learning Target:</th>
<th>Success Criteria:</th>
<th>Identify where the learning progression shows strengths for this target:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning progressions build on precursory skills and knowledge needed to master the big idea.</td>
<td>Each learning target specifies what the students will learn rather than the activity the students will do.</td>
<td>Identify where and how on the learning progression this target can be improved:</td>
</tr>
<tr>
<td>Learning Target:</td>
<td>Success Criteria:</td>
<td>Identify where the learning progression shows strengths for this target:</td>
</tr>
<tr>
<td>Learning progressions build from less difficult to more difficult items in an appropriate grain size.</td>
<td>The learning targets are sequenced in a hierarchy of learning to build student competence as difficulty increases.</td>
<td>Identify where and how on the learning progression this target can be improved:</td>
</tr>
</tbody>
</table>

**Assessing with Learning Progressions in Science**
Math Science Partnership
File Name: Peer assessment

**Funding information:**
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B
<table>
<thead>
<tr>
<th>Component</th>
<th>3: Ready to put in practice</th>
<th>2: Needs some modification</th>
<th>1: Needs a complete overhaul</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Idea</td>
<td>The big idea is a concept that clearly aligns with a science standard big idea.</td>
<td>The big idea is stated in language that is difficult to align with a science standard.</td>
<td>The big idea does not align with a science standard.</td>
</tr>
<tr>
<td></td>
<td>e.g., All plants and animals have life cycles.</td>
<td>e.g., Plants and animals have interesting lives.</td>
<td>e.g., A Monarch is a kind of butterfly.</td>
</tr>
<tr>
<td>Learning Targets</td>
<td>Each learning target states a precursory skill (cognitive understanding) or body of knowledge (information) needed to master the big idea.</td>
<td>The context in which the learning target will be framed is written as part of the learning target.</td>
<td>Skills unrelated to the big idea are stated as learning targets.</td>
</tr>
<tr>
<td></td>
<td>e.g., Skill: Distinguish between the life cycle of a plant and the life cycle of an animal.</td>
<td>e.g., In its life cycle, a butterfly develops from egg to larva to pupa to adult.</td>
<td>e.g., Butterflies have wings.</td>
</tr>
<tr>
<td></td>
<td>e.g., Body of knowledge: Animals have life cycles that include</td>
<td></td>
<td>The learning target identifies the activity the students will do rather than what they will learn.</td>
</tr>
<tr>
<td></td>
<td>1. being born;</td>
<td></td>
<td>e.g., Students will record observations of a butterfly’s life cycle.</td>
</tr>
<tr>
<td></td>
<td>2. developing into juveniles, adolescents, adults;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. reproducing;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. and eventually dying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progression</td>
<td>The learning targets are sequenced in progressively sophisticated ways of thinking about the big idea.</td>
<td>The learning targets need to be rearranged to develop a sequential progression to the big idea.</td>
<td>The learning targets do not represent knowledge and skills needed to master the big idea over time.</td>
</tr>
<tr>
<td>Success Criteria</td>
<td>The success criteria are descriptions and/or examples of learning target achievement written in student friendly language.</td>
<td>The success criteria are written in language difficult for students to understand.</td>
<td>The success criteria are stated as a prescribed number of correct answers or the number of times something is included in a product or performance.</td>
</tr>
<tr>
<td></td>
<td>e.g., I can compare the life cycles of two different animals.</td>
<td>e.g., I can compare and contrast life processes of a mammal with the life processes of an amphibian.</td>
<td>e.g., I can correctly name three stages in an animal’s life cycle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The success criteria are not aligned to the learning targets.</td>
</tr>
<tr>
<td>Formative Assessments</td>
<td>The assessments are developed to elicit responses that can be used to determine student proficiency of the learning targets.</td>
<td>Some assessments require the students to do extra work that is not needed to determine proficiency of the learning targets.</td>
<td>The assessments are not aligned to the learning targets.</td>
</tr>
</tbody>
</table>

Assessing with Learning Progressions in Science
Math Science Partnership
File Name: Rubric for Learning Progressions
Learning Progressions self-assessment

Learning Target:
Learning progressions build toward a big idea: a single important concept.

Success Criteria:
We identified the big idea by looking at the state standards together with our teaching materials.

Learning Target:
Learning progressions build on precursory skills and knowledge needed to master the big idea.

Success Criteria:
We identified the precursory skills and bodies of knowledge our students need to master the big idea, and these became our learning targets.

