FOSS ® NATIONAL WATER PLANET
TEACHER PREPARATION VIDEO TRANSCRIPT

<Teacher Guide Introduction>
Narrator: Before you begin teaching this module, it is important to look through the entire Teachers Guide. The FOSS Teacher Guide for this module include 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 in each I-Check. Scoring guides are included in this folio. After these two assessment folios, you'll find the Assessment Masters. See the Assessment sections 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, along with 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 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.

<Module Introduction>
Narrator: Hi. I'm Sue Jagoda, and I'm here to get you started with Water Planet. In this module, students will focus on the Earth; its place in the solar system and how water moves through the water cycle, and contributes to the weather we experience here on Earth…the water planet.

These three boxes make up the Water Planet 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.

If you are the first person to use the Water Planet kit, you'll want to prepare some of the materials for the first time. These preparations only need to be done if this is the first time the kit is being used. You will want to check to see if these materials are available and prepped before subsequent uses.

There are 18 thermometers in the kit. You'll want to find pairs of thermometers that read the same temperatures before beginning investigation 3, Heating the Earth. Allow the thermometers to sit out at room temperature for 5 to 10 minutes before matching them up. Then use a permanent marker to label the pairs by number: two 1s, two 2s, two 3s, etc. Each collaborative group will be assigned a number and use that pair of thermometers during the investigation.

You will need water for many of the activities. Plan ahead to make sure you will have water on hand, including ice water and hot water.

Check the food coloring in the materials kit. Make sure you have a good supply to be used for coloring the water in some of the activities.

You'll need to dry the potting soil used in Investigation 3. Spread the soil onto newspaper and allow to dry for several days. Stir the soil occasionally to hasten the drying process. Each group will need 100 mL of soil.

As you finish each activity, make sure that all plastic items in the kit are rinsed and dried for storage and later reuse.

You will need to make copies of science notebook sheets before each investigation. Some sheets should also be copied onto transparencies. You should also make copies of Teacher sheet no. 1, Letter to Parents. Send the letter home with your students a few days before you begin the module.

You'll want to decide how you will 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 composition notebooks you provide. One strategy that works very well is having the students paste the notebook sheets on the left side of the composition books, leaving the right side open for any additional recording.

If your students are ready to take on the responsibility of what, how, and when they record information and process data, you may decide to have them work in blank composition books. Your students are usually ready for this version of a science notebook once they have worked through several more structured versions.

For more information about the use of science notebooks, read through the Science Notebooks section in the Overview chapter in the teacher guide.

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.

As part of the FOSS assessment system, a pretest should be given to students before beginning the module. You will give the same test as a posttest at the end of the module, so you will be able to assess your students' progress after they engage in the investigations, readings and other activities. Make copies of the test before beginning the module.

You may also want to place the safety poster up in your classroom.

<Investigation 1, Part 1>
Narrator: In this investigation, students focus on the solar system. In part 1, they work with a set of solar-system cards as they organize the various objects found in the solar system into categories.

For this part, use the solar-system cards from the kit. There are 16 sets of cards. Each set has 18 cards.

Make copies of Science Notebook sheets 1, called Solar-System Data, and 2, called Solar-

System Tour Questions.

The Solar-System Data sheet will be used as an embedded assessment. Read through the Embedded Assessment chapter in the teacher guide to find out more about how you can use these sheets to assess your students' progress.

The Solar-System Tour Questions student sheet lists the review questions for a reading of the same title in the FOSS Science Resources book. Students will be reading this book throughout the module.

Before starting the investigation with your students, take some time to review a set of the solar-system cards. Each deck includes a card for the Sun, each planet, and other objects such as the Moon and satellites of other planets, an asteroid, and a comet.

Begin this part by asking your students what they know about the solar system.

Teacher: Samantha?

Narrator: Listen to student responses before defining the solar system.

Tell students that you have some cards with pictures of various objects in the solar system. Some of the objects can be seen during the day, others at night. Some of the objects can be seen with bare-eyes, others require binoculars or telescopes.

Teacher: Okay, have we passed out all of the envelopes? All the plastic bags? I'd like you to group them together. If you see a difference I'd like you to separate them.

Narrator: Give students about 10 minutes to sort the cards for the first time.

Teacher: Again, comparison and contrast. This is an activity we often do in language and language arts. And then make sure they're spread out so we can kind of get an idea of how you group them. We'll talk about how you actually compared them and how you contrasted them.

Now before you tell me what groups you put them in I'd like you to ask yourselves why did you put some things together and why did you put some things apart from one another. And I'd like you to think about that and maybe give me an example of that. Any ideas? How about Winnie?

Student: Um, there's one group that are all planets.

Teacher: Planets. Pictures of planets. Okay, let's leave that up there as an idea. Okay, so Peggy I noticed you have a group of six cards here and your partner Tre has a group of twelve cards over here. I'm just curious what is it about this group of six that made you want to put them into one group?

Student: Um, it's not round.

Teacher: They're not round. Excellent. Let's put that down.

Narrator: Keep a tally on the board of different categories students have used to sort the cards.

Teacher: …spherical. We have landforms, which could be anything you see on the surface…

Narrator: Students can now turn the cards over to read the information on the back. Review the categories with them: Type, Distance from Sun or other object, Diameter, Orbit period, Maximum and minimum surface temperature, Composition.

Tell students that some of the categories may state "unknown." That's because scientists don't have the information yet.

Review what the term "orbit" means with the class.

Teacher: Write down the word orbit. Would you please do that now? Word bank…

Narrator: Have students place only the planet cards in order of distance from the Sun, using the information on the back of the cards.

Teacher: …but rather by distance from the Sun. Planets only, distance from Sun outward, planets only.

Narrator: After reporting their results, students add the remaining cards and put them in order.

Once students have put all the cards in order, discuss their results as a class.

Have each group work together to record their results on a Solar-System Data sheet.

Now students work with the nine planet cards to group them based on composition. Introduce terrestrial planets and gas giants.

When this investigation was developed, Pluto was still regarded as one of the planets. So it may be included in the card deck as a planet. You will have the opportunity to discuss this new idea at the end of this part.

Use the Solar-System Data sheets for an assessment.

At the end of this part you'll begin the word bank. You'll also begin the content chart by adding new concepts and student questions. The students will add to these charts as the module continues.

Introduce A Tour of the Solar System, the first reading in the ***Science Resources*** book.

Introduce the Glossary, and show students how to identify the boldface words in the articles as glossary words.

Choose the best strategy for reading the article with your class. Students can read on their own, in small groups, or you could read the article as a class.

Questions are included at the end of the article. Have students respond to the review questions on science notebook sheet no. 2, Solar-System Tour Questions. Then you can discuss these questions as a class.

<Investigation 1, Part 2>
Narrator: In this part, students consider the effect of gravity in the solar system. Here's what you'll need from the kit: one plastic ball, string, and the Planets and the Solar System video. Preview the video before showing it to your students, so you'll be ready for any questions that come up.

Make copies of Science Notebook sheet 3: Planets and the Solar System. This sheet includes focus questions for the students to consider as they view the Planets and the Solar System video.

For assessment, plan to give the class I-Check 1 at the conclusion of this part. For more on assessment, check out the Benchmark Assessment chapter in the Teacher Guide.

You'll need to assemble the ball and string. Just tie a 2-meter length of string to the ball. Practice swinging the ball around your head and releasing it before your classroom demonstration.

Teacher: Ideas about what orbit is?

Narrator: Begin this part with a review of the word orbit using the mini-lecture on Sir Isaac Newton in the teacher guide.

Then use the ball-and-string to demonstrate an orbit.

Teacher: Now who can tell me what does each one of these orbits represent. You should know that from the calendar.

Class: A year!

Teacher: Good, would you count the years starting right now.

Teacher/Class: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Teacher: Which happens to be about the age of all of you.

Narrator: As you demonstrate orbit, ask: Did the planet, the ball, orbit the Sun, my hand? What shape was the orbit? Was the planet traveling in a straight line? What made the planet travel in a circle? Remind students of Newton's law saying that objects travel in straight lines unless acted upon by a force.

Have students discuss the circular path of the ball-planet in their groups. Then discuss their ideas as a class.

Teacher: Now what do you suppose it is about these orbits that keeps them in the same distance in the same orbit year in and year out, year after year after year after year after year? What do you suppose it is? Uh, Lui Chen? Yes, sir?

Student: Gravity.

Teacher: Gravity. Who knows what gravity is by the way? Pretty sure you all know what gravity is. What could I do with this ball right here in my hand to demonstrate to you the power of gravity? Any ideas? Ah, I see Brian in the back has his hand up.

Student: Just drop it.

Teacher: Just drop it. Let's take a look and see what happens. Now if there's gravity what's gonna happen?

Class: Fall.

Teacher: What if there is no gravity?

Class: It's gonna fall.

Teacher: Could things have gravity enough to make this ball fall? Pretty obvious question right? Let's try it, here it goes. There it goes. Well somebody mentioned, it was Lui Chen that mentioned gravity which is what kept these things in orbit. What do you suppose would happen if there wasn't gravity? I need someone to pay attention. If I didn't have gravity here: I don't know maybe that's Earth, I don't know maybe that's Venus, maybe we can get further out to Jupiter, maybe to Saturn. Any ideas what's gonna happen if there's no gravity? What's gonna happen if there's no gravity? What's gonna happen to this guy? I had someone raise their hand. What if this power of gravity, which is so strong suddenly didn't exist? Raise your hand if you know what would happen? You know what I'm gonna do? I'm gonna magically remove the gravity. I need someone to tell me what happens to his large large thing rotating around me? What's gonna happen? I see a few hands up. I don't know, any other ideas? How about Catherine, right next to me here? Catherine what's gonna happen if suddenly I can magically remove the gravity from this particular orbit?

Student: Um, it would be floating.

Teacher: It would be floating. You think it would just float around in the sky like maybe a balloon?

Class: No.

Teacher: What do you suppose it might do Lui Chen?

Student: It's gonna go around and around and then crash into other planets.

Teacher: It may crash and what would happen as it crashed? Would it get closer to Earth or farther away from Earth? Well let's see what happens when the gravity escaped. You ready? Hmm…?

Class: Wow, whoah!

Teacher: Now why did that happen? Why did that happen? Is it because I let go?

Class: Yes.

Teacher: Well if I was the Sun and I was holding on what would be the power I had to make that thing hold on so it would never let go and go flying across like that. What power was I demonstrating for you guys? Ah, over there—Anna, what power did I just demonstrate?

Student: Gravity.

