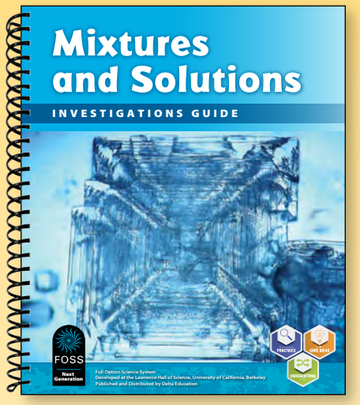
FOSS

Developed at:

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

A lifelong fascination with science starts here.

FOSS K-8 Sampler



FOSS COMPONENTS

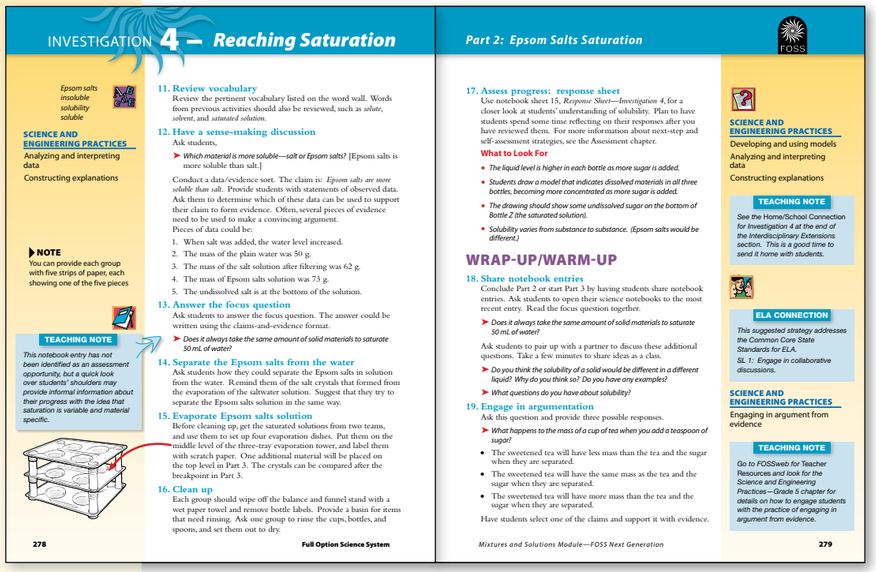
Teacher Toolkit for Each Module

The FOSS Next Generation Program has three modules for grade 5—Mixtures and Solutions, Living Systems, and Earth and Sun.

Each module comes with a *Teacher Toolkit* for that module. The *Teacher Toolkit* is the most important part of the FOSS Program. It is here that all the wisdom and experience contributed by hundreds of educators has been assembled. Everything we know about the content of the module, how to teach the subject, and the resources that will assist the effort are presented here. Each toolkit has three parts.

Investigations Guide. This spiral-bound document contains these chapters.

- Overview
- Framework and NGSS
- Materials
- Technology
- Investigations (five in this module)
- Assessment



INVESTIGATION 4 — *Reaching Saturation*

Part 2: Epsom Salts Saturation

Epsom salts
insoluble
solubility
soluble

SCIENCE AND ENGINEERING PRACTICES
Analyzing and interpreting data
Constructing explanations

NOTE
You can provide each group with five strips of paper, each showing one of the five pieces

TEACHING NOTE
This notebook entry has not been identified as an assessment opportunity, but a quick look over students' shoulders may provide informal information about their progress with the idea that saturation is variable and material specific.

11. Review vocabulary
Review the pertinent vocabulary listed on the word wall. Words from previous activities should also be reviewed, such as *solute*, *solvent*, and *saturated solution*.

12. Have a sense-making discussion
Ask students,

➤ *Which material is more soluble—salt or Epsom salts?* [Epsom salts is more soluble than salt.]

Conduct a data/evidence sort. The claim is: *Epsom salts are more soluble than salt.* Provide students with statements of observed data. Ask them to determine which of these data can be used to support their claim to form evidence. Often, several pieces of evidence need to be used to make a convincing argument.
Pieces of data could be:

1. When salt was added, the water level increased.
2. The mass of the plain water was 50 g.
3. The mass of the salt solution after filtering was 62 g.
4. The mass of Epsom salts solution was 73 g.
5. The undissolved salt is at the bottom of the solution.

13. Answer the focus question
Ask students to answer the focus question. The answer could be written using the claims-and-evidence format.

➤ *Does it always take the same amount of solid materials to saturate 50 mL of water?*

14. Separate the Epsom salts from the water
Ask students how they could separate the Epsom salts in solution from the water. Remind them of the salt crystals that formed from the evaporation of the saltwater solution. Suggest that they try to separate the Epsom salts solution in the same way.

15. Evaporate Epsom salts solution
Before cleaning up, get the saturated solutions from two teams, and use them to set up four evaporation dishes. Put them on the middle level of the three-tray evaporation tower, and label them with scratch paper. One additional material will be placed on the top level in Part 3. The crystals can be compared after the breakpoint in Part 3.

16. Clean up
Each group should wipe off the balance and funnel stand with a wet paper towel and remove bottle labels. Provide a basin for items that need rinsing. Ask one group to rinse the cups, bottles, and spoons, and set them out to dry.

17. Assess progress: response sheet
Use notebook sheet 15, *Response Sheet—Investigation 4*, for a closer look at students' understanding of solubility. Plan to have students spend some time reflecting on their responses after you have reviewed them. For more information about next-step and self-assessment strategies, see the Assessment chapter.

What to Look For

- *The liquid level is higher in each bottle as more sugar is added.*
- *Students draw a model that indicates dissolved materials in all three bottles, becoming more concentrated as more sugar is added.*
- *The drawing should show some undissolved sugar on the bottom of Bottle Z (the saturated solution).*
- *Solubility varies from substance to substance. (Epsom salts would be different.)*

WRAP-UP/WARM-UP

18. Share notebook entries
Conclude Part 2 or start Part 3 by having students share notebook entries. Ask students to open their science notebooks to the most recent entry. Read the focus question together.

➤ *Does it always take the same amount of solid materials to saturate 50 mL of water?*

Ask students to pair up with a partner to discuss these additional questions. Take a few minutes to share ideas as a class.

➤ *Do you think the solubility of a solid would be different in a different liquid? Why do you think so? Do you have any examples?*

➤ *What questions do you have about solubility?*

19. Engage in argumentation
Ask this question and provide three possible responses.

➤ *What happens to the mass of a cup of tea when you add a teaspoon of sugar?*

- The sweetened tea will have less mass than the tea and the sugar when they are separated.
- The sweetened tea will have the same mass as the tea and the sugar when they are separated.
- The sweetened tea will have more mass than the tea and the sugar when they are separated.

Have students select one of the claims and support it with evidence.

SCIENCE AND ENGINEERING PRACTICES
Developing and using models
Analyzing and interpreting data
Constructing explanations

TEACHING NOTE
See the Home/School Connection for Investigation 4 at the end of the Interdisciplinary Extensions section. This is a good time to send it home with students.

ELA CONNECTION
This suggested strategy addresses the Common Core State Standards for ELA.
SL.1: Engage in collaborative discussions.

SCIENCE AND ENGINEERING PRACTICES
Engaging in argument from evidence

TEACHING NOTE
Go to FOSSweb for Teacher Resources and look for the Science and Engineering Practices—Grade 5 chapter for details on how to engage students with the practice of engaging in argument from evidence.

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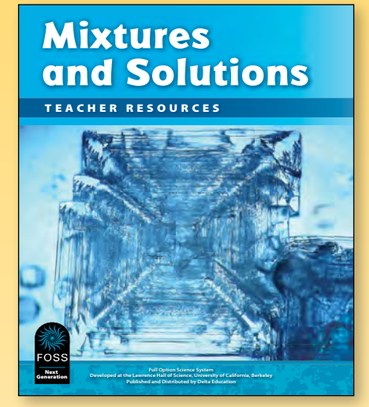
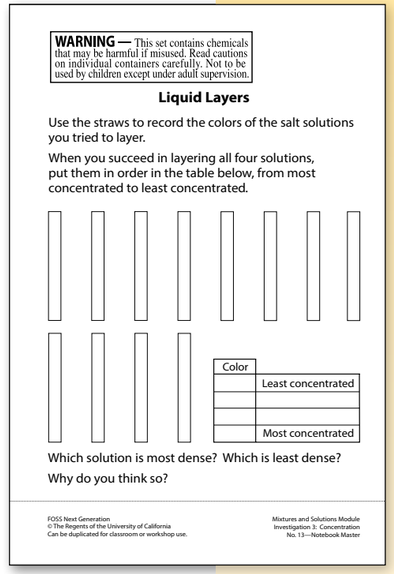
Mixtures and Solutions Module—FOSS Next Generation 279

FOSS Science Resources book. One copy of the student book of readings is included in the *Teacher Toolkit*.

Teacher Resources. These chapters can be downloaded from FOSSweb and are also in the bound *Teacher Resources* book.

- FOSS Program Goals
- Planning Guide—Grade 5
- Science and Engineering Practices—Grade 5
- Crosscutting Concepts—Grade 5
- Sense-Making Discussions for Three-Dimensional Learning—Grade 5
- Access and Equity
- Science Notebooks in Grades 3–5
- Science-Centered Language Development
- FOSS and Common Core ELA—Grade 5
- FOSS and Common Core Math—Grade 5
- Taking FOSS Outdoors
- Science Notebook Masters
- Teacher Masters
- Assessment Masters





WARNING — This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

Liquid Layers

Use the straws to record the colors of the salt solutions you tried to layer.

When you succeed in layering all four solutions, put them in order in the table below, from most concentrated to least concentrated.

Color	
	Least concentrated
	Most concentrated

Which solution is most dense? Which is least dense?

Why do you think so?

FOSS Next Generation
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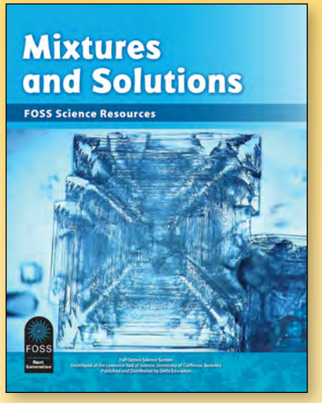
Can be duplicated for classroom or workshop use.

