Developed by Arizona Project WET using the 
*Project WET Curriculum and Activity Guide*
2.0, 2011 and *Project WET Activity Guide, 1st* 
edition, 1995
Students should complete the Pre Student Questionnaire before starting lessons.

## PRE-LESSON Sequence

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATERSHEDS</td>
<td>WATERSHEDS</td>
<td>WATER CYCLE</td>
<td>GROUNDWATER</td>
<td>WATER</td>
</tr>
<tr>
<td><strong>Focus Questions:</strong></td>
<td><strong>Focus Questions:</strong></td>
<td><strong>Focus Question:</strong></td>
<td><strong>Focus Question:</strong></td>
<td><strong>Focus Questions:</strong></td>
</tr>
<tr>
<td>What is a watershed?</td>
<td>What is a watershed?</td>
<td>How does water move and change form in the earth’s natural system?</td>
<td>How is the groundwater system connected to the water cycle?</td>
<td>Why do we conserve water?</td>
</tr>
<tr>
<td>How do we “manage” it to make sure our water is clean and plentiful?</td>
<td>How do we “manage” it to make sure our water is clean and plentiful?</td>
<td></td>
<td></td>
<td>How can we conserve water?</td>
</tr>
<tr>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
</tr>
<tr>
<td>Evidence</td>
<td>Watershed</td>
<td>Evaporation</td>
<td>Groundwater</td>
<td>Potable</td>
</tr>
<tr>
<td>Claim</td>
<td>Ridge</td>
<td>Condensation</td>
<td>Pore spaces</td>
<td>Conservation</td>
</tr>
<tr>
<td>Valley</td>
<td>Precipitation</td>
<td>Saturate</td>
<td>Permeable layer</td>
<td>Renewable resource</td>
</tr>
<tr>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
</tr>
<tr>
<td>Evidence</td>
<td>Watershed</td>
<td>Evaporation</td>
<td>Groundwater</td>
<td>Potable</td>
</tr>
<tr>
<td>Claim</td>
<td>Ridge</td>
<td>Condensation</td>
<td>Pore spaces</td>
<td>Conservation</td>
</tr>
<tr>
<td>Valley</td>
<td>Precipitation</td>
<td>Saturate</td>
<td>Permeable layer</td>
<td>Renewable resource</td>
</tr>
<tr>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
<td><strong>Vocab:</strong></td>
</tr>
<tr>
<td>Evidence</td>
<td>Watershed</td>
<td>Evaporation</td>
<td>Groundwater</td>
<td>Potable</td>
</tr>
<tr>
<td>Claim</td>
<td>Ridge</td>
<td>Condensation</td>
<td>Pore spaces</td>
<td>Conservation</td>
</tr>
<tr>
<td>Valley</td>
<td>Precipitation</td>
<td>Saturate</td>
<td>Permeable layer</td>
<td>Renewable resource</td>
</tr>
</tbody>
</table>

**Optional – observations for this activity can be made over a multi-day period before the Festival.

---

## POST-LESSON Sequence

Teacher Resource page:

https://arizonawet.arizona.edu/content/arizona-water-festival-teacher-resources
Watersheds Unit: Pre-festival, Day 1

Unit Focus Question:
- What is a watershed?
- How do we “manage” it to make sure our water is clean and plentiful?


Time Frame: 40 minutes

Standards Addressed:
- **S1C1-PO3** Formulate predictions in the realm of science based on observed cause and effect relationships.
- **S1C2-PO5** Record data in an organized and appropriate format (e.g., t-chart, table, list, written log).
- **S1C4-PO1** Communicate verbally or in writing the results of an inquiry.
- **S1C4-PO3** Communicate with other groups or individuals to compare the results of a common investigation.

Learning Objective(s):
Students will:
- observe what happens when water is dropped on different surfaces.
- make claims based on evidence.
- draw conclusions about how their observations might relate to water in the earth system.

Materials Needed:
- Student notebook
- Per group of 4-5 students:
  - Aluminum foil
  - Aluminum tray
  - Cardboard
  - Wax paper
  - Paper towel
  - Eye dropper
  - Cup of water
  - Block to make a slope
Vocabulary:
- Evidence
- Claim

Do Now:
Students will record their answer to the investigation question-
How will water act when dropped on different surfaces?

Lesson Sequence:
1) Students will make predictions and investigate the behavior of water when dropped on different surfaces, while recording observations in their Evidence → Claims data table.
   Students will have these questions to guide them:
   - What happens when water falls on different types of flat surfaces?
   - What happens when water drops on a slope?
   - What happens when water drops on a peak?
   - How does the size of a water drop affect the way it flows down a slope?
   - Can you set up a water drop race?

2) Making claims based on evidence-
   The teacher should model making a claim based on evidence, using the following example:

   **Evidence**
   Some water sticks to the cardboard even when it’s on a steep slope.

   **Claim**
   Water doesn’t just run off surfaces, it also sticks to surfaces. This is a unique property of water.

3) Students should make claims based on the evidence they recorded during the investigation and share them with the class.

Wrap-up:
Students will begin to think about how their observations might relate to the real world. What happens when water falls on different surfaces using the following questions:
1) **What would the different surfaces that you investigated represent on the earth?**
   [e.g. paper towel = might be soil with vegetation; wax paper = pavement, etc.]
2) **What do you think would happen when it rains on a slope based on your observations?** Water will flow downhill. Some will stick and sink in.
3) **What force moves water downhill?** [gravity] If they don’t know drop a pencil and ask again.
4) **What do you think happens when it snows in the mountains?** [It melts and flows down to the lower elevations]
Assessment/Check for Understanding:

- Reflection: Make a claim based on evidence about how water will act on a given surface.
- Predict what that surface might be in the natural earth system.
Watersheds Unit: Pre-festival, Day 2

Unit Focus Question:
- What is a watershed?
- How do we “manage” it to make sure our water is clean and plentiful?


Time Frame: 40 minutes

Standards Addressed:
- S1C1-PO3 Formulate predictions in the realm of science based on observed cause and effect relationships.
- S1C4-PO1 Communicate verbally or in writing the results of an inquiry.
- S6C3-PO1 Identify the sources of water within an environment (e.g., ground water, surface water, atmospheric water, glaciers)
- S6C3-PO2 Describe the distribution of water on the Earth’s surface.

