Engage Students in FOSS Next Generation

NSTA Atlanta 2018
Goals

• Learn about the K-5 Next Generation Edition of FOSS.

• Experience two FOSS Next Generation lessons from Materials and Motion (K) and Energy (4th).

• Explore the ways FOSS provides a rich context for developing skills and understandings that meet the vision of Next Generation Science Standards
Stay to the End

- Fill out the evaluation form
- Drawing for $75.00 gift certificate
- Link to presentation.
FOSS is a complete, modular, research-based curriculum developed at the Lawrence Hall of Science with support from the National Science Foundation.
Goals of the FOSS Program

1. Scientific Literacy
   • Provide students with appropriate experiences with core science ideas, scientific practices, and engineering experiences

2. Instructional Efficiency
   • Provide teachers with a complete and flexible program that reflects current research and best practices in education

3. Systemic Reform
   • Provide schools with a program that addresses community science-achievement standards
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<th>PHYSICAL SCIENCE</th>
<th>EARTH SCIENCE</th>
<th>LIFE SCIENCE</th>
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<td>Waves; Gravity and Kinetic Energy</td>
<td>Planetary Science</td>
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<td>Mixtures and Solutions</td>
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<td>Air and Weather</td>
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<td>Plants and Animals</td>
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Module Components

For Teachers
Investigations Guide and Teacher Resources

For Students
FOSS Science Resources

Equipment
Equipment Kit with materials for 32 students (3 uses)

Technology
Access to FOSSweb for all technology resources
Complete Kits include

- 1 Teacher Toolkit
- Equipment kit for 32 students
  - Consumables for 3 class uses
  - Measurement tools included
- 32 FOSS Science Resources books
- 1 FOSS Science Resources big book (K-2)
- Access code for FOSSweb content
FOSS
Active Investigation includes:

• Hands-on activities
• Science notebooks
• Science-centered language development
• Technology-based activities
• Formative assessment
• Outdoor activities
Student Science Notebooks

- Students use a composition book to record their science learning.
- Components include:
  - Focus Question
  - Observations
  - Making Sense of Data
  - Next Steps
My Responsibilities

I agree that I will...

- Explain my ideas
- Listen to others and show that I am listening
- Ask questions when I am confused or can’t hear
- Connect my ideas to others’ (explain, add to, respectfully disagree).
- Participate because all ideas lead to learning (speak loud and clear).
Bridge The Storyline
Investigation 4:
Getting Things to Move

Part 1:
Pushes and Pulls
How can you make this toy move?
How can you make this toy move?
What causes objects to move?
How can we get a ball to move?
Moving a Ball

How can we get a ball to move?
You changed the speed of the ball by changing the strength of your push.

What is the cause and effect in our ball-rolling activity?
Pushes and Pulls

What other things move with pushes and pulls?

<table>
<thead>
<tr>
<th>Push</th>
<th>Pull</th>
</tr>
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</table>
The pull that makes things move down is called gravity.
What causes objects to move?
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- Are You an Engineer? ...................................... 9
- The Story of a Box ......................................... 13
- What Is Fabric Made From? ............................... 19
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- Land, Air, and Water ....................................... 41
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Investigation 4, Part 2: Colliding Objects
Collisions

What will happen when the ball rolls down the ramp?
Collisions

What will happen when the ball rolls down the ramp?

What are other examples of collisions?

-
What happens when objects collide?
Explore collisions using blocks, ramps, and balls.
Can you set up your ramp so that the ball rolls into the "pond?"
Pond Challenge 2

Can you set up your ramp to roll a ball into the "pond?"

Your ramp cannot be pointed at the "pond."
Sense Making Circle

When scientists share their own ideas, they may say...

- I observed...
- I noticed...
- My data show...
- I think... because...
- I wonder...
Vocabulary Review

collide/collision

direction

ramp/slope
Focus Question

What happens when objects collide?