Mixtures and Solutions Module
Investigation 3: Concentration
No. 13—Notebook Master

Equipment for Each Module or Grade Level

The FOSS Program provides the materials needed for the investigations, in sturdy, front-opening drawer-and-sleeve cabinets. Inside, you will find high-quality materials packaged for a class of 32 students. Consumable materials are supplied for three uses before you need to resupply. Teachers may be asked to supply small quantities of common classroom materials.

Delta Education can assist you with materials management strategies for schools, districts, and regional consortia.



FOSS Science Resources Books

FOSS Science Resources: Mixtures and Solutions is a book of original readings developed to accompany this module. The readings are referred to as articles in *Investigations Guide*. Students read the articles in the book as they progress through the module. The articles cover specific concepts, usually after the concepts have been introduced in the active investigation.

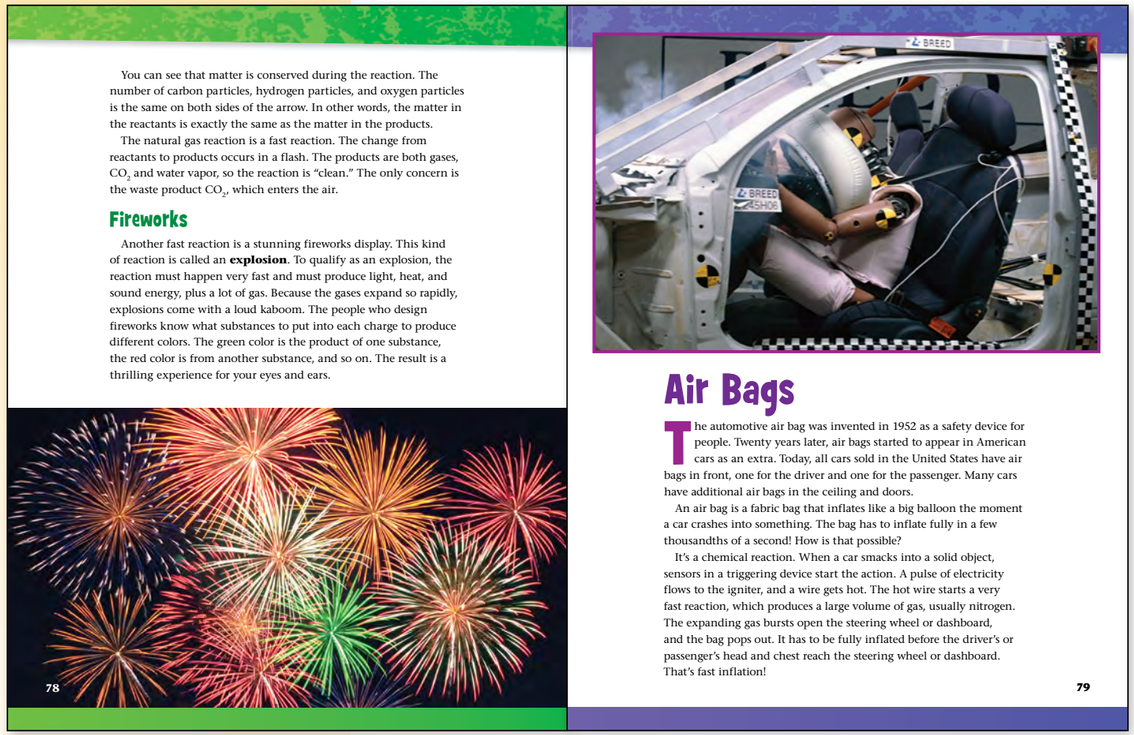
The articles in *FOSS Science Resources* and the discussion questions provided in *Investigations Guide* help students make connections to the science concepts introduced and explored during the active investigations. Concept development is most effective when students are allowed to experience organisms, objects, and phenomena firsthand before engaging the concepts in text. The text and illustrations help make connections between what students experience concretely and the ideas that explain their observations.

Technology

The FOSS website opens new horizons for educators, students, and families, in the classroom or at home. Each module has digital resources for students and families—interactive simulations, virtual investigations, and online activities. For teachers, FOSSweb provides online teacher *Investigations Guides*; grade-level planning guides (with connections to ELA and math); materials management strategies; science teaching and professional development tools; contact information for the FOSS Program developers; and technical support. In addition, FOSSweb provides digital access to PDF versions of the *Teacher Resources* component of the *Teacher Toolkit*, digital-only instructional resources that supplement the print and kit materials, and access to FOSSmap, the online assessment and reporting system for grades 3–8.

With an educator account, you can customize your homepage, set up easy access to the digital components of the modules you teach, and create class pages for your students with access to tutorials and online assessments.

NOTE
To access all the teacher resources and to set up customized pages for using FOSS, log in to FOSSweb through an educator account. See the Technology chapter in this guide for more specifics.



You can see that matter is conserved during the reaction. The number of carbon particles, hydrogen particles, and oxygen particles is the same on both sides of the arrow. In other words, the matter in the reactants is exactly the same as the matter in the products.

The natural gas reaction is a fast reaction. The change from reactants to products occurs in a flash. The products are both gases, CO_2 and water vapor, so the reaction is "clean." The only concern is the waste product CO_2, which enters the air.

Fireworks

Another fast reaction is a stunning fireworks display. This kind of reaction is called an **explosion**. To qualify as an explosion, the reaction must happen very fast and must produce light, heat, and sound energy, plus a lot of gas. Because the gases expand so rapidly, explosions come with a loud kaboom. The people who design fireworks know what substances to put into each charge to produce different colors. The green color is the product of one substance, the red color is from another substance, and so on. The result is a thrilling experience for your eyes and ears.

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Air Bags

The automotive air bag was invented in 1952 as a safety device for people. Twenty years later, air bags started to appear in American cars as an extra. Today, all cars sold in the United States have air bags in front, one for the driver and one for the passenger. Many cars have additional air bags in the ceiling and doors.

An air bag is a fabric bag that inflates like a big balloon the moment a car crashes into something. The bag has to inflate fully in a few thousandths of a second! How is that possible?

It's a chemical reaction. When a car smacks into a solid object, sensors in a triggering device start the action. A pulse of electricity flows to the igniter, and a wire gets hot. The hot wire starts a very fast reaction, which produces a large volume of gas, usually nitrogen. The expanding gas bursts open the steering wheel or dashboard, and the bag pops out. It has to be fully inflated before the driver's or passenger's head and chest reach the steering wheel or dashboard. That's fast inflation!

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Ongoing Professional Learning

The Lawrence Hall of Science and Delta Education strive to develop long-term partnerships with districts and teachers through thoughtful planning, effective implementation, and ongoing teacher support. FOSS has a strong network of consultants who have rich and experienced backgrounds in diverse educational settings using FOSS.

NOTE
Look for professional development opportunities and online teaching resources on www.FOSSweb.com.

FOSS INSTRUCTIONAL DESIGN

FOSS is designed around active investigation that provides engagement with science concepts and science and engineering practices. Surrounding and supporting those firsthand investigations are a wide range of experiences that help build student understanding of core science concepts and deepen scientific habits of mind.

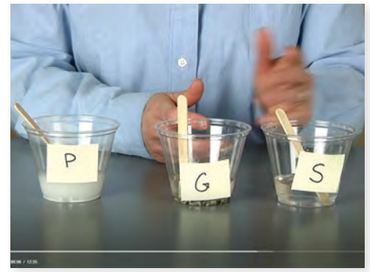
The Elements of the FOSS Instructional Design

Teacher Support

Tools for Effective Teaching

Three-Dimensional Learning Support

Investigation-specific scientific background information for the teacher is presented in each investigation chapter organized by the focus questions. The **Teaching Children about** section makes direct connections to the NGSS for the grade level and are referenced throughout the investigations. For example, see pages 90–95 of your ***FOSS Mixtures and Solutions*** *Investigations Guide.*



Teacher Preparation Video

Teacher Preparation Videos

Videos provide helpful equipment setup instructions, safety information, and a summary of what students will do and learn throughout a part.

Teacher Resource Introductory Videos

Videos provide a general overview of the instructional practices such as making sense of phenomena and sense-making discussions, within FOSS lessons in actual classrooms.

Access and Equity Video

Custom Professional Learning

FOSS provides unrivaled teacher support through its strong network of consultants who have rich and experienced backgrounds in diverse educational settings using FOSS.

Home/School Connections

Home-based activities in science and math that can be used for parent involvement or remote learning.

Figuring Out Phenomena

Student Work and Multisensory Strategies

Throughout the FOSS investigations, all students experience multiple ways of interacting with and figuring out phenomena and expressing their understanding through a variety of modalities. Here's an example of weaving a relevant phenomenon into the Guiding the Investigation of FOSS. The yellow step boxes inserted below into the flow of Guiding illustrate how that is done.

Introduce the anchor phenomenon to organize students' learning, activate prior knowledge, and elicit questions.

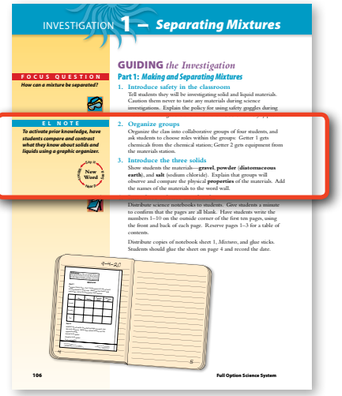
EL NOTE

To activate prior knowledge, have students compare and contrast what they know about solids and liquids using a graphic organizer.

2. Organize groups
Organize the class into collaborative groups of four students, and ask students to choose roles within the groups: Getter 1 gets chemicals from the chemical station; Getter 2 gets equipment from the materials station.

3. Introduce the three solids
Show students the materials—**gravel**, **powder** (**diatomaceous earth**), and **salt** (sodium chloride). Explain that groups will observe and compare the physical **properties** of the materials. Add the names of the materials to the word wall.

STEP 3 Share the scenario about students observing a pond at the construction site. Have students share their prior knowledge with a partner about the phenomenon. Ask students what questions they have about the scenario and ideas they could try to find out what might be happening. When students suggest they test different materials, introduce the three solids.


INVESTIGATION 1 — *Separating Mixtures*

FOCUS QUESTION
How can a mixture be separated?

GUIDING *the Investigation*
Part 1: *Making and Separating Mixtures*

1. **Introduce safety in the classroom**
Tell students they will be investigating solid and liquid materials. Caution them never to taste any materials during science investigations. Explain the policy for using safety goggles during

EL NOTE
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Show students the materials—**gravel**, **powder** (**diatomaceous earth**), and **salt** (sodium chloride). Explain that groups will observe and compare the physical **properties** of the materials. Add the names of the materials to the word wall.