Learning Target:
Learning progressions provide formative assessment with success criteria for each learning target.

Success Criteria:
We specified what the students will learn rather than what the students will do in each of our learning targets.

Learning Target:
Learning progressions provide formative assessment with success criteria for each learning target.

Success Criteria:
We developed a learning progression that matches our tolerance for detail.

Success Criteria:
We developed success criteria that are statements of achievement in student friendly language.

Learning progressions are strategically sequenced learning targets that provide a framework for mastery of a big idea.
My Learning Progression

**FOSS Matter and Energy, Investigation 1**

**EALR 4:** Physical Science; **Big Idea:** Energy Transfer, Transformation and Conservation; **Core Content:** Heat, Light, Sound, and Electricity

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**Prerequisite knowledge:**
- Different forms of energy are used in everyday activities grades 2-3

**I can describe energy can be transferred from one place to another and changed from one form to another.**

**I can draw and label diagrams that show energy can be transferred from one place to another.**

**I can identify different forms of energy in a system.**

**I can describe how energy can be changed from one energy form to another form.**

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**Inv. 1 Part 1 (3 sessions)**

**Form. Assess. Task:** While observing an electric circuit system, list forms of energy in the system: i.e., in an electric motor system: electricity, motion, sound, heat.

**Form. Assess. Technique:** Exit ticket. Students write list on a card.

**Inv. 1 Part 2 (3 sessions)**

**Form. Assess. Task:** Describe how a truck that uses gasoline for fuel can be said to be powered by sunlight.

**Form. Assess. Technique:** 5 minute essay: Embedded. Students complete FOSS Sci. Notebook Sh.t 5, “Energy”

**Inv. 1 Part 3 (3 sessions)**

**Form. Assess. Task:** Preteach energy diagrams

**Form. Assess. Technique:**
- Draw and label diagrams of energy transfers in given energy systems.
- Embedded. Students complete FOSS Sci. Notebook Sh.t.s 6-7, with the addition of a labeled diagram for each system.

**Extension (not in FOSS)** Students rotate through inquiry centers.

**Form. Assess. Task:**
- Given a diagram of a battery-bulb electrical system with a missing part, students draw in the missing part and complete the diagram by labeling electrical energy transfers from one part to another and/or changes from electrical energy to different form(s) of energy.
- Students explain in writing that an electric circuit requires a complete loop of conducting materials for the system to work.

**Form. Assess. Technique:**
- 10 min. Quick Write/Quick Draw

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**Later big ideas that build on this big idea include:**
- Energy can be transformed grades 6-8
- Energy cannot be created nor destroyed (conservation) grades 9-12

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**Assessing with Learning Progressions in Science**

Math Science Partnership

File Name: ExampleLrnProg

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**Funding Information:**
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B
Step 1: Identify 3 to 4 big ideas.

FOSS Matter and Energy, Investigation 1

Investigation 1

Big Idea: Energy: Transfer, transformation, and Conservation

- Energy comes in many forms.
- Energy can be transferred from one place to another.
- Energy can be transformed from one form to another.

Investigation 2

Big Idea: Inquiry: Evidence

- Scientific explanations emphasize evidence.

Investigation 3

Big Idea: Matter: Properties and Change

- Matter may exist in different states – solid, liquid, gas.

Investigation 4

Big Idea: Matter: Properties and Change

- Matter can be changed from one state to another by heating or cooling.

All but one of the FOSS Matter and Energy concepts in Investigation 2 are part of Standard PS3D for grades 6-8:

“Visible light from the Sun is made up of a mixture of all colors of light. To see an object, light emitted or reflected by that object must enter the eye.”

Since this content is a 6-8 science standard, I looked closely at the investigation to see if one of the cross cutting standards at the 4-5 level is applicable to the lessons. Providing evidence is a good fit with the FOSS materials.
Step 2: Identify concepts listed in teaching materials.

**FOSS Inv. 1, part 1**
- Energy makes things happen.
- Energy takes many forms.
- Energy can be stored.

**FOSS Inv. 1, part 1**
- Most of the energy used by living things comes from the sun in the form of light.

**FOSS Inv. 1, part 1 and 2**
- Machines and lining things can convert energy into motion and heat.

**Inv. 1, part 3**
- Energy can be carried from one place to another by waves, electric current, and moving objects.

**Inv. 1, part 1**
- Energy can be converted to other forms of energy.

**Investigation 1**

**Big Idea:**
Energy has many forms that can be transformed (changed) and transferred (moved).

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Assessing with Learning Progressions in Science
Math Science Partnership
File Name: Matter and EnergyLPa_step2

Funding Information:
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B
Step 2: Identify concepts listed in teaching materials.

