FOSS® NATIONAL MATTER AND ENERGY
TEACHER PREPARATION VIDEO TRANSCRIPT

<Introduction to Module>

Narrator: This module is an introduction to the concepts of Matter and Energy at the third grade level. The four investigations introduce the multiple forms that matter and energy can take and give students experience with the transfer of energy and the conversion of energy from one form to another. Light absorption and reflection is the focus of an entire investigation. Students also conduct and observe chemical reactions and learn that matter on Earth is made of tiny pieces, called particles.

These three boxes make up the Matter and Energy kit. There are enough permanent materials for a class of 32 students working in collaborative groups and enough consumables for at least two classroom uses. Make sure you check the Kit Inventory List in the boxes and in the Materials Chapter of the Teacher Guide.

<Teacher Guide Introduction >

Narrator: Before you begin teaching Matter and Energy, it is important that you read through the Teacher Guide. You will find everything you need to teach the module here.

The FOSS teacher guide for this module includes these sections: Overview, Materials, Investigation Folios, Science Notebook Masters, Teacher Masters, Teacher Answer Sheets, Embedded Assessment, Benchmark Assessment, Assessment Masters, Science Notebooks, Reading Extensions, FOSS Website, and Investigation Outline.

Be sure to read the overview folio before you begin teaching the module. It contains many helpful suggestions for getting started. In it are an overview matrix, the standards that are addressed in this module, background information, ideas on preparing Science Notebooks, and suggestions for scheduling the activities.

In the Materials folio you'll find an inventory list for the kit, a description of the materials you'll need to provide for the investigations, directions for preparing the materials, and information on ordering any replacements.

Next are the investigation folios. These are the heart of the program and will be described in detail in this video. The first page gives overview information. The At a Glance chart summarizes the investigation and helps you plan for assessments and extension activities. Next you'll find background information specific to the investigation.

There is a section called Teaching Children About, which gives you some insight into the research on how children think and learn. Each investigation has several parts. For each part you'll find a materials list, Getting Ready section, and step-by-step directions for conducting the activity with your students. The interdisciplinary section at the end of each investigation has many ideas for extending the activity into other areas of your curriculum.

The next sections contain the Science Notebook Masters and the Teacher Masters. Here you'll find all of the student sheets used in the investigations. There are also masters for math extensions and Home/School Connections for each investigation.

There are many ways to assess your students' learning as they move through the investigations. Read through the Embedded Assessment folio for more information about FOSS formative assessment. This folio includes tips on what to look for when assessing some of the notebook sheets, a suggested teaching schedule, and an assessment summary for the module.

The Benchmark Assessment folio has detailed information on FOSS summative assessment. Students take a pretest called a survey before beginning the module, along with an identical posttest after the module is complete. At the end of each investigation, students also take I-Checks, which assess student understanding of the concepts contained in each investigation. Be sure to read through the ways to involve students in self-assessment of at least some of the items on each I-Check. Scoring guides are included in this folio.

After these two assessment folios, you'll find the Assessment Masters. See the assessment section of this video for more information.

The Science Notebooks folio describes the benefits of using science notebooks with FOSS. It offers a detailed discussion of using notebooks with your grade level.

Check out the Reading Extensions. This annotated list includes both nonfiction books and fiction books for student reading, and teacher resources.

The FOSS Website folio introduces you to the interactive, multimedia website for teachers, parents, and students.

In the Investigation Outline folio you'll find a complete outline of the module by session.

In the kit, you'll find one copy of the *FOSS Science Resources* book for this module. The articles contained in this book are designed to be read periodically throughout the module, after students have had hands-on experience with the activities.

<Before You Begin>

Narrator: There are a few things to get ready before beginning the module.

Plan on conducting the Pretest, called a Survey before you begin teaching. This won't be graded, but will help you assess students' prior knowledge and plan your teaching accordingly.

On large chart paper you'll want to make a word bank. This is where you'll keep all the new vocabulary as it appears throughout the module. Also, you'll make a content inquiry chart. Here is where you'll write statements that summarize what the students have learned. It's also a good place to keep any questions that students may have at the end of each part.

You'll also want to decide how you'll use notebooks before beginning the module. In the Science Notebook Masters chapter there are two types of masters. Full-page masters and half-sheet masters. The half-sheet masters are designed to be copied and then cut apart and pasted into a composition notebook. One strategy that works very well is having the students paste the notebook sheets on the left side of the composition book, leaving the right side open for any additional recording.

Be sure to place the FOSS Safety Poster contained in the kit where it is visible to students. You'll also want to copy and send home the Letter to Parents before beginning the module.

<Investigation 1, Part 1>
Narrator: In this Investigation, students explore how energy makes things happen. They work with different sources of energy and observe how it is transferred and changed from one form of energy to another.

For Part 1, Energy Sources, this is what you'll need from the kit: For the opening demonstration, a flashlight and two AA batteries. For each of the four different stations, you will set up two basins with identical materials. Put one set of materials in each of the basins.

Both groups using station 1 will share the lamp. In each basin, place a solar cell, a motor with leads and a masking tape flag, and a copy of the instruction card, Teacher Sheet no. 2.

For Station 2, in each basin, you'll place a tone generator, a 9-volt battery, and a copy of the instruction card, Teacher Sheet no. 3.

To prepare the tone generator, remove the battery cover found on the bottom, attach a battery to the snaps and replace the cover.

At Station 3, in each basin you'll place a motor with a lead and a masking tape flag, a AA battery, and a copy of the instruction card, Teacher Sheet no. 4.

At Station 4, for each basin, pour gravel into a cup and place a birthday candle in the gravel. Also include a copy of the instruction card, Teacher Sheet no. 5.

The two activities at this station are unrelated. They were put together to create two short experiences at one station, not for another conceptual reason.

FOSSweb.com has fast motion video of a burning candle that can be used in place of the candle station, if needed. It is also good to use for discussion later.

You will need to provide: masking tape for the motor flags, and matches. You may also want to provide sheet protectors for the station instructions, so they can be permanent parts of the kit.

To place the flag on the motor, take a piece of masking tape and wrap it around the motor's spindle.

Before you use the solar cell, you may need to activate it by placing it in direct sunlight or facedown on an overhead projector for three to five minutes. Be sure to test the solar cell to make sure it's powering the motor before you have your students work with it. To prepare the solar cell, unscrew the nuts and set them aside. Take off the little metal bar if there is one; you won't need that piece. Take the wire and place the eye at the end over the bolt. Screw the nuts down to hold the wire in place. Make sure the nuts are screwed down tightly, to ensure good connections. You may need to show the students how to connect the ends of the motor's wires to the solar cell. The ends of the solar cell wires have clips, and you can place one wire from the motor here and the other wire on the other side.

For the class, from the kit you'll need the transparency of Teacher Sheet no. 6, Flashlight Demonstration. For the students, copy Science Notebook sheets nos. 1 and 2, Energy Source and Action A and B and Science Notebook Sheet no. 3, Energy Sources Questions. Before beginning this part, you'll also want to send home the Letter to Parents, copy and conduct the survey, and prepare the Science Notebooks (if you haven't already done so) as described in the Before You Begin section of this DVD.

Begin this investigation by finding out what students know about energy.

Teacher: What is energy? Lawrence?

Student: Energy is um… something that like makes a machine works like the ability.

Teacher: Something that makes machines work. Anyone else have another idea to add to that? That's a good answer. Okay.

Student: Energy makes heat?

Teacher: Energy makes heat, yes. Jasmine?

Student: Energy makes light?

Teacher: Good. Excellent. Energy can make light, energy can make heat, energy can make things move. I want to do a little demonstration here. I think you all know what this is. When I put my hand down, tell me what this is.

Class: Flashlight.

Teacher: And I need a volunteer to come up here and make this flashlight work. Jenny? Is it working?

Student: No.

Teacher: Hmm. Why don't you think this flashlight is working? What does it need? Do you have an idea, Jenny?

Student: It needs battery.

Teacher: Batteries, okay. I have a couple batteries here. Can you put those in the flashlight for me? Good. That's a little tricky, to get that to screw on. Let me give you a hand there. The batteries are in the flashlight, let's see if it works. Ah! Show everybody. Is it working?

Class: Yes.

Teacher: So what did we need in order to make the flashlight work? Sandy.

Student: It needs battery.

Teacher: And what action did you observe? What did you see happen? Wendy.

Student: Um, the batteries made the flashlight work, so it makes light.

Teacher: Excellent. Okay. We're going to answer these questions, and as I write the answers you give on the transparency, I'd like you to write them on your worksheet. Alright, now let's see if we can complete this sentence. We have a sentence here with a couple blanks in it, and we need to think of some good words to fill in, in the blanks. Right now, it reads, "the energy in the blank converted into blank energy." Does anyone have an idea of what words and you might want to look back at our answers, what words could we fill in, in the blanks here?

Student: The energy in the battery changed into light energy?

Teacher: The energy in the batteries converted, or changed, into light energy. Now, I'd like you all to read that together.

Narrator: Explain that students will work in groups and rotate through four different energy stations.

Teacher: There's a few safety things you need to be aware of. Now, this is a very important one, with regard to safety, because we have a birthday candle here, and we're going to light it, so there will be an open flame here. It's very important that you're careful around that. Should you put your hand over the top of it?

Student: No.

Teacher: No, you should keep back.

Narrator: If you are concerned about candle safety, consider doing this station as a class demonstration or accessing the candle video on FOSSWeb.com.

Teacher: I don't want anybody taking this lightly.

Narrator: The teacher should always be the one to light the candle. Remember to test the solar cell before your students use it. Activate the cell as needed.