Teacher: Gravity. And what about…

Narrator: At this point, have students read the article in the *Science Resources* book, Why Doesn't Earth Fly Off Into Space? Use the questions at the end of the article to discuss it in class. This is a possible place for a break point.

Have students read and discuss the articles about Ramon Lopez and Mae Jemison.

It's now time to view the video included in the kit, Planets and the Solar System. Distribute copies of science notebook sheet no. 3 called Planets and the Solar System, one to each student. Review the questions before you watch the video and have students complete the sheet afterwards. Then use the questions on the sheet to guide discussion with your class.

Add new words to the Word Bank. Add new concepts to the content chart.

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

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

<Investigation 2, Part 1>

Narrator: In this part, students are introduced to evaporation by observing a demonstration.

Here's what you will need from the kit: plastic cups, dome lids, a balance, a half-liter container.

You'll need to provide water and paper towels.

Make copies of science notebook sheet no. 4, Wet Paper Towels.

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 beam is balanced. Check to make sure that the pointer lines up with the line on the base.

Discuss how wet things get dry. Then talk about how we use paper towels.

Teacher: And when we use them, they get all wet. But we can reuse them again if we let them dry out. So we're going to do a little experiment with them. I'm making sure these towels are equally wet. I'm going to check my balance over here and see. We're going to put a dome lid on top of one. And a dome lid underneath the other one. And they should still balance. Now we're going to let them sit for a day and observe them and see how they dry out.

Narrator: The next day the students are pretty amazed they can see the paper towel in the open cup looks dry while the paper towel in the cup with the lid looks the same as it did before.

Teacher: What else is different about it besides being bigger? Phillip?

Student: All the water is gone.

Teacher: All the waters gone. It's all dried out. Let's take the lid off and see what happens to this one. Michael?

Student: The water is still there.

Teacher: Yes, it's still wet. Why do you think different things happen to different paper towels? Omar?

Student: The one without the lid got more air to it so it dried up easily. Then the one with the lid on it didn't get no air so it's still wet.

Narrator: The students realize that the water in the open cup went into the air. Introduce the term evaporation.

Teacher: That might be a new word for you, evaporation.

Narrator: Develop the idea of the evaporation further by explaining that the evaporated water becomes an invisible gas called water vapor. Its still water but it's in the form of a gas instead of liquid.

You can now have students complete science notebook sheet no. 4, Wet Paper Towels. You can use this sheet to assess student progress. Check to see that students have the idea that water evaporates and that water vapor goes into the air.

Go over new vocabulary and add it to the Word Bank. Add new concepts to the content chart.

To end Part 1, have the students read and discuss the article in the *Science Resources* book called Drying Up. Use the questions at the end of the article to direct discussion.

<Investigation 2, Part 2>
Narrator: In this part, students investigate the effect of location on evaporation.

Here is what you'll need for this part. From the kit you'll need four plastic trays which you will label A, B, C and D. You'll also need sticky notes, plastic cups, half-liter containers, 50-milliliter syringes, thermometers, balances, and transparent tape.

You will need to provide water.

Make copies of Science Notebook sheet, Evaporation Location Charts. You will use this sheet for assessment. Make an evaporation chart like the sample chart found in your teacher guide on chart paper or on the board.

Teacher: Let’s look at two paper towels we left sitting over night. One was wet and one was dry.

Narrator: Begin this part by reminding students of the wet paper towel from the first part of the investigation. Ask the students where they might put the towel so it would dry quickly.

Teacher: Who has some ideas where we might put paper towels so they’ll dry quickly?

Student: Outside.

Student: On a stove for a day or two.

Student: You can put it in a warm room.

Student: Next to a heater.

Narrator: Ask students where they might put it so it would dry slowly.

Student: In a bottle with a cap.

Student: Underneath the cup.

Narrator: Record the students' ideas on the board. Students choose two locations where the towel might dry quickly and two locations where the towel might dry slowly.

Have students come up with a plan for investigating how fast water will evaporate in the

locations. The plan should include:
• Putting equal volumes of water at each location.
• Deciding on a time for observing the cups at the designated locations.
• A way to measure the water in the cups after the evaporation has occurred.

Each group labels four cups A, B, C and D to identify the four evaporation locations. The students can use a bit of transparent tape to attach the sticky labels more securely to the cups.

Each member of the group gets a chance to use the syringe to put 50 milliliters of water in a cup.

Student: Push hard.

Narrator: The cups are placed on the tray with the matching label.

Student: That's hard.

Narrator: Introduce the temperature chart and tell the students that they will check the temperature every morning and every afternoon for four days and record the temperatures on this chart.

Choose students to put the trays in their selected locations, and read and record the temperatures.

Student: It's 20.

Narrator: The students check and record the temperature twice a day for four days.

On the fourth day, all of the trays are brought back to the Materials Station. The final data is recorded.

Students can determine the amount of water that evaporated from each cup by measuring the amount that remains with a graduated cylinder, or the balance, and subtracting the final amount from the starting amount.

Distribute copies of science notebook sheet Evaporation Location Charts, and have students record their measurements.

Review the data on the temperature chart. Have some students average the temperatures and record the averages on the class chart. Everyone should include the averages on the notebook sheet.

Students can now put the cups in order from most evaporation to least evaporation and complete Chart 2 on the notebook sheet.

After students have ordered the cups, ask:
• Which one had the most evaporation? How do you know?
• Which cup had the least evaporation? How do you know?

Confirm that the cup with the least amount of water left experienced the most evaporation, and the cup with the most water left experienced the least evaporation. Then discuss the relationship between temperature and evaporation.

Have students answer the four questions at the bottom of the notebook sheet. You can use this sheet as an assessment. Check to see how they organized their data and make sure that they understand the warmer the environment, the greater the evaporation.

Wrap up Part 2 by adding new wording to the class word bank. Add new concepts to the content chart.

To end Part 2, have the students read and discuss the article in the *Science Resources* book, called Evaporation. Use the questions at the end of the article to direct discussion.

<Investigation 2, Part 3>
Narrator: In this part, students investigate how surface area affects evaporation.

Here's what you'll need from the kit: the trays, the flat lids that fit the half-liter containers, dome lids, graduated cylinders, one half-liter containers, 50-mL syringes, and 100-mL beakers.

You need to provide water.

Make copies of science notebook sheet no. 6, Surface-Area Chart, no. 7, Julie and Art's Experiment A, and sheet no. 8, Julie and Art's Experiment B. Make copies of teacher sheet no. 2, Evaporation Place Mat, one for each group.

Make copies of notebook sheet no. 9, Response Sheet—Water Vapor.

Plan on a place where you can store the eight trays with the different containers for evaporation.

This part will take three sessions: one session to set up the investigation, a second session four days later to observe the results, and one more session to read and discuss the Science Resources article, Surface-Area Experiment.

Begin the activity by showing the students the four containers: the cylinder, the beaker, the dome lid, and the flat lid.

Teacher: I want you to notice the size of the opening of these containers.

Narrator: Ask the students to compare the sizes of the openings on the containers. Explain that of the water in each container, the area of the water touching the air is its surface area. Ask the students in which container water will evaporate the fastest.

Review the definitions of variable and controlled experiments. Challenge students to plan a surface-area experiment.

Students work in their groups to design an experiment. They should be able to identify the variables and which variable they will control in the experiment.

During class discussion, record the variables on the board. There should be agreement that surface area will be the independent variable because students will know how big each surface area is before the experiment begins. The amount of water and the location should be controlled for each container. That is, temperature and other environmental conditions need to be the same. The amount of evaporation is what will be measured as an outcome. The amount of evaporation is the dependent variable.

The students use the syringe to add 25 milliliters of water to each container before placing them on the tray with the evaporation placemat.

The students put all four containers in the circles, being particularly careful with the large flat lid. They will store the containers for four days.

When the four days are up, the students retrieve the trays and measure the amount of water in the graduated cylinder.

Student: 1, 2, 3…

Narrator: When they finish measuring the water, they pour it into the half-liter container and then use the graduated cylinder to measure the water remaining in each of the other containers. They can use the syringe to transfer water from the other containers to the cylinder.

Student: 9. 9.

Student: 14.

Student: Here you go…

Narrator: The students in this group are careful to suck up every last drop in the flat lid.

Student: It’s not quite 5; it’s 3 I think.

Student: Yeah, it’s 3.

Narrator: Students record their results on science notebook sheet 6, Surface-Area Chart. They calculate the amount of water lost to evaporation.

Visit with the students as they complete the science notebook sheet, checking to see that they understand that:

• Although the water volume was the same in each container, the level was different.
• Subtracting the water volume at the end of the experiment from the initial volume will give

them the amount of water evaporated.
• The greater the surface area, the greater the rate of evaporation.

Once students have completed their calculations, have them put the containers in order from the greatest amount of evaporation to the least. Students should compare the amount of evaporation to the surface area.

They can now rank the containers by rate of evaporation on the notebook sheet.

Go over the experimental procedure by reviewing which variables were controlled, which variable was the independent variable, and which were the dependent variables.

Have students consider the wet paper towel experiment and how they might dry the towel out more quickly.

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

Have students read the Surface-Area Experiment article in the *Science Resources* book. This article is a narrative report of a surface-area evaporation experiment. Students will extract experimental data from the reading and use science notebook sheets no. 7 and no. 8 to record and analyze the data. Use the questions on sheet no. 8 to guide discussion about the article and the experiment.

Have students complete the response sheet for this investigation to assess student understanding of evaporation and surface area. Collect the sheets to review for student misconceptions and incomplete ideas. Then return the sheets and have students discuss their ideas. For more information about using this Response sheet for assessment, read the Embedded Assessment chapter in the teacher guide.

<Investigation 2, Part 4>
Narrator: In this part, students observe condensation on a cup of icy water and set up and observe condensation chambers.

Here's what you'll need from the kit, pitchers, 50-mL syringes, one half-liter containers, plastic cups, dome lids, 100-mL beakers, thermometers, craft sticks, food coloring, rock salt and sticky notes. You will need to provide ice and water.

Review step 5 in the Getting Ready section to learn more about the optional condensation inquiry in this part.

Make copies of science notebook sheet no. 10, Condensation Observations. Make copies of the assessment, I-Check 2 to give the class at the conclusion of this part.

You should consider humidity before scheduling this part. Check for the dewpoint online. If the dewpoint is 5°C (that's 41°F) or above, your students should be able to observe condensation on a cold surface. If the dewpoint is lower, you might want to add some humidity to the room by running a humidifier or heating water in an open hotpot for about an hour before the activity is scheduled.