Draw how you were able to get your ball into the pond. Label your drawing with arrows to show direction and movement.
# Table of Contents

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What happens when objects collide?
Active Investigation

• **Context**: focus question and planning

• **Activity**: doing and observing

• **Data management**: recording and organizing information

• **Analysis**: discussing and writing explanations
  – Sense-making discussion
Investigation 1: Energy and Circuits

Investigation 2: The Force of Magnetism

Investigation 3: Electromagnets

Investigation 4: Energy Transfer

Investigation 5: Waves
INVESTIGATION 4 — Energy Transfer

Part 1
Presence of Energy ................. 278

Part 2
Rolling Balls Down Slopes .... 288

Part 3
Collisions ........................... 297
Prior Knowledge

Concepts students explore prior to activity we will engage in:

→ Energy is evident whenever there is motion.
→ Energy can be transferred from place to place.
Investigation 4, Part 2:
Rolling Balls Down Slopes
Investigate balls rolling down ramps.

Each pair needs the following materials:
- 1 large steel ball
- 1 medium steel ball
- 1 ramp
- 1 meter tape
- masking tape

Remember to keep good notes about what you observe!
You have two ramp-and-runway systems in your group.

What additional things can you find out using two systems together?
When the ball is at the top of the ramp, what forces are acting on the ball?

How would you describe the motion of the ball?

When an object is not moving, the forces on the object are balanced. The motion of the ball on the ramp starts because the forces acting on the ball are unbalanced. The force of Earth's gravity pulls the ball straight down, but the force of the ramp pushes up on the ball at an angle.
How can you determine if one ball is rolling faster than another?

**Hint:** Speed is a relationship between distance and time—how far an object goes in a unit of time.
How can you determine if one ball is rolling faster than another?

**Hint:** Speed is a relationship between distance and time—how far an object goes in a unit of time.

If you predetermine *time*, how do you know which ball travels fastest?

If you predetermine *distance*, how do you know which ball travels fastest?

Come up with a plan to determine which ball is traveling fastest in your ball-and-ramp system.
How does the starting position affect the speed of a ball rolling down a ramp?
We want to find out whether the starting position on the ramp affects the speed of the ball. We will release two balls at different starting positions on the ramp.

What else do we need to do in our design so the data gives us evidence for our answer?

•
Procedure

1. Tape two ramps side by side so the bottom edges are even.
2. Measure 50 cm from the bottom of the ramp and place a basin at that spot.
3. Place one large ball on a ramp so the front of the ball lines up with the line at position 5.
4. Place a second large ball on the other ramp in line with position 2.
5. One person will count down to start the race. At the signal, a second person will release the balls at the same time.
6. Watch and listen to determine which ball reaches the finish line first.
7. Record your data in your notebook.
8. Repeat the process two more times.
Which ball reached the finish line first? Tally your results.

<table>
<thead>
<tr>
<th>Ball at position 2</th>
<th>Ball at position 5</th>
<th>Balls finish at the same time</th>
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Are the two balls traveling at the same speed? What is your evidence?

What is the relationship between the release position and the speed of the ball? What is your evidence?
Why do you think the ball travels faster when the starting position is higher?
Potential Energy and Kinetic Energy

Why do you think the ball travels faster when the starting position is higher?

An object's potential energy is determined by its position above Earth's surface.

The greater the distance above Earth's surface, the more potential it has to move faster.

The potential energy of a ball is transformed into kinetic energy, or energy of motion.
Return all materials to the materials station.
potential energy

kinetic energy
How does the starting position affect the speed of a ball rolling down a ramp?

Be sure to include the roles of potential and kinetic energy.
What else could you test using the balls and ramps?

- 

In your group, plan and conduct a ball and ramp experiment of your choosing.
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**Investigation 4: Energy Transfer**

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How does the starting position affect the speed of a ball rolling down a ramp?