[Students talking.]

Student: So, this is the motor, right? So we put it right like that.

Student: Can I do it again?

Student: I'll hold the back.

Student: What action did you observe?

Teacher: So read your questions on your worksheet, and see if you can figure out the answers while you observe.

Student: It's burning.

Teacher: The candle is lit.

Student: The wax is melting.

Teacher: Wax is melting, good. Anything else? What do you see happening?

Student: It has a flame?

Teacher: It has a flame, great.

Student: What kind of energy causes that action?

Student: Flame?

Student: Heat!

Student: Yea, heat. What was the energy source?

Student: Flame?

Student: First everyone should rub their hands together quickly. Record an observation on your notebook sheets. Ouch.

Teacher: Do you notice anything when you do that? What?

Student: Heat. Heat comes.

Teacher: Do it again. Now, press hard together. And do it fast. Does it feel hot?

Student: Yea

Teacher: What do you think causes that? So what action did you observe?

Student: Heat.

Teacher: You observed heat coming, yea. And it's caused by motion. Now, there's a word for that. Do you guys know what it is when two things in motion rubbing together cause heat? Do you know what that's called? I'm going to give you a word for that. Friction.

Narrator: After students have visited all four stations, they regroup with the teacher to discuss their results.

Teacher: Have you filled those out? Let's share with the class what your answers are to each of those sentence blanks. Okay, Jeffrey, for the motor, what did you fill in the last question with the blanks there?

Student: The energy in the battery changed into movement energy.

Teacher: Did everybody hear that? Alright, so we're looking at conversions, and the energy in the battery changed or was converted into movement, the spinning of the spindle on the motor. Excellent.

Narrator: Students have observed that energy makes things happen and can be stored in many forms. They have also observed energy change from one form into another.

Teacher: And what did you get?

Student: The energy in the muscle changed into motion energy.

Narrator: The teacher records their responses on a chart. To wrap up this session, add new words to the word bank. Add new concepts to the content chart. Include any questions students may have.

In the next session, have students read the article Energy Sources in the Science Resources book. Have students answer the review questions at the end of the article on Science Notebook sheet no. 3. After students have completed their answers, collect the notebook sheets to see how well students have understood the concepts. See the Embedded Assessment folio for additional guidance. Return the students' notebook sheets to them and discuss the questions with the students. Ask them to make corrections and/or additions as you go.

<Investigation 1, Part 2>
Narrator: For this part, from the kit, you'll need a set of energy cards for each pair of students. Make one copy of teacher sheet no. 10, Demo Energy Cards and cut it apart. You'll use the masking tape that you provide to stick these cards to the board in the class demonstration.

Copy science notebook sheet no. 4 Energy Conversions and science notebook sheet no. 5 Response Sheet—Energy for your students. If you ever need to replace your energy cards you can follow the instructions in the teacher guide and use teacher sheet nos. 7, 8, and 9 to make replacement cards.

Start off Part 2 by reviewing what students have learned about energy.

Teacher: So, we spent some time the other day looking at different sources of energy. Can anyone remind me of one source of energy? One source. Yes.

Student: A battery?

Teacher: A battery. A battery is a source of energy. Excellent.

Narrator: Introduce the Energy Conversion activity using demonstration cards and describe how to use them.

Teacher: Light. Now, what do you think I could use to show that a battery's energy can be changed into light? How about something that looks like this? What's this?

Student: An arrow.

Teacher: An arrow, yea. Where do you think I should put the arrow? Should I put the arrow like that?

Student: No.

Teacher: No. Should I put the arrow like that?

Student: No.

Teacher: Should I put the arrow like that?

Student: No.

Teacher: Who can show us how we should put the arrow? Polly, come on up. What do you think? Yea? All right. We have got some sets of cards. There are yellow cards which are stored energy cards, and what does this one say, stored energy source is wood.

Student: Wood

Teacher: Really little. Then, we also have action cards. And here's one action card you've seen before, it's called light. OK? You'll also receive arrows to connect them. Your job is to connect as many stored energy cards to the action cards as you can. You ready to give it a shot? Yea.

Narrator: Students begin to work in pairs. Remember that your cards are different colors than the ones these students are working with.

Student: Wood?

Student: Look at this one. Gasoline.

Student: Give me to arrows. Please?

Student: Apple, batteries make machine motion. How 'bout the Sun? Sun makes light.

Narrator: Visit each group, challenging the students to make every possible energy conversion they can.

Teacher: What do we have going here?

Student: Look at this!

Teacher: Our stored energy is apple, and our apple is converting into what? Muscle movement? Okay. What else do we have here? Wood. And what can you do to wood? Sure, and if you burn it, what kind of action do you get?

Student: Heat.

Teacher: Heat and…

Student: Light.

Teacher: Light. Okay. Wow, so there are a lot of energy sources that can give us heat and light.

Narrator: After students have spent some time completing their layouts, they record their results on science notebook sheet, no. 4, Energy Conversion.

Students share their results with the class, connecting energy sources to actions.

Teacher: Gasoline goes to muscle? Which one was that? Machine motion.

Narrator: Add new words to the word bank. Add new concepts to the content chart.

Have students read the article Energy Conversion in the Science Resources book. After the reading, discuss the questions with students.

Give students the Response Sheet—Energy to complete on their own. See the Embedded Assessment folio for information about interpreting student responses. Plan to spend time discussing the sheets with students after you have reviewed them.

<Investigation 1, Part 3>
Narrator: Energy on the Move is another station-oriented investigation. Students rotate between stations to explore how energy is transferred from one object to another.

For the class you'll need these items from the kit: two tennis balls, a table tennis ball, the clear basin, one 1-liter zip bag and the video, All about the Transfer of Energy. You'll need to provide a way to view the video.

You also need to provide rice, a piece of cardboard cut to fit inside the one liter bag, masking tape, water to fill the clear basin, and 12 empty plastic water bottles or soda cans. You may also want to provide sheet protectors for the station instructions, so they can be permanent parts of the kit.

For three of the stations, set up 2 basins with identical materials. Put one set of materials in each basin.

For Station 1, place the tone generator, a 9-volt battery, a small zip bag containing about 50 grains of rice, and a copy of the instruction card, Teacher Sheet no. 12, in each of the two basins.

For Station 2 put the spring toy and a copy of the instruction card, Teacher Sheet no. 13, in the basin for two groups to share.

Station 3 needs one ball, 6 of the plastic bottles or soda cans, and a copy of the instruction card, Teacher Sheet no. 14, in each of the two basins. Make sure you find a contained area for this station.

In the Station 4 basins, place a motor with a masking tape flag, an AA battery, and a copy of the instruction card, Teacher Sheet no. 15.

To prepare the demonstration, half-fill the clear basin with water and float a table tennis ball on the water. You'll create waves using the cardboard in the one-liter bag. If you choose to use an overhead projector, place the basin on the projector, allowing students to observe the waves on the screen. If you decide not to use the projector, place the basin high enough so that students can observe the table tennis balls rising and falling on the waves.

For the class, from the kit you will need the transparency of Teacher Sheet No. 11, How Does Energy Travel? For the students, copy Science Notebook Sheets Nos. 6 and 7, How Does Energy Travel A and B, and Science Notebook Sheet No. 8, All about the Transfer of Energy. You will also need to make copies of the assessment for this Investigation, I-Check 1.

This part begins with a review of stored energy.

Teacher: Stored energy. What is it?

Student: It's like; an energy source is a place where we store the energy.

Teacher: A source is stored. What do we mean by stored?

Student: I mean it's like put into, it's like kept there.

Teacher: Kept there, put there. And then when we need it, we can…

Student: Use it.

Teacher: Use it. Very good. Okay. So stored energy is energy that we keep in a place and it's available when we need to use it, right?

Narrator: Review other examples of stored energy before asking students to consider Energy Transfer.

Teacher: Try to spread the rice out in the bag and hold it above the speaker…. and observe the rice.

Narrator: Discuss the activity and how the students should focus their attention as they try to figure out how energy gets from an energy source to an energy converter.

Teacher: This is going to be our bowling ball.

Narrator: Describe the four stations, reminding students that there are instructions at each station.

Teacher: And these empty plastic bottles will be our pins.

Narrator: Students move to their first station and the action begins.

Student: Wow.

Teacher: Alright now, I want you to think about, where did the energy come from, where did it go, what did it do, and how did it get from point A to point B. Can you guys think about that? Where did the energy come from?

Student: From my hand when I threw it?

Teacher: Can you say it louder?

Student: From my hand, when I threw it.

Teacher: From your hand, and it moved through your muscle. And where did the energy go?

Student: To the floor?

Teacher: To the floor? Did it go to the floor?

Student: To the pins?

Teacher: To the pins. Okay, and what did it do?

Student: Knocked down the pins?

Teacher: Very good, it knocked down the pins. And how did the energy get from your hand to the pins where it knocked them down?

Student: Through the floor when I rolled it.

Teacher: Do you guys think the floor carried it?

Student: No, I think the ball.

Teacher: The ball. Okay, yea. Now, the ball did roll along the floor, but I think the factor here is that you sent the energy with the ball, and it did work over there. Try that a few more times, let everybody have a try. What are we seeing? Say it again?

Student: The rice are moving.

Teacher: The rice are moving. Show me; see how much you can get it to move. Okay, now turn it off for a second and let's think about this. Now, was this bag touching down on the speaker?

Student: No.

Teacher: No, what did you, what happened? Pardon me? Can you say that a little louder?

Student: The rice is moving.

Teacher: The rice is moving. And what made that happen? Where did the energy come from, to make the rice move?

Student: Vibrations? The battery?