Learning Objective(s):
Students will:
- describe what a watershed is.
- observe the potential impacts that could occur when it rains on cities, farms, and old mines that share a watershed.

Materials Needed:
- Spray bottles
- 2 pieces of 8-1/2 by 11 white paper per student (scrap paper can be used if blank on one side)
- Water soluble markers (green, blue, brown, red, purple)
- Scotch Tape

Vocabulary:
- Watershed
- Ridge
- Valley
Do Now:
Have students answer the investigation questions-
1. What is a watershed?
   a. Define watershed- address misconceptions: a shed ≠ building; shed = to shed off of the land
   b. Watershed Dance:
      Tell students to repeat after you and copy your hand motions.
      Hold your hands straight out in front of you in line with your shoulders, with palms down. Say:
      "A watershed is a land area that drains to the low points." As you say this, move your hands slowly together and down until they meet to form a “V” with palms still facing down.

2. What marks the edge or boundary of a watershed? The high points.

Lesson Sequence:
We are going to make a raised relief map that will contain many partial watersheds and some whole watersheds.
1) Put a piece of 8 ½ by 11 white paper down on the table in front of you (blank side up if using scrap paper).
2) Crumple the second piece of 8 ½ by 11 white paper (blank side facing out if using scrap paper).
3) Un-crumple the paper until you can find all four corners but do not lay it all the way flat.
4) Tape all four corners of the un-crumpled paper to the white piece of paper in front of you.
5) Using water soluble markers, draw symbols that represent different features on your relief map using the following key:
   a. Green marker to draw a line along all of the ridges (the up folded areas).
   b. Blue marker to draw a line along all of the valleys (the down folded areas).
   c. Red marker to indicate any abandoned mines with a * symbol.
   d. Purple marker to indicate cities with a # symbol.
   e. Brown marker to indicate a farm with a colored-in area.
6) You have made a model of the land surface or a raised relief model.
7) Predict how water is going to flow on your model when we spray them with water. What direction will water flow? Why?
8) Are there areas on your model that have no outlet and will store water?
9) Take your model outside and spray it with a spray bottle, in other words make it rain on your model!

Wrap-Up:
After students have sprayed their models, ask them to use their fingers to trace the boundaries of the watersheds or parts of watersheds. Remember the boundaries are the ridges colored in green.
1) Use your finger to follow the high points, or the green lines, on your map. How many watersheds or partial watersheds are shown on your map?
2) What are the parts of a watershed? The water, the city, the farm, high points, low points, etc. What is the white area? Go back to the definition of a watershed. It is the land area.
3) Do a gallery walk so that students can view other students’ maps. How are they the same? How are they different?
4) Point out a very flat map. Does it still show watersheds? Yes. How do you know? Because a watershed is a land area that drains to the low points.
5) Point out a map that shows one large ridge going all the way across it. Has anyone heard of the continental divide? This is a ridgeline that cuts the United States from north to south. To the right, or east of this ridgeline, all of the water flows east eventually to the Atlantic Ocean. To the left, or west of this ridgeline, all of the water flows west eventually to Pacific Ocean.
6) Did any of your cities flood? If there was pollution on your city streets, could it get into your farm field? Could excess pesticide or fertilizers from your farms go into your cities? Could old mines affect water coming into cities or farms? What is a watershed again? Do you think you live in a watershed?

Back in the classroom: What do you think we manage when we talk about watershed management? It’s really the land area or land use that we manage to maintain water quantity and quality in a drainage or stream! Runoff is water that flows over the land surface to a drainage.

Assessment/Check for Understanding:
- Have students write a reflection paragraph describing a watershed.
- Have students write a second paragraph about how they could act as a watershed manager, making sure that water quality and quantity are protected.

© 1995 by the Project WET Foundation. Used with permission.
Water Cycle Model Lesson Plan

Water Cycle Unit: Pre-festival, Day 3

Unit Focus Question:
- How does water move and change form in the earth’s natural system?


Time Frame: 40 Minutes

Standards Addressed:
- **S1C1-PO2** Formulate a relevant question through observation that can be tested by an investigation.
- **S1C1-PO3** Formulate predictions in the realm of science based on observed cause and effect relationships.
- **S6C3-PO1** Identify the sources of water within an environment (e.g., ground water, surface water, atmospheric water, glaciers).
- **S6C3-PO2** Describe the distribution of water on the Earth’s surface.

Learning Objective(s):
Students will:
- explain how each process works within the water cycle: condensation, evaporation, and precipitation.
- describe the form water is in when it moves through the water cycle, focusing on when it is in a cloud.

Materials Needed:
- Water Cycle Diagram handout
- Hot plate or coffee heater
- Metal pot ¾ full of water
- Aluminum or glass dish/pie plate
- Pot holder
- Water
- If a heat source is not available or allowed, use a video.

Vocabulary:
- Evaporation
- Condensation
- Precipitation

© 1995 by the Project WET Foundation. Used with permission.
Do Now:
When it rains or snows, students see evidence of the water cycle. But some components of the water cycle are not visible to the eye. Ask students to brainstorm what they think of when they think of the water cycle.

Lesson Sequence:
1) Water Cycle Diagram handout – have students label the places water can go within the water cycle and the processes that move water through the water cycle using their prior knowledge. They should label with descriptive words and draw arrows.
2) Ahead of time boil water in a pot.
3) Get students to gather around the pot and tell them that you want them to describe to you everything that they see in detail using simple words. **Ask students, what do you see happening? Use descriptive words.** The water is boiling. **What form is the water in the pot?** Liquid. There is steam coming up from the pot. **Do you think the water is hot?** Yes, it’s boiling.
4) Take a colder dish or pie plate. Let students feel it to see that it is completely dry inside. Hold the colder dish/plate over the pot. **What’s happening?** The cold pot has water drops on it. **Where did the water come from?** Start with the boiling water. The hot liquid water is turning to a gas. **Don’t allow them to say that it’s evaporating, have them explain the meaning at each step.** Then you can ask: **Do you know what this process is called?** Evaporation. Ask them: **What happens when the water in the form of a gas hits the colder surface?** The water changes from a gas to a liquid. **What is that process called?** Condensation. **Why does liquid water gather here again?** It touches a colder surface, so it condenses to become liquid.
5) Continue the demonstration. Drops of water vapor should condense on the bottom of the dish/plate and fall back into the pot. “Look! Water is dripping at the bottom.” **Ask, why is it dripping?** Enough liquid water has come together that it’s too heavy to keep sticking to the pan. **What pulls the water down?** Gravity. **What do we call this process?** Precipitation.
6) **What does the cold pot represent in the natural water cycle?** Water molecules have to have something to stick to in order to change from a gas to a liquid. Dust particles up...
high in the cold atmosphere give water molecules in the gas form something to stick to. Remember that liquid water is “sticky” and sticks to other things (adhesion). Water also sticks to itself (cohesion).