Distribute science notebooks to students. Give students a minute to confirm that the pages are all blank. Have students write the numbers 1–10 on the outside corner of the first ten pages, using the front and back of each page. Reserve pages 1–3 for a table of contents.

Distribute copies of notebook sheet 1, *Mixtures*, and glue sticks. Students should glue the sheet on page 4 and record the date.

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Investigation 1, Part 1
Steps 2 and 3, Page 106

Students carry out investigations with science equipment to collect data about core ideas.

7. Describe the materials
Ask a few students to describe their observations. During this time, you can provide additional information about the solid materials. Students may want to write this additional information on the page facing the notebook sheet.

- The gravel is natural rock material found in rivers and streams.
- The powder (diatomaceous earth) is used in filters, such as swimming-pool filters. It is the shell remains of aquatic organisms called diatoms.
- The salt is sodium chloride, the same salt used to season food.

8. Add water to each cup
Ask,

➤ *What do you think might happen if you add water to each cup containing the dry materials?*

After students share their ideas, preview Part 2 of the notebook sheet. Have Getter 2s get a basin containing a syringe, three stirring sticks, a container of water, and a paper towel. Outline what students should do.

a. Use the syringe to put 50 mL of water into each cup.

b. Stir the contents with a stick.

c. Observe what happens, and record it in your notebook.

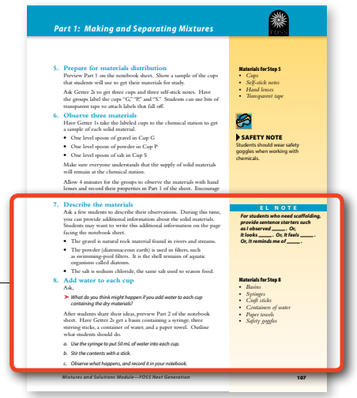
EL NOTE

For students who need scaffolding, provide sentence starters such as I observed _____. Or, It looks _____. Or, It feels _____. Or, It reminds me of _____.

Materials for Step 8
- *Basins*
- *Syringes*
- *Craft sticks*
- *Containers of water*
- *Paper towels*
- *Safety goggles*

STEP 7 Be sure to make the connection between the materials used and the materials at the construction site. The powder is similar to the small particles of rocks (clay). The salt could be a chemical at the construction site.

STEP 8 Have students collect data about the materials when combined with water.


Part 1: Making and Separating Mixtures

5. **Prepare for materials distribution**
Preview Part 1 on the notebook sheet. Show a sample of the cups that students will use to get their materials for study.
Ask Getter 2s to get three cups and three self-stick notes. Have the groups label the cups "C," "P," and "S." Students can use bits of transparent tape to attach labels that fall off.

6. **Observe three materials**
Have Getter 1s take the labeled cups to the chemical station to get a sample of each solid material.
- One level spoon of gravel in Cup G
- One level spoon of powder in Cup P
- One level spoon of salt in Cup S

Make sure everyone understands that the supply of solid materials will remain at the chemical station.
Allow 4 minutes for the groups to observe the materials with hand lenses and record their properties in Part 1 of the sheet. Encourage

Materials for Step 1
- *Cups*
- *Self-stick notes*
- *Hand lenses*
- *Transparent tape*

SAFETY NOTE
Students should wear safety goggles when working with chemicals.

7. **Describe the materials**
Ask a few students to describe their observations. During this time, you can provide additional information about the solid materials. Students may want to write this additional information on the page facing the notebook sheet.
- The gravel is natural rock material found in rivers and streams.
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EL NOTE
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Ask,

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a. Use the syringe to put 50 mL of water into each cup.
b. Stir the contents with a stick.
c. Observe what happens, and record it in your notebook.

Materials for Step 8
- *Basins*
- *Syringes*
- *Craft sticks*
- *Containers of water*
- *Paper towels*
- *Safety goggles*

Mixtures and Solutions Module—FOSS Next Generation 107

Investigation 1, Part 1
Steps 7 and 8, Page 107

Students engage in sense-making discussions to analyze collected data and connect it to the anchor phenomenon.

14. Have a sense-making discussion
After the powder-and-salt mixtures have been filtered, ask students to carefully open up the two filter papers and spread them flat on a paper towel on the table. Ask,

➤ *Which mixtures were you able to separate with a filter?* [Only the powder and water.]

➤ *What caused the powder to separate from the water?* [The holes in the filter paper were too small.]

➤ *How are a screen and a paper filter similar? How are they different?* [Both separate materials, but the paper filter has finer holes.]

15. Introduce *solution*
Have students discuss in their groups what they think happened to the salt. Record a few of their ideas on chart paper, then explain,

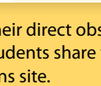
*If a solid material is mixed with water, and the solid material disappears in the water, the mixture is a **solution**. Salt disappears, or **dissolves**, in water to make a saltwater solution.*

*When a solid material dissolves in water, the solution is **transparent** (clear), and it can't be separated with a filter.*

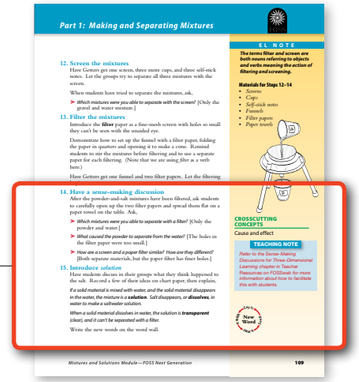
Write the new words on the word wall.

CROSSCUTTING CONCEPTS
Cause and effect

TEACHING NOTE
Refer to the Sense-Making Discussions for Three-Dimensional Learning chapter in Teacher Resources on FOSSweb for more information about how to facilitate this with students.



STEP 14 Ask students to make the connection between their direct observations and those the students made at the constructions site. Have students share their thinking about what is happening with the pond at the constructions site.


Part 1: Making and Separating Mixtures

12. **Screen the mixtures**
Have Getters get one screen, three more cups, and three self-stick notes. Let the groups try to separate all three mixtures with the screen.
When students have tried to separate the mixtures, ask,
➤ *Which mixtures were you able to separate with the screen?* [Only the gravel and water mixture.]

13. **Filter the mixtures**
Introduce the **filter** paper as a fine-mesh screen with holes so small they can't be seen with the unaided eye.
Demonstrate how to set up the funnel with a filter paper, folding the paper in quarters and opening it to make a cone. Remind students to stir the mixtures before filtering and to use a separate paper for each filtering. (Note that we are using filter as a verb here.)
Have Getters get one funnel and two filter papers. Let the filtering

EL NOTE
The terms filter and screen are both nouns referring to objects and verbs meaning the action of filtering and screening.

Materials for Steps 12–14
- *Screens*
- *Cups*
- *Self-stick notes*
- *Funnels*
- *Filter papers*
- *Paper towels*

14. **Have a sense-making discussion**
After the powder-and-salt mixtures have been filtered, ask students to carefully open up the two filter papers and spread them flat on a paper towel on the table. Ask,
➤ *Which mixtures were you able to separate with a filter?* [Only the powder and water.]
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*When a solid material dissolves in water, the solution is **transparent** (clear), and it can't be separated with a filter.*
Write the new words on the word wall.

CROSSCUTTING CONCEPTS
Cause and effect

TEACHING NOTE
Refer to the Sense-Making Discussions for Three-Dimensional Learning chapter in Teacher Resources on FOSSweb for more information about how to facilitate this with students.

Say it / New Word / See it / Hear it

Mixtures and Solutions Module—FOSS Next Generation 109

Investigation 1, Part 1
Steps 14 and 15, Page 109

Students use informational text and digital resources to gather evidence and confirm or revise their thinking.

FOSS Science Resources student interactive eBook

"Solutions" online tutorial

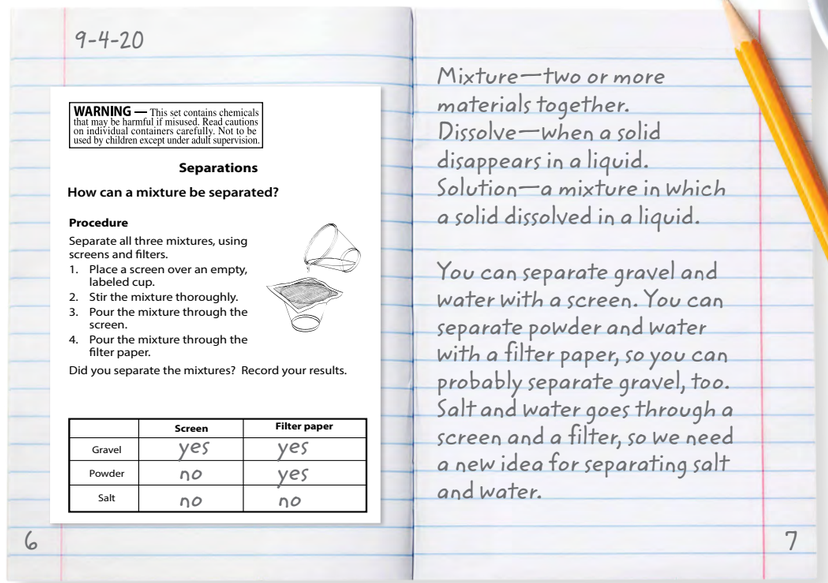
"Separating Mixtures" online activity

Student Progress

Three-Dimensional Performances

The FOSS Assessment System includes both formative and summative assessments. FOSS provides a variety of tools to monitor learning, measure progress, and support self-reflection for learning.

Students construct an explanation of the phenomenon in their science notebook.



9-4-20

WARNING — This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

Separations

How can a mixture be separated?

Procedure

Separate all three mixtures, using screens and filters.

1. Place a screen over an empty, labeled cup.
2. Stir the mixture thoroughly.
3. Pour the mixture through the screen.
4. Pour the mixture through the filter paper.

Did you separate the mixtures? Record your results.

	Screen	Filter paper
Gravel	yes	yes
Powder	no	yes
Salt	no	no

6

Mixture—two or more materials together.
Dissolve—when a solid disappears in a liquid.
Solution—a mixture in which a solid dissolved in a liquid.

You can separate gravel and water with a screen. You can separate powder and water with a filter paper, so you can probably separate gravel, too. Salt and water goes through a screen and a filter, so we need a new idea for separating salt and water.

7

Teacher assesses student progress by using the "What to Look For" in the *Investigations Guide*.