Teacher: The battery, because we know there's a battery in there. Okay, I hear you saying vibration. How did the energy get from the battery to the rice?

Student: Electricity.

Teacher: Well, electricity, but you just said you were holding the bag above the speaker, so there's no connection here.

Student: Volume.

Teacher: Well, the volume is how loud it is, but how did it, what's between the bag of rice and the speaker here? What's between there? Right now, what's between there? Is there anything between there?

Student: No.

Teacher: There's nothing. Nothing at all?

Student: Volume.

Teacher: No, what's between here?

Student: Vibrations.

Teacher: Well, right now, what's…

Student: Air?

Teacher: Say it louder.

Student: Air.

Teacher: Air. Isn't there air between there? So these vibrations you're talking about, they had to go through the what? If you're not touching it, they had to go through the…

Student: Air.

Teacher: Air. How did they do that? How did those vibrations go through the air?

Student: Cool.

Teacher: Did everyone have a chance to try this? Now, listen to me for a second. When you do this, I want you to think about, remember we're talking about energy transfer, right? Where does the energy come from? I mean, can you see energy transferring here? How is it transferred when you see this, kinda like, okay, do like this? Zhoom. Like that, what does that remind you of? This like, undulating thing, what does that remind you of?

Student: Waves?

Teacher: Aha. Doesn't it look kinda like a wave? Kinda just lift your hand up quickly. Doesn't that kinda look like a wave there?

Student: Yea.

Teacher: Okay, this, this spring toy shows us one way that energy travels—through waves. Yea.

Narrator: After the students have rotated through the stations, and recorded their findings, they share their findings as other students add to the explanations or offer alternative ideas.

Teacher: Where's the energy stored?

Student: In the battery.

Teacher: Okay, yea. Then where did it go when we turned the tone generator on?

Student: It went to the rice and made it move around like vibrations.

Teacher: Okay good, so it made the rice move. How did it get from the battery to the rice? How was it transferred?

Student: Um, like the battery gave the tone generator sounds, so they traveled in like sound waves to the rice and made it move around.

Teacher: So, now the rice was not touching the speaker, right?

Student: Uh-huh.

Teacher: Who can tell me what's between the rice and the speaker? Andy?

Student: Vibrations.

Teacher: You're on the right track, but my question is what's between the speaker and the rice, the bag of rice, what's between there? Are they touching?

Student: No, the bag.

Teacher: No, the rice is in the bag, but still the bag is not touching the speaker. What's between those two things?

Student: Air?

Teacher: Air. Very good. Okay. Energy, in the form of sound, got from the speaker to the rice, so it must have gone through the…

Class: Air.

Teacher: And Wendy nailed it when she said "sound waves," and they travel through the…

Student: Air.

Teacher: Air.

Narrator: Add to the description of energy transfer by further describing how energy can be carried by waves, by wires, and by moving objects.

Teacher: Now, can everyone see that?"

Narrator: In the following session, bring out the spring toy to further explore waves.

Teacher: When Jeffrey moves his end of the spring toy, will anything happen to this piece of tape in the middle? Ah.

Student: Ready? Three, two, one, wow!

Narrator: The students then observe water waves causing the table tennis ball to move in the clear basin.

Teacher: How is the energy transferred from my muscles, through the paddle, to the ping pong ball? Jasmine?

Student: The water.

Teacher: The water. Can you tell me a little more? Tell me about energy and water.

Student: The muscle made the water, made the water move the ping pong ball.

Teacher: Right, so the energy's transferred through the water. When I move the paddle in the water at this end, the energy transfers through the water, causes a motion in the ping pong ball.

Narrator: Have the class watch the video All about the Transfer of Energy. Then hand out notebook sheet, No. 8, All about the Transfer of Energy and discuss the video and students' responses.

Add new words to the word bank. Add new concepts to the content chart.

The students have explored how energy moves and transfers from one thing to another. They have observed waves in various forms.

Have students read the article, Energy on the Move and the Summary article, Energy, in the Science Resources Book. Look in the Reading and Writing in Science chapter of the Teacher Guide for strategies to support English learners and below-grade-level readers. After the reading, discuss the questions with students.

This part concludes with an assessment: I-Check No. 1. For all I-Checks, students should work alone to complete their responses, although you may choose to read the questions aloud to them. Use the scoring guide in the Benchmark Assessment folio to score students' work and to plan your next steps based on student responses. After you have scored the student papers, return them for self-assessment and discussion.

At the end of each investigation, you'll find the interdisciplinary extensions and the home/school connection. The interdisciplinary extensions include language extensions, art extensions, science extensions, and math extensions.

The home/school connections provide activities for use at home. You'll want to look ahead to the home/school connections before beginning an investigation for notes on when each activity should go home. Parents can also download these home/school connections from FOSSweb.com.

<Investigation 2, Part 1>
Narrator: In this investigation, students explore light, a form of energy that travels in a straight line from a light source. They investigate reflected light and colored light.

For this part, you will need these materials from the kit: mirrors, mirror clips, flashlights, and AA batteries. If this is the first time the kit is being used, remove the protective film that covers the mirrors and place the batteries in the flashlights.

You need to provide books and index cards or scratch paper.

From the kit, for the class you will need the transparency of teacher sheet no. 16, Rearview Mirror. For the students make copies of Science Notebook Sheets, nos. 9 and 10: Mirror Challenges A and B.

It is probably a good idea to practice with the mirrors before presenting the challenges to your students. Stand mirrors up using the clips and use a flashlight to try out the different challenges. This is one way you could solve challenge four, shinning the light on the back of the first mirror.

Teacher: Today we're going to talk about one form of energy. Light. I had an interesting thing happen to me last night, I was sleeping and I had the sensation that something was crawling on my body. So I jumped out of bed and I groped my way into the bathroom and I looked in the mirror, but I couldn't see anything. Does anybody know why I couldn't see anything? Michael.

Class: Because there's no lights.

Teacher: There's no light. Can you see in the dark?

Class: No.

Teacher: Can any animal see in the dark?

Class: Yes.

Teacher: Now, when I say dark, I mean total darkness. Absolutely no light at all. Can any animal see with their eyes in total darkness?

Class: No.

Teacher: Well, the answer is no, because seeing requires light. You have to have light in order to see.

Narrator: Introduce mirrors and instruct students to explore using the mirrors.

Teacher: I want you to explore what you can do with them.

Narrator: On a sunny day, students will take the mirrors outside to explore. Review outdoor mirror behavior, being sure to remind student not flash light into the faces of other students and not to look directly at the Sun.

If the day is overcast, allow students to explore the mirrors inside the classroom.

Class: I can see the table. I can see Wendy. I can see Jasmine. I can see Mike.

Narrator: After 10 to 12 minutes of exploration, ask students to share their discoveries.

Teacher: A discovery or two they made with the mirrors. Wendy?

Class: It's like, when I put my, when I put the mirror on the nose and it's like when somebody sees it, it looks like my glasses are stuck together and it doesn't have the middle part.

Teacher: Ah. So, you can kind of change your perception and make it look like something's missing there. It's not being reflected somehow. Did anyone use the mirror to try to look behind themself? Who tried that? Who can tell me what you see when they try to look behind yourself? Jasmine?

Class: When I try to look behind me, I saw Chris's hair.

Teacher: So where did you hold the mirror in order to do that?

Class: In front of me.

Teacher: Can you demonstrate that?

Class: Like this.

Teacher: Did you hold it directly in front of you?

Class: No.

Teacher: What do you have to do?

Class: I need to like, um, see half of me.

Teacher: So you're kind of holding the mirror off to the side a little bit, right, and then you can look behind you. Like right now, if you look behind you and you look at the wall and the words on the wall behind you, what do you notice?

Class: It's backwards.

Narrator: Introduce light and reflection to the class. First discussing light sources.

Teacher: Sources. Can you tell me what any light sources you know are. That means something that's giving off light. Can anybody think of any light sources? Andy.

Class: The lights. The lights up there.

Teacher: The electric lights like we have in the room.

Class: The Sun.

Teacher: The Sun. Okay. So let's talk about light for a moment. Light is a form of energy which we've been talking about. And it travels in straight lines. It travels in what we call rays. Can you guys say that for me?

Class: Rays.

Teacher: Which go in straight lines? They never curve. But they can bounce off things. They hit something and they bounce off, and that is our third word here, a reflection. All together, reflection.

Class: Reflection.

Teacher: Now that's what you've been experimenting with, with your mirrors. A mirror is nothing more than a very flat and shiny surface that bounces light perfectly. We have a mirror and we have…

Narrator: Project the Rearview Mirror transparency, discussing how a rearview mirror works.

Teacher: And it hits the mirror and is reflected into his eyes.

Narrator: In the next session, students attempt the Mirror Challenges. Provide each group, four mirrors, four mirror clips, and a flashlight, giving them two hints: One, lay the flashlight down and move the mirrors around to solve the challenges and two, use the index card as a screen to see where the light beam is going.

Class: Yay.

Narrator: Visit groups as they work to assess progress.

Teacher: So, you need, it's a tricky thing, but you need to look carefully to make sure your diagram shows what is happening here. You see what I'm saying, Connie? Like, where would the light go if you have your mirror like this, and you set the flashlight here and the mirror like you have it, it's going to come over here? But in your diagram, your other mirror is over here, isn't it? So, is that going to work?

Class: No.

Teacher: How does this mirror need to be angled in order to make this work? More like this. And that one? You play around with that.

Class: I've got my hand on it.