7) **What happens when a whole bunch of water molecules are all stuck together up there in the sky?** A cloud forms. **So what form is water in when it’s in a cloud?** It’s liquid! **This is a big misconception about the water cycle.** If it were a gas, could we see it? No, it’d be invisible. So it’s liquid. The cloud forms when **condensation happens.**

8) **What causes precipitation then?** The liquid water in the cloud gets too heavy and falls.

9) Let’s go back to the picture: **What makes the water cycle keep moving?** THE SUN is a main driver. Gravity is another.

**Note to the teacher:** We are actually using steam to speed this water cycle demonstration up. In order to not cause misconceptions, you can ask about the steam. **Can you see the steam? Is it liquid or vapor?”** It’s liquid! Because we can see it, just like the cloud.

**Wrap-Up:**
Summarize today’s learning by student pair sharing describing to one another exactly what they learned in the demonstration.

**Assessment/Check for Understanding:**
- Have students return to their water cycle diagram and fill in any missing processes that they learned about in this lesson.
- Have students describe without using the process words what happened in the demonstration.
- Have students write about what they know now about condensation, evaporation and precipitation.
Water Cycle Diagram

Name: ___________________________ Date: ___________________________

Use arrows to show all the places you think water moves throughout this land area.
Water Cycle Unit: Pre-festival, Day 3

Unit Focus Question:
- How does water move and change form in the Earth's natural system?


Time Frame: 40 Minutes setup then observations over 5 days

Standards Addressed:
- S1C1-PO2 Formulate a relevant question through observation that can be tested by an investigation.
- S1C1-PO3 Formulate predictions in the realm of science based on observed cause and effect relationships.
- S6C3-PO1 Identify the sources of water within an environment (e.g., ground water, surface water, atmospheric water, glaciers).

Learning Objective(s):
Students will:
- compare and contrast the effects of condensation and evaporation on water.

Materials Needed:
- Two identical clear glass jars or one cut 2 liter bottle
- Sand
- One small rock
- Water
- Tape
- Water Cycle in a Jar handouts (instructions and observation sheet)

Vocabulary:
- Evaporation
- Condensation
- Saturate
Do Now:
When it rains or snows, students see evidence of the water cycle. But some components of the water cycle are not visible to the eye. Ask students to brainstorm what they think of when they think of the water cycle.

Lesson Sequence:
1) Give students a copy of “Water Cycle in a Jar” instructions, found at the end of this lesson. Have students construct their own models or construct a single class model.

2) Have students place the jar in a window or outside.
3) Have students make observations at 3 different times per day over 5 days completing their observation sheet, found at the end of this lesson.

Wrap-Up:
Have students reflect on their prior knowledge of the water cycle and compare it to their current knowledge. Ask students to identify the processes of evaporation and condensation.

Assessment/Check for Understanding:
- Students should make an Evidence → Claims data table in their notebook from their observations made over the week.

© 1995 by the Project WET Foundation. Used with permission.
Water Cycle in a Jar

1. Take two identical jars; put a pile of sand in one and saturate with water. Place a rock in the sand. Tape together the open ends of the two jars. (See diagram.)

2. Put the jars near a sunny window.

3. Observe the jars several times during the day for a period of at least a week.

4. Record your observations on the observation sheet.

Diagram:
- JAR
- MOUTHS TAPE TOGETHER
- ROCK
- SAND
- WATER
# Observation Sheet

## Water Cycle Model

**Team Members:** [Indicate names]

**Date:** [Indicate date]

<table>
<thead>
<tr>
<th></th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solar Energy</strong></td>
<td>obs. 1</td>
<td>obs. 1</td>
<td>obs. 1</td>
<td>obs. 1</td>
<td>obs. 1</td>
</tr>
<tr>
<td><strong>Record:</strong> Good/Fair/Poor</td>
<td>obs. 2</td>
<td>obs. 2</td>
<td>obs. 2</td>
<td>obs. 2</td>
<td>obs. 2</td>
</tr>
<tr>
<td></td>
<td>obs. 3</td>
<td>obs. 3</td>
<td>obs. 3</td>
<td>obs. 3</td>
<td>obs. 3</td>
</tr>
<tr>
<td><strong>Evaporation</strong></td>
<td>obs. 1</td>
<td>obs. 1</td>
<td>obs. 1</td>
<td>obs. 1</td>
<td>obs. 1</td>
</tr>
<tr>
<td><strong>Record:</strong> Good/Fair/Poor</td>
<td>obs. 2</td>
<td>obs. 2</td>
<td>obs. 2</td>
<td>obs. 2</td>
<td>obs. 2</td>
</tr>
<tr>
<td></td>
<td>obs. 3</td>
<td>obs. 3</td>
<td>obs. 3</td>
<td>obs. 3</td>
<td>obs. 3</td>
</tr>
<tr>
<td><strong>Condensation</strong></td>
<td>ob. 1</td>
<td>ob. 1</td>
<td>ob. 1</td>
<td>ob. 1</td>
<td>ob. 1</td>
</tr>
<tr>
<td><strong>Record:</strong> Good/Fair/Poor</td>
<td>ob. 2</td>
<td>ob. 2</td>
<td>ob. 2</td>
<td>ob. 2</td>
<td>ob. 2</td>
</tr>
<tr>
<td></td>
<td>ob. 3</td>
<td>ob. 3</td>
<td>ob. 3</td>
<td>ob. 3</td>
<td>ob. 3</td>
</tr>
<tr>
<td><strong>Water Level</strong></td>
<td>obs. 1</td>
<td>obs. 1</td>
<td>obs. 1</td>
<td>obs. 1</td>
<td>obs. 1</td>
</tr>
<tr>
<td>(measure in inches or centimeters)</td>
<td>obs. 2</td>
<td>obs. 2</td>
<td>obs. 2</td>
<td>obs. 2</td>
<td>obs. 2</td>
</tr>
<tr>
<td></td>
<td>obs. 3</td>
<td>obs. 3</td>
<td>obs. 3</td>
<td>obs. 3</td>
<td>obs. 3</td>
</tr>
</tbody>
</table>