All but one of the FOSS Matter and Energy content concepts in investigation 2 are part of Standard PS3D for grades 6-8:

“Visible light from the Sun is made up of a mixture of all colors of light. To see an object, light emitted or reflected by that object must enter the eye.”

The final concept in Investigation 2 is not stated in the standards.

The content concept written on each Post-it Note is the FOSS concept.

Through investigation into this content, the students learn to provide evidence to back up their explanations of the visual phenomena.
Step 2: Identify concepts listed in teaching materials.

**FOSS Inv. 3, Part 1**
Common matter on Earth has three forms (states): solid, liquid, and gas.

**FOSS Inv. 3, part 2**
A measurement standard is a unit agreed upon and used by a large number of people.

**FOSS Inv. 3, part 2**
Measurement is used to quantify observations.

**FOSS Inv. 3, part 2**
The gram (g) is the standard unit of measure used to quantify mass in the metric system.

**FOSS Inv. 3, part 2**
Volume is a measure of the three-dimensional space occupied by matter.

**FOSS Inv. 3, part 2**
Opinion is based on belief; scientific evidence is based on observation.

**Investigation 3**
Big Ideas:
Matter may exist in different states - solid, liquid, gas.
Scientific explanations emphasize evidence.

**FOSS Inv. 3, part 3**
The liter (L) is the standard for measuring fluid volume in the metric system.

**FOSS Inv. 3, Part 2**
Measurement is used to quantify observations.

**FOSS Inv. 3, part 2**
The gram (g) is the standard unit of measure used to quantify mass in the metric system.

**FOSS Inv. 3, part 2**
Volume is a measure of the three-dimensional space occupied by matter.

**FOSS Inv. 3, part 2**
Opinion is based on belief; scientific evidence is based on observation.

**Investigation 3**
Big Ideas:
Matter may exist in different states - solid, liquid, gas.
Scientific explanations emphasize evidence.

**FOSS Inv. 3, part 3**
The liter (L) is the standard for measuring fluid volume in the metric system.
Step 2: Identify concepts listed in teaching materials.

**Foss Matter and Energy**

**FOSS Inv. 4, part 1**

- Degrees Celsius (°C) is the unit used when scientists measure temperature.
- Melting occurs when solids are heated.
- Different substances melt at different temperatures.

**FOSS Inv. 4, part 2**

- Evaporation occurs when liquids are heated.
- All matter on Earth is made of tiny particles.

**FOSS Inv. 4, part 3**

- When two substances are combined, a reaction may occur, producing a new substance with unique properties.

**Investigation 4**

**Big Ideas:**

- Matter can be changed from one state to another by heating or cooling.
Step 3: Meld state standards with concepts from science materials.

**FOSS Matter and Energy**

- **FOSS Inv. 1, part 1**
  - Energy makes things happen.

- **FOSS Inv. 1, part 1**
  - Energy can be stored.

- **FOSS Inv. 1, part 1**
  - Energy takes many forms.

- **FOSS Inv. 1, part 1**
  - Most of the energy used by living things comes from the sun in the form of light.

- **FOSS Inv. 1, part 1 and 2**
  - Machines and lining things can convert energy into motion and heat.

- **4-5 PS3a**
  - Heat energy can be generated a number of ways.

- **FOSS Inv. 1, part 2**
  - Energy can be converted to other forms of energy.

- **4-5 PS3b**
  - Energy can be transformed from one form to another.

- **Inv. 1, part 3**
  - Energy can be carried from one place to another by waves, electric current, and moving objects.

**Investigation 1**

**Big Idea:**

Energy has many forms that can be transformed (changed) and transferred (moved).

**Assessing with Learning Progressions in Science**

Math Science Partnership

File Name: Matter and EnergyLPa_step3

**Mathematics & Science Partnership under Title II, Part B**

Program Code: 62

CFDA 84.366B
All but one of the FOSS Matter and Energy concepts in investigation 2 are part of Standard PS3D for grades 6-8:

“Visible light from the Sun is made up of a mixture of all colors of light. To see an object, light emitted or reflected by that object must enter the eye.”

The final concept in Investigation 2 is not stated in the standards.

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**FOSS Inv. 2, Part 1**

Light is a form of energy that travels in straight lines from a light source.

Light can reflect off surfaces that it strikes.

A mirror is a smooth reflective surface.