Teacher: But when you draw your diagram, you get it? Is it going on the flashlight? Okay, good, that's good. I see the beam over there. How about there? Is that it? Okay. So when you draw this, you gotta make sure that this angle is correct, so the light would go that way. So you've got to think about how does the light reflect. It's a very tricky thing, so give that some thought and be careful with it.

Class: Don't move anything. What are you doing? Directions. Found it.

Class: Don't move the mirror. Oh, yea.

Narrator: Add new words to the word bank. Add new concepts to the content chart.

End this part with students reading the article Reflection in the Science Resources book. Discuss students' responses to the review questions.

<Investigation 2, Part 2>
Narrator: In this part, students investigate how the color of light affects the color of objects they see.

You will need these materials for each group from the kit: the red and green gels, the cardboard tubes with caps, flashlights and batteries, and the gram pieces. For the class, you'll need the light bulb and lamp, and the red 1-liter plastic bottle. You will also need the video, All about Light, and access to the Internet.

You will also need to provide colored pens or pencils.

Take 8 of the larger zip-bags and place about 25 gram pieces into each bag. Make sure that every bag contains at least 2 white cubes. Also, practice setting up a light tube and looking at a gram piece through one of the colored gels. Roll up a gel and place it in the tube, making sure the hole in the side is blocked by the gel. Put a cube in the tube and shine a flashlight through the gel in the side. In class, students will place the top hole firmly against their eyes so no outside light enters through the top.

When using the red plastic bottle, make sure that students view the objects inside through the mouth of the bottle, using their hands to block any light from entering the mouth. This way, they see only red light hitting the objects.

Make copies of Science Notebook Sheets, Nos. 11, Unknown Colors, 12, *All about Light* Questions, and 13, *Throw a Little Light on Sight* Questions. You will also need to make copies of the assessment for this Investigation, I-Check 2.

Before introducing colored light, start off this part by reviewing light and vision.

Teacher: Who can tell me what we need in order to see. What do we have to have in order to see?

Class: Light.

Teacher: We need light, yea. So, before we listed some different sources of light. Let's go ahead and get a couple of those sources of light. What are some of the things that we had listed before that give us light? Wendy?

Class: Lightning.

Teacher: Lightning gives off light. Excellent. Jasmine?

Class: Sun.

Teacher: The Sun gives us light. What color is the light coming from the Sun? What color is the light coming from the Sun? Sandy?

Class: Um, rainbow?

Teacher: Rainbow? Hmm... What do we think? Rainbow colors? How about right up here. Joyce?

Class: White.

Teacher: White light? Huh. White light is a combination of all the colors of the rainbow. Yea. But is everything we see white?

Class: No.

Teacher: All right. Let's remember again. What do we need in order to see? On my hand down, one, two, three.

Class: Light.

Teacher: Okay. When we looked at the mirrors, remember this right here? We see a…

Class: Reflection.

Teacher: So. Here's the tough part. This box right here. What color is reflecting to your eyes?

Class: Yellow?

Teacher: Yellow. The top of this pen. What color is reflecting to your eyes?

Class: Blue.

Teacher: Yes. This fruit? What color is reflecting to your eyes?

Class: Orange.

Teacher: Orange, yea. Okay. Now, this is the hard part. Wait. What color is reflecting to your eyes?

Class: Green.

Teacher: Okay. What happened to all the other colors? What happened to all the other colors? If light hits this and only green gets reflected to your eyes, what happened to all the other colors? Lawrence.

Student: The other color was stored by the green color and the green color is reflected to our eyes.

Teacher: There's a new word. We have it right up here in our word bank. Absorb. Let's say that together.

Class: Absorb.

Teacher: Question: what does absorb mean? If this green plastic sheet absorbs all the light except for green, what does absorb mean?

Student: All the other colors are trapped.

Teacher: Nice. What word did he use? Traps. It traps all the colors except for green, which reflects back to your eyes. So what we'll do is each group will get a green plastic sheet, and a flashlight. What I'd like you to do is to see what happens when you shine the light through the plastic sheet, okay?

Student: I can't see anything.

Student: I think it was white and green.

Teacher: Now, let's remember back. What does the green plastic gel do to all these other colors except for green? What happens to all those colors?

Student: They are absorbed or are trapped inside the green plastic gel.

Teacher: They are absorbed or are trapped inside the green plastic gel. What's the only color that makes it through? Ready?

Class: Green.

Teacher: So, should I draw blue on this side?

Class: No.

Teacher: Should I draw red on this side?

Class: No.

Teacher: What color should I draw on this side?

Class: Green.

Teacher: Good, green. Now. Green, so if I take my flashlight then, and shine it here, green light makes it through. Make sense? Okay. Now, what I'd like you to do is to use some other little tools here, these gram pieces. Take out a couple, look at what color they are, put them in the tube, and see what happens to their color.

Student: What color do you want to put in?

Student: Wow.

Narrator: Remind students to firmly hold the top holes of the tube from their eyes.

Teacher: Right up here is a red plastic bottle, okay? While you are looking through your green gels, you can go ahead and come up here and put different things in here and see what happens to their color. Okay? I'll put this right here. Second, if you're having trouble seeing with the flashlight, then you also have a light bulb that I'll leave on right there, so you can go ahead and come up to here when you have the gel inside. Third, I'll also give you a piece of red plastic and one more tube, so you can practice or look at different things under red and green light as well. Okay?

Student: Nice. Ooh.

Student: I think he's supposed to be in our group.

Student: Green and two oranges.

Teacher: When we put it in here, what is the only color of light that is hitting the pen? What is the only color or light that is hitting the pen? Any ideas? Grace?

Student: Um, red.

Teacher: Red. If red light is the only color hitting this, is there red in here to reflect back? What color is the cap?

Class: Red.

Teacher: Red. So will it reflect red?

Narrator: Remind your students to look through the mouth of the bottle.

Student: One black, one white, one brown.

Narrator: After several minutes of free exploration, explain how to set up the unknown-colors activity. Students prepare two identical rows of 3 cubes. The first cube is always white. One row goes into a tube with the green gel; the other identical row goes into a tube with the red gel.

Teacher: And record what color it looks. Now, once you've done yours, okay, both of these here then give them to another group, okay, so you can pass them on.

Class: Ouch.

Teacher: Now, under green light will that white one look white? Not necessarily, okay? But this will remind us that the top cube is always white. Now, with your set of unknown colors, write what color they look like under the green light. So green light, red light, white light. When you're done with your two cubes, or two sets of cubes, we'll pass them to the next table. So I should see you recording, making sure you've got those colors there, talk together with the people in your group if you have a different idea. Remember guys, white light is when you pull the cubes out and you look at them under the classroom lights.

Student: Oh.

Teacher: What I'd like you to do is this, alright? You have your sets of cubes inside your red and green tube here, okay? Now, you don't want the other group, the next group to see what colors they are. So, you'll take your two tubes and give them to the next group, okay? Jenny, we'll take her two tubes from this group and pass them on to the next group and all the way around. Now, this is your red, this is your green, so what color did these look in the green light?

Student: White, green, green.

Teacher: White, green, green? Okay. And then under red light?

Student: White, black, black.

Teacher: Okay, and then if I put these right here, what color are they?

Student: White, green, blue.

Teacher: Okay, go ahead and write that down. White, green, blue. Good. So you are ready to look at the next groups, right?

Narrator: Students exchange tubes and observe the other group's cubes, making sure not to look at them under the white light until after they've observed them through both gels.

Student: Duh, you keep on trying to cheat.

Student: I know.

Student: Um… black. White, black.

Teacher: Green cube.

Narrator: Have students answer the last two questions on their notebook sheets before discussing colors and colored light.

This is a good place for a break.

In the next session, students view the video titled All About Light. They answer questions on the notebook sheet and discuss their responses.

Have the class try the colored-light simulation on FOSSweb.com.

In this activity, students look at four splotches of paint using different colored light bulbs. They drag a light bulb to the flashlight and click the on button. After they've looked at the splotches using all three colors of bulb, they predict what colors they think the splotches are under white light. They check their answers by dragging the white bulb to the flashlight and clicking the on button.

Add new words to the word bank. Add new concepts to the content chart.

Have students read the article Throw a Little Light on Sight in the Science Resources book.

To conclude this investigation, read the summary article, Light. Discuss the reading with the students.

Follow the summary reading and discussion with an assessment: I-Check No. 2.

Be sure to check out the Extensions and the Home/School Connection ideas in the Teacher Guide.

<Investigation 3, Part 1>
Narrator: In Investigation 3, students explore the states of matter and learn how to measure mass

and volume.

For this part, you'll prepare 8 bags of materials like this one.

In each bag place these materials from the kit: First, a bubble you will have to cut from the bubble wrap, a rubber band, a craft stick, a plastic tube, wire, and a piece of cloth.

In addition, you will prepare 6 vials for each bag. There are 48 vials in the kit. The first vial has only air. Half-fill the second vial using the sand and funnel in the kit. You'll need to provide corn syrup, chocolate chips, colored dishwashing detergent, and water colored a different color than the dishwashing detergent. You can use a plastic cup from the kit to mix the water and food coloring you provide. After you've prepared the vials, place them in the bag. Remind students not to open the vials.

For the class demonstration, you'll need one zip-bag with a rock, one zip-bag with colored water, and one zip-bag inflated with air. You'll need to provide the rock and food coloring to color the water.

Make copies of Science Notebook Sheet No. 14, Solid, Liquid or Gas? and No. 15, Properties of Solid, Liquid, and Gas.

This investigation starts with an introduction to matter.

Teacher: I have here a bag. Does anybody think they can identify what's inside this bag? Jasmine?

Class: Rocks

Teacher: Right, these are rocks. Okay and I have another bag here. Does anybody think they can identify that? Wendy?