You will also need a pitcher of blue ice water and a one of green room temperature water. You should allow tap water to stand for at least an hour to reach room temperature.

Student: It looks like green Jell-O.

Student: I want to taste it.

Student: No. It's nasty.

Student: What does it smell like?

Teacher: Remember, you're going to leave these in the middle of the table and not touch them. You're only going to observe.

Narrator: Begin this part by filling a plastic cup with blue ice water and another one with green room temperature water for each group. Ask the students to observe the differences.

Student: This looks freezing.

Student: This feels hotter.

Student: It's cold.

Student: It's freezing.

Student: This one just stays the same.

Student: It's just like regular water comes…

Teacher: When you looked at the two cups, what did you observe? Devani?

Student: The one with the blue food coloring it—it got foggier.

Narrator: Discuss what the students observed and have them consider how the water got on the outside of the cup and whether it formed on the outside of both cups.

Step 3 includes an optional condensation inquiry if you decide to have students further investigate condensation by designing new experiments. The students report they saw water on the outside of the cup with blue water.

Student: And when the air blows past the cold, it gets on the cup. And that's how it fogs up on the outside.

Narrator: Explain the droplets of liquid water on the outside of the cup came from the water vapor in the air.

When water vapor touches a cooler surface, it changes from water vapor to liquid water. That's called condensation.

Teacher: That's called condensation.

Narrator: Students tell about situations in their own life when condensation occurs. They may think of the bathroom mirror after a shower, eyeglasses fogging up, or their breath on a cold day.

Student: When it rains—my Dad's car it fogs up cause of the coldness.

Student: Um, when it rains and you're in your house and it fogs up you can write on the windows with the fog.

Narrator: Each group adds 50 mL of water to a dome lid and covers it with a cup to create their own condensation chamber. They label their chambers with a sticky note.

Students put the condensation chambers in a sunny place in the room. The next day, they retrieve them for observation.

Student: Is it hot?

Student: No it's just warm.

Student: Do we know if that's cold water?

Student: It looks like a foggy day.

Student: Oh it does!

Student: No, it's cold.

Student: It's not foggy down there. It's foggy up here.

Student: You see that fog right there? There's a little bit of fog down there.

Student: I think it's moist in there. It needs some air. Let's open it.

Teacher: What happened inside of these cups? What did you see?

Student: When you look at it, the drops of water, it makes like—it's foggy on the outside or foggy on the inside and the drops of water make it come through so you can see it clear better.

Narrator: When the teacher asks what made the water vapor condense on the inside of the cup, the students figure out it came from the 50 mL of water inside evaporating and condensing when it hit the cool sides of the cup.

Students now investigate what might happen if they create a colder surface for condensation. They get a cup of ice and use the 100-mL beaker to measure 50 mL of rock salt over the ice. They stir the ice and observe. You may want to have students breathe gently on the outside of the cup and observe what happens.

After about 10 minutes students should observe that the condensation is freezing. They can scrape the frost off of the cup with a stirring stick. Students consider how the condensation froze and measure the temperature inside the cup. They should find that the temperature may be as low as -15°C. Explain to students that water changes state from liquid to solid at 0°C and discuss experiences students have had with frost in other situations.

Distribute copies of science notebook sheet 10. Have students fill in their observations and explanations of condensation and frost formation. You can use this sheet as an assessment to see how well they understand the concept.

To complete this part, go over new vocabulary and add it to the Word Bank. Add new concepts to the content chart.

You can now have students read the article titled Condensation in the *Science Resources* book. The article describes the process of condensation and its results that we routinely see, such as clouds, rain, snow, and more. Use the questions at the end of the article to guide discussion.

To conclude this Investigation, have the students read Summary: Water Vapor in the *Science Resources* book. They should complete the summary questions on a plain sheet of paper in their notebooks. Discuss the reading in class and then give students I-Check 2.

<Investigation 3, Part 1>
Narrator: In this Investigation, students investigate how uneven heating of the Earth causes convection currents. They also learn how compressing air can increase pressure, focusing on air pressure in the atmosphere.

In this part, students set up an investigation to find out what happens to earth materials when exposed to the Sun.

These are the materials you will need from the kit: the potting soil, one liter containers, the pitcher, ¼-liter containers and lids. Use the lids with slits. You'll also need two plastic cups and two syringes, cardboard, thermometers, transparent tape, sticky notes, and a permanent marking pen.

You will need to provide water, newspaper, colored pens or pencils, and a clock or watch with a second hand.

Make copies of these science notebook sheet no.11, Heating Earth Materials A, sheet no. 12, Heating Earth Materials B, and no. 13, Graph of Earth-Materials Temperatures.

You can use science notebook sheet no. 11 and sheet no. 12 as an assessment. You'll want to see whether students can develop a plan for an investigation. For more details take a look at the Embedded Assessment chapter in the teacher guide.

This activity needs two playground sites, one in the Sun and one in the shade. The best time of day is some time between 10:30 a.m. and 2 p.m.

This part requires completely dry soil. If you haven't already done so, spread any soil that isn't dry on newspaper and let it dry for a few days. Stir it from time to time to bring the damp soil to the top.

You need to prepare measuring cups before you start. To do this, use the 50-mL syringe to measure 100 milliliters of water. Fill the syringe twice.

Then mark the level with the permanent marker. You need to make 2 of these measuring cups. The students are going to use these cups to measure 100 milliliters of dry material.

When you set up, you want to push the top of the thermometer through the bottom of the lid. This will help ensure your lids last for subsequent uses.

If you have students set up one day and take their measurements the next, plan on where you want to have the students store the containers overnight.

Set up two stations for the distribution of earth materials. At the first station, place 2, 1-liter containers of dry soil and 2 plastic cups with the 100-mL level marked. At the second station, place 2, 1-liter containers of water and 2, 50-mL syringes.

Begin this session with a short discussion about evaporation and an introduction to solar energy.

Teacher: …observed evaporation. We observed the water cycle. We saw liquid water turning into a gas. What's that gas called?

Student: Water vapor!

Teacher: Yes, on the nose! Good job. So we saw liquid water turn into water vapor and then it went into the air and we talked about how water is evaporating everywhere all over the Earth. And in order to go from a liquid to a gas it requires energy. What is the source of that energy?

Student: The Sun.

Teacher: The Sun. You guys are good. The Sun is the source of that energy. We call that…

Class: Solar.

Teacher: Solar energy. Excellent. And it provides the energy for something to go from a liquid to a…

Class: Gas.

Teacher: Good, OK, so just store that information away.

Narrator: Review the term "earth material" and ask students to suggest some examples before showing the class the earth materials you have.

Teacher: But I have two in particular. Do you see any earth materials on the cart?

Student: Yes.

Teacher: Yes? You see some earth materials?

Class: Yes.

Teacher: So an earth material is something that is non-living. Is there something non-living on that cart?

Class: Yes.

Teacher: And it comes from the Earth. I mean there are some things that are non-living but they didn't come from the Earth they are made synthetically. They are made synthetically. So I've got something in here and based on your observation what does it look like is in here?

Class: Water.

Teacher: Water? I will confirm that statement. It is water. I'm not trying to pull anything over on you. And what do we think—I mean you can't really see it from your table, but what do you think might be in this bag?

Class: Soil.

Teacher: So it is some kind of soil or dirt; it's potting soil. And this is another earth material. I've got two earth materials; water and potting soil on the science table. We're going to apply some solar energy to our two earth materials and the question is what do you think is going to happen? If we put some water and some potting soil outside in the Sun and exposed it to solar energy. What will happen to them? What do you think everybody? It's a nice sunny day.

Student: Heat up!

Teacher: You think they're going to heat up?

Class: Yes.

Teacher: Thumbs up if you agree with that. Well, I agree with you. They are going to heat up but the questions is this; is the water; compared to the soil, will they heat up in the same amount of time? Will they get the same; will they arrive at the same temperature if they do heat up? And then if we put them in the Sun what will happen if we move them to the shade? All those unanswered questions. If we put them in the Sun and moved to the shade what do you think might happen to them? Julian?

Student: Well, yes they'll get colder.

Teacher: So girls and boys we're going to do an experiment to confirm your ideas and to further investigate the idea of what happens when we expose these two things to solar energy. Let me show you some of the tools that I have. I have this thing; what kind of…

Student: Thermometer.

Teacher: This is a what?

Class: Thermometer.

Teacher: And a thermometer is used to measure what?

Class: Temperature.

Teacher: Excellent. And then I have some of these. What are these?

Class: Tubs.

Teacher: They're tubs and I'm going to tell you right now notice the black marker. Does everyone see the black marker? So we're going to put water or soil in this container up to the black marker, OK? So you already know how much. And that's about 100 mL. Alright? And then I have this, what is this?

Class: A lid.

Teacher: OK and this lid is special because it's got a what?

Class: Hole in it.

Teacher: It's actually a hole, and what do you think the holes for?

Class: Thermometer.

Teacher: That is correct. So we're going to use these lids, this thermometer, our earth materials and we're going to come up with an experiment to see how solar energy affects them.

Narrator: Have the students talk in their groups about how to design an experiment.

Student: …what the temperature is.

Student: and then…

Student: And then you move it to the shade, really quickly.

Student: And you would wait a bit for like ten minutes maybe and then…we would leave them and switch them to the shade for the same amount of time.

Narrator: Visit the groups as they work, checking to see that they have the core idea of an experiment.

Teacher: So, did you talk in your groups about your plan?

Class: Yes.

Teacher: I passed out a sheet of paper that you'll find at your desk to help guide you in your plan.

Narrator: Distribute the science notebook sheet called Heating Earth Materials and review is as a class.

Teacher: Then you need materials. I've shared with you some of the materials I have. I have one more material to add and that's syringe to use with the water. Um, and then you have to come up with a procedure. Like what kind of steps are you going to follow to do your experiment? Um, and that's what we need to do and then finally—it's not on here—but finally we need away to collect our…

Student: Data.

Teacher: We need to collect our date and our information our results in some way. OK? So using this sheet I want you to talk in your groups. I want you to fill this out. You can go ahead and put your sheet on the left and on the right you write your experiments using your groups and then we'll share with what you came up with. OK? Alright go ahead and start doing that.

Narrator: You will be able to use these sheets to assess your students' progress.