An object is seen only when light from that object enters an eye.

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**Investigation 2**

**Big Idea:**

Scientific explanations emphasize evidence.

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**FOSS Inv. 2, Part 2**

White light is a mixture of all colors of light.

Light can be absorbed by matter.

The apparent color of an object is a result of the light it reflects.

Light can reflect off surfaces that it strikes.

Scientific investigations involve asking and answering questions and comparing the answers with evidence from the real world.

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Assessing with Learning Progressions in Science
Math Science Partnership
FileName: Matter and EnergyLPa_step3

Funding Information:
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B

Northwest Educational Service District 189
Together We Can

Math & Science Collaborative Inquiry Project
Step 3: Meld state standards with concepts from science materials.

**FOSS Inv. 3, part 2**

Measurement is used to quantify observations.

**FOSS Inv. 3, part 2**

Volume is a measure of the three-dimensional space occupied by matter.

**FOSS Inv. 3, part 2**

A measurement standard is a unit agreed upon and used by a large number of people.

**FOSS Inv. 3, part 2**

Opinion is based on belief; scientific evidence is based on observation.

**FOSS Inv. 3, part 3**

The liter (L) is the standard for measuring fluid volume in the metric system.

**FOSS Inv. 3, Part 1**

Common matter on Earth has three forms (states): solid, liquid, and gas.

4-5 PS2Aa

Matter can exist in different states: solid, liquid, gas.

**FOSS Inv. 3, Part 1**

Air is a gas.

Air fills a closed container completely.

**FOSS Inv. 3, Part 1**

The gram (g) is the standard unit of measure used to quantify mass in the metric system.

Investigation 3

Big Ideas:

- Matter may exist in different states - solid, liquid, gas.
- Scientific explanations emphasize evidence.

**FOSS Inv. 3, Part 2**

Volume is a measure of the three-dimensional space occupied by matter.

**FOSS Inv. 3, Part 2**

A measurement standard is a unit agreed upon and used by a large number of people.

**FOSS Inv. 3, Part 2**

Opinion is based on belief; scientific evidence is based on observation.

4-5 INQG

Scientific explanations emphasize evidence.

**FOSS Inv. 3, Part 3**

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**FOSS Inv. 3, Part 1**

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Investigation 3

Big Ideas:

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- Scientific explanations emphasize evidence.

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**FOSS Inv. 3, Part 3**

The liter (L) is the standard for measuring fluid volume in the metric system.

Investigation 3

Big Ideas:

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- Scientific explanations emphasize evidence.

**FOSS Inv. 3, Part 2**

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**FOSS Inv. 3, Part 2**

Volume is a measure of the three-dimensional space occupied by matter.

**FOSS Inv. 3, Part 2**

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**FOSS Inv. 3, Part 2**

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4-5 INQG

Scientific explanations emphasize evidence.

**FOSS Inv. 3, Part 3**

The liter (L) is the standard for measuring fluid volume in the metric system.
Step 3: Meld state standards with concepts from science materials.

FOSS Inv. 4, part 1

Degrees Celsius (°C) is the unit used when scientists measure temperature.

FOSS Inv. 4, part 1

Different substances melt at different temperatures.

FOSS Inv. 4, part 2

All matter on Earth is made of tiny particles.

FOSS Inv. 4, part 1

Melting occurs when solids are heated.

FOSS Inv. 4, part 2

Evaporation occurs when liquids are heated.

4-5 PS2A:

Heating or cooling can change matter from one form to another.

Investigation 4

Big Idea:

Matter can be changed from one state to another by heating or cooling.

4-5 PS2Ab:

Heating or cooling can change matter from one form to another.
Investigation 1
Big Idea:
Energy has many forms that can be transformed (changed) and transferred (moved).

FOSS Inv. 1, part 1
Energy makes things happen.

FOSS Inv. 1, part 1
Energy takes many forms.

FOSS Inv. 1, part 2
Machines and lining things can convert energy into motion and heat.

4-5 PS3Ca
Heat energy can be generated a number of ways.

FOSS Inv. 1, part 1 and 2
Most of the energy used by living things comes from the sun in the form of light.

FOSS Inv. 1, part 1
Energy can be converted to other forms of energy.

4-5 PS3B
Energy can be transformed from one form to another.

FOSS Inv. 1, part 3
Energy can be carried from one place to another by waves, electric current, and moving objects.

4-5 PS3B
Energy can be transferred from one place to another.

4-5 PS3D
Sound energy can be generated by making things vibrate.