Class: Um, juice?

Teacher: It does look like juice, but I added some color to it. So if you know that, then what do you think it is, Wendy?

Class: Water?

Teacher: Very good. And then I have one last bag here. Who thinks they know what's in there? Jenny?

Class: Air.

Teacher: Air, ah, very good. I thought you might say nothing, but you can see there's something in there if you press on the sides. How can you tell there is something in these three bags?

Narrator: Listen to student responses before asking students to help describe the properties of the material in each bag.

Teacher: Let's start with rock here. I want you to raise your hand if you can tell me some of the properties of rocks.

Class: Rocks have different sizes and different shapes.

Teacher: Different sizes and shapes. Sizes and shapes. But you know what; I'm going to underline this word, shapes, because do rocks have a shape? They do have a shape. They have a lot of different shapes, but they have a shape, right? And that's an important thing as we'll see.

Narrator: List all of the words students use to describe the materials on the board. Introduce the concept of matter.

Teacher: So these three bags contain matter. Can you guys repeat that word after me? Matter.

Class: Matter.

Teacher: And matter is anything that takes up space. The rocks take up space, the colored water takes up space, and air takes up space. How about you, are you matter?

Class: Yea.

Teacher: You take up space, don't you? So you're matter. How about this school? Is this school matter? It takes up space. Anything that takes up space is matter. Now, matter is found on earth in three states, or three forms. They can be like a rock, which we call a solid. They can be like the colored water, liquid, or it can be like the air, gas. So, the three states are, repeat after me, solid.

Class: Solid.

Teacher: Liquid.

Class: Liquid.

Teacher: and Gas.

Class: Gas.

Narrator: Have students provide some additional examples of the three states of matter before introducing the sorting activity.

Teacher: Now we're going to do an activity involving the materials in this bag. Each group will get a bag like this and there are different materials in there. Your job is to sort them into solids, liquids and gases. Do you think you can do that?

Class: Yes.

Teacher: Then send the equipment monitors up here to get a bag, and we'll start the sorting.

Student: Oooh. Liquid.

Student: It looks like a liquid but it's slow.

Student: Solid, solid, solid, solid.

Student: Solid, solid.

Student: Liquid. These are slow.

Student: And one gas.

Student: Liquid pours, but this pours, too.

Narrator: After ten minutes, identify the names of the substances and distribute the notebook sheet called Solid, Liquid, or Gas for students to record their sorting results. If a group is uncertain about a material, they can record it in the "unsure" box.

Teacher: Another place for liquids, a place for gases, and if there are any materials you aren't quite sure, is that a solid, is that a liquid, is that a gas, if you're not quite sure, you can put them in the unsure box, okay?

Student: Liquid, liquid, solid.

Student: Is this a liquid?

Student: Let's see, how should I call it? Popsicle stick?

Student: This is sand.

Narrator: Visit groups as they work to assess student progress. After students are done recording, it may be a good time to take a break.

Teacher: Did everyone have this in their gas column?

Narrator: Begin the next session by referring back to the matter sorting results.

Teacher: What about this? I imagine…

Narrator: Record students' answers on the board. If there is disagreement about a material, it is recorded in the "unsure" box. At the end of the part, have students refer back to the materials in the “unsure” box and make any necessary changes based on the class discussion.

Distribute the notebook sheet called Properties of Solid, Liquid, and Gas to the groups. Give students ten to fifteen minutes to work in their groups to answer the questions, leaving the last two lines under each question blank.

Discuss gasses, liquids, solids, and unsure materials with students before having them summarize the important characteristics of matter on their Properties of Solid, Liquid, and Gas sheets.

Teacher: Does anyone know what these are? Jenny? Sometimes when I do this activity, kids are a little confused about what state of matter these are.

Narrator: Have them use the last two lines of each question, which they previously left blank.

Confirm that solid materials have definite shape and do not flow. Solids make piles. Liquid materials flow can be kept in open containers, and take the shape of their container. Liquids do not make piles. Gas fills all parts of a container and will escape from an open container.

Add new words to the word bank. Add new concepts to the content chart. Students have determined what matter is and how different states are identified.

End this part by having students read the article States of Matter in the Science Resources book. Discuss the reading as a class.

A note about cleaning up this part. You’ll want to put liquids of the same kind in bags together, with no fabric or other materials. This will make any spills much easier to clean up. Make sure the caps are tightly screwed down.

<Investigation 3, Part 2>
Narrator: In this part, students are introduced to the concept of mass. Mass is the amount of stuff in an object. This book has a greater mass than this pencil. This ten-gram piece has more mass than a one-gram piece. In our everyday language, we equate those two terms, mass and weight, with how heavy an object is. And that's where we leave it for third grade students. They will learn to measure mass in grams.

Mass and weight are discussed further in the “Background for the Teacher” section of this investigation.

There are three sessions in this part. For the first session, you will need from the kit: balances, plastic cups, and mass sets in bags each with 20, 10, 5 and 1 gram pieces. These you will need to assemble ahead of time if the kit is new. You’ll need to place 25 jumbo paper clips in cups for half of your groups and 50 regular paper clips in cups for the other half of your groups. You will also need the plastic chips, wood squares and metal disks.

Make copies of Science Notebook Sheets 16, Measuring Mass, 17, The Sponge Question, and 18, *Opinion and Evidence* Questions.

The FOSS balance has three parts: The base, the beam and the pointer. When the kit arrives new, the pointers will be in this small plastic bag. To insert the pointer, put the rounded end into the beam so that the flat edge hangs down in front of the raised line on the base. Place a cup on the two edges of the beam and then zero the balance by moving the plastic slider to one side or the other until the balance is achieved. Check to make sure that the pointer lines up with the line on the base.

Begin this investigation with a discussion about mass.

Teacher: Today we're going to find out how heavy things are. And the way we're going to do that is to start off by using the objects in this cup. We have a few things in here. This is a little metal washer.

Narrator: Set the challenge for the students. Place a plastic chip, a metal disc, and a wooden square in order from heaviest to lightest.

Teacher: Okay, which one is the lightest? The poker chip?

Class: This one. This is the heaviest. This is the lightest, this is the second lightest and this is the heaviest.

Narrator: As each group completes the task, the reporters list the results on the board. But the groups don't report the same results. Lead a discussion to resolve this problem.

Teacher: We have a good idea of what the heaviest and what's the lightest, but how can we find out for sure? What can be a way we can find out for sure? Samantha.

Student: If we had a, like, you know like the stuff they have in grocery stores to weigh them? We could use one of those if we had one.

Teacher: Very good. What is that called, the thing they have in grocery stores?

Student: I can't remember.

Teacher: Does somebody else know? What do you call those things they have in the produce department at the grocery store? What's that called?

Student: A scale.

Teacher: Scales. They do have scales in the grocery store. We're going to be using a tool today that's not a scale, but it's similar to a scale.

Narrator: After you demonstrate how to set up and zero the balance, the students do the same.

Student: Come on, it's stuck.

Student: Almost there.

Student: I'm trying to move this thing. Oh, it's hard. Oh! What? Nope. All right, your turn.

Narrator: The students compare the objects using the balance.

Class: No, No. Well. It's the same.

Narrator: Now the students know the order of the objects from heaviest to lightest. But they don't know how much each object weighs. Introduce paper clips as a measurement unit. And the students weigh the metal disc using the paper clips.

Student: What are you doing?

Student: I'm taking some out.

Student: It's not even in.

Student: Yes, it is. The washer's in there.

Student: Well, I think we have a little too much of this.

Student: That looks just right.

Student: It is. So let's see. Let's take them out and count how many.

Student: Yea, count them. I'll count these, one, two, three.

Narrator: The students may need to do this more than once.

Class: One, two three…

Narrator: The reporters record the mass of the metal discs on the class chart and again find a discrepancy. When the teacher asks why, a student suggests the clips may not be the same.

Teacher: This is group number one's paperclip. This is group number two's paperclip. What happened here? Let's see group number three's paperclip. Oh, you have big ones, don't you? You have big paperclips. What about number four? What does your paperclip look like? And you guys have small paperclips.

Narrator: When the students realize the need for a standard, introduce the gram. Have the students weigh the objects in grams and record the results on Notebook Sheet No. 16.

This may be a good time for a break.

For the second session, you will need from the kit the balances, plastic cups, the mass sets, the container of gravel, the small zip bags, and the permanent marking pen to label the zip bags. You'll need to provide transparent tape, and an apple or an orange.

To start this session, pose a new challenge.

Teacher: We're going to try to see if we can weigh this apple using our balance and our gram pieces. So let's see how much it weighs. Let's see. Let's put some fives in there and see if that.

Student: All of them.

Teacher: It's still not moving. Let's put some more fives in there. No. Well, it didn't move. Let's pour all the blues in there and see if we can get that to… uh-oh. That didn't work. We don't have enough gram pieces. How are we going to weigh this apple?

Narrator: After the students have shared their ideas, suggest they use cups of gravel in small zip bags to make and label a 100 gram mass piece to add to their mass sets.

Class: Thirty-five, forty, forty-five…

Narrator: These students are counting out 50 grams and will use them to measure 50 grams of gravel twice.

Student: Why don't you take two yellows?

Teacher: I'm going to give you another tool. I'm going to give you some gravel and some little plastic bags, and with the gravel and plastic bags, and your gram pieces, you're going to figure out a way to weigh this apple using these tools.

Student: A little more. Good, it's good.

Student: Straight? Is it straight?

Student: Yea, it's straight.

Student: Can you help me?

Student: Good, now let's pour it into the bag.

Student: Now put it in here. No, put it in here.

Student: One hundred fifty.