Student: I think for the procedure we should just write; wait three minutes or more. Maybe we should just…

Teacher: The first thing on your sheet was to come up with a question. This is the question I came up with. You can use this question or you can come up with your own, but in general your question should somehow be slightly related to this because that's what we're trying to find. Alright? Materials—I told you the materials I had: water, soil, I have this cup, you know the container, a lid, I do have a thermometer and then I have something else. I have some cardboard here. I'm going to tell you what we're going to use that for once we start. The final step is your procedure. You need to design an experiment. What are you going to do? Step number 1, Step number 2, Step number 3, so really quick who has Step number 1 for me?

Narrator: Students should create data tables with three columns, making sure to leave space to record the starting temperatures of both materials.

Teacher: This could be the what…

Class: Soil.

Teacher: OK, so this is the temperature of the soil and this is the temperature of the…

Class: Water.

Teacher: Water, OK so we need to make our data tables. We need to gather the supplies and once everybody has their data table completely filled out like this—when everybody has their supplies and they've assembled their stations so that it looks like this then at that point we'll be able to go outside and start gathering our data. So measure 100 mL of soil and water into the cups.

Narrator: This teacher has chosen to review the procedure on the board before students collect their materials.

Teacher: And as far as the cup and the soil goes I've already marked 100 mL on the cup. So you just have to fill it 'til the soil gets to that black mark and you'll have 100 mL. Thermometers inside the slit. It goes underneath the earth material. Make sure yours does too, but it doesn't touch the bottom. But it's under the earth material with the water. It's below the water, but it doesn't touch the bottom. We're going to put our supplies on this piece of cardboard and the reason for doing that is so that the heat energy from the ground doesn't get absorbed into our containers. This cardboard will act to insulate your containers from the ground; the only heat that we want to get should be from the what…

Class: Sun.

Teacher: From the Sun up above. We don't want any of the heat from the ground. So we're going to use the cardboard, so that's one more supply you're going to need for your group. And then we're going to go outside. We're going to measure the temperature every what…

Class: Three minutes.

Teacher: Alright, so we're going to measure every three minutes for fifteen minutes in the Sun and another fifteen minutes in the shade.

Narrator: Once the Getters pick up the materials for their group, students should set up their investigations, using the cardboard as a base for their experiments. This can be a good place for a break.

If you've taken a break, review the experiment before moving outdoors.

Teacher: Alright time check; 3-minute check.

Narrator: You should call out the time every 3 minutes.

Student: 26.

Student: The water?

Student: Yeah. This oil is 35.

Narrator: Students first work in the Sun. After fifteen minutes, have students move to the shade, noting the temperature before they move.

Continue calling out the 3-minute intervals. You may choose to take a break after the students have collected their data.

Begin the next session by distributing science notebook sheet number 13, called Graph of Earth-Materials Temperatures. Have students graph and analyze their results. You may want to have students use colored pens or pencils when graphing each of the materials.

Teacher: I'm going to connect the dots now.

Narrator: This teacher has chosen to create a class graph as well.

Introduce the concepts of energy transfer and heat sink.

Class: Heat sink.

Teacher: It says heat sink. A heat sink basically is any material that can absorb heat. Did the soil absorb some heat?

Class: Yes.

Teacher: It certainly did. Did the water absorb some heat?

Class: Yes.

Teacher: So they both are heat sinks. They both are capable of absorbing that heat. But between soil and water, which one was able to hold the heat longer?

Class: Water.

Teacher: Water. Water is considered to be a very good heat sink. It takes a long time to heat it up, but once it's heated up it actually takes a significant amount of time to cool down, so it holds the temperature more. That's a good point it's more efficient. Soil is not as good of a heat sink, because it heats up and then it cools down very quickly.

Narrator: To conclude part 1, go over new vocabulary and add it the Word Bank. Add new concepts to the content chart.

Have students read the Uneven Heating article in the *Science Resources* book. Use the review questions at the end of the article to guide discussion.

<Investigation 3, Part 2>
Narrator: In this part, students use water of different temperatures to discover the relationship between temperature and density. They create a convection current and relate convection to wind on Earth.

Here's what you will need from the kit. For each group, 3 plastic cups, 1 50-mL syringe, 2 vials, 2 small zip bags, and 2 pipettes. For the class, you'll need 2 pitchers, the dispensing bottle, 1 thermometer, the rubber stopper, a vial cap, 1 cork, and the blue food coloring.

You need to provide, ice water, room temperature water, hot water, a large clear plastic cup, and a penny,

Make copies of science notebook sheet no. 14, Heating Water. You will also need to make copies of the Response Sheet for this part.

To make colored ice water, add 30 drops of blue food coloring and ice water to the dispensing bottle. You may want to store the ice water in a cooler or refrigerator to keep it very cold.

Plan to have about one liter of hot water available. Hot tap water about 60°C will work. You may choose to keep it warm by storing it in an insulated container if you don't have access to hot water. You don't need to add any food coloring to the hot water.

For room temperature water, just fill the pitchers with tap water and let them stand for an hour. You don't need to add any food coloring to the room-temperature water.

Teacher: It's just regular room temperature water. I've got some interesting tools. I've got this thing.

Narrator: To begin this part, fill a large container with room-temperature water and introduce the cork, vial cap, rubber stopper, and penny.

Teacher: We're going to put them in the water. What do you think we're going to look for?

Student: If it floats?

Teacher: If it floats or if it…

Class: Sinks.

Teacher: OK. OK, so first should we start with the cork?

Student: Sure, that would be cool.

Teacher: Think in your head. What's going to happen when I drop the cork into the water?

Class: Float.

Teacher: Ready? A very small, not to loud drum roll please. Ready here we go, 1, 2, 3…

Student: Yeah!

Teacher: It floats, yeah! OK drum roll please…the plastic vial. 1, 2, 3…

Class: Floats.

Teacher: Floats. OK now, no drum roll. Make your predictions, this is the rubber stopper.

Class: Float.

Teacher: Think about your prediction.

Student: Sink and then float to the top.

Teacher: OK ready? Drum roll please, 1, 2, 3…Whoa. Hands up if your prediction was correct. Ooh we have a lot of correct predictions, interesting? OK, the final thing I have is our penny. Sink or float? Make your prediction.

Class: Sink.

Teacher: Drum roll please, very small not too loud. 1, 2, 3…what do we think? Hands up if your prediction was correct. OK, so you did very well. Hands down, eyes up here please. Shhh. If an object floats in water the object is said to be less…

Student: Dense.

Teacher: …dense than water. If an object sinks in water the object is said to be…

Class: More dense.

Teacher: It is…

Class: More dense.

Teacher: More dense than water, so based on this investigation which objects are less dense than water? Let's hear what your answers are. What's in there? The cork and what else?

Class: Lid.

Teacher: OK, so the cork and the lid appear to be what?

Class: Less dense.

Teacher: Less dense than water, OK. Which objects are then denser than water? Think about it. Which ones in there, do you remember? What are your answers? Let's hear them.

Class: Penny and the rubber.

Teacher: OK, so the penny and the rubber stopper, so I would agree with you. Now what do you think about this…is water…really think about this. Is water, this stuff, is it less dense than cork.

Student: Yes.

Teacher: What do you think?

Student: No, it's more dense.

Teacher: Is water less dense than cork?

Class: No.

Student: It's more dense.

Teacher: It's more dense. It's OK to make a mistake. It's OK to be thinking. It's OK to be wrong. So water is less…sorry I almost made that mistake too. Water is denser than cork because the cork what. What does the cork do?

Class: Floats.

Teacher: OK the cork floats. If the cork floats the water must be…

Class: More dense.

Teacher: There you go. Water must be more dense. Now let's take a look at the vial cap. OK, now listen to my question. Is the vial cap denser or less dense than the penny?

Class: Less dense.

Teacher: Less dense, the vial cap. The penny's on the bottom here and the vial cap is floating on the top, so I ask is the vial cap less dense or denser than the penny and the answer is, it is…

Class: Less dense.

Teacher: It is less dense than the—than the penny. Very good. The penny sinks in the water, so we say that its denser than the vial cap and the penny is also denser than…

Class: The vial cap.

Teacher: It's denser than water and it's denser than the vial cap and it's denser than the cork. Good job. Do you think ice water is denser, less dense, or the same density as room-temperature water? And I just happen to have some ice water right here and it's colored…

Class: Blue.

Teacher: I've got some blue ice water right here. Do you think this ice water if we compare it to the room-temperature water is less dense, more dense, the same as this. We're going to compare these two and I've got some tools here. I see you've got some ideas. I'm so excited. It's wonderful. Hold your ideas because I'm going to let you investigate and add-on to your ideas. I've got some materials to help you. Let me show you your materials. Material number 1, this, do you remember what this is called?

Class: Pipette.

Teacher: Ooh you are good; good memories. I have a pipette and then right here I have a what, what do we call this?

Class: Vial.

Teacher: Yup this is the pipette and the vial. And I'm going to take my pipette and my vial and I'm going to fill this vial nearly full with room-temperature water, so not all the way to the top, pretty close. Then you have to take this and set it on your desk, and let it sit there for one minute. That's the hard part because when you put it on somebody's desk and your table it's easy to like jar the table and then it makes it wiggle. So you're going to have to choose a desk and everybody's just going to have to be still for how long?

Class: One minute.

Teacher: So your purpose in doing that is to let the water become very what…

Class: Still.

Teacher: Yeah, we want it to be very still. We don't want it to be moving. We want it to be very very calm. Then you are going to use this pipette to soak up some of the ice cold water that is what color…

Class: Blue.

Teacher: Blue OK, so I'm going to come around and give you the blue water, so the getter you're getting the vial, the room-temperature water, and the pipette, and a cup. I'm going to give you the cold blue water. So after a minute, once it's sat and it's very still your table can raise their hands to let me know that you're ready for your cold ice blue water. You're going to gently squeeze up some of that blue water. I'm going to pour some in here. You raised your hand, you said Miss. Barb we're ready. I poured that in there; the starter has decided who's going to do that remember you squeeze this to let the air out, put it in here and squeeze it back in and let it fill up. We'll try that again, so squeeze all the air out, put it in here, and then let it fill up with cold blue water. Now this is the tricky part…at your table you have to decide do you want to release the cold water at the top of your vial or at the bottom? So you and your partner have to decide because every table is going to have two of these setups. Blake, listen please. You're going to have two, so you're going to have enough supplies to work in either buddies or truddies. So in your small group within your table you have to decide. Whatever your decision is once you've made that then, you know, whoever the person is that's going to release it they need to, in one slow squeeze, let the water out. So watch my nice slow squeeze, one slow squeeze. If I'm going to do it on the top – and you know what I don't want to actually do it for you – I'll just show you what I mean. If you're going to do it on the top you put the bulb, the pipette, the tip right there at the top and then one slow squeeze let it out. If it's the bottom, put it all the way on the bottom, Aliza, and one slow squeeze.