4-5 PS3D PE
Sound energy is transferred through the air from a source to a receiver.

4-5 PS3B
Energy can be transformed from one place to another.

Energy can be carried from one place to another by waves, electric current, and moving objects.
Step 4: Find standards lurking in lessons.
All but one of the FOSS Matter and Energy concepts in investigation 2 are part of Standard PS3D for grades 6-8:

“Visible light from the Sun is made up of a mixture of all colors of light. To see an object, light emitted or reflected by that object must enter the eye.”

The final concept in Investigation 2 is not stated in the standards.
Step 4: Find standards lurking in lessons.

**FOSS Inv. 3, part 1**
Common matter on Earth has three forms (states): solid, liquid, and gas.

4-5 PS2Aa
Matter can exist in different states: solid, liquid, gas.

**FOSS Inv. 3, part 1**
Air is a gas.

4-5 PS2Ba
Air fills a closed container completely.

**FOSS Inv. 3, part 2**
Measurement is used to quantify observations.

**FOSS Inv. 3, part 2**
A measurement standard is a unit agreed upon and used by a large number of people.

**FOSS Inv. 3, part 2**
The gram (g) is the standard unit of measure used to quantify mass in the metric system.

**FOSS Inv. 3, part 2**
Volume is a measure of the three-dimensional space occupied by matter.

**FOSS Inv. 3, part 2**
Opinion is based on belief; scientific evidence is based on observation.

4-5 INQG
Scientific explanations emphasize evidence.

**FOSS Inv. 3, part 3**
The liter (L) is the standard for measuring fluid volume in the metric system.

Investigation 3
Big Ideas:
Matter may exist in different states - solid, liquid, gas.

Scientific explanations emphasize evidence.

Assessing with Learning Progressions in Science
Math Science Partnership
File Name: Matter and EnergyLPa_step4

Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B
Step 4: Find standards lurking in lessons.

Investigation 4
Big Idea:
Matter can be changed from one state to another by heating or cooling.

FOSS Inv. 4, part 1

Degrees Celsius (°C) is the unit used when scientists measure temperature.

FOSS Inv. 4, part 1

Different substances melt at different temperatures.

FOSS Inv. 4, part 2

All matter on Earth is made of tiny particles.

FOSS Inv. 4, part 1

Melting occurs when solids are heated.

4-5 PS2Ab
Heating or cooling can change matter from one form to another.

FOSS Inv. 4, part 2

Evaporation occurs when liquids are heated.

4-5 PS2Ab
Heating or cooling can change matter from one form to another.

FOSS Inv. 4, part 3

When two substances are combined, a reaction may occur, producing a new substance with unique properties.

FOSS Inv. 4, part 2

4-5 PS2C
The total amount of matter is conserved (stays the same) when it undergoes a physical change (i.e. is broken or changes state).

Assessing with Learning Progressions in Science
Math Science Partnership
File Name: Matter and EnergyLPa_step4

Funding information:
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B
Investigation 1

**Big Idea:**
Energy can be carried from one place to another by waves, electric current, and moving objects.

FOSS Inv. 1, part 3
Energy can be transferred from one place to another.

Machines and lining things can convert energy into motion and heat.

Energy can be converted to other forms of energy.

Heat energy can be generated a number of ways.

Energy can be transformed from one form to another.

Energy can be transformed from one place to another by waves, electric current, and moving objects.

Heat energy can be generated a number of ways.

Energy can be stored.

Energy can be converted to other forms of energy.

FOSS Inv. 1, part 2

Inv. 1, part 3

Energy can be carried from one place to another by waves, electric current, and moving objects.

Energy can be transformed from one place to another.

Most of the energy used by living things comes from the sun in the form of light.

Energy takes many forms. Such as heat, light, sound, motion, and electricity.

Energy makes things happen.

Energy has many forms.
All but one of the FOSS Matter and Energy concepts in investigation 2 are part of Standard PS3D for grades 6-8:

“Visible light from the Sun is made up of a mixture of all colors of light. To see an object, light emitted or reflected by that object must enter the eye.”

The final concept in Investigation 2 is not stated in the standards.
Step 5: Establish progressive learning targets

Learning Target:
Evidence is based on observation and data.
Inv. 3, Part 2, 4 sessions

FOSS Inv. 3, part 2
Measurement is used to quantify observations.

FOSS Inv. 3, part 2
A measurement standard is a unit agreed upon and used by a large number of people.