Teacher: Are you guys ready to weigh the apple? Let's see if you can do it.

Student: That's a hundred fifty.

Student: Stop stop stop!

Student: It's perfect.

Narrator: The whole class will need ten 100 gram bags of gravel. Have a few groups make extra gravel bags so that you end up with ten 100 gram bags of gravel to make the kilogram weight.

Now, have the student's think of objects or groups of objects that are approximately equal to one kilogram. Search for objects in the room that have a mass of about a kilogram.

This may be a good time for a break.

For the third session, you will need from the kit: balances, plastic cups, mass sets, small sponges, half-liter containers, and a pitcher of water.

Start this session with a discussion of sponges. How much water can a sponge pick up? Two times its weight? Four times its weight? Find out what the students think. Then, ask them to design a plan to find out, and check those plans before they begin the investigation.

Ask them to predict and record what they think the weight of the dry sponge is and how much water it can pick up. Most groups will plan to weigh the dry sponge first.

Student: The sponge is heavy. I never knew a sponge was heavy. I thought it was light.

Student: Yea. Yea!

Narrator: The getters bring one half-liter container of water to their groups and the students soak the sponge.

Student: One, two, three, four, five, six, seven, eight, nine, ten. Okay.

Narrator: The students record the weight of the dry sponge and the soaked sponge and calculate the difference. Most students are surprised to find out that a sponge can pick up eight to ten times its weight in water.

Add new words to the word bank. Add new concepts to the content chart. The students have learned that the gram is the standard unit of measure for mass in the metric system. A balance is a tool used to compare unknown masses to known masses.

Have students read the article Opinion and Evidence in the Science Resources book. Students should answer the questions at the end of the article on Notebook Sheet No. 18, Opinion and Evidence Questions. After the reading, discuss the questions with students and collect the notebook sheets to use as an assessment. See the Embedded Assessment folio for additional guidance.

<Investigation 3, Part 3>
Narrator: In the last part of Investigation 3, students explore volume and capacity using a variety of measuring tools.

There are 2 active sessions in this part. For the first session, from the kit you will need the basins, the 1-liter containers, the half-liter containers, cups, 100-milliliter beakers, the liter beaker, and a 1-mL spoon. You'll need the two pitchers for water and the small and large vials. Don't put the vials out on the materials table because you don't want the students to know there are two sizes of vials.

You will need to provide the water, and the paper towels in case of a spill.

In this part, the students discover the need for a standard unit to accurately measure capacity.

Challenge them to find out the capacity of this cup. How much water will it hold when it's filled all the way up to the rim?

Distribute a vial to each group. Half the groups get small vials. The other half get large vials. But don't let the students know that you're distributing two different vials.

Each group measures the capacity of the cup with their vial.

Student: Two, three.

Teacher: How many did it take?

Student: It took us 9 vials to fill up the cup.

Teacher: Okay.

Student: Seven and a half vials to fill up the cup.

Student: 14 vials.

Student: 7 vials.

Student: 12 vials.

Teacher: 12 vials, okay.

Narrator: Ask the students how they could get such varied answers.

Teacher: Why do you think that is?

Student: Maybe some vials are smaller and some are bigger?

Teacher: That's absolutely correct.

Narrator: When you hold up two vials, the students confirm they are different sizes.

Teacher: We realize that vials are not all the same size. So how can people measure the capacity, or how much water is in a container if our vials are different sizes?

Narrator: When the students agree that a standard unit of measure is needed, introduce the liter.

Teacher: And we have what's called a liter. It's the metric standard for measuring volume. Volume refers to the amount of space that's taken up inside of something.

Narrator: Explain to the students that the liter is a large volume. But it's been subdivided into 1,000 parts called milliliters. This spoon holds one milliliter. Ask the students how many spoonfuls of water it would take to fill this beaker up to the one liter mark.

Introduce the 100 milliliter beaker and demonstrate how to use it. Once the beaker is full of water, place it flat on the table and move your eye level down to observe the water line.

When the water is measured perfectly, ask how many 100 milliliter beakers will it take to fill the one liter beaker. The getters pour the water from the small beakers into the one liter beaker, counting as they work.

Teacher: Delman, and Erica. Kayla's next. Mario.

Narrator: When all of the groups have taken their turn, the one liter beaker will still not be full. The class will find that it takes ten 100 milliliter beakers to fill the one liter container. This way they confirm that there are 1,000 milliliters in one liter.

This may be a good time for a break.

For the second session, you will need from the kit the basins, the liter containers, the syringes, the graduated cylinders, and two pitchers for water. You'll also need eight plastic cups. You'll need to prepare these by marking each one with four lines: A, B, C and D. You'll need to collect a variety of containers. You will also need paper towels in case of a spill.

Make copies of Science Notebook Sheet No. 19, Measuring Volume. You will also need to make copies of the assessment for this Investigation, I-Check 3.

To begin this session, hold up the cup of water that you filled up to the level C. Tell the students there's a volume of water in the cup and it's their job to find out what that volume is.

Each student in the group practices measuring 50 milliliters of water with the syringe.

Student: Is that enough?

Student: Let's take turns. I'm next.

Student: Yea, that's enough.

Narrator: The starter fills the cup to the first mark. The group predicts the volume of water in the cup. The students measure the actual volume by pouring the water into the graduated cylinder.

Student: It is…

Student: Forty six?

Student: Forty four.

Narrator: They record the measurement and calculate the difference between their prediction and the actual volume.

Each student takes a turn filling the cup to the next higher mark. At each level, students first make predictions of the volume and then measure actual volumes to see if their predictions improve as they go.

To conclude this part, students use a variety of containers, practicing first predicting capacity and then measuring the actual capacity.

Add new words to the word bank. Add new concepts to the content chart. Students have learned how to measure volume, and that the liter is the standard unit for measuring volume in the metric system.

Have students read the article The Metric System in the Science Resources book. After the reading, discuss the questions with students.

To conclude this investigation, read the article Summary: Matter. Discuss the reading with the students.

Follow the summary reading and discussion with the assessment: I-Check No. 3.

Be sure to check out the Extensions and the Home/School Connection ideas in the Teacher Guide.

<Investigation 4, part 1>
Narrator: In Investigation 4, students measure temperature in degrees Celsius using thermometers. They investigate evaporation and melting and conduct a simple chemical reaction. They learn about atoms and read about the Periodic Table of the elements.

For the first part, from the kit you will need pitchers for water, half-liter containers, the straws for stirring, the syringes and thermometers. You'll also need sticky labels for labeling the cups. Each group will need three cups labeled A, B, and C.

Just before starting the activity, put 100 milliliters of room temperature water in Cups A and C. Put 100 milliliters of ice cold water in Cup B. The basins are optional.

You will need to provide room temperature water, ice water, hot water and paper towels just in case of a spill.

Make copies of Student Sheet No. 19, Measuring Temperature.

Begin this session with a class discussion of temperature. Then challenge the students to put three cups of water in order from warmest to coldest.

Each group has three cups of water labeled A, B and C. Each student puts one finger in each cup only once. Then they put the cups in order from warmest to coldest.

When each group has agreed on the order, ask the reporters to list the order on the board. Not all of the groups will agree which cup is warmer, A or C. Give them a thermometer to help them solve the dilemma.

Teacher: The thermometer has a thin glass tube, like a straw. And inside it is filled with alcohol. How many of you see the red alcohol in my thermometer? Fantastic. Now, when you use a thermometer, by dipping the bulb, which is the round part filled with alcohol at the bottom, into the liquid, if it is warm, it heats up the alcohol, which makes the alcohol expand and push up the glass tube. To check to see how many degrees Celsius your water is, you would look at the top of the red column of alcohol, and whatever number is at the top tells you the temperature in degrees Celsius that that particular liquid is that you dipped the bulb into.

Narrator: Getters get a thermometer for their groups and now students can measure the exact temperature of each cup.

Student: Okay, go.

Student: What does it say?

Student: 19.

Narrator: The students record their measurements on their Student Sheets. The students may be surprised that Cups A and C are actually the same temperature. This provides an excellent opportunity to discuss why they weren't able to detect that when they tested with their fingers.

Teacher: Where is the line here? Oh, perfect. That goes in the cup.

Narrator: Distribute 100 milliliters of hot water to each group.

Student: It’s high.

Student: It's high. It's about 50.

Student: Wait, it keeps going.

Student: It's at 56.

Narrator: The students record the temperature of the hot water.

Student: It's 10.

Student: That's exactly 10.

Narrator: The students record the temperature of the cold water. After discussing what the students have found, ask what they think will happen if they mix equal parts of the hot and the cold water.

Teacher: Let's estimate and guess what the new temperature would be. Aaron?

Student: I think 35.

Teacher: 35 degrees Celsius after mixing the two, the hot and cold water together? What do you think, Lanicia?

Student: 33.

Teacher: 33 degrees Celsius.

Narrator: The students place 50 milliliters of hot water and 50 milliliters of cold water in a cup. They stir the water with a straw. They measure the temperature of their mixture and record the results.

Add new words to the word bank. Add new concepts to the content chart. In this part, students have learned how to measure temperature in degrees Celsius using a thermometer.

There is no reading in this part.

<Investigation 4, Part 2>
Narrator: In this part, students investigate what is needed to melt and to evaporate materials.

From the kit you will need: half-liter containers, plastic cups, pebbles, toothpicks, thermometers, and the birthday candles cut into pieces about the size of a chocolate chip. For the class demonstration, you'll also need these materials from the kit: the lamp, a graduated cylinder, a syringe, and two cups.