Pair up with a partner to

- share the data from your data table;
- discuss how the starting position affects the speed of the ball.
K-12 science education should reflect the interconnected nature of science as it is practiced and experienced in the real world.

NGSS – Appendix A
NGSS Architecture

- The 3 dimensions will be incorporated into every standards statement.
- Emphasis on depth of thought over breadth of content
- Engineering is more prominent
- Science is updated
- Progression of learning revised throughout multiple years

Anchor Phenomenon

Driving question(s) for Module

Described on the first page of the Overview and Investigation 1.

A module has 4–5 investigations

Inv. 1 Phenomenon
Described in Purpose on page 1 of each investigation

Guiding Question for Inv. 1
Displayed on page 1 of each investigation

Focus Question 1
Focus Question 2
Focus Question 3
Focus Question 4

Science and Engineering Practices and Crosscutting Concepts

Disciplinary Core Ideas applied to real-world phenomena

Inv. 2 Phenomenon

Guiding Question for Inv. 2

Focus Question 1
Focus Question 2
Focus Question 3
Focus Question 4

Science and Engineering Practices and Crosscutting Concepts

Disciplinary Core Ideas

Inv. 3 Phenomenon

Guiding Question for Inv. 3

Focus Question 1
Focus Question 2
Focus Question 3
Focus Question 4

Science and Engineering Practices and Crosscutting Concepts

Disciplinary Core Ideas

Inv. 4 Phenomenon

Guiding Question for Inv. 4

Focus Question 1
Focus Question 2
Focus Question 3
Focus Question 4

Science and Engineering Practices and Crosscutting Concepts

Disciplinary Core Ideas

Anchor Phenomenon

Driving question(s) for Module

An investigation has 4 parts

The approaches and lenses to explore phenomenon

The explanatory ideas

Disciplinary Core Ideas

Disciplinary Core Ideas

Disciplinary Core Ideas
FOSS GRADE FOUR INSTRUCTIONAL MODULE: ENERGY

Anchor Phenomenon: Energy—motion, electric current, sound, light, or heat

Driving Question for the Module
How does energy transfer between systems?

Guiding Questions for Investigations
How does energy transfer in a complete circuit?
What affects magnetic force?
What causes electromagnetism and how can we use it to transfer energy?
How does energy transfer between objects or systems?
What do waves have to do with energy?

Students who demonstrate understanding can:

3-PS2-3*: Ask questions to determine cause-and-effect relationships of electric or magnetic interactions between two objects not in contact with each other. (*Addressed in grade 3 and extended here.)

4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

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.]

4-PS4-4. 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.]

4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.]

4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information. [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment. [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
INVESTIGATION 1 – Soils and Weathering

1. Materials used in the current steps
2. Key three-dimensional highlights
3. Embedded assessment “What to Look For”
4. Sense-making discussions
5. Helpful drawings and diagrams
6. Strategies to introduce new words in context
7. Teaching notes from experienced users

Part 3: Chemical Weathering

11. Retrieve the FOSS trays
   Have students remove their group’s tray. Give students a few minutes to look at the tray and report what they observed. (The rocks are no longer itching.)

12. Discuss evaporating the vinegar
   Ask: How can we find out if a chemical reaction occurred, creating some material that dissolved in the liquid?

   Suggest: If students need help, that evaporating the liquid from each tray will provide evidence of dissolved material. If anything is left behind after evaporation, that is the material that dissolved.

   Materials for Step 9
   - Styptic witch

   TEACHING NOTE
   Students have completed the Mission and Master Module, they know that evaporation will separate the liquid from any dissolved solid material.
Teacher Resources

- Science and Engineering Practices
- Crosscutting Concepts
- Sense-Making Discussions
- Science Notebooks
- Taking FOSS Outdoors

- Access and Equity
- Science-Centered Language Development
- Common Core Connections in ELA and Math
- Planning Guide
Thank you!

- Evaluations
- Drawing for $75 Gift Certificate!

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