FOSS Inv. 3, part 2
The gram (g) is the standard unit of measure used to quantify mass in the metric system.

FOSS Inv. 3, part 2
Volume is a measure of the three-dimensional space occupied by matter.

FOSS Inv. 3, part 2
Opinion is based on belief; scientific evidence is based on observation.

4-5 INQG
Scientific explanations emphasize evidence...

Investigation 3
Big Ideas:
Matter may exist in different states - solid, liquid, gas.
Scientific explanations emphasize evidence.

Learning Target:
Matter can exist in different states.
Inv. 3, Part 3, 4 sessions...

FOSS Inv. 3, Part 1
Common matter on Earth has three forms (states): solid, liquid, and gas.
4-5 PS2Aa
Matter can exist in different states: solid, liquid, gas.

FOSS Inv.3, Part 3
Common matter on Earth has three forms (states): solid, liquid, and gas.

FOSS Inv. 3, part 2
Air is a gas.
Air fills a closed container completely.

4-5 PS2Ba
Air is a gas.

Assessing with Learning Progressions in Science
Math Science Partnership
File Name: Matter and EnergyLPa_step5

Funding Information:
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B

Northwest Educational Service District 189
Math & Science Collaborative Inquiry Project
Together We Can
Step 5: Establish progressive learning targets

Learning Target:
Heating or cooling can change matter from one form to another.
Inv. 4, Part 1, 1 session

Investigation 4
Big Idea:
Matter can be changed from one state to another by heating or cooling.

FOSS Inv. 4, part 1

- Degrees Celsius (°C) is the unit used when scientists measure temperature.
- Melting occurs when solids are heated.
- Different substances melt at different temperatures.

FOSS Inv. 4, part 2

- Evaporation occurs when liquids are heated.
- All matter on Earth is made of tiny particles.

FOSS Inv. 4, part 3

- The total amount of matter stays the same (is conserved) when it changes from one form to another.

Learning Target:

- When two substances are combined, a reaction may occur, producing a new substance with unique properties.

Funding Information:
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B
Learning Progression  
**FOSS Matter and Energy, Investigation 1**

**Unit Target:**
Energy has any forms that can be transformed (changed) and transferred (moved).

**Learning Target:**
Energy can move from one place to another (transferred).
Inv. 1, Part 3, 3 sessions

Later big ideas that build on this big idea include:
- Heat energy (thermal) always moves from a warmer to a cooler place.
- Electrical energy is a convenient way to transfer energy.
- Sound energy is produced by a vibrating object.

**Success Criteria:**
I can...

**Formative Assessment:**

**Prerequisite skill:**
Different forms of energy are used in everyday activities. Grades 2-3

**Learning Target:**
Energy has many forms.
Inv. 1, Part 1, 3 sessions

**Success Criteria:**
I can...

**Formative Assessment:**

**Learning Target:**
Energy can be changed from one form to another form (transformed).
Inv. 1, Part 2, 3 sessions

**Success Criteria:**
I can...

**Formative Assessment:**

Grades 6-8

Funding information:
Mathematics & Science Partnership under Title II, Part B  
Program Code: 62  
CFDA 84.366B
**Big Idea:**
Energy has any forms that can be transformed (changed) and transferred (moved).

**Later big ideas that build on this big idea include:**
- Heat energy (thermal) always moves from a warmer to a cooler place.
- Electrical energy is a convenient way to transfer energy.
- Sound energy is produced by a vibrating object.

**Grades 6–8**

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**Learning Target:**
Energy can be moved from one place to another (transferred).
Inv. 1, Part 3, 3 sessions

**Success Criteria:**
I can... describe how energy can be transformed from one energy form to another.

**Formative Assessment:**
Energy diagram:
Students choose one energy system from their completed Science Notebook sheets #6-7, “How does energy travel?” and construct an energy diagram for the system.

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**Learning Target:**
Energy has many forms.
Inv. 1, Part 1, 3 sessions

**Success Criteria:**
I can... identify different forms of energy in a given system.

**Formative Assessment:**
Exit ticket:
Students identify the forms of energy in a given system and note them on a card.

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**Learning Target:**
Energy can be changed from one form to another form (transformed).
Inv. 1, Part 2, 3 sessions

**Success Criteria:**
I can... describe how energy can be changed from one energy form to another energy form.

**Formative Assessment:**
Response Sheet -- Energy:
Notebook sheet #5
Students describe energy transformations in a given scenario.

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**Prerequisite skill:**
Different forms of energy are used in everyday activities.