You will need to provide: room temperature water, hot water at about 60ºC, a vacuum bottle or electric kettle to keep the water at the right temperature, chocolate chips, and a stick of cold margarine cut into pieces about the size of the chocolate chips. Be sure to remind students never to eat anything during science class. You'll also need to provide a permanent marking pen, and a sheet of chart paper.

Prepare one half-liter container for each group by drawing a line 2 cm up from the bottom with a permanent marking pen. You will be adding hot water to this line. This container will nest inside a second unmarked half-liter container for insulation.

Make copies of Science Notebook Sheet No. 21, Melting.

Teacher: How many milliliters of water do I have in each cup? How many milliliters of water? Right over here, Kathy.

Student: One hundred milliliters.

Teacher: One hundred milliliters, yea. So, what we'll do now, we'll take these two cups. We're going to put them back here. One cup we're going to set just on the counter here, and the other cup we're going to put under the light here. Okay. Now. Who can read the thermometers and give us our starting temperatures? Does anyone want to give it a try?

Student: Twenty.

Teacher: Twenty okay good.

Student: This one's twenty too.

Teacher: Twenty as well, or 22?

Student: It looks like 21.

Teacher: 21? Okay, which is right with that one right there, so that's 21. Okay, so the one we're leaving on the counter is 20 degrees Celsius, and the one that we're putting underneath our light is starting off at 21 degrees Celsius. Probably a little difference in the thermometer. Victor, do you want to put that one under the light? Got it? Excellent. Okay. Let's go ahead and go to the front; you two can have a seat. Okay, the cup under the light, Victor, what was the temperature starting off?

Student: 21 degrees.

Teacher: 21 degrees Celsius. Okay and it was Wendy, what was the temperature?

Student: 20.

Teacher: 20 degrees Celsius.

Narrator: Try to get at least two more temperature measurements during the day, leaving the final volume measurements for the following day.

After setting up the evaporation investigation, introduce the four materials students will use in the melting investigation.

Teacher: A chocolate chip, a pebble, a little piece of margarine, or like butter, and a piece of wax. Okay. We're going to dunk these in hot water. And what I would like you to do is on the first column in the data table in your lab notebook sheet, is to predict if you think each material will melt or not.

Narrator: This teacher has decided to let each group feel how warm the water is before making their predictions.

Teacher: Make your predictions; you can talk to each other. Here you go hands underneath.

Student: Pebble, no. Rocks don't.

Student: What? There we go. I'm done.

Student: Yes, yes, no, yes.

Teacher: You are going to receive a cup that looks like this. See the black line right there? Okay. What we'll do is I am going to pour hot water in and we're going to put it in here so it's kind of insulated. Kinda like a little thermos. Get the temperature and record it on your sheets. You'll see that there's a line in the top paragraph to record the temperature, and after you've done that you can take the thermometer out and put your cup in. You probably will have to hold it down. Okay? Then, what's the next thing you need to do? Nicholas.

Student: Wait for it to melt.

Teacher: Excellent, Nicholas. You need to wait for them to melt. However, do you think everything will melt? I don't know, you've made your predictions.

Narrator: After the teacher brings hot water, students begin the investigation.

Student: Ready?

Student: Hey, I'm without hands.

Student: I'll hold it.

Student: Okay, you hold it.

Teacher: Don't forget to write down your observations, please. Write down what you see.

Student: I want to poke the chocolate chip.

Student: It's melted.

Student: It's melting.

Student: Melting.

Student: I didn't even get to poke it yet. Justin, you stink.

Student: What about the pebble?

Student: What about the wax?

Student: Justin.

Student: What?

Student: Don't be selfish.

Student: Now let's see. Not even the wax.

Student: Not even the pebble's melting.

Student: Well, duh, it's not melting.

Teacher: I have a question. What does melting mean?

Student: Like getting like smaller.

Teacher: Like smaller. Is it spreading out or staying together?

Student: It's spreading out.

Teacher: It's spreading out.

Student: It's sort of like a liquid.

Teacher: It's sort of like liquid. Okay. So a solid is turning into a liquid. Very good. Go ahead and let's see those. Kathy? Wendy? Let's see those observations as well. Is it spreading out or not, is it soft or not? Okay, very good. So write down what you see happening. Not just melt, but is it turning into liquid, is it spreading out, is it staying together, be very clear in your observations.

Narrator: Allow groups to work for about 5 minutes, before drawing their attention to the questions at the bottom of the notebook sheet. Have them work in their groups to answer the questions.

You may want to visit the groups as they answer the questions on the notebook sheet to assess student progress.

Teacher: Turned into a liquid, yea. Good. So how do you know? It turned into a…

Student: Liquid.

Teacher: There you go. Okay?

Narrator: Close this session by discussing student responses to the notebook questions.

Teacher: First of all, which materials melted completely? Which materials melted completely? Crystal.

Student: The butter.

Teacher: The butter, or the margarine, right? How do you know? Who can help us out here? Go ahead, Crystal, finish it up.

Student: Because of the heat of the water.

Teacher: Because of the heat of the water, and what happened to the margarine? What can we say we observed that caused us to say it melted? Okay? Kathy.

Student: It was getting softer and softer and it was also turning into, like, liquid.

Teacher: Excellent.

Narrator: Remember to try to get at least two more temperature readings for the evaporation investigation before the end of the day. Record the readings on the chart.

Class: Oh, so Justin's prediction at the very beginning, of it getting hotter and hotter is actually happening, huh? We'll check the volume tomorrow morning, okay? All right.

Narrator: Be sure to let the evaporation setup sit overnight.

This teacher is using a lamp with a metal shade. The shade is not needed, you can use the lamp included in the kit, which does not come with a shade.

The next day review the setup, measure the volume of water in each cup, discuss the results, and review heat energy.

Teacher: Thinking back, where else might you see some water, let's say, after it rains? Where would you see water outside after it rains? Crystal?

Student: On the ground.

Teacher: On the ground, but let's say that after the rain the Sun comes out. What's going to happen to that water? What's going to happen to that water? Kathy.

Student: The water might dry up.

Teacher: The water might dry up. All right. What else do we think might happen to that water? Alvin.

Student: It evaporated.

Teacher: It evaporated. Oh, do we know that word? E-vap-or-ate. Let's say that together. E-vap-or-ate. Good. Now…

Narrator: Using the mini-lecture in the teacher guide explain that all the matter in the world is made of tiny bits called particles. Particles are so tiny that they are impossible to see. A tiny grain of sand is made of millions of particles. All solids, all liquids, and all gases are made of particles. Particles are always moving. Particles in solids are stuck together. Particles in liquids are touching, but not stuck together. Particles in gases are not touching. When heat energy transfers to matter the particles start to move faster. When a solid material heats up enough the particles move faster and faster until they move past each other and the solid matter changes into liquid matter. This is called melting. When a liquid heats up enough the particles move faster and faster until they start to fly off into the air and the liquid matter changes into gas matter. This is called evaporation.

After finishing the evaporation discussion add new words to the word bank. Add new concepts to the content chart. The students have learned that changing solids to liquids by adding heat is called melting and that changing liquids to gas by adding heat is called evaporation. They have also learned that matter on Earth is made of tiny pieces called particles.

Have students read the articles Change of State and Particles in the Science Resources book. After the reading, discuss the questions with the students.

<Investigation 4, Part 3>
Narrator: The final part of Matter and Energy introduces students to chemical reactions.

From the kit, you will need these materials for each group: a balance, three plastic cups, and a mass set. For the class, you'll need these materials from the kit: the baking soda, syringes, half-liter containers, 5-mL spoons, craft sticks, and the video, All about Solids, Liquids and Gases.

You will need to provide white vinegar and safety goggles.

To make your life easier, set up two materials stations. One should have the balances, mass sets, 8 cups, and goggles. The other should have 16 cups, the baking soda with spoons and craft sticks to level out the baking soda and two half-liter containers of vinegar with syringes.

Make copies of Science Notebook sheet No. 22, Baking Soda and Vinegar and No. 23, All about Solids, Liquids, and Gases. You will also want to prepare the assessments: I-Check 4 and the Posttest.

Before beginning this part, be sure to review safety, including how to make the goggles fit properly.

Begin this part by showing the students a container of baking soda…

Teacher: All right, so this is our solid. We call it baking soda.

Narrator: and a bottle of vinegar.

Teacher: Yea. Is it a solid, a liquid, or a gas? Call it out.

Class: Liquid.

Teacher: Liquid, good. Now, I took some of this vinegar out and I put it in these containers right here. Okay? Now, what do you think is going to happen when we mix these two substances? Does anyone have any ideas? What do you think might happen? Alvin.

Student: Um, it's going to explode.

Teacher: It's going to explode. That's one idea. Do we have any other ideas? How about Justin?

Student: It's going to, like, it'll be like [student makes exploding noise].

Teacher: Okay. Explode, or [teacher makes exploding noise], or something like that? How about another idea? Any other idea you think might happen? How about Brittany?

Student: It could hurt your eyes if you go too near it.

Teacher: Good, it'll hurt your eyes if you go too near it, that's why today we're going to use goggles. Okay.

Narrator: After asking students to predict the mass of the mixture, preview the procedure.

Teacher: One scoop of baking soda. Question, is that one scoop?

Class: No.

Teacher: No. What do I need to do to make it one scoop? Donna?

Student: You like need to get a stick and scoop some of it off.