20. Assess progress: notebook entry

Collect students' notebooks. After class, check that students can explain the difference between a mixture and a solution, and the phenomenon of dissolving.

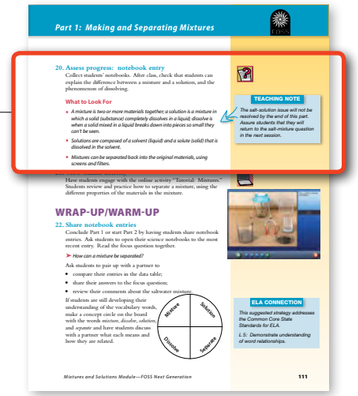
What to Look For

- *A mixture is two or more materials together; a solution is a mixture in which a solid (substance) completely dissolves in a liquid; dissolve is when a solid mixed in a liquid breaks down into pieces so small they can't be seen.*
- *Solutions are composed of a solvent (liquid) and a solute (solid) that is dissolved in the solvent.*
- *Mixtures can be separated back into the original materials, using screens and filters.*

TEACHING NOTE

The salt-solution issue will not be resolved by the end of this part. Assure students that they will return to the salt-mixture question in the next session.

STEP 20 As students identify the effects of combining materials with water, chart them on the board. Ask students to revisit their explanation of the anchor phenomenon.



Part 1: Making and Separating Mixtures

20. Assess progress: notebook entry

Collect students' notebooks. After class, check that students can explain the difference between a mixture and a solution, and the phenomenon of dissolving.

What to Look For

- A mixture is two or more materials together; a solution is a mixture in which a solid (substance) completely dissolves in a liquid; dissolve is when a solid mixed in a liquid breaks down into pieces so small they can't be seen.
- Solutions are composed of a solvent (liquid) and a solute (solid) that is dissolved in the solvent.
- Mixtures can be separated back into the original materials, using screens and filters.

TEACHING NOTE

The salt-solution issue will not be resolved by the end of this part. Assure students that they will return to the salt-mixture question in the next session.

Have students engage with the online activity "Tutorial: Mixtures." Students review and practice how to separate a mixture, using the different properties of the materials in the mixture.

WRAP-UP/WARM-UP

22. Share notebook entries

Conclude Part 1 or start Part 2 by having students share notebook entries. Ask students to open their science notebooks to the most recent entry. Read the focus question together.

➤ *How can a mixture be separated?*

Ask students to pair up with a partner to

- compare their entries in the data table;
- share their answers to the focus question;
- review their comments about the saltwater mixture.

If students are still developing their understanding of the vocabulary words, make a concept circle on the board with the words *mixture, dissolve, solution,* and *separate* and have students discuss with a partner what each means and how they are related.

ELA CONNECTION

This suggested strategy addresses the Common Core State Standards for ELA.

L.5: Demonstrate understanding of word relationships.

Mixtures and Solutions Module—FOSS Next Generation 111

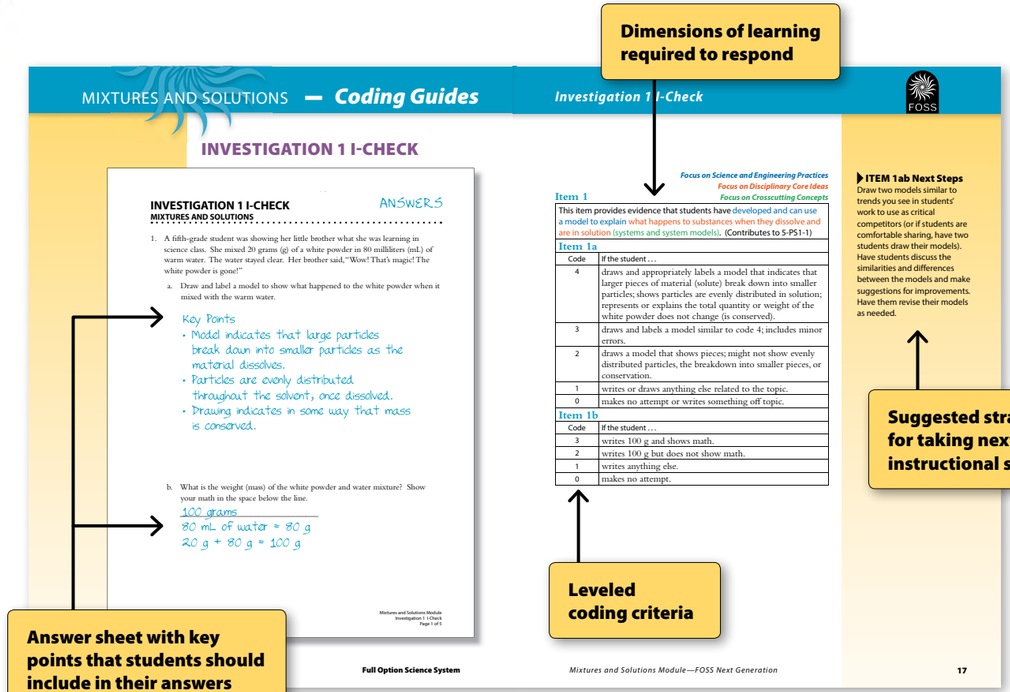
Investigation 1, Part 1
Step 20, Page 111

FOSS helps teachers monitor progress.

The **Assessment Coding Guide (ACG)** on FOSSweb helps teachers assess student learning of the Performance Expectations. Next-step strategies are provided to allow students time to reflect and revise explanations and models through an iterative process.

These Performance Expectations are addressed in Investigation 1 of ***FOSS Mixtures and Solutions*.**

- **5-PS1-1.** Develop a model to describe that matter is made of particles too small to be seen.
- **5-PS1-2.** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
- **3-5-ETS1-1.** Define a simple design problem reflecting a need or 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.



Dimensions of learning required to respond

MIXTURES AND SOLUTIONS — *Coding Guides* — *Investigation 1 I-Check*

INVESTIGATION 1 I-CHECK

INVESTIGATION 1 I-CHECK ANSWERS

MIXTURES AND SOLUTIONS

1. A fifth-grade student was showing her little brother what she was learning in science class. She mixed 20 grams (g) of a white powder in 80 milliliters (mL) of warm water. The water stayed clear. Her brother said, "Wow! That's magic! The white powder is gone!"

   a. Draw and label a model to show what happened to the white powder when it mixed with the warm water.

Key Points
- Model indicates that large particles break down into smaller particles as the material dissolves.
- Particles are evenly distributed throughout the solvent, once dissolved.
- Drawing indicates in some way that mass is conserved.

   b. What is the weight (mass) of the white powder and water mixture? Show your math in the space below the line.

100 grams
80 mL of water = 80 g
20 g + 80 g = 100 g

Mixtures and Solutions Module Investigation 1 I-Check Page 1 of 5

Answer sheet with key points that students should include in their answers

Focus on Science and Engineering Practices
Focus on Disciplinary Core Ideas
Focus on Crosscutting Concepts

Item 1

This item provides evidence that students have developed and can use a model to explain what happens to substances when they dissolve and are in solution (systems and system models). (Contributes to 5-PS1-1)

Item 1a

Code	If the student …
4	draws and appropriately labels a model that indicates that larger pieces of material (solute) break down into smaller particles; shows particles are evenly distributed in solution; represents or explains the total quantity or weight of the white powder does not change (is conserved).
3	draws and labels a model similar to code 4; includes minor errors.
2	draws a model that shows pieces; might not show evenly distributed particles, the breakdown into smaller pieces, or conservation.
1	writes or draws anything else related to the topic.
0	makes no attempt or writes something off topic.

Item 1b

Code	If the student …
3	writes 100 g and shows math.
2	writes 100 g but does not show math.
1	writes anything else.
0	makes no attempt.

Leveled coding criteria

ITEM 1ab Next Steps

Draw two models similar to trends you see in students' work to use as critical competitors (or if students are comfortable sharing, have two students draw their models). Have students discuss the similarities and differences between the models and make suggestions for improvements. Have them revise their models as needed.

Suggested strategies for taking next instructional steps

Full Option Science System

Mixtures and Solutions Module—FOSS Next Generation 17

Other assessment tools to monitor student progress include response sheets (grades 3-5), teacher observation using three-dimensional checklists, performance assessments, and interim assessments (grades 3-5).

Diverse Learning Needs

Designed for All Learners

Access and Equity

The FOSS Program has been designed to maximize the science learning opportunities for all students, including those who have traditionally not had access to or have not benefited from equitable science experiences—students with special needs, ethnically diverse learners, English learners, students living in poverty, girls, and advanced and gifted learners. FOSS is rooted in a 30-year tradition of multisensory science education and informed by recent research on UDL and culturally and linguistically responsive teaching and learning. See the Access and Equity chapter on FOSSweb for strategies and suggestions.

English Language Development (ELD)

The FOSS active investigations, science notebooks, *FOSS Science Resources* articles, and formative assessments provide rich contexts in which students develop and exercise thinking and communication in both science and language arts. Students experience the natural world in real and authentic ways and use language to inquire, process information, and communicate their thinking about scientific phenomena.

Logical Sequence

Designed for NGSS

The FOSS curriculum provides a coherent vision of science teaching and learning. The program is designed around learning as a developmental progression, providing experiences that allow students to continually build on their initial notions and develop more complex science and engineering knowledge throughout a module and at multiple grade levels. FOSS investigations integrate engagement with scientific ideas (content) and the practices of science and engineering by providing firsthand experiences.

GRADE 5: *FOSS Mixtures and Solutions* Learning Progression

Driving Questions for Anchor Phenomena: What is matter? What happens when matter interacts?