Narrator: Have getters get materials. Remind students that the blue coloring in the cold water is very concentrated. They should be extra careful so the water doesn't spill or stain anything.

After the room temperature water has settled, distribute cold blue water to each of the groups.

Student: That's a lot of blue water.

Teacher: I know and you don't need all of it.

Student: Woo, that's a lot of water.

Student: What?

Student: We're doing bottom remember? We're doing bottom. Do it really slow and keep the squeeze remember. Aaahhh, keep the squeeze! Squeeze, now take it out.

Student: It's sinking guys.

Narrator: If students do not release the blue water slowly, and smoothly, the cold and room temperature water will mix, as you see here. This is what you don't want to see.

Student: This isn't sinking.

Student: OK wait, just give me a second.

Student: See if you can fill it up anymore.

Student: No, we can put a little more.

Student: Can I do it? I never tried it before.

Student: Proves that the it's denser cause the water seems to be going down.

Student: Yeah.

Student: Rock 'n Roll!

Student: That's weird. When you guys…yours is going up and ours is going down.

Student: Maybe the density is the same.

Student: No ours is going down. See look, most of it, see look.

Narrator: Once students have observed the sinking blue water, the teacher calls for attention.

Teacher: What happened? What did you discover? I saw some of you decided to redo your experiment which is what scientists often have to do because something happened or you want to do it again to see if what really happened is true. You have to repeat them over and over. What did you observe in your experiment especially in relation to our question up here? What do you think? Kiera?

Student: Um, well what our group we did it a couple times because it kind of accidentally got messed up, but we but we observed like every time the water seemed to sink, so which is like means it's denser then, so cold water, we observed that cold water is denser than room.

Narrator: Ask students what they think will happy if they warm up the bottoms of the vials where the cold water is sitting. Then describe the heating procedure.

Teacher: And we're going to carefully place the vial with blue water on the bottom into a plastic cup, into a plastic cup that has nothing in it. So it's empty. Alright? Then we're going to take our plastic bag and using a syringe, this container has warmish hot water, it's not going to burn you, but you're going to use the syringe to fill this up with warm water. This is a little tricky; we might need both getter 1 and getter 2 up here. Yeah I think we'll need both getters to fill this in here with warm water and then make sure you make sure you what…

Class: Close it.

Teacher: Close it and you're going to take it back to your table. You're going to have your blue water and then you're going to put this into the cup. So you've got your empty cup…

Narrator: Be sure to remind students to only use vials in which the water has not mixed.

Teacher: You're going to put a bag of hot water next to it and the question is what do you think will happen if we warm up the bottom of the vial where the cold water is sitting?

Narrator: When students have set up their materials, getters get the hot water.

Student: Ooh this is warm, it's nice and warm.

Student: Now let's watch it. Watch it!

Teacher: Is anything happening?

Students: No.

Student: Three minutes.

Student: Oh yeah I see its rising to the top.

Student: Me too.

Narrator: When students have observed what happens with the hot-water investigation, have them record their observations on the Heating Water notebook sheet. Encourage them to draw accurate illustrations of the movement of the water in the vial.

Teacher: Aiden said that he observed the blue water started to participate in kind of a what…

Student: Water cycle.

Teacher: Well not a water cycle, well kind of yeah it was a water cycle. In a cycle, right? It started to move up. So the question is, why do you think the blue water moved up? Why did it start to move up from the bottom of the vial toward the top? What was happening in that process there? Adrianne?

Student: Well the um warm water and the bag made the cold water heat up and move up and then when it got to the top it sat there for like one minute and then it kind of cooled down and went back down to the bottom. And went in a circle over and over again.

Teacher: That was excellent. So we've got the bag with the warm water providing some heat…

Class: Energy.

Teacher: Energy and its transferring that energy—remember we talked about that—to the blue water. The blue water starts to heat up and it starts to do what?

Student: Melt.

Teacher: It's not melt. Team, what's it doing?

Student: Rising.

Teacher: It's rising…

Student: because heat goes up.

Teacher: Heat rises and this cold blue water that was really dense is now becoming what?

Student: Less dense.

Teacher: Less dense and you notice it gets to the top here; it got to the top and here this was the heat energy but it gets to the top and then what happens to it? It's no longer so hot anymore, right Jasper?

Student: Yes.

Teacher: So it starts to cool off and it starts to do what?

Class: Come back down.

Teacher: It starts to come back down it starts to sink and as soon as it comes right back down it hits that heat energy again. The heat energy heats it up, so it starts to rise up then it cools off and it starts to go down and we get this thing that kind of looks like a cycle. Does everybody…how many people observed that? Did you observe that? And if you didn't there's many reasons why you might not have. If it was mixed up, if the table got hit a little bit – that kind of thing happens. But what we're observing here is a very important phenomena and it's called—what am I writing; I don't think you'll know this word.

Class: Convection.

Teacher: It's called a convection…

Class: Current.

Teacher: So what we're observing this cycle here the water the cold water is heated up and then it rises and then it cools down and it sinks and then it's heated up again. This is called a convection current. It's going in a circle.

Narrator: Wrap up Part 2 by adding new words to the class Word Bank. Add new concepts to the content chart.

Have students complete the response sheet for this investigation to assess whether they understand that convection currents are driven by uneven heating.

Have students read the Wind article in the *Science Resources* book. This article relates what students have learned about uneven heating of Earth's surface and convection currents to the movement of air. Use the review questions at the end of the article to guide discussion.

<Investigation 3, Part 3>
Narrator: In this part, students explore air pressure and look for evidence that Earth's atmosphere is exerting pressure on everything.

Here's what you'll need from the kit: 30-mL syringes, flexible tubing, small binder clips, a rubber stopper with a hole, and a long piece of flexible tubing.

You will need to provide a ½-liter water bottle and a fork.

Make copies of student sheet no. 16, Air and Syringes, and sheet no. 17, Atmospheric Pressure at Work. Make copies of I-Check 3 to give students at the end of the investigation. For more on assessment, read the Benchmark Assessment chapter in the Teacher Guide.

Practice working with the syringes before starting the investigation with your students.

- Attach a piece of short plastic tubing to the tip of the syringe.
- Move the plunger back and forth to move air in and out of the syringe.
- Pull the plunger to the top and bend and crimp the tube to keep air from moving in and out. You can use a small binder clip to secure the bend in the tube. Observe what happens when you push and pull on the plunger. Pushing in compresses the air inside of the syringe.
- You can also try starting with the plunger all the way down before you crimp the tube.
- Finally, attach two syringes together with a single piece of tubing and observe what happens as you move the plungers in and out of the syringe.
- Practice using a fork to remove the tubing from the syringe.

You need to prepare the air-pressure demonstration before class. You'll need the ½-liter water bottle, the rubber stopper and the long piece of tubing.

- Moisten the end of the plastic tubing and insert it as far as possible into the rubber stopper.
- Push the stopper into the mouth of the water bottle. Make sure it is secure.
- Suck the air out of the bottle through the tubing. The bottle should collapse.
- For a more dramatic demonstration, you can also suck the air out of the bottle by putting your mouth on the bottle directly.

Teacher: Most of the air is only—Jasper—in the first nine miles.

Narrator: Part 3 starts with a review of what students have discovered about air so far. Introduce atmosphere.

Teacher: So now let's do an investigation. We're going to do an investigation related to air and related to air pressure. And I've got some tools. What's this?

Class: Syringe.

Narrator: Begin the air investigation by showing the students the syringe and plastic tubes.

Teacher: Plastic tube. So, this is a syringe. You can use it to find out more about air. Each of you is going to get a syringe and a piece of plastic tubing. You can work with your syringe alone or you can work with other students at your table. You should not use the syringe improperly. Don't use it to annoy another student. One way you can annoy another student is maybe by going up to them and pulling this out and what?

Student: Squirting.

Teacher: I mean it's only air, but please don't do that to your fellow classmate. So please use it respectfully. If you don't use it respectfully than that tells me that you don't want to…

Student: Use it.

Student: Participate.

Teacher: Use it or participate. So, syringe, tube, and a clip. Use it appropriately to explore the concept of air and we're going to apply that to the atmosphere and pressure. So today we're air, atmosphere, pressure. Those are our words that we're focused on. Um, what—when you're investigating with these three tools (and I'm not going to tell you what to do with them, except don't bother your neighbor with them or use them in appropriately) you're going to try to answer these questions. What's happens to air in the syringe when you push and pull on the plunger? This is the plunger, so what happens to the air that's your first question. And then what can air do?

Student: What can air do?

Student: Yes.

Student: Air can go absolutely nowhere when it has a clip on it.

Teacher: You know what, the one thing we want to be careful of if we pull too hard it'll break this off. And we really don't want that to happen. But if we take a fork and stick it in there I've heard that it will work. There we go.

Student: Push it down.

Teacher: This is going to help guide your further investigations. I'm going to pass this out.

Narrator: After students have observed the syringes with the binder clips, distribute the notebook sheet Air and Syringes.

Teacher: I want you to answer the questions on this sheet, OK? Alright, so I'm going to pass this out and keep working. Alright? Spread those around please.

Student: I've got an idea. While you…no while you push in I'll push out, so then I'll suck up.

Student: Then I'll push in.

Student: Wait, am I pushing in?

Student: No I am. 1, 2, 3. Ah, it's so cool! Don't do it again. Don't do it again.

Student: No pull out. Pull out.

Student: Ready, set, go!

Narrator: Bring the students together after about 20 minutes of exploration with the syringes.

Teacher: Anything you did with your tools. What did you discover about air pressure? What can air do? What happens to the air when you push and pull on the plunger? What are the answers to those questions? I see lots of hands up. Alexa.

Student: I found that if you started with it, um, open then it was hard to push it in. But if you started with it in it was hard to open it.

Teacher: That is—I like that. Alright, Connor.

Student: Um I found out when you attach one of these to the tube and another one of them at the end; you could only pull one at a time because it would suck out the other tube.

Teacher: So I don't understand what you mean. You attach one of what to one of what.

Student: Attach one syringe…

Teacher: Show me.

Student: …and to the tube and the other syringe to the other end of the tube. When I try to pull one it was hard to pull because it was sucking the other syringes air.

Teacher: So you started with the plunger pushed in or out?

Student: Um, pushed in.

Teacher: So, two syringes together with the plungers pushed in and you found that it was really hard to pull the plunger…

Student: Out.

Teacher: OK interesting. What would you say about the pressure with that?