What time of day does condensation usually appear? [Indicate time]

What processes are occurring to make these changes? [Indicate processes]

What is the role of sunlight and temperature? [Indicate role]

**Conclusions:**

[Write conclusions]

---

*Water Models*

*Project WET Curriculum and Activity Guide*
Groundwater Unit: Pre-festival, Day 4

Unit Focus Question:
- How is the groundwater system connected to the water cycle?


Time Frame: 40-50 minutes

Standards Addressed:
- **S1C1-PO3** Formulate predictions in the realm of science based on observed cause and effect relationships.
- **S1C2-PO2** Plan a simple investigation that identifies the variables to be controlled.
- **S1C2-PO4** Measure using appropriate tools and units of measure.
- **S1C2-PO5** Record data in an organized and appropriate format.
- **S1C3-PO3** Determine that data collected is consistent with the formulated question.
- **S1C3-PO4** Determine whether the data supports the prediction for an investigation.
- **S1C4-PO1** Communicate verbally or in writing the results of an inquiry.
- **S1C4-PO3** Communicate with other groups or individuals to compare the results of a common investigation.

Learning Objective(s):
Students will:
- observe that groundwater is in the pore spaces between sand grains, gravel and other earth materials.
- prove that groundwater flows, because gravity works below ground just like it works above ground.
- understand that groundwater is a part of the water cycle.

Materials Needed:
- water pitchers
- foil tins
- flat containers
- large cups
- small cups
- small cups with holes
- coffee filters
- mulch wood
- sand
- gravel
- clay
- timers

© 2011 by the Project WET Foundation. Used with permission.
Vocabulary:
- Groundwater
- Impermeable layer
- Pore spaces
- Permeable layer

Do Now:
Conduct a whole body simulation to demonstrate how water moves through different earth materials:

1. Select ¼ of the students in the class to act as water molecules. The rest of the students will be earth material.
2. Round 1- Water Movement through Gravel: Students become gravel by stretching their arms out away from their bodies. Students should be able to rotate all the way around and touch only the tips of other students’ fingers. Students should then drop their hands to their sides. The goal of the students representing water molecules is to move (flow) all the way through students representing gravel (see page 145 in PW 2.0 book). Say “go” and time how long it takes the water molecule students to move through the gravel. Record the time.
3. Round 2- Water Movement through Sand: Choose a different ¼ of the students to act as water molecules. Students become sand by putting their hands on their hips and rotating all the way around so that only the tips of other students’ elbows touch. Students should then drop their hands to their sides. The goal of the students representing water molecules is to move (flow) all the way through students representing sand (see page 145 in PW 2.0 book). Say “go” and time how long it takes the water molecule students to move through the sand. Record the time.
4. Round 3- Water Movement through Clay: Choose a different ¼ of the students to act as water molecules. Students become clay by keeping their arms at their sides and standing shoulder to shoulder. The goal of the students representing water molecules is to move (flow) through students representing clay (see page 145 in PW 2.0 book). But there aren’t very many pathways. Tell them they might be able to get through with a lot of effort but it wouldn’t be easy. This simulates water trying to move in to clay. Over a long period of time water can soak in between the fine plates of clay. But in normal time frames clay acts as an impermeable layer. Stop the simulation there.
5. Discuss the results. Which one did water move through the fastest? Gravel Why? The spaces were bigger. We call these spaces between earth materials pore spaces. When water moves through spaces in rocks we say they are permeable. What do you think permeable means? Water can move through it. When we think of water moving into the clay what happens? It can’t get through. What do you think we call this clay layer? Impermeable.
Groundwater Models Lesson Plan

Lesson Sequence:

1) **What do we know from the simulation?** Water moves through some earth materials and not through others.
2) Tell students that they are going to design an experimental model to answer the question:
   • **How does water move underground?**
3) Introduce the materials available to each table group for their model: foil tins, flat containers, big cups, small cups, small cups with holes, coffee filters, sand, gravel, clay, timers.
4) Each student group should:
   a. Discuss the question and brainstorm as many answers as your group can think of.
   b. Choose one of them to develop into an experiment.
   c. Gather materials. (You can include a timing device).
   d. Write down the procedure that you will follow in your notebook.
   e. Develop a data collection chart or table.
   f. Make a prediction about what you think will happen.
   g. Now add water to your model, following your procedure, and record observations and measurements.
   h. Record data in the table and write down what happened.
5) Be prepared to tell your classmates these things when your group reports out:
   a. What was your procedure?
   b. What was your prediction?
   c. What claims can you make based on evidence you observed?
Wrap-Up:
Discuss with students:
We saw how water moves through spaces between grains of sand, gravel, and clay. It moves down through a filter in a cup due to gravity. This is how water moves from the earth’s surface down into the groundwater. It can also move laterally from the higher area to a lower area in a tin pan due to gravity. This is how it moves through the groundwater system once it’s in the ground. Also some earth materials filter groundwater and some add dirt and other things into groundwater.

Assessment/Check for Understanding:
• Reflection: Describe how water moves through different earth materials and not through others.
Blue Planet Lesson Plan

Water Conservation Unit: Pre-festival, Day 5

Unit Focus Questions:
- Why do we conserve water?
- How can we conserve water?


Time Frame: 30-40 minutes

Standards Addressed:
- S6C3-PO2 Describe the distribution of water on the earth’s surface.

Learning Objective(s):
Students will:
- estimate the percentage of Earth’s surface that is covered with water.
- explain the differences between salt water and fresh water.
- discuss the percentage of fresh water available for humans to use in relation to all water on Earth.