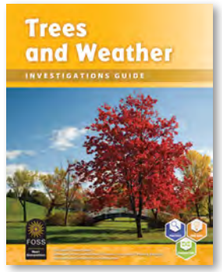
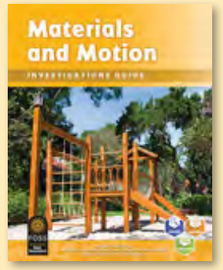
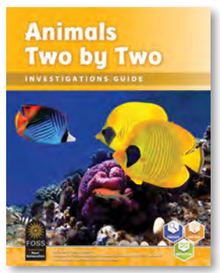
ANCHOR PHENOMENON 1	ANCHOR PHENOMENON 2	ANCHOR PHENOMENON 3
What caused the formation of the pond and how do you explain the changes observed to the water and plants?	**How can you identify the mystery substance safely?**	**What causes you to burp?**
INVESTIGATIONS 1–3	**INVESTIGATION 4**	**INVESTIGATION 5**
NGSS PEs: 5-PS1-1, 5-PS1-2, 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3	**NGSS PEs: 5-PS1-1, 5-PS1-2 , 5-PS1-3, 3-5-ETS1-1, 3-5-ETS1-2**	**NGSS PEs: 5-PS1-1, 5-PS1-2, 5-PS1-3 5-PS1-4**
Students investigate the changes to water and plants in a pond after a hard rain. They begin to construct an explanation of the changes in the water by mixing three solid materials (gravel, powder, and salt) into cups of water to observe three types of mixtures, revealing a phenomenon; dissolving. Next, they use measurement tools to gather evidence that the dissolved material (salt) is still present, but not visible (conservation of matter), and develop a model for the dissolved salt in water. Then, they use evaporation to separate salt from water. They apply what they learned about separating mixtures to construct an explanation of the changes to the water that has ponded. Finally, they analyze solutions and develop a model for concentration and use this model to determine impact of concentration of solutions on plants.	Students are given a problem to determine a mystery substance. They compare the amount of different substances that dissolve in a given amount of water. They analyze the crystal signature of different substances and then plan and carry out investigations using the properties of solubility and crystal pattern to identify the mystery substance.	Students combine two substances with water to discover the a chemical reaction. They collect and analyze data about the effects of mixing different combinations of substances with water to discover that new substances with different properties form. They construct explanations about the amount of a new substance produced in different chemical reactions and apply these ideas to explain what causes a burp.

FOSS Next Generation K–8 Topic Arrangement Learning Progression

PRIOR KNOWLEDGE		FUTURE KNOWLEDGE
KINDERGARTEN	**GRADE 2**	**MIDDLE SCHOOL**
PEs: K-PS3-2, K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3	**PEs: 2-PS1-1, 2-PS1-2, 2-PS1-3, 2-PS1-4, K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3**	**PEs: MS-PS1-1, MS-PS1-2, MS-PS1-3, MS-PS1-4, MS-PS1-5, MS-PS1-6, MS-PS3-3, MS-PS3-4, MS-PS3-5, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4**
In ***FOSS Materials and Motion,*** students conduct investigations to identify and compare properties of common solid materials. They learn that different properties are suited for different purposes. They use these ideas to design and build a structure with materials that will reduce the warming effect of sunlight on an area.	In ***FOSS Solids and Liquids,*** students plan and conduct investigations to describe and classify materials by their observable properties. They design, construct, and reconstruct structures (towers and bridges) using a set of objects that meet criteria. After exploring properties of liquids, they observe what happens when common materials are mixed. Finally, they explore changes to materials due to heating and cooling and argue with evidence if toothpaste is a solid or liquid.	In ***FOSS Chemical Interactions,*** students build on matter interactions, introduced in grade 5. They observe a (chemical) reaction of a mystery mixture of two solid substances and water. They conduct investigations to figure out the composition of the mystery mixture, using materials, virtual simulations, and readings. They learn about elements, atoms and molecules, phase change, kinetic energy, and the conservation of matter. They design a thermos to apply ideas related to energy transformations. As they experience different reactions, they develop models to describe the atomic composition of simple molecules and conclude by applying the ideas to the mystery mixture.

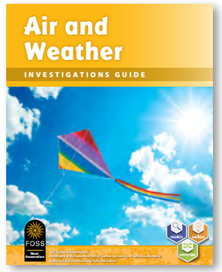
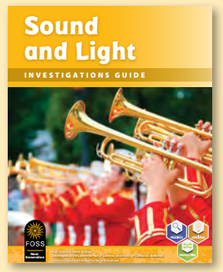
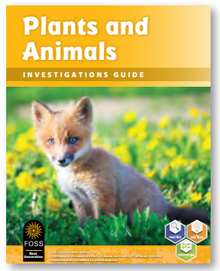
Instructional Segments

Grade K At a Glance

Module Storyline	NGSS Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 **4 INVESTIGATIONS** **Trees and Weather Module** To a kindergartner, the oak on the corner, the pines at the park, and the mulberry tree at school are all phenomena. Systematic investigation of trees over the seasons provides students with a better understanding of the place of trees in the community. Students observe day-to-day changes in weather over the year and the impact weather has on living things. Students have experiences that help them understand what plants (and animals) need to survive and the relationship between their needs and where they live. By monitoring weather, they find patterns and variations in weather and come to understand the importance of weather forecasts to prepare for severe weather.	**LIFE SCIENCES:** **K-LS1-1*** **EARTH AND SPACE SCIENCES:** **K-ESS2-1, K-ESS2-2*, K-ESS3-1*, K-ESS3-2** **PHYSICAL SCIENCES:** **K-PS3-1*** **ETAS: K-2-ETS1-2** * These PEs are addressed in two kindergarten modules.	**LS1.A:** Structure and function **LS1.C:** Organization for matter and energy flow in organisms **ESS2.D:** Weather and climate **ESS2.E:** Biogeology **ESS3.A:** Natural resources **ESS3.B:** Natural hazards **PS3.B:** Conservation of energy and energy transfer **ETS1.B:** Developing possible solutions	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Structure and function • Stability and change
 **4 INVESTIGATIONS** **Materials and Motion Module** Students start by investigating materials—wood, paper, and fabric—and determine how material properties determine their use. Students use those materials to engineer structures, applying ideas of energy transfer. Students come to understand that humans use natural resources for everything they do and that people impact the world around them. After building a repertoire of practices with materials and objects, students investigate the effect of pushes and pulls on objects, and apply their intuitive notion of the concept of variables to change the speed and direction of rolling balls and balloon rockets to achieve specific outcomes.	**PHYSICAL SCIENCES:** **K-PS2-1, K-PS2-2, K-PS3-1*, K-PS3-2** **EARTH AND SPACE SCIENCES:** **K-ESS3-3** **ETAS: K-2-ETS1-1, K-2-ETS1-2*, K-2-ETS1-3** * These PEs are addressed in two kindergarten modules.	**PS1.A:** Structures and properties of matter **PS2.A:** Forces and motion **PS2.B:** Types of interactions **PS3.B:** Conservation of energy and energy transfer **PS3.C:** Relationship between energy and forces **ESS3.A**: Natural resources **ESS3.C:** Human impacts on Earth systems **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Energy and matter • Structure and function
 **4 INVESTIGATIONS** **Animals Two by Two Module** Students have close and personal interactions with common land and water animals—observing and describing the structures of fish, birds, snails, earthworms, and isopods. Classroom habitats are established for some organisms and students find out what the animals need to live and grow. Animals are studied in pairs. Students observe and care for one animal over time, and then they are introduced to another animal similar to the first but with differences in structure and behavior. Close-up photos, some related to animals that students have observed in class and some to animals that are new, enhance the firsthand activities for rich comparisons.	**LIFE SCIENCES:** **K-LS1-1*** **EARTH AND SPACE SCIENCES:** **K-ESS2-2*, K-ESS3-1*** * These PEs are addressed in two kindergarten modules.	**LS1.A:** Structure and function **LS1.C:** Organization for matter and energy flow in organisms **ESS2.E:** Biogeology **ESS3.A:** Natural resources	• Asking questions and defining problems • Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Constructing explanations and designing solutions • Engaging in argument from evidence • Obtaining, evaluating, and communicating information	• Patterns • Cause and effect • Systems and system models • Structure and function

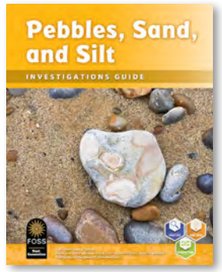
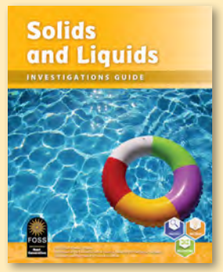
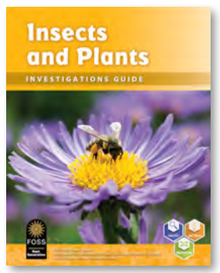
Instructional Segments

Grade 1 At a Glance

Module Storyline	NGSS Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 **4 INVESTIGATIONS** **Air and Weather Module** Students turn their focus upward to explore that objects in the sky change position in predictable ways. They explore the natural world by using simple instruments and calendars to observe and monitor change. They use new tools and methods to build on their understanding of the weather and to find out about properties of air by exploring how objects interact with air. They observe daily changes in air temperature and connect them to the daily movement of the Sun in the sky. They monitor changes in hours of daylight over seasons and changing weather conditions. And they find the Moon in the day and night skies and monitor its movement over the month.	**EARTH AND SPACE SCIENCES:** **1-ESS1-1, 1-ESS1-2** **ETAS: K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3**	**ESS1.A:** The universe and its stars **ESS1.B:** Earth and the solar system **ESS2.D:** Weather and climate **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• 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 • Obtaining, evaluating, and communicating information	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Structure and function • Stability and change
 **4 INVESTIGATIONS** **Sound and Light Module** Students develop an understanding of how to observe and manipulate the phenomena of sound and light using simple tools and musical instruments. They learn that sound comes from vibrating objects, has volume and pitch, and develop simple models for how sound travels. With light, students find out what happens when materials with different properties are placed in a beam of light, and explore how to create and change shadows and reflections. Students explore how to use sound and light devices to communicate information and compare the ways that animals use their senses (ears and eyes) to gather information about their environment.	**PHYSICAL SCIENCES:** **1-PS4-1, 1-PS4-2, 1-PS4-3, 1-PS4-4** **LIFE SCIENCES:** **1-LS1-1** **ETAS: K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3**	**PS4.A:** Wave properties **PS4.B:** Electromagnetic radiation **PS4.C:** Information technologies and instrumentation **LS1.D:** Information processing **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• Asking questions and defining problems • Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Constructing explanations and designing solutions • Obtaining, evaluating, and communicating information	• Patterns • Cause and effect • Systems and system models
 **4 INVESTIGATIONS** **Plants and Animals Module** Students observe firsthand the structures of plants and discover ways to propagate new plants from mature plants (from seeds, bulbs, roots, and stem cuttings). They observe and describe changes that occur as young plants grow, and compare classroom plants to those in the schoolyard. They design terrariums (habitat systems) and provide for the needs of both plants and animals living together in the classroom. They explore variation in the same kind of organism, including variation between young and adults, and find out about the behaviors of parents to help their offspring survive. They explore structure and function relationships as they sort different kinds of animal and plant structures, including animal sensory structures.	**LIFE SCIENCES:** **1-LS1-1, 1-LS1-2, 1-LS3-1** **ETAS: K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3**	**LS1.A:** Structure and function **LS1.B:** Growth and development of organisms **LS1.D:** Information processing **LS3.A:** Inheritance of traits **LS3.B:** Variation of traits **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• 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	• Patterns • Cause and effect • Systems and system models • Structure and function