Student: Um it was pretty…um…pretty hard.

Teacher: OK

Narrator: Use the questions in the teacher guide to discuss additional observations.

Student: It doesn’t have as much room, so the air’s more trapped.

Narrator: Introduce compressed and pressure.

Teacher: What’s this word?

Class: Compressed.

Teacher: How do we say this word?

Class: Compressed.

Teacher: The word is compressed, try it again.

Class: Compressed.

Teacher: Alright! When you push on the plunger the air is forced into a smaller space and the air is…

Class: Compressed.

Teacher: The same amount of air is still in the syringe when it is…

Class: Compressed.

Teacher: Now you push the air into that small space and the air particles are getting really squished and they’re building up this thing called…

Class: Pressure.

Teacher: If the force on the plunger is released—remember I let go of the plunger—the pressure and the compressed air is going to push the plunger…out.

Class: Out.

Teacher: Take a look at this picture right here. I have a little picture. Exhibit A. There are 20 (and I counted them) there are 20 little air particles in here. Air is made up of tiny particles. The little particles are called…what do you think?

Class: Molecules.

Teacher: Alright, you guys are on it. The little particles are called molecules. As we know, most of Earth's air is made up of nitrogen and oxygen molecules. Molecules are so small that we cannot…

Class: See them.

Teacher: You can't see them. The molecules in gases are free to roam. They move around, so in here (this is a confined space) but even within here they're moving around, they're bumping into each other. There's—I'd say—there's quite a bit of space between the molecules in that one. What do you think?

Student: Yeah.

Teacher: So now I'm going to take—this is a plunger, it may not look like one, but it's a plunger. And I'm going to push down on this space, now I still have how many molecules?

Class: 20.

Teacher: I still have 20 molecules, but now you notice they do not have the same amount of what?

Student: Space.

Teacher: The same amount of what?

Class: Space.

Teacher: They don't have the same amount of space. So over here they had more space to bump back and forth. And here they have less space, so what do you think that does to the pressure?

Student: Higher.

Teacher: Yeah higher pressure. The pressure is building up. Molecules compressed into a smaller space they start banging into to one another more often and this creates…oh come on come on.

Class: Higher pressure.

Teacher: It's just creating higher pressure. The pressure pushes not only on the plunger but its actually pushing on all directions. The pressure in here…the plunger is the only thing able to move out. If they could they'd push this out, this out, and this out.

Narrator: This may be a good place for a break.

Teacher: I have two supplies here. I've got some kind of soda bottle and I've got some kind of water bottle.

Narrator: Begin the next session with a demonstration.

Teacher: I'm going to take a deep breath and suck the air in and I want you to think what's going to happen, everyone in your head right now think.

Narrator: This teacher has modified the demonstration slightly from the teacher guide.

Teacher: What's going to happen? Raise your hand if you have an idea of what you think might happen if I put my mouth on either of these two bottles and I take a deep breath and I suck the air in? What's going to happen? Ben.

Student: It's losing all the air so; the pressure makes um it crumple up kind of.

Teacher: I like that. How about you count for me?

Class: 1, 2, 3.

Teacher: Why did it do that? Why did it do that, it's so weird? Do you think it might be different with this one?

Class: No.

Teacher: OK let's try. Ready, count for me.

Class: 1, 2, 3.

Teacher: So now talk, stay focused. Why did this happen? What happened to make it crumple?

Student: I think it will probably reopen because the air was still in there.

Student: The water bottle I think it was more like it sucked in more because there wasn't as much space. The soda bottle was bigger, so it went faster.

Student: Yeah the plastic is getting…no! The pressure.

Student: Oh yeah the pressure.

Student: The pressure is making the water bottle cave in. Somehow.

Teacher: The bottle has been kind of corked in place to show when I suck the air out it collapsed. So I asked you to talk in your table groups why that is and if I pull this out we notice that…seemed like air came back in there. Why did it collapse? OK Larkin, what's your idea?

Student: Well our table thought that it was because um the air was kind of like space and when you sucked all the air out it was like you were sucking all the space out and so the bottle didn't have as much space so it had to squish together.

Teacher: OK

Narrator: To provide more evidence for pressure, demonstrate a two syringe system.

Teacher: I'm going to hold the side that's already pushed in; Kiera's holding the side that's pulled out. What do you think we want Kiera to do?

Class: Push in.

Teacher: OK! Kiera go ahead and push the plunger in. Interesting. So when she pushed it in what happened? OK, so now I'm going to try it, ready? Interesting. So what are we doing there? Why is that doing that? Think about everything we've done so far. Kiera, thank you let's give her a little round of applause.

Narrator: Have students work with the syringes again and come up with an explanation for what they observe.

Student: So in that experiment thing where you were pushing it the air went through the syringe, through the tube, and then it went to the other one. And the pressure pushed the other one back.

Teacher: Is air going to escape?

Class: No!

Teacher: No. If I push even this little tiny bit of plunger in I'm just forcing that air into a smaller amount of what?

Class: Space.

Teacher: Space. The air particles in that small space are starting to do what?

Class: Bump together.

Teacher: They're bumping into each other faster and faster because there is so little space. As they're bumping into each other that's causing the pressure to do what?

Student: Increase.

Teacher OK, it's increasing. The pressure is increasing and then if I take my thumb off of the plunger suddenly there's more space in there so the pressure is now…

Student: Loosening up.

Teacher: It's loosening up, there's less pressure in there. The question is what makes the plunger go back into the barrel where it started? So I push to here then I let go and then it pops back out. I push it in and it pops back out and I'm not even going to ask for your answer. I'm going to tell you. Are you ready? New word, it's on the board.

Class: Atmospheric pressure.

Teacher: When I pull out on the plunger the small amount of air in the syringe has more room to spread out, but did the number of air molecules inside; did it change?

Class: No.

Teacher: No it stayed the same. It stayed constant. The pressure exerted on the walls and plunger of the syringe, by the air inside the syringe is less because fewer molecules are banging on the surfaces at any given time.

Narrator: After the atmospheric pressure mini-lecture, distribute science notebook sheet no. 20, Atmospheric Pressure at Work. Have students work alone to answer the questions. You can use responses to this sheet and the Air and Syringes sheet to assess student understanding of air pressure.

To complete part 3, go over new vocabulary and add it to the Word Bank. Add new concepts to the content chart.

Have the students read and discuss the article The Pressure Is On! in the *Science Resources* book. The article describes how the weight of a column of air in Earth's atmosphere compresses air to produce atmospheric pressure. Use the questions at the end of the article to guide discussion of the article.

To conclude this Investigation, have the students read Summary: Heating Earth in the *Science Resources* book. They should complete the summary questions on a plain sheet of paper for their notebooks. Discuss the reading in class and then give students I-Check 3.

<Investigation 4, Part 1>
Narrator: In this Investigation students explore the water cycle and investigate weather, including severe weather and how to make weather maps and use them to forecast weather.

In this part students look at water on Earth and how water moves through the water cycle.

Here's what you'll need from the kit: the inflatable globe, the dice, the 1-liter beaker, 1 graduated cylinder, 1 30-mL syringe, 1 pipette, and two posters: Earth's Water and Water Cycle.

You need to provide water, chart paper, and a marking pen.

Make copies of Science Notebook sheet Water-Cycle Game. You will need one copy for each group plus one for each student.

Make one copy each of the Water-Location Posters. You might consider putting these sheets in plastic sheet protectors or even laminating them. You can also use teacher sheet no. 12 called Water-Cycle Game Tally to make a transparency to use to record results of the Water Cycle Game.

You will need four sessions for this part: one to investigate water distribution on Earth, another to conduct the water-cycle activity, and two more to read and discuss the articles in the Science Resources book.

You will want to consider where to play the globe activity before you start this part. You need an open area like a playground on a calm day or a multipurpose room or gym. Don't forget to inflate the globe before starting this part.

You should also review the water-distribution demonstration. Review the teacher guide and practice using the tools to conduct the demonstration.

Start this part by asking students, what is the water cycle? You'll use this quick write question to assess student understanding. Tell students that including a picture is fine and allow them five minutes before you collect their papers.

Continue by introducing the globe activity, asking students to imagine they are visitors from another planet approaching Earth from above the Pacific Ocean.

Teacher: And this is what you see. What's your description of Earth? Tom?

Student: The whole planet got lots of water. It keep coming back and stuff.

Teacher: Emily.

Student: Um, it looks blue.

Teacher: It looks blue and the blue is representative of what?

Student: Water.

Teacher: Water.

Narrator: Have students form a circle and explain the activity.

Teacher: We're going to toss this globe around and wherever you catch it your index finger, wherever you catch it on your right hand index finger, you're going to tell me whether you have landed in water or land. We're going to do this for about five minutes. We're just going to toss it gently to one another and your index finger on the right you catch it the globe there and you tell me it's on water. Alright, so we're going to do it five times and I will put a tally here, so we will know we're on land or water.

Narrator: A student recorder will keep a tally as the game is played.

Teacher: You tally and after they toss it they'll tell you whether they landed on land or water. Here's the toss.

Student: It is water.

Teacher: Water. OK now you can toss it to someone else.

Student: It is water.

Teacher: Water, OK.

Student: It landed on water.

Teacher: Water, OK.

Narrator Students should find that their fingers land more often on water than land. The longer the game is played the better the results.

Student: Um, there's more water than land.

Teacher: That's very good. There is more water than land on Earth. And in fact, of the entire Solar System, which planet has the most water? Tiffany?

Student: Earth.

Teacher: Earth.

Narrator: Now ask students to think about where water is found on Earth.

Teacher: What kind of water we have on Earth? So everyone sort of mentioned that water is a dominant feature on Earth. What kind of water are we talking about?

Student: Salt water.

Teacher: Salt water.

Narrator: Tell students that 97% of Earth's water is salt water found in the oceans. Only 3% of Earth's water is fresh water. Ask students what they think is meant by fresh water.

Listen to student responses before putting up the Where is Earth's Water poster found in the kit. Refer students to the copy of this diagram in their Science Resources books.

To review the distribution of water on earth, use the questions in your teacher guide to discuss the location of fresh water, then move on to the water distribution demonstration.

Teacher: OK, so what we're going to do is to sort of visualize what these percentages look like. We're going to do a little activity.

Narrator: Fill the 1-liter beaker with water exactly to the 1000 mL level, and tell students that this water represents ALL of Earth's water. Salt water and fresh water.

Teacher: What we're going to do is we're going to extract some of that water to represent the 3% that is fresh water. OK?