Materials Needed:
- Computers or chrome books

Vocabulary:
- Potable
- Conservation

Do Now:
Students should answer the question, how much of the Earth’s surface is water? How much is land? Have students discuss what the Earth looks like from space (show them a photo or diagram). Does it look like there’s more water or land? Students should estimate how much of the earth is covered by water. (~75%) They should also estimate the amount of the earth that is covered by land.

Lesson Sequence:
1) Students will play a short game in which they see how much of the earth is covered in water. This can be done as a whole group with a projector or Smart Board, in pairs, or individually.
2) Have students go to Discoverwater.org online. Click on the button titled Blue Planet then the button on the right titled Blue Planet Activity.

3) After clicking start, students click at random on the spinning earth. The flashing red dot will indicate whether students landed on water or land. They should choose the appropriate option (land or water) to the right of the earth. They will play 25 times then the percentage of each will be revealed.

4) Have students answer the questions on the screen in their notebooks.
   i. What percentage of your clicks landed in water?
   ii. What percentage landed on land?
   iii. Does this reflect the actual percentage of water at Earth’s surface?

5) Click on exit when completed.

Wrap-Up:
Have students reflect on the amount of fresh water on Earth and discuss why it is important to conserve water.

Assessment/Check for Understanding:
- Have students take the “What Did I Learn?” quiz on the right side of the Blue Planet Activity page. (Answer key is found by clicking on the Educators and Parents tab.)
Water Conservation Unit: Pre-festival, Day 5

Unit Focus Questions:
- Why do we conserve water?
- How can we conserve water?


Time Frame: 30 minutes

Standards Addressed:
- S1C2-PO4 Measure using appropriate tools (e.g., ruler, scale, balance) and units of measure (i.e., metric, U.S. customary).
- S6C3-PO2 Describe the distribution of water on the Earth’s surface.

Learning Objective(s):
Students will:
- calculate the percentage of fresh water available for human use.
- discuss the percentage of fresh water available for humans to use in relation to all water on Earth.

Materials Needed:
- Blue construction paper
- White scrap paper
- Liter water container or 1000 mL graduated cylinder
- 100 mL graduated cylinder (can use 50 mL)
- 2 10mL graduated cylinders
- Dropper
- Small metal bucket

Vocabulary:
- Potable
- Conservation
- Renewable resource
A Drop in the Bucket Lesson Plan

Do Now:
Give each student a sheet of blue paper and a sheet of white scrap paper. Tell students they are going to estimate the proportion of potable (drinkable) water on Earth and compare it to the rest of the water on the planet. The blue paper represents all of the water on earth. The white paper represents the amount of fresh water available today as potable water. Have students tear the white sheet to a size that shows their prediction of what percent of the blue paper is fresh potable water. Students should hold up the piece of white paper against the blue piece of paper.

Lesson Sequence:
1) Show the class a liter (1,000 mL) of water and tell them it represents all of the water on Earth. Use 1000 mL graduated cylinder if possible.
2) Ask where students believe most of the water on Earth is located? (reflect back on what they learned in the “Blue Planet” lesson)
3) Ask students to estimate how many milliliters of water they think would represent all of the fresh water on Earth? Have a volunteer measure 30 mL of the water into a 100 mL graduated cylinder. Ask students what they think this 30 mL represents? The Earth’s fresh water. Have another student read the 1000 mL graduated cylinder. It should now read 970 mL. (Alternatively, you could subtract 30 mL from 1000 mL).
What does the remaining amount represent? Salt Water. Take the 1000mL graduated cylinder and set it aside.
4) What percentage of the whole amount of water on Earth is 30 mL? Demonstrate how to calculate a fraction:

\[ \frac{1000}{30} \times 100 = 3\% \text{ of the water is fresh water} \]

\[ \frac{1000}{970} \times 100 = 97\% \text{ of the water is salt water} \]

© 2011 by the Project WET Foundation. Used with permission.
5) **Ask students what is at the Earth’s poles?** The North Pole is frozen sea ice and Antarctica is land covered with an ice sheet. Have students estimate what percentage of Earth’s fresh water is stored in its frozen state. Have a student measure 6 mL of the 30 mL of fresh water into a small graduated cylinder (10 mL cylinder).

**Ask students how much is left in the 100 mL graduated cylinder?** 24 mL of fresh water. **What do they think this water represents?** Fresh water that is frozen in ice caps and glaciers.

\[
30 mL \sqrt{24 mL} = 0.80 \times 100 = 80\% \text{ of the fresh water is frozen}
\]

\[
30 mL \sqrt{6 mL} = 0.20 \times 100 = 20\% \text{ of the water is liquid fresh water}
\]

6) Have a student measure 1.5 mL of the 6 mL of fresh water into a small graduated cylinder (10mL cylinder).

**Ask students how much is left in the 10 mL graduated cylinder?** 4.5 mL of fresh water. One is surface water and one is groundwater. Have student groups discuss which they think is which and why. Give them time to report out. Tell them that the earth’s crust alone is 35 kilometers (21 mi) thick. So:

\[
6 mL \sqrt{1.5 mL} = 0.25 \times 100 = 25\% \text{ of the liquid fresh water is surface water}
\]

\[
6 mL \sqrt{4.5 mL} = 0.75 \times 100 = 75\% \text{ of the liquid fresh water is groundwater}
\]
7) Pour both 1.5 mL and 4.5 mL in a dish or shallow cup and tell them this is liquid surface water and groundwater combined. Have a student use an eyedropper to remove a single drop of water. Release this one drop into a small metal bucket so the students can hear the sound of the drop hitting the bottom. What do they think this water represents? This represents clean, fresh water that is not polluted or otherwise unavailable for use, about .003 percent of the total water on Earth!

8) Discuss the results of the demonstration. At this point many students will conclude that a very small amount of water is available to humans. However, this single drop is actually a large volume of water on a global scale. Have students look at the Water Availability Table (found in the Arizona Water Festival power point presentation) and discuss the amount available per person.

9) Point to the 970 mL of salt water available on earth. Do you think that you could figure out how to take the salt out and make this water available for drinking?