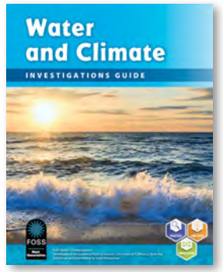
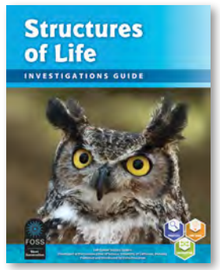
Instructional Segments

Grade 2 At a Glance

Module Storyline	NGSS Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 **4 INVESTIGATIONS** **Pebbles, Sand, and Silt Module** Students observe the properties of rocks and soil, study the results of weathering and erosion, locate natural sources of water, and determine how to represent the shapes and kinds of land and bodies of water on Earth. They use simple tools to observe, describe, analyze, and sort solid earth materials and learn how the properties of the materials are suited to different purposes. Students explore how wind and water change the shape of the land and compare ways to slow the process of erosion. The investigations complement the students' experiences in the **Solids and Liquids Module** with a focus on earth materials and the influence of engineering and science on society and the natural world.	**EARTH AND SPACE SCIENCES:** **2-ESS1-1, 2-ESS2-1, 2-ESS2-2, 2-ESS2-3** **PHYSICAL SCIENCES: 2-PS1-1, 2-PS1-2** **ETAS: K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3**	**ESS1.C:** The history of planet Earth **ESS2.A:** Earth materials and systems **ESS2.B:** Plate tectonics and large-scale system interactions **ESS2.C:** The roles of water in Earth's surface processes **PS1.A:** Structures and properties of matter **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Energy and matter • Stability and change
 **4 INVESTIGATIONS** **Solids and Liquids Module** Students engage with physical sciences core ideas dealing with matter and its interactions and engineering design. Students build on the science concepts of matter and its interactions developed in kindergarten using new tools to enrich observations. Students observe, describe, and compare properties of solids and liquids. They conduct investigations to find out what happens when solids and water are mixed and when liquids and water are mixed. They use their knowledge to conduct an investigation on an unknown material (toothpaste). They gain firsthand experience with reversible changes caused by heating or cooling, and read about changes caused by heating that are irreversible.	**PHYSICAL SCIENCES: 2-PS1-1, 2-PS1-2, 2-PS1-3, 2-PS1-4** **ETAS: K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3**	**PS1.A:** Structure and properties of matter **PS1.B:** Chemical reactions **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Energy and matter • Structure and function • Stability and change
 **5 INVESTIGATIONS** **Insects and Plants Module** In order to provide young students with indepth opportunities to experience the biodiversity on Earth, they will become naturalists and study insects and plants in and out of their classroom. Students build on their understanding of growth and development of plants and animals from grades K–1 by observing new organisms over time. Students see the life cycles of insects unfold in real time and compare the structures and functions exhibited by each species to reveal patterns. At the same time, students grow a flowering plant in the classroom. They gain experience with the ways that plants and insects interact in feeding relationships, pollination, and seed dispersal.	**LIFE SCIENCES: 2-LS2-1, 2-LS2-2, 2-LS4-1** **ETAS: K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3**	**LS1.A:** Structure and function **LS1.B:** Growth and development of organisms **LS2.A:** Interdependent relationships in ecosystems **LS4.D:** Biodiversity and humans **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• 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	• Patterns • Cause and effect • Structure and function • Stability and change

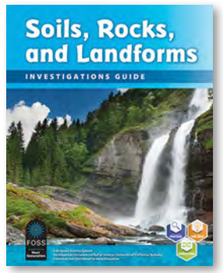
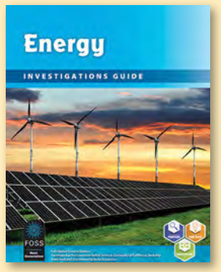
Instructional Segments

Grade 3 At a Glance

Module Storyline	NGSS Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 **5 INVESTIGATIONS** **Water and Climate Module** Water is the most important substance on Earth. Water dominates the surface of our planet, changes the face of the land, and defines life. Weather is driven by the Sun and involves the movement of water over the earth. Climate is determined in part by the amount of precipitation in a region and by temperature fluctuations. Students engage with these ideas as they explore the properties of water, the water cycle, interactions between water and other earth material, and natural hazards due to weather interactions. They learn how humans use water as a natural resource and how societies depend on water and new technologies to conserve and protect this resource.	**EARTH AND SPACE SCIENCES:** **3-ESS2-1, 3-ESS2-2, 3-ESS3-1** **ETAS: 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3**	**ESS2.C:** The roles of water in Earth's surface processes **ESS2.D:** Weather and climate **ESS3.A:** Natural resources **ESS3.B:** Natural hazards **ESS3.C:** Human impact on Earth systems **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models
 **4 INVESTIGATIONS** **Motion and Matter Module** Students investigate physical science core ideas dealing with forces and interactions, matter and its interactions, and engineering design. Magnetism and gravity are the anchor phenomena investigated as students look for patterns of motion to predict future motion. Students work with magnets and paper clips, wheel-and-axle systems, paper air twirlers, and rotating tops. Students use their knowledge of science to enter the engineering design process and through the process refine their science understanding.	**PHYSICAL SCIENCES:** **3-PS2-1, 3-PS2-2, 3-PS2-3, 3-PS2-4** **ETAS: 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3**	**PS2.A:** Forces and motion **PS2.B:** Types of interactions foundational to PS2 **PS1.A:** Structures and properties of matter **PS1.B:** Chemical reactions **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Energy and matter
 **4 INVESTIGATIONS** **Structures of Life Module** Students experience that organisms exhibit a variety of strategies for life, have a variety of observable structures and behaviors, have varied but predictable life cycles, and reproduce their own kind by passing inherited characteristics to offspring. Students explore how individual organisms have variations in their traits that may provide an advantage in surviving in a particular environment, and how our knowledge of animals that survived in past environments is inferred by studying fossil characteristics.	**LIFE SCIENCES:** **3-LS1-1, 3-LS2-1, 3-LS3-1, 3-LS3-2, 3-LS4-1, 3-LS4-2, 3-LS4-3, 3-LS4-4**	**LS1.A:** Structure and function **LS1.B:** Growth and development of organisms **LS2.C:** Ecosystem dynamics, functioning, and resilience **LS2.D:** Social interactions and group behavior **LS3.A:** Heredity: Inheritance of traits **LS3.B:** Variation of traits **LS4.A:** Evidence of common ancestry and diversity **LS4.B:** Natural selection **LS4.C:** Adaptation **LS4.D:** Biodiversity and humans	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Structure and function

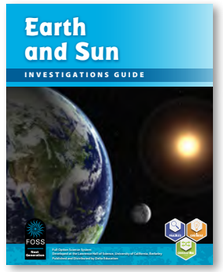
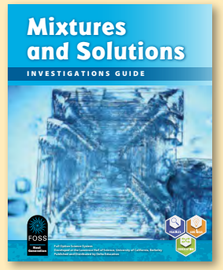
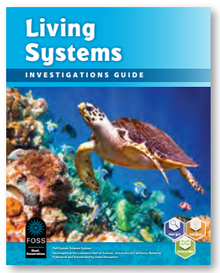
Instructional Segments

Grade 4 At a Glance

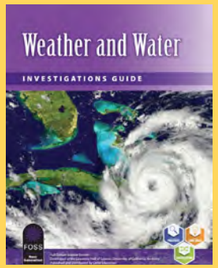
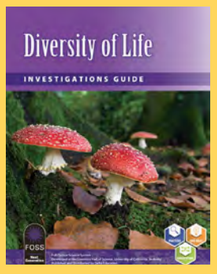
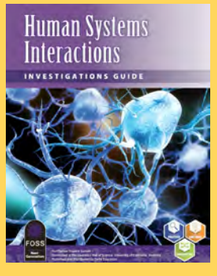
Module Storyline	NGSS Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 **4 INVESTIGATIONS** **Soils, Rocks, and Landforms Module** Students have firsthand experiences with soils and rocks, and modeling experiences using tools such as topographic maps and stream tables. Students come to understand that weathering by water, ice, wind, living organisms, and gravity breaks rocks into smaller pieces, erosion transports earth materials to new locations, and deposition is the result of that transport process that builds new land. Students conduct controlled experiments to determine the impact of changing the variables of slope and amount of water in stream tables. Students interpret data from diagrams and visual representations to build explanations from evidence and make predictions of future events.	**EARTH AND SPACE SCIENCES: 4-ESS1-1, 4-ESS2-1, 4-ESS2-2, 4-ESS3-1, 4-ESS3-2** **ETAS: 3-5-ETS1-1, 3-5-ETS1-2**	**ESS1.C:** The history of planet Earth **ESS2.A:** Earth materials and systems **ESS2.B:** Plate tectonics and large-scale systems interactions **ESS2.C:** The role of water in Earth's surface processes **ESS2.E:** Biogeology **ESS3.A:** Natural resources **ESS3.B:** Natural hazards **ETS1.A:** Defining and delimiting an engineering problem **ETS1.B:** Developing possible solutions	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Structure and function • Stability and change
 **5 INVESTIGATIONS** **Energy Module** Students investigate electricity and magnetism as related effects and engage in engineering design while learning useful applications of electromagnetism in everyday life. They conduct controlled experiments to determine how to make an electromagnet stronger. They investigate how the amount of energy transfer changes when balls of different masses hit a stationary object. They explore energy transfer through waves that results in sound and motion. They gather information about fuels derived from natural resources that affect the environment, and explore alternative sources of energy that use renewal resources.	**PHYSICAL SCIENCES: 4-PS3-1, 4-PS3-2, 4-PS3-3, 4-PS3-4, 4-PS4-1, 4-PS4-2, 4-PS4-3** **ETAS: 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3**	**PS3.A:** Definitions of energy **PS3.B:** Conservation of energy and transfer **PS3.C:** Relationship between energy and forces **PS3.D:** Energy in chemical processes and everyday life **PS4.A:** Wave properties **PS4.B:** Electromagnetic radiation **PS4.C:** Informational technologies and instrumentation **ESS3.A:** Natural resources **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• 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	• Patterns • Cause and effect • Systems and system models • Energy and matter
 **4 INVESTIGATIONS** **Environments Module** The study of the structures and behaviors of organisms and the relationships between one organism and its environment builds knowledge of limits—important because humans can change environments. Students design investigations to study preferred environments, range of tolerance, and optimum conditions for growth and survival of terrestrial organisms, and aquatic organisms. They conduct controlled experiments to determine the range of tolerance for early growth of seeds and hatching of brine shrimp, and use these data to develop and use models to understand the impact of changes to the environment. Students explore how animals use their sense of hearing and develop models for detecting and interpreting sound.	**LIFE SCIENCES: 4-LS1-1, 4-LS1-2**	**LS1.A:** Structure and function **LS1.D:** Information processing **LS2.C:** Ecosystem dynamics, functioning, and resilience **LS4.D:** Biodiversity and humans	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Energy and matter