Narrator: Have a student use the pipette to take up a small amount of water and transfer a single drop to the graduated cylinder. This represents all of the water found in Earth's rivers and streams.

Have another student use the pipette to transfer 20 drops of water to the graduated cylinder. These 20 drops represent all of the water in Earth's atmosphere.

Have a third student use the syringe to take up 1 mL of water and transfer it to the graduated cylinder. This single mL represents all of the moisture in Earth's soil.

Have another student use the syringe to transfer 3 mL of water to the graduated cylinder. These 3 mL represent all the water in Earth's lakes.

A fifth student uses the syringe to transfer 4 mL of water to the graduated cylinder. These 4 mL represent all of Earth's groundwater.

The last student transfers 21 mL of water to the graduated cylinder. This represents all of Earth's frozen fresh water in ice caps and glaciers.

The volume of water in the cylinder should total about 30 mL, or 3% of the 1000 mL that represented all of Earths' water.

Teacher: All of Earth's water, OK? So how much water is left in this large container boys and girls? How much water? Jason Z?

Student: Approximately 970 mL.

Teacher: 970 mL which represents the amount of water, salt water, on Earth.

Narrator: Tell students that only 5 mL of the water in the graduated cylinder represents water that is available for use by land plants and animals, including humans.

Close this session by leaving students with three questions to think about. What prevents us from running out of water? Where does new water come from? What can people on Earth do to ensure that there is plenty of water for people and other living things on Earth? This is a good place for a breakpoint. When you continue this part, you will start with the water-cycle game.

Before beginning the game, you'll want to place the 9 water-location posters at different locations around the room.

Introduce the activity to the students.

Teacher: I want you to think about a single water molecule.

Narrator: Each group of three or four students will represent one water molecule. During the game, the groups will move from place to place, represented by the posters, just like water molecules on Earth. A roll of the die will determine where students go next.

Distribute one copy of the science notebook sheet called Water-Cycle Game to each group. You might also want to provide clipboards. Each time students roll the die they need to write in the location in the first table at the top of the sheet.

Teacher: And you're also going to have a starter in charge of rolling the die. Alright?

Narrator: Review the roles with the groups.

Teacher: The reader and we have a recorder and a monitor.

Narrator: Pass out the dice and assign each group to a location. Let the game begin.

When each group has rolled the die ten times, have each student transcribe their group results onto their own copies of the Water-Cycle Game sheet.

Total the results for the entire class on the board or a transparency.

Teacher: So this is from the activity. What can you conclude about your water molecule? Stanley.

Student: Most of the water molecules went to the ocean.

Teacher: Here's water in the ocean.

Narrator: Show students the water-cycle poster and use it to describe the water cycle using the mini-lecture in your teacher guide.

Teacher: And the condensation, it moves from here over land and it comes back down as precipitation.

Narrator: At the end of the game, students should understand that water cycle has two meanings: the general cycle, as shown on the poster, and the smaller, more complex ways that water can cycle through the environment.

Teacher: I don't think anyone completed the entire cycle, did they?

Narrator: After this discussion, have students complete the two items at the bottom of the Water-Cycle Game sheets.

When students have completed the sheets, it's time to summarize what they've learned using the mini-lecture in your teacher guide.

Return students' original quick writes from the beginning of this part and have them comment and revise their original ideas and drawings.

Wrap up this part by adding new vocabulary to the Word Bank. Add new concepts to the content chart.

In the next session, have students read Earth's Water and The Water Cycle in their *Science Resources* books. Use the review questions at the end of the articles to guide discussion.

<Investigation 4, Part 2>
Narrator: In part 2 students learn about the types of severe weather, the conditions that produce them and their effects on life and property.

In this part the students will read the article called Severe Weather in the *Science Resources* book. Make copies of Science Notebook sheet no 19, Severe Weather Questions. You use this sheet to assess student understanding of severe weather.

Class: What is weather? What is the weather today?

Narrator: Begin this part by asking students for their ideas about weather.

Teacher: What is weather? What does it mean to you? And then, you've already been outside today; what is the weather today? So think about it, take a moment think about it. I see some of you really thinking. I see the cogs are working. I want you to turn to your neighbor and calm quiet voice talk about your ideas for the next three minutes.

Student: Cloudy, or snowy, or rainy.

Student: I think right now it's about 65, 70 maybe.

Student: It's definitely like temperature, heat and wind.

Student: It depends on Earth's axis I think.

Teacher: Good job girls and boys. I heard a lot of good ideas out there. Let's hear some of your ideas. What is weather? Let's here what we've got to say and I'm going to go to the popsicle sticks and I made sure this morning that everybody's name was in there. Just in case. So Corina, what's your idea?

Student: I think it was sunny, or windy, or it's snowing or different types of air, stuff like that.

Teacher: Alright, Carlo.

Student: Weather is kind of like temperature. Like if it's sunny the temperature goes up. If it's snowy the temperature goes down.

Narrator: After listening to student's ideas, help students develop a general definition of weather and consider the variables that contribute to weather.

Teacher: So the three important variables are the wind, the heat, and the moisture in the air. Everybody, ready?

Teacher/Class: The wind, the heat, and the moisture in the air.

Teacher: Turn to your neighbor and say, Did you know what the three important variables of the weather are?

Class: Did you know what the three important variables of the weather are?

Teacher: Now go ahead and tell them.

Class: The wind, the heat, and the moisture.

Teacher: Alright, let's open up to page 227 and now we're going to talk about something that is very interesting because a lot of people are extremely fascinated by what. What's the title of this article?

Class: Severe weather.

Teacher: People love…

Student: severe weather.

Teacher: They do, they love severe weather. Why do you think that is? Why are people so fascinated by severe weather? Think about the sever weather we've had in our country, in this world. What do you think draws people's attention to it? Ronan, what do you think?

Student: Well I think many people are interested in severe weather because it can affect many things like for example, last year, no two years ago in our country Hurricane Katrina hit New Orleans and people were like devastated because that killed like so many people and destroyed so many houses. And it's depressing and people are working on a solution to try and stop it before it comes you know. That's why I think so many people are interested in it.

Teacher: Good ideas, so I heard how it affects people's lives. Just the fact that it's cool looking. There was that movie where people chased tornadoes I think. That was…and people do this as a hobby. They go out in their car and chase them, so they can take photographs of them and video tape them. Who knows somebody in this room could be that person. You might become fascinated with that.

Student: In Gulf states, summer days are often hot and humid, moist.

Narrator: Read the Severe Weather article in the Science Resources book aloud with your students, stopping occasionally to discuss the ideas presented.

Student: These are the normal weather conditions that people come to expect where they live.

Teacher: So boys and girls, here in the bay area and particularly in the east bay usually in this time of year in the morning it is typically what?

Class: Cold.

Teacher: Yeah we've been really lucky that's it's been so warm and sunny, but often times it's cold, foggy. A lot of times our end of the school year picnic is at Lake [name] and it's really what?

Class: Cold.

Teacher: It's really cold. And so we're having a little bit a-typical weather, but that's pretty common for us. Our winters it usually rains, although this year we didn't have a lot of that. Alright.

Narrator: After you've finished reading the article, hand out copies of science notebook sheet no. 19 called Severe Weather Questions for students to complete.

After students have finished writing, discuss their answers to the questions.

Student: Well I think tornadoes are caused by like cold air and warm air. They flow together and they make pressure and the warm air goes up and the cold air goes underneath it which makes spinning. Then it spins and takes out like anything in its path. And it comes down from around here and it comes up and then the cold air comes down from here and join together right around here and then it causes tornadoes and stuff like that.

Teacher: Thanks Jasper, that was great. I think he did a good job, right? Let's give him a little round of applause. Good job Jasper. So we've got warm air coming down from the Gulf of

Mexico up here coming down. I guess this is coming up, that's coming down. Are we all looking over here please? They meet, the cold air goes underneath the…

Class: Warm air.

Teacher: And the warm air gets pushed…

Class: Up.

Teacher: And the rush of that cold air under the warm air causes it to start spinning and then we have a…

Class: Tornado.

Teacher: A tornado. OK good. Let's move on…

Narrator: Collect the completed sheets after the discussion so you can assess student knowledge about severe weather.

Student: Also because the ocean is a big part of the weather in California.

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

<Investigation 4, Part 3>
Narrator: In this part students learn about meteorology and how meteorologists get weather data. They learn how weather is represented on weather maps.

In this part the class will read the article called Weather Maps in the *Science Resources* book. You'll need to make copies of science notebook sheet 20, called Weather Map Questions. You can use this sheet to assess students' ability to identify weather map symbols and interpret their meaning to make simple weather forecasts.

Plan to give the class I-Check 4 at the conclusion of this part.

You will also need to get some weather maps for students to review. You can find national weather maps in most daily newspapers. Look for one that shows high and low pressure centers and fronts. You will need to get the maps for 4 consecutive days. Attach the first three days of maps to a piece of paper and put the day 4 map on its own sheet of paper. Then make copies of both sheets for each student.

Begin this part by introducing weather forecasting.

Teacher: So we know what the weather is like today. All we have to do is maybe take a step outside. So we go outside, it looks like its sunny, it's warm, but I wonder what the weather will be like tomorrow. How can we figure out what the atmospheric conditions are going to be like tomorrow? I mean today we can see, but how do we know what's going on tomorrow? So everybody put your thinking cap on. How can you figure out what the weather would be like tomorrow? How can *you*, OK? Think about that. Julian.

Student: Well, the, um really really easy way to um find out the weather for tomorrow's you could look on the newspaper.

Teacher: Why, what does the newspaper have?

Student: Newspaper has the weather for the week and previous weeks um before that.

Teacher: Thank you. That was so good. Julian says read the newspaper. You could also look on the Internet. You can watch TV. Because there are people called…do you remember what they're called?

Class: Meteorologists.

Teacher: And they don't study…meteors, they study…

Class: Weather!

Teacher: OK and so one job for a meteorologist, one of their jobs, is to do predicting of the weather. They forecast what the weather is going to be based on looking at the sky, taking measurements, looking at previous data, but they are the ones doing the weather, so they can't rely on the TV. Right? So I'm going to put something on right now really quick. Austin, will you hit the lights? And you can tell me what this is once I put it on. OK, so what we have here is a…well it's a weather map right and it's actually three weather maps. Here we have one days version of the weather, followed by another days version, followed by the third days version. And what I'm going to have you do is each of you is going to get this same piece of paper and I want you to look at it and you can talk to your partner, you can talk to your table. I want you to see if you recognize anything on here. I want you to look and see if you notice any changes from one day to the next. And can you describe those changes and then based on these—this is three days of weather—can you make a prediction what the fourth day would be?