© 2011 by the Project WET Foundation. Used with permission.
Wrap-Up:
Referring to the Warm Up, remind students of their earlier predictions of how much water on Earth is available to humans and compare the actual percentage of Earth’s water available. Have students adjust their proportion. Ask students if this water is a renewable resource? The available fresh water on Earth can be replenished naturally through the water cycle and human management. But if it is overused in a given area it becomes nonrenewable.

Assessment/Check for Understanding:
- Have students write a paragraph in their science notebook explaining how water is a renewable and limited resource.
### Arizona Water Festival Curriculum Unit –
Based on *Project WET Curriculum and Activity Guide 2.0*

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATERSHEDS</td>
<td>WATERSHEDS</td>
<td>WATER CYCLE</td>
<td>GROUNDWATER</td>
<td>WATER CONSERVATION</td>
</tr>
<tr>
<td><strong>Focus Questions:</strong>&lt;br&gt;What is a watershed?&lt;br&gt;How do we “manage” it to make sure our water is clean and plentiful?</td>
<td><strong>Focus Questions:</strong>&lt;br&gt;What is a watershed?&lt;br&gt;How do we “manage” it to make sure our water is clean and plentiful?</td>
<td><strong>Focus Question:</strong>&lt;br&gt;How does water move and change form in the earth’s natural system?</td>
<td><strong>Focus Question:</strong>&lt;br&gt;How is the groundwater system connected to the water cycle?</td>
<td><strong>Focus Questions:</strong>&lt;br&gt;Why do we conserve water? How can we conserve water?</td>
</tr>
<tr>
<td>“Storm Water”&lt;br&gt;Parts 1 &amp; 2&lt;br&gt;(PW 2.0, pg. 395, data sheet handout)</td>
<td>“Sum of the Parts”&lt;br&gt;(PW 2.0, pg. 283, picture handout)</td>
<td>“Blue Traveler” Website Activity&lt;br&gt;(<a href="http://www.discoverwater.org">www.discoverwater.org</a>) and&lt;br&gt;“Thirsty Plants” (optional data sheet handout)</td>
<td>“Common Water”&lt;br&gt;(PW 2.0, pg. 249)</td>
<td>“Use Water Wisely” water detectives’ activity&lt;br&gt;(<a href="http://www.discoverwater.org">www.discoverwater.org</a>)</td>
</tr>
<tr>
<td><strong>Vocab:</strong>&lt;br&gt;Pollution&lt;br&gt;Permeable/ Impermeable&lt;br&gt;Best Management Practices</td>
<td><strong>Vocab:</strong>&lt;br&gt;Pollution&lt;br&gt;Cumulative Effect</td>
<td><strong>Vocab:</strong>&lt;br&gt;Evaporation&lt;br&gt;Condensation&lt;br&gt;Precipitation&lt;br&gt;Surface Flow&lt;br&gt;Percolation&lt;br&gt;Transpiration&lt;br&gt;Gas or Vapor</td>
<td><strong>Vocab:</strong>&lt;br&gt;Renewable resource&lt;br&gt;Nonrenewable resource&lt;br&gt;Safe Yield&lt;br&gt;Overdraft</td>
<td><strong>Vocab:</strong>&lt;br&gt;Conservation</td>
</tr>
</tbody>
</table>

**Students should complete the Post Student Questionnaire after completing all lessons.**

Teacher Resource page:<br>[https://arizonawet.arizona.edu/content/arizona-water-festival-teacher-resources](https://arizonawet.arizona.edu/content/arizona-water-festival-teacher-resources)
Watersheds Unit: Post-festival, Day 1

Unit Focus Question:

- What is a watershed?
- How do we “manage” it to make sure our water is clean and plentiful?


Time Frame: 50 minutes

Standards Addressed:

- **S1C1-PO3** Formulate predictions in the realm of science based on observed cause and effect relationships.
- **S1C2-PO2** Plan a simple investigation that identifies the variables to be controlled.
- **S1C2-PO4** Measure using appropriate tools and units of measure.
- **S1C2-PO5** Record data in an organized and appropriate format.
- **S1C3-PO4** Determine whether the data supports the prediction for an investigation.
- **S1C4-PO1** Communicate verbally or in writing the results of an inquiry.
- **S1C4-PO3** Communicate with other groups or individuals to compare the results of a common investigation.

Learning Objective(s):

Students will:

- identify permeable and impermeable surfaces and Best Management Practices.
- make claims about permeable and impermeable surfaces based on experimental evidence.

Materials Needed:

Each cooperative learning group will need:

- 1 Storm Water Worksheet for each member of the group (handout)
- 2 aluminum trays (9x13, one with hole in one end for draining)
- 3 regular size sponges cut into quarters (3x5)
- Quart size ziplock bags
- Liquid measuring cup or 100 mL graduated cylinders
- A set of Best Management Practice cards (PWET 2.0 book, pg. 402)

© 2011 by the Project WET Foundation. Used with permission.
Storm Water Lesson Plan

Vocabulary:
- Pollution
- Permeable/Porous
- Impermeable/Nonporous
- Best Management Practices

Do Now:
Have students discuss what they have learned about water in the natural environment:
- What happens when rain falls on different surfaces? What happens when it rains in the city? What happens when it rains on the grass? What happens when it rains in a forest?
- Where does the water go?

Lesson Sequence:
1) Give each student a Storm Water Worksheet.
2) Have students define what a permeable landscape is and how water behaves on a permeable landscape - water soaks or infiltrates into the soil. Once in the soil, it can go into plants or keep traveling further to reach groundwater. Some water also evaporates. Have students write down examples of permeable landscapes on their worksheet, Step I.
3) Have students define what an impermeable landscape is and how water behaves on an impermeable landscape - water stays on the surface or runs off. Water can also evaporate. Have students write down examples of impermeable landscapes on their worksheet, Step I.
4) Look at an aerial view of your school (find on google maps). Have students identify the permeable and impermeable surfaces on campus. Alternatively, you can take the students on a walk around campus.
5) **What happens to the water when it rains on campus?** Some of the water collects and then disappears. This can be from evaporation or infiltration. Some of the water runs off and Water Managers call this water Storm Water.
6) **Where do you think storm water goes?** Storm water exits the urban environment through storm drains. **Why would storm water be considered a bad thing?** Think of all the activities we do on the land surface (drive cars, fertilize plants, animals go to the bathroom). These things can be picked up by runoff from landscapes, city streets and sidewalks. As the “storm water” picks up the particles, it is collected in our storm drains.
7) Have students define Best Management Practices - Best Management Practices are techniques that everyone can use to help keep as much storm water as possible out of our storm drains and sewers. Some of these Practices can be implemented by City Water Managers, but many of these can be done by everyday people living on the land.