Instructional Segments

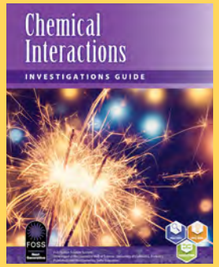
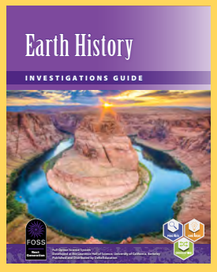
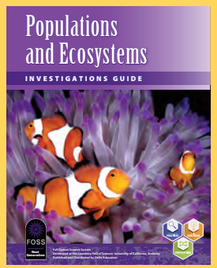
Grade 5 At a Glance

Module Storyline	NGSS Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 **5 INVESTIGATIONS** **Earth and Sun Module** The constant renewal of water on Earth's land surfaces by the activities in the atmosphere is one of the defining characteristics of Earth, the water planet. Students investigate the properties of the atmosphere, energy transfer from the Sun to Earth, and the dynamics of weather and water cycling in Earth's atmosphere. Other experiences help students to develop and use models to understand Earth's place in the solar system, and the interactions of Earth, the Sun, and the Moon to reveal predictable patterns—daily length and direction of shadows, day and night, and the seasonal appearance of stars in the night sky.	**EARTH AND SPACE SCIENCES:** **5-ESS1-1, 5-ESS1-2, 5-ESS2-1, 5-ESS2-2, 5-ESS3-1** **PHYSICAL SCIENCES:** **5-PS1-1 , 5-PS2-1** **ETAS: 3-5-ETS1-2, 3-5-ETS1-3**	**ESS1.A:** The universe and its stars **ESS1.B:** Earth and the solar system **ESS2.A:** Earth materials and systems **ESS2.C:** The roles of water in Earth's surface processes **ESS3.C:** Human impacts on Earth systems **PS1.A:** Structure and properties of matter **PS2.B:** Types of interactions **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solutions	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Energy and matter
 **5 INVESTIGATIONS** **Mixtures and Solutions Module** Students engage with matter and its interactions in our everyday life—mixtures, solutions, solubility, concentration, and chemical reactions. They come to know that matter is made of particles too small to be seen and develop the understanding that matter is conserved when it changes state—from solid to liquid to gas—when it dissolves in another substance, and when it is part of a chemical reaction. Students have experiences with mixtures, solutions of different concentrations, and reactions forming new substances. Knowing about properties and systems of substances, how things go together and are taken apart, enables us to develop models that explain phenomena too small to see directly.	**PHYSICAL SCIENCES:** **5-PS1-1, 5-PS1-2, 5-PS1-3, 5-PS1-4** **ETAS: 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3**	**PS1.A:** Structure and properties of matter **PS1.B:** Chemical reactions **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution	• 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	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Energy and matter
 **4 INVESTIGATIONS** **Living Systems Module** Students start by looking at Earth as the interaction of four Earth systems or subsystems—the geosphere, the atmosphere, the hydrosphere, and the biosphere. They focus on the biosphere and investigate systems on different scales—nutrient and transport systems within an organism that moves matter and provides energy to the individual organism, and feeding relationships in ecosystems that move matter among plants, animals, decomposers, and the environment. They come to understand that plants get the materials they need for growth primarily from water and air, and that energy in animals' food was once energy from the Sun. Students explore how human activities in agriculture, industry, and everyday life can have major effects on these systems.	**LIFE SCIENCES:** **5-LS1-1, 5-LS2-1** **PHYSICAL SCIENCES:** **5-PS3-1** **EARTH AND SPACE SCIENCES:** **5-ESS2-1, 5-ESS3-1**	**LS1.C:** Organization for matter and energy flow in organisms **LS1.D:** Information processing **LS2.A:** Interdependent relationships in ecosystems **LS2.B:** Cycles of matter and energy transfer in ecosystems **PS3.D:** Energy in chemical processes and everyday life **ESS2.A:** Earth materials and systems **ESS3.C:** Human impacts on Earth systems	• 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	• Patterns • Scale, proportion, and quantity • Systems and system models • Energy and matter • Structure and function • Stability and change

FOSS COURSES—GRADE 6

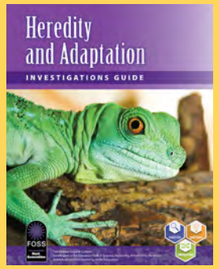
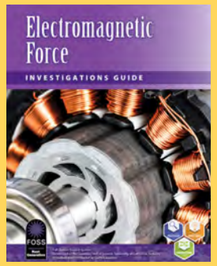
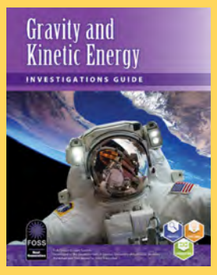
	Course Description	Course Overview	DCIs	Life Science Content	Earth Science Content	Physical Science Content
FOSS Course 1	**FOSS Weather and Water** Students explore physical science processes to explain earth science phenomena. They learn about atoms and molecules, density, wind, and energy transfer then investigate phase change, the water cycle, ocean currents, climate change, and meteorology. 	**Driving question for phenomena:** *What makes weather happen?* **Recommended instructional sequence:** This is a good course to begin the year with, because students explore physical science properties that explain weather and climate phenomena and learn about climate change. This establishes the storyline for grade 6 and sets the groundwork for students to think about interactions between changing environments and organisms' reproductive success.	ESS1.B, ESS2.C, ESS2.D, ESS3.B, ESS3.C, ESS3.D, PS1.A, PS3.A, PS3.B, ETS1.A, ETS1.B, ETS1.C Engineering: • Design criteria • Evaluate solutions • Analyze data • Iteratively test and modify	• Human changes to Earth's environment can have dramatic impacts on different organisms.	• Weather and climate involve interactions among Earth's subsystems. • The movement of water and interacting air masses helps determine local weather patterns and conditions. • Density variations drive global patterns of air and ocean currents. • Water cycles between the land, ocean, and atmosphere. • Burning fossil fuels is a major cause of climate change. Strategic choices can affect the rate of climate change and its impacts.	• Temperature measures the average kinetic energy of the particles that make up matter. • Energy transfers from hot materials to cold materials. • The type and amount of matter affects how much an object's temperature will change.
FOSS Course 2	**FOSS Diversity of Life** Students discover that all living things share the same basic characteristics, that all organisms are composed of cells, and that a single cell is the fundamental unit of life. Students then explore the relationship of organisms to their environment, and explore the concept of biodiversity. 	**Driving question for phenomena:** *How do you know something is living?* **Recommended instructional sequence:** This course creates the foundation for students to think of organisms as made of interacting subsystems. They think about how local conditions affect organisms' growth and reproduction, and consider how changes to climate may affect this reproductive success.	LS1.A, LS1.B, LS1.C, LS2.C, LS3.A, LS3.B	• All living things are made of cells. • The body is a system made of interacting subsystems. • Local conditions affect the growth of organisms. • Variations of inherited traits arise from genetic differences. • Genetic traits and local conditions affect the growth of organisms. • Organisms rely on their body structures and behavior to survive, but these adaptations may not be enough to survive as the climate changes.	• Human farming and land use practices can cause soil to increase in salinity. • Climate change can result in changes to local climate patterns that affect organisms' habitable regions.	• Molecules are the building blocks of cellular structures, and atoms are the building blocks of molecules.
FOSS Course 3	**FOSS Human Systems Interactions** Students tackle big questions about body systems and the factors that affect them. They learn about what happens when the body is attacked by an invader or an organ system malfunctions, how cells get the resources they need to live, and how systems support the human organism as it senses and interacts with the environment. 	**Driving question for phenomena:** *How do humans live, grow, and respond to their environment?* **Recommended instructional sequence:** This course builds on students' developing model of subsystems from Diversity of Life with a focus on understanding the human body. Students explore the complexity of human body system interactions, and then learn about how humans interact with the environment and form complex memories.	LS1.A, LS1.C, LS1.D, PS3.D	• The body is a system made of interacting subsystems. • Food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. • Sensory receptors respond to any array of mechanical, chemical, and electromagnetic stimuli. • Sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.	• Climate change can result in changes to local climate patterns conditions that affect organisms' habitable regions. ***Review the FOSS Grade 6—FOSS Course Foundation Boxes at the end of this chapter for more details about each course.***	• Aerobic cellular respiration is the process by which energy stored in food molecules is converted into usable energy for cells.