Narrator: Each student gets a copy of the sheet with the first three days of weather maps.

Student: And then it gets really big.

Student: Wait.

Student: Also with the rain.

Student: I think there's snow.

Student: Moving outward like toward the Atlantic Ocean. I don't know about here. Go out to the ocean.

Teacher: Alright. Trevor, what do you think about day 4? What kind of weather are we going to see on day 4?

Student: On this day, it's really cold it seems. It has a lot of low temperatures.

Teacher: OK, are we ready to discuss it?

Student: What do these symbols mean?

Teacher: I want you to try and come up with your own idea and then we'll learn.

Student: OK.

Teacher: Alright, so we were looking at weather maps. A weather map is the end product of a lot of data gathering and organizing.

Narrator: Have the class read the Weather Maps article in the Science Resources book aloud, stopping to reinforce the important concepts and processes.

Teacher: So our warm front is what color?

Class: Pink.

Teacher: Pink. The warm front is this one right here and the side that the little half circles are on indicates the…

Class: Direction.

Teacher: It indicates the direction that the warm front is moving. And then it looks like the cold front is the…

Class: Blue.

Teacher: It's the blue one and it's got the little kind of arrows and the direction they're moving is the direction the arrows point is the direction the cold front is moving. Let's keep reading in your book please.

Narrator: This teacher has chosen to demonstrate a high-pressure area by having a group of students step inside a large hoop.

Teacher: A very high-pressure area. Does it feel pretty—is there a lot of pressure in there?

Class: Yes.

Teacher: So, if you're in an area of high pressure—what do you really want to do right now?

Student: Break away!

Teacher: But if you're going to go from a high pressure area where are you going to go to?

Student: Over here.

Teacher: Where, where do you go from? But what's over here? What is that called then?

Student: Low pressure.

Teacher: So if this is high pressure and it's very tight and all squished together and they really want to come over here where you said there's more space. This must be an area of what?

Class: Low pressure.

Teacher: OK, this is an area of low pressure, so I don't know how you are going to do this. Can you drop the hula hoop? And disperse to areas of low pressure throughout the room once it's all touching the ground. Now they're dispersing from that high pressure. Everybody disperse to a lower pressure. Disperse to a low pressure and that feels a lot better.

Narrator: When you finish reading the article, have students answer the review questions on the Weather Maps Questions sheet.

Teacher: OK, Kylie come on up. Show us where you think its raining please.

Narrator: Discuss the questions as a class.

Student: I think its raining in this area because this is where the cold weather and the hot weather collide and in the other areas it's just cold weather. So I think that spot would be where.

Teacher: OK. Thank you very much. I agree with you and I'm going to add on. So it's raining right in this area. How many other people agreed with that? Looking around the room, it looks pretty good. We also know it's raining over here. And finally, it's raining around here. Did people guess those areas? Maybe, maybe not, maybe those were surprising. Let's get somebody to come up and show us…

Narrator: Collect the sheets to use as an assessment. This may be a good place for a break.

Have students return to the sheet with the three weather maps and ask them to use them to come up with a weather forecast for the following day.

Ask them to consider where the fronts will be on day 4 and where there will be wind and precipitation.

Teacher: Two quick minutes—you can talk to your neighbor, you can think by yourself if that works better for you. You can even write over here; what do you think day 4 is going to look like? What's the map going to look like? Go ahead and write about it. You don't even have to write complete sentences. Talk to your neighbor, what do you think. How is the map going to change for day 4? Go ahead and take two quick minutes.

Student: Rain storms are going to rain out all the snow and like clear it all out. So there seems to be a lot of rain storms over here near the stormy area. Snowy area. So this rain storms going there, and there's low pressure which is and that means stationary.

Teacher: Try to look for these three things. Where the fronts? Which direction is the wind going? And, where would you find precipitation? Like rain or snow on the map. So try to look for these particular things. Where the fronts going to be? Where is the wind going? And where would you find precipitation? OK, you can keep going.

Student: Somewhere off Florida or Tennessee.

Student: Here there's probably not going to be as much snow.

Student: And then, where it was snowing up here; you know its probably going to over here. There's going to be a little bit of snow.

Teacher: Look at the map, what do you see? You see that wherever the low pressure is what kind of weather tends to be there.

Student: Moist.

Teacher: So there's thunderstorms, good. So wherever the high pressure is; what kind of weather do you think we might have?

Student: Not a lot of wet weather.

Teacher: Not a lot of wet weather. You guys are so good.

Narrator: Give students a copy of the day 4 weather map to compare to their weather predictions. Have them share how their forecasts compared to the actual weather.

Student: It just spread it out more.

Student: No, compare it to day 2. It's like the snow has shrank and…

Student: Grew, shrank, grew. I think I knew what happened. Maybe, the windstorm, it was cold and then over here it's going to get colder. Mostly over here is where it snows and stuff. So it's getting bigger as it comes over here. And then it shrinks down, so it's getting hotter and smaller as it goes down.

Student: Look at it. It's like going in a roller coaster almost. The low, high, low, low, low…

Narrator: To summarize talk about trends in weather that meteorologists use in their weather forecasts.

- Weather systems tend to move from west to east in North America.
- Wind tends to blow from areas of high pressure to areas of low pressure.
- Air tends to be cool and dry in high-pressure areas and tends to be warm and moist in low-pressure areas.

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

At the end of this part give students I-Check 4.

<Investigation 4, Part 4>
Narrator: In part 4 students research the source and use of water in their communities and look at how water is used in their daily lives, especially in food production and preparation.

You will need these materials from the kit: Water Facts cards, and the poster, Weather.

Make copies of science notebook sheet no. 21 called Mealtime. Make copies of the Posttest to use at the end of this part.

Take some time to find out about your local water resources. You can often call the local water company or district for information about where your water comes from and the number of communities or people served by the company. Many water districts have websites that include this information. If you can find a suitable map with enough details for your area, make copies for your students.

Begin this part by revisiting the questions you asked in part one.

Teacher: Why don't we ever run out of water? Questions #2: Where does new water come from? And question #3: Is there something you and I can do to make sure that there's always plenty of water? What can we do? Trevor?

Student: Well one thing we can do is make sure we don't leave water running after we use it. Because sometimes we might turn off the water faucet, but its still on a little bit. So we need to make sure that we always turn off the water after we use it.

Narrator: If you've obtained a map of your local water supply ask students to discuss the map in pairs.

Teacher: When we talk about water for people, we usually think of drinking water. Right? Water for people, a lot of times we think of drinking water. But we have water for other things, like let's see we; what do we do?

Student: Wash our hands.

Teacher: We wash our hands. We…

Student: Swim.

Teacher: Swim. We might swim in a pool. We…

Student: Shower.

Teacher: Shower. We use the hose, we wash our car, we water our gardens.

Student: Water balloons.

Teacher: We have water balloon fights. And you know what; we might have one in a week at our party. Shh, hold that thought, hold that thought. And we use it for cooking. So we use water a lot in many different ways because so many things that we do everyday require water.

Narrator: Distribute Science Notebook sheet no. 21 called Mealtime.

Teacher: So it says look over, direction #1 says look over the list of food items, select eight items that you would like to put together for a meal. Write the eight items on the lines in the item column. You can go ahead and do that, only eight.

Student: I love white rice.

Student: Hamburger and cheese.

Narrator: After students have chosen their eight items, introduce the Water Facts card.

Teacher: So we're going to pass this out and you're going to use this to help you write down how much water. You're going to be looking at the side that says how much water does it take to produce one serving of and there's this nice little card here that you get to move. And when you move it the arrow next to the food—in the little answer column here, there's an answer column—it shows you how much water. You record that information in the column that says water.

Narrator: Distribute one Water Facts card to each group. Have students record the water price of each item in the water column on the notebook sheet.

Student: For pasta? For two ounces of pasta? Easy. 36 gallons of water for two ounces of pasta. That's interesting. That's actually scary.

Student: Let's go to butter.

Student: What's tomato sauce?

Student: Butter is forty-wait, butter is 46.

Student: What's tomato sauce?

Student: Tomato sauce is 13 gallons.

Student: White rice is 25, wait 25 gallons.

Narrator: After students have found the total water price for their meals, they answer questions four and five.

Take a few minutes to discuss student responses.

Teacher: That's interesting. That's a good observation. Maybe that can make us think about our own eating habits if you want to choose to use up that much water. That's something you have to choose on your own. Is there another observation that you might have noticed in here? Kylie?

Student: Well um, I've noticed that Larkin at our table she did steak and she had one of the most um the most water and I heard that meat has the, a lot of water because it comes from other animals. And as you know, living things need a lot of water, so…

Narrator: You can now have students read the article called Summary: Weather in the *Science Resources* book and answer the summary questions. Discuss the questions as a class. When all of the investigations have been completed, give students the Water Planet posttest.

Make sure your students check out the Learning More about the Water Planet section in the *Science Resources* book. This section includes ideas for further research and projects your students might like to try.

You might also want to introduce some of the extensions found in your teacher guide to extend the module into areas of language, social studies, and more about severe weather.

<FOSS Assessment>
Narrator: Students using FOSS learn science content in three ways: through active investigation, through reading, and through assessment. Unlike many curriculums that treat assessment 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: Spreading out.

Teacher: It's spreading out.

Narrator: Assessment activities in FOSS provide teachers with immediate feedback about student understanding and gives student 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: So 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 student's shoulders to see if they're 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 student's 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 when 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 student's papers. Hand the papers back to the students. Guide them in using a self-assessment strategy to reflect on their answers and there own thinking.

Teacher: Why are you drawing it the way you are drawing it?

Narrator: 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: We drew it like this because, um, I thought that when the warm water, when the cold water warmed up it would go to the top and then slowly it would cool off and go back in to the bottom and then it would warm up again and continue its cycle.

Teacher: OK, excellent. Does anyone want to add to what she did? Add more evidence? Explain it. Or does anyone disagree with what she said and you want to come explain that. Ronan, do you want to come up here?

Student: Well, um, I kind of disagree with Alexa's statement. I think the water is 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 its going to mix up the bottle. So then at the end, like for example, when we were doing our project, if you shaked it too much it'd go completely mixed. So you can see that's a very fragile system. So that's why I think that it'd just go up and then mix the whole bottle.

Teacher: OK, so similar, a similar idea. What I really want to hear from somebody—great job, Ronan thank you, you can 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? OK, Corina.

Student: Um, well when the warm water heats up the cold blue water it gets less dense because cold water is denser then um, 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.