© 2011 by the Project WET Foundation. Used with permission.
8) Tell students they are going to conduct an experiment that deals with permeable and impermeable surfaces and compare landscapes that do and do not have storm water Best Management Practices applied. The first thing is to have students, in groups, set up a model that will represent an area of land. Distribute the materials and demonstrate how to set it up. Two aluminum trays should be nested, the inside tray should have a drain hole, and two ziplock bags, each having 6 quarters of a sponge, placed in them.

9) Have students look at their model. **What do you think the sponges in the plastic bags represent?** Impermeable layer. **What do you think the sponges outside the bags represent?** Permeable layer. **Can you locate the storm drain at the bottom of the land area?** The goal of this game is to discover and explore ways to manage storm water by reducing run off.

10) To run the experiment, we first have to measure the amount of water that runs off the impermeable land in a rain storm. Pour 250 mL of water on the model with the sponges still in the plastic bags. Demonstrate this and then allow students to do it. Let the pan drain and collect into the second tray for one minute. Have them measure how much water ran off with a graduated cylinder, recording on the data table on Step II of their worksheet and make observations. Have students calculate the amount of water that was left (retained) in the model by subtracting the amount of runoff from the original amount (250mL). Record the result on their data table and any observations they made.

11) Each group of students will have a stack of cards, each card has a different Best Management Practice that can help to manage storm water and reduce runoff. It will describe the practice and have them remove a certain number of sponges from the bag and place it back in the tray. Once a plastic bag is empty, you can take it out of the tray.

12) Students take turns drawing a card randomly from the stack and read the card. Discuss the card and record the Best Management Practice type at the bottom of their worksheet (Step III) checking if they have seen this practice in their school or community. Then, follow the directions on the card for removing sponges. **Students will NOT add water until 10 minutes is up.**

13) After 10 minutes, have the students STOP and pour 250 mL of water on the top portion of the tray, Step IV. Let the pan drain and collect into the second tray for one minute. **Measure:** How much water is collected compared to the amount poured in? **Record:**
Record the amount of runoff and calculate how much water was retained by subtracting the amount of runoff from the original amount (250mL). Have students make observations.

14) As a class make a runoff vs retention chart on the board (the data that students recorded in the table in Step V of the worksheet). Lead a discussion about the relationships between runoff and retention and permeable and impermeable surfaces.

Wrap-Up:
Have students answer the questions in Step VI:

1) What claims can you make about impermeable surfaces based on the evidence that you observed? See example below:
   Evidence – more water ran off the land area.
   Claim – more water will run off streets and roofs etc. than off the land areas.

2) What claims can you make about permeable surfaces based on the evidence that you observed? See example below:
   Evidence – more water stayed in the land area, less water ran off the land area.
   Claim – more water will soak in to the land areas and areas where best management practices have been applied.

Assessment/Check for Understanding:

- Have each student come up with one Best Management Practice that could be implemented at their school and write a paragraph about how it would be beneficial.
Step I: List Examples of Permeable and Impermeable Surfaces

<table>
<thead>
<tr>
<th>Permeable Surface</th>
<th>Impermeable Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Step II: Pour Water on the Model of the Impermeable Landscape

1. Measure and record the amount of water that came off of the impermeable surface as runoff in the table below. Record observations.

<table>
<thead>
<tr>
<th>Round 1</th>
<th>Original Amount of Water</th>
<th>Amount of Runoff</th>
<th>Amount of water retained in the model</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impermeable Landscape</td>
<td>250 ml</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ml – milliliters

2. Calculate the Amount of Water Retained in the Model and Record:
   Using your measured values, how will you calculate the amount of water that was left in the model? Talk with your table group.

   250 ml

Step III: Best Management Practices (cards) change your impermeable landscape

1. Each group gets a stack of cards
2. One person draws a card, reads it and removes sponges from the plastic bag as indicated.
3. Return sponges to the model.
4. Record BMP and check whether you’ve ever seen this at your school or in your community.
5. Pass the stack of cards to the next person who will do the same thing.
6. Keep doing this for 10 minutes. Remember to record BMP’s below.

List Best Management Practices (BMP’s) 

<table>
<thead>
<tr>
<th>Seen this?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

1. ____________________________________________________________
2. ____________________________________________________________
3. ____________________________________________________________
4. ____________________________________________________________
5. ____________________________________________________________
6. ____________________________________________________________
7. ____________________________________________________________
8. ____________________________________________________________
Step IV: Pour Water on the Model with Permeable Landscape (after 10 minutes)

1. Measure and record the amount of water that came off (runoff) of the landscape with permeable surfaces in the table below. Record observations.

<table>
<thead>
<tr>
<th>Round 2</th>
<th>Original Amount of Water</th>
<th>Amount of Runoff</th>
<th>Amount of water retained in the model</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscape with Permeable Surfaces</td>
<td>250 ml</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ml – milliliters

2. Calculate the Amount of Water Retained in the Model and Record:
Using your measured values, how will you calculate the amount of water that was left in the model? Talk with your table group.

   250 ml

Step V: Compare runoff and retention from the landscapes

<table>
<thead>
<tr>
<th>Landscape</th>
<th>Runoff</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impermeable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permeable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Step VI: Claims and Evidence

1. What claims can you make about impermeable surfaces based on the evidence that you observed?

2. What claims can you make about permeable surfaces based on the evidence that you observed?
Watersheds Unit: Post-festival, Day 2

Unit Focus Question:
- What is a watershed?
- How do we “manage” it to make sure our water is clean and plentiful?


Time Frame: 30 minutes

Standards Addressed:
- **S2C2-PO2** Describe the interaction of components in a system (e.g., flashlight, radio).
- **S3C1-PO1** Describe how natural events and human activities have positive and negative impacts on environments (e.g., fire, floods, pollution, dams).