Teacher: Look what I've got right here. I have a stick. And what we'll do is I'll scoop some of it off. Is that one scoop? Yes. Okay. So we'll put that in one cup, just like that. Now, second step, I'll have another person come over and get vinegar. Actually, I'll do it, but from your tables, I'll tell you the color that we'll get. Okay? And we will get one full syringe of vinegar, okay? So we'll stick it under here and pull up 50… 50 whats? Milliliters of vinegar, and we'll put it in the cup like that, okay? And then what I'm going to do is this. This is the tricky part. So in your group you'll take the baking soda and you're going to take the cup and put it inside like this. Not mixing. Totally clear right here, okay? We'll put this in one side of our balance. We'll get another cup, and what do you think I need to do next? What do you think I need to do next? Alvin?

Student: Um, you need to put some gram pieces?

Teacher: Exactly. Just like Alvin said, we'll take some gram pieces in here until we have our mass. Okay? Then we stop. Do we mix yet?

Class: No.

Teacher: No. Okay? So. If you are the color… let's say orange. Listen orange. Listen. What I would like you to do is you will get the 50 mL of vinegar. If you are yellow, you will get 1 scoop of baking soda. If you are blue, you will get one extra cup to use for your balance and you will, along with green, find the mass of these two together. So, do I go this way? No. I put this cup, the vinegar cup on top of the baking soda cup. And then do I mix them? No. Everybody know what you need to do? Goggles on?

Narrator: Getters collect the materials they need for the investigation.

Groups then work to determine the mass of the materials before mixing.

Teacher: Predict what's going to happen to the mass after mixing. Will the mass be greater, will it be the same, or will it be less?

Narrator: Have students predict what the mass will be after mixing and record their responses on their notebook sheets.

Teacher: Now, there's one thing though that you need to know. First of all, first of all, I do want us to make sure that we have our goggles on. Okay? So let's get those on. Second, when we pour the vinegar into the baking soda, are we going to pour the baking soda into the vinegar?

Class: No.

Teacher: No. When we pour the vinegar into the baking soda, are we going to do it with our face right over it? No.

Student: You have to do it far away.

Teacher: We have to do it a little bit far away. Thanks, Gavin. Okay. So, the other thing you need to know is we want to do it slowly. Do a little bit, pour a little bit, pass it to your neighbor, pour a little bit, pass it to your neighbor, pour a little bit, pass it around until all the vinegar is gone. Okay? Now, I'm going to pretend that I've already done it; I'll dump this out in the sink. Okay? So I've already done it, I've already had whatever's going to happen, happen. Then I need to measure the mass after the reaction, or after whatever happens, happens. Question, do I have to include this cup?

Class: No.

Teacher: Did I include this cup when I took the first mass?

Class: Yes.

Teacher: So do I need to include this cup when I do the second mass?

Class: No.

Teacher: Guess what. Yes, you do. Okay? Because you don't want to take away this mass and it'll be less but all it is, is because you took away the cup. So put this inside here. We'll measure the mass after. After. Then I'll give us a table up here so that we can record our new mass. Now, one last thing. If we look on our lab notebook sheet right here, there's a place for you to record your observations, what do you notice, what do you observe, and then the mass of the baking soda and vinegar after whatever happens.

Student: Put the rest in.

Student: Yea, don't do it fast.

Narrator: Visit groups as they work to make sure they are following the procedure properly, pouring the vinegar slowly and carefully into the baking soda.

Student: He needs to pour last, Justin.

Student: You pour half.

Student: Is this done?

Student: Yes.

Student: Alvin!

Student: That first! That first.

Student: Alvin, why are you so bossy helping?

Student: Okay, here it comes. Come on.

Narrator: Groups find the mass of the new mixture.

Student: So this part is heavier.

Student: 40. Okay, watch this.

Student: 45.

Narrator: Students record their results on the notebook sheet.

Teacher: So this is our beginning mass. Our ending mass.

Narrator: Record group results on the board and discuss the value of multiple results.

Teacher: When we mixed the baking soda and vinegar together, we had something called a reaction. Can we say that together? Reaction. And in that reaction, something new was made. And, Nicholas, what was that something new that was made?

Student: Carbon dioxide gas.

Teacher: Carbon dioxide gas. And that carbon dioxide gas was inside the what? The bubbles. Yea, it was inside the bubbles. Where did the carbon dioxide go? What do you think? Want to give it a try, Wendy?

Student: In the bubbles?

Teacher: In the bubbles. And where did the bubbles go? Did the gas stay in the cup? Or did it go away? And if it went away…

Student: The weight got less.

Teacher: The weight got less. The mass became less. Wow.

Narrator: The next session begins with the video, All about Solids, Liquids and Gases. After watching the video, have students answer the questions on notebook sheet no. 23, called All About Solids, Liquids and Gases. Discuss the questions as a class.

Add new words to the word bank. Add new concepts to the content chart.

Have students read the article Reactions and the article Summary: Changing Matter in the Science Resources book. After the reading, discuss the questions with students.

At this point, give the class I-Check 4.

After the students have completed all of the activities and readings in all of the investigations and have reviewed their learning, give them the posttest to assess what they have learned. Use the scoring guide in the Benchmark Assessment chapter to score students' work.

<FOSS Assessment>
Class: Oh, that's so cool.

Narrator: Students using FOSS learn science content in three ways. Through active investigation, through reading, and through assessment. Unlike many curriculums that treat assessments as a separate component only related to giving grades, FOSS assessment is integrated into the instruction throughout the module.

Teacher: Spreading out, or staying together?

Student: It's spreading out.

Teacher: It's spreading out.

Narrator: Assessment activities in FOSS provide teachers with immediate feedback about student understanding and give students the opportunity to reflect on their own learning. There are two kinds of assessments in the FOSS curriculum. Embedded assessments are integrated into the activities of each investigation part, and are used diagnostically.

Teacher: Now, see, you have to look carefully at how the flashlight and the mirror has an angle here. But when I look at your sheet, I see your mirror angled like that.

Narrator: Benchmark assessments occur before instruction begins, after each investigation, and after instruction is completed. Benchmark assessments were developed to be used as an evaluation tool, but have proven to be even more valuable as a learning tool for both students and teachers, especially when students assess their own work.

Teacher: One question in particular that I want us to look at in more detail, and that's question 45.

Narrator: If this is the first time that you have used the FOSS curriculum, you may want to wait until you have taught a module or two before adding another layer of complexity by using the assessment materials. If you are an experienced user, the information that follows will help you get started using FOSS assessments.

In each investigation, you will find suggestions for embedded assessments in the Getting Ready section, as well as the Guiding the Investigation section. Embedded assessment is an important part of each day's lesson. It may be an observation in which you look over students' shoulders to see if they are developing inquiry skills, or it may be a look at a notebook sheet or a response sheet to look for content understanding. Embedded assessment is integrated into instruction, so your students may not even realize that assessment is a part of the activity.

The Embedded Assessment chapter provides more information about each embedded assessment. It shows the standard that is the focus of the assessment, the suggested assessment to use, what to look for in students' answers, and if appropriate, an answer sheet. It also includes a teaching schedule that will help you plan both Embedded and Benchmark Assessments. Benchmark Assessments are given at several points during the module.

You give a pretest before instruction begins, to find out what students already know about the topic. You give a posttest after the module is completed, to find out what they've learned. What's new and innovative are the I-Checks that are given after each investigation. An I-Check is usually 8 to 10 questions long, and focuses on the content learned in the investigation that students have just completed. You will notice on the schedule that there is also a day for review scheduled after each I-Check. This review session is meant to be a day in which students use the I-Checks as a learning tool, using self-assessment strategies to clarify and improve their inquiry skills and understanding of content.

We suggest the following procedures for dealing with Benchmark Assessments. Give the Benchmark Assessment as you would any other quiz or test. Feel free to read the questions out loud to your students. This helps ensure that the assessment will check science knowledge rather than reading level.

Score the students' responses, but only record the scores for yourself. Don't write them on the students' papers. Hand the papers back to the students. Guide them in using a self-assessment strategy to reflect on their answers and their own thinking.

Self-assessment strategies include sharing answers and brainstorming key points that should be included in an answer, then having students compare those key points to what they wrote.

Student: Isn't it like this? Because, um, I thought that, um, when the cold water warmed up it would go to the top and then slowly it would cool off and go back down to the bottom, and then it would warm up again and continue its cycle.

Teacher: Okay, excellent. Does anybody want to add to what she did, add more evidence, explain it, or does anybody disagree with what she said and you want to come explain that? Ronin, do you want to come up here?

Student: Well, um, I kinda disagree with Alexis's statement. I think the water's going to go up and then when it gets up there it starts to cool down, but instead of going straight back down, I think it's going to mix up the bottle, so then at the end, for example when we were like doing our project, if you shake it too much, it would go completely mixed, so you can see that it's a very fragile system. So that's why I think it would just go up and then mix up the bottle.

Teacher: Okay. So it's similar, a similar idea. What I really want to hear from somebody, great job Ronin, thank you, go have a seat, awesome, is why. A lot of you said, well, it warmed up and it went up and then it came back down, but why? Why did it do that? Okay, Corrina.

Student: Um, well, when the warm water heats up the cold blue water, it gets less dense, um, because cold water is denser than warm water, and so then it heats up and it rises, but then when it moves away from the warm water, it gets denser.

Narrator: Students improve their answers by rewriting or adding to their answers to include any key points they missed.

Here's another self-assessment strategy. After students have clarified their answers with their group or the class, they use sentence starters to continue the process. The goal is for students to identify how their thinking has changed and think about why they may have gotten an answer wrong. They may have simply made a careless mistake, or find they need to ask the teacher for further guidance. The goal of self-assessment work is to help students rethink and clarify their understanding. They also gain perspective on what your expectations are for full and complete answers.

In addition to referring often to your teacher guide, be sure to check FOSSweb for additional teaching notes and self-assessment strategies.