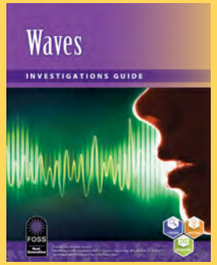
FOSS COURSES—GRADE 7

	Course Description	Course Overview	DCIs	Life Science Content	Earth Science Content	Physical Science Content
FOSS Course 1	**FOSS Chemical Interactions** Students conduct experiments to observe macroscopic matter transformations and apply kinetic particle theory to explain those transformations at the atomic level. They explore conservation of energy and matter and use those principles to explain phase change and chemical reactions. 	**Driving question for phenomena:** *How does matter interact?* **Recommended instructional sequence:** This is a good course to begin the year with, because it provides a foundation for conservation of matter, conservation of energy, and energy transfer that students will draw on as they explore geology and ecosystems in the later courses.	PS1.A, PS1.B, PS3.A, PS3.B, ETS1.A, ETS1.B, ETS1.C Engineering: • Design criteria • Evaluate solutions • Analyze data • Iteratively test and modify	• Food contains many elements essential for life. • Oxygen, carbon, and hydrogen are the most abundant elements in the human body.	• Earth materials are mostly made of eight different elements. • Earth has mineral, energy, and water resources that are unevenly distributed by geoscience processes.	• The interaction and motions of atoms explain the properties of matter. • Thermal energy affects particle motion and phase of matter. • Matter is conserved in physical changes and chemical reactions. • Energy cannot be created or destroyed, only transferred. • Chemical reactions make new substances and can release or absorb thermal energy. • Synthetic materials impact society.
FOSS Course 2	**FOSS Earth History** Students read evidence from rock, landforms, and fossils. They grapple with Earth's processes and systems that have operated over geologic time to understand the cycling of Earth's materials and the flow of energy that drives this process. They consider human interactions with natural resources and the technology that supports the geosciences. 	**Driving question for phenomena:** *How do we tell the geologic story of a place?* **Recommended instructional sequence:** This course builds on the concepts of conservation of matter and energy from Chemical Interactions as students explore geologic processes that define areas on Earth. Students begin to explore human impact on Earth systems, and will build on these ideas when they explore ecosystem dynamics in the next course.	ESS1.C, ESS2.A, ESS2.B, ESS2.C, ESS3.A, ESS3.B, ESS3.C, ESS3.D, LS4.A Engineering: • Evaluate solutions	• Evidence for the existence and diversity of life on Earth, including extinctions, is found in the fossil record. • Design solutions can help maintain biodiversity and ecosystem services.	• Geologic processes change Earth's surface, and rock layers provide a record of Earth's history. • Fossils, rocks, continental shape, and seafloor structures provide evidence of plate motion. • Damage from natural hazards can be reduced. • Rock is constantly being recycled and can be transformed into other rock types. • Earth has mineral, energy, and water resources that are unevenly distributed by geologic processes.	• Uneven heating within Earth explains varying densities of Earth materials that result in convection and plate motion. • Matter is conserved in physical changes and chemical reactions.
FOSS Course 3	**FOSS Populations and Ecosystems** Students learn that every organism has a role to play in its ecosystem. To understand how ecosystems work and what they need to remain healthy, students explore how changes to one part of the ecosystem affect others by studying ecosystem interactions of matter and energy. 	**Driving question for phenomena:** *How do organisms, matter, and energy interact in an ecosystem?* **Recommended instructional sequence:** This course culminates students' grade-level study of energy and matter by asking students to explore interactions in complex ecosystems. Students continue to explore human impact on Earth systems by researching human interactions in a particular ecosystem and providing recommendations for an engineering problem within the ecosystem.	LS1.C, LS2.A, LS2.B, LS2.C, LS4.D, PS3.D, ESS3.C, ETS1.A, ETS1.B Engineering: • Design criteria • Evaluate solutions	• Biotic and abiotic changes affect ecosystem populations. • Matter cycles and energy flows among living and nonliving parts of ecosystems. • Organisms grow and get energy by rearranging atoms in food molecules. • Resource availability affects organisms and ecosystem populations. • Humans depend on ecosystem services. • Design solutions can help maintain biodiversity and ecosystem services.	• Varying climate, terrain, elevation, and latitude define regions known as biomes. • Earth has mineral, energy, and water resources.	• Matter is conserved in physical changes and chemical reactions. • Energy cannot be created or destroyed, only transferred. • Chemical reactions make new substances and can release or absorb thermal energy.

Review the FOSS Grade 7—FOSS Course Foundation Boxes at the end of this chapter for more details about each course.

FOSS COURSES—GRADE 8

	Course Description	Course Overview	DCIs	Life Science Content	Earth Science Content	Physical Science Content
FOSS Course 1	**FOSS Heredity and Adaptation** Students explore evidence for evolution, including the fossil record, the similarities between past and present organisms, the genetic principles of inheritance, and how natural selection produces adaptations that lead to changes in species and eventually the creation of new species. 	**Driving question for phenomena:** *How can we explain the diversity of life that has lived on Earth?* **Recommended instructional sequence:** This is a good course to begin the year with, because students may develop questions about what causes Earth's systems to change dramatically over time (and relatively quickly); this establishes the storyline for grade 8 and sets the groundwork for the capstone project at the end of the year.	LS3.A; LS3.B; LS4.A; LS4.B; LS4.C; ESS1.C	• Mutations in genes affect organisms' structures and functions. • Evidence from fossils, anatomy, and embryos support the theory of biological evolution. • Natural selection is the main mechanism that leads to evolution of species that are adapted to their environment. • Changes to environments can affect probabilities of survival and reproduction of individual organisms, which can result in significant changes to populations and species.	• Rock layers record Earth's history like pages in a book. • The fossil record documents the existence, diversity, extinction, and change of life forms throughout Earth's history. • Earth's environments change over time.	• Predictable chemical properties of matter can be used to interpret the composition and age of rocks.
FOSS Course 2	**FOSS Electromagnetic Force** Students begin to explore the concept of force. They measure the force of invisible magnetic fields, learn to build a circuit, design an electromagnet, and explain the energy transfers that make it all possible. They consider energy sources for human use and limitations of renewable and nonrenewable resources 	**Driving question for phenomena:** *What is the relationship between magnetic and electric forces?* **Recommended instructional sequence:** This course creates the foundation for the physics concepts of force, potential energy, and kinetic energy, which are developed further in Gravity and Kinetic Energy. The idea of human extraction and use of Earth's natural resources provides additional footing for the capstone project, human impact on Earth systems, in Planetary Science.	PS2.A; PS2.B; PS3.A; PS3.B; PS3.C; ESS3.A; ESS3.C; ETS1.A; ETS1.B; ETS1.C Engineering: • Design criteria • Evaluate solutions • Analyze data • Iteratively test and modify		• Energy sources can be categorized as renewable or nonrenewable. • Engineers develop new designs to minimize environmental impact from human energy use.	• Net force is the sum of the forces acting on a mass. • Magnets are surrounded by an invisible magnetic force field, which acts through space. • Electricity and magnetism are observable phenomena stemming from the fundamental force of electromagnetism. • Energy cannot be created or destroyed, only transferred.
FOSS Course 3	**FOSS Gravity and Kinetic Energy** Students explore speed, acceleration, gravity, and collision physics. They explore how the force of gravity is related to the mass of objects and distance between them, and how this relates to gravity on various celestial objects. They learn Newton's laws and engage in an engineering challenge to design a helmet that will provide protection during impact. 	**Driving question for phenomena:** *How can we explain the motion of objects?* **Recommended instructional sequence:** This course builds on students' developing model of force from Electromagnetic Force to understand the stability of orbits, which will be used to explain the Earth/Moon/Sun system and solar system formation in Planetary Science. Students can think back to Heredity and Adaptation to understand how natural selection could result in adaptations in organisms to better sustain the force of collisions.	PS2.A; PS2.B; PS3.A; PS3.B; PS3.C; ESS1.B; ETS1.A; ETS1.B; ETS1.C Engineering: • Design criteria • Evaluate solutions • Analyze data • Iteratively test and modify	• An organism's body tissue can be damaged by forces applied in collisions. • Engineering designs can protect human body organs in collisions.	• Gravity plays a major role in determining motions with the solar system and galaxies. • Newton's Laws explain the forces and motions of objects on Earth and in space.	• Velocity and mass determine the results of collisions between objects. • Gravitational and electromagnetic fields are the basis of noncontact forces. • Changing the arrangement of objects in a system affects the potential energy stored in that system.

	Course Description	Course Overview	DCIs	Life Science Content	Earth Science Content	Physical Science Content
FOSS Course 4	**FOSS Waves** Students learn about mechanical and electromagnetic waves. They manipulate springs and lasers to determine properties of waves that are eventually used to explain how their cell phones and other modes of modern communications work. They create designs that affect transmission of sound waves in an engineering challenge. 	**Driving question for phenomena:** *How is energy transferred through waves?* **Recommended instructional sequence:** This course relies on the physics foundation of energy and force from courses 2 and 3 as it builds on observable properties of physics to develop a model of electromagnetic waves. Students will apply their understanding of electromagnetic waves and their implications for data transmission when they learn about exploration of the solar system and beyond in Planetary Science.	PS4.A; PS4.B; PS4.C; ETS1.A; ETS1.B; ETS1.C Engineering: • Design criteria • Evaluate solutions • Analyze data • Iteratively test and modify	• The senses of vision and hearing rely on information transmitted by waves. • The visible spectrum is the part of the electromagnetic spectrum humans can detect.	• Ocean waves transfer energy through mechanical waves in water. • Seismic waves reveal information about the interior layers of Earth.	• Waves are reflected, absorbed, or transmitted through various materials. • Wave-based digital technologies provide very reliable ways to encode and transmit information.
FOSS Course 5	**FOSS Planetary Science** Students develop a thorough understanding of the local cosmos—including the organization of the solar system and day/night/seasons—before turning their study to the top planetary science headlines of our times, in particular the hunt for exoplanets. In a capstone project that completes students' middle school science careers, students use satellite images to analyze changes to Earth's systems and draw conclusions about human impact upon Earth's systems. 	**Driving question for phenomena:** *What is my cosmic address?* **Recommended instructional sequence:** This course is recommended to culminate grade 8 as students work on a capstone project drawing from all disciplines. Students draw from courses 2 and 3 to explain orbits and solar system formation. They draw from Waves when considering space science data collection using electromagnetic radiation. In the capstone project, students consider sudden and gradual changes to Earth's systems, ranging from human resource use to meteor impacts, and build on understandings from Heredity and Adaptation to make connections between these events as a driving force that causes evolution of life on Earth.	ESS1.A; ESS1.B; ESS1.C; ESS2.A; ESS2.C; ESS3.A; ESS3.C; ESS3.D; PS2.B; PS4.B; ETS1.A Engineering: • Design criteria	• Living systems are affected by physical changes in the environment. • Sudden changes to the environment can lead to mass extinction events.	• Models explain lunar phases and eclipses of the Sun and Moon. • Annual cycles in the amount of sunlight absorbed cause Earth's seasons. • Gravity plays a major role in determining motions with the solar system and galaxies. • Landforms on celestial objects can indicate presence of water. • Increases in human population and per-capita consumption increase demand for ecosystem services and impact Earth's systems.	• Newton's Laws explain the forces and motions of objects on Earth and in space. • Information transmission via electromagnetic waves is the only way humans can explore far beyond Earth. • Spectra of emitted and absorbed light can reveal presence of water.

Review the Grade 8—FOSS Course Foundation Boxes at the end of this chapter for more details about each course.