Learning Objective(s):
Students will:
- become watershed managers, identifying potential effects that land uses can have on a river system.
- observe how watershed management can protect water quality and quantity.

Materials Needed:
- Sum of the Parts handout which shows a side of the page as a blue river
- Markers, colored pencils, or crayons
- Paperclips, beads, or rubber bands

Vocabulary:
- Pollution
- Cumulative Effect

Do Now:
Students should discuss what they learned about watersheds at the festival focusing on:
1. What is a watershed? (have students do Watershed Dance)
2. What is watershed management?

Lesson Sequence:
1) Inform students that they have just inherited a piece of riverfront property and a billion dollars. They need to decide how they want to use the land and the money.
2) Using markers, colored pencils, or crayons, let students illustrate how they want to use their land and money making their pictures detailed and using a lot of color. Even if they don’t want to build anything, they should show what the land looks like in color.

3) Have students line up the river pieces: to start, one student should face another and match their rivers up, laying their sheets on the floor river to river. The rest of the students should line up in two equal lines next to these students. Then, facing the student in the opposite line, match river to river. Finally, they should lay their sheets on the floor to make the whole river. Tell them that the water is flowing from the first two students down towards the others.

4) The first two students will take turns describing what is on their property. The other students will be thinking of any ways that the described properties could possibly effect the rivers quantity or quality. Paper clips, rubber bands, beads, indicate those possible effects.
   a. e.g. Construction of an amusement park might cause more soil to go in to the river. That might make it shallower over time. **What do you think that would do to the river?** A lot of people go to an amusement park and people have to go to the bathroom, which might get in the river. Rides machinery uses oil and oil could get in the river. For each one of these things add a few paperclips.
   b. Even if the student decided to build nothing it’s likely that their actions produced a potential effect to the river. For instance, with all the buildup along the river, a natural site could be where wild animals concentrate. Wild animals also have to go the bathroom!
   c. **How could water quantity be affected?** Students might divert water from the river or pump water from the ground for growing plants. Both would affect the amount of water in the river.
   d. Farming can cause disturbance of the soil, fertilizers used to grow plants can runoff and cause nitrogen or phosphorus to build up in the river, and/or chemicals used to keep pests and weeds away can move in to the river.

5) As you move downstream hearing about students’ properties, move the objects along with them.
Wrap-Up:
How did the students in the middle or at the end of the river feel? Could a student downstream be affected by the actions of a student upstream? Could upstream users alter the water quality of those downstream? Where did this buildup of possible pollution come from? Human actions. So who can make sure that these things don’t build up? People.

Does this mean we shouldn’t go enjoy a river? No, it means that we have to be aware of the possible effects of our actions.

Assessment/Check for Understanding:
- Students should redesign their property taking in to consideration the possible effects that those actions could have on the quality and quantity of the river.
Blue Traveler Lesson Plan

Water Cycle Unit: Post-festival, Day 3

Unit Focus Question:
- How does water move and change form in the earth’s natural system?

Resource: website activity, [www.discoverwater.org](http://www.discoverwater.org)

Time Frame: 30-40 minutes

Standards Addressed:
- **S1C1-PO3** Formulate predictions in the realm of science based on observed cause and effect relationships.
- **S2C1-PO2** Describe science-related career opportunities.
- **S6C3-PO1** Identify the sources of water within an environment (e.g., ground water, surface water, atmospheric water, glaciers).
- **S6C3-PO2** Describe the distribution of water on the Earth’s surface.

Learning Objective(s):
Students will:
- identify places that water can go in the water cycle.
- describe processes that move water within the water cycle.
- identify the roles of different scientists who study water.

Materials Needed:
- Computers or chrome books

Vocabulary:
- Evaporation
- Condensation
- Precipitation
- Surface Flow
- Percolation
- Transpiration

Do Now:
Have students share their Water Cycle Journey bracelets from the water festival by identifying the nine places they moved in the water cycle using the corresponding color bead. They should use the hand motions they learned for evaporation, precipitation, condensation, percolation, and flow.
Lesson Sequence:

1) Students will first complete “The Water Cycle Activity” to review places and processes in the water cycle. Then, they will play a digital version of the “Incredible Journey” game that they played at the water festival, learning more about the water cycle and scientists who study water. This can be done individually or in small groups.

2) Have students go to Discoverwater.org online. Click on the button titled The Water Cycle then the button on the right titled The Water Cycle Activity.

3) Students hover over each word on the right to learn more about it. They should drag each word to the correct arrows in the water cycle illustration until they have placed all of the process words. Click on exit when completed.

4) Once students have returned to the Water Cycle page they should click on the button on right titled Blue Traveler Activity.

5) Students should play the game, following the instructions on the screen, for at least one round (approx. 10 min). Students will meet scientists and travel to different places in the water cycle.

6) Have students record their journey in their notebook.

7) Students can print out the Blue Traveler Passport page at the end of their round at the teachers’ discretion.

Wrap-Up:
Summarize today’s learning by having students share their water journeys using their notebook or their Blue Traveler Passport page.

Assessment/Check for Understanding:

- Have students complete Blue Traveler Passport page by filling in the arrows on their Blue Traveler Passport page with the appropriate transition words.
- Students will create a product that shows their understanding of the water cycle (e.g. write a story, draw a comic strip, make a model.)
Water Cycle Unit: Post-festival, Day 3

Unit Focus Question:
- How does water move and change form in the earth’s natural system?


Time Frame: 50 minutes with time in between for bags on plants

Standards Addressed:
- S1C1-PO3 Formulate predictions in the realm of science based on observed cause and effect relationships.
- S1C2-PO1 Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry.
- S6C3-PO1 Identify the sources of water within an environment (e.g., ground water, surface water, atmospheric water, glaciers).

Learning Objective(s):
Students will:
- explain how plants transport water through transpiration.
- describe the importance of plants in the water cycle.

Materials Needed:
- Celery stalks or white carnations
- Prior to class, place celery or a carnation with a stem in a clear container filled with water (colored with red or blue food coloring) overnight, until leaves or petals are colored with the dye.
- Paper towel tube
- Paper that is cut into a series of connecting circles (see diagram)
- Clear plastic bag and twist tie for each group
- Thirsty Plants data sheet (optional math extension)
Vocabulary:
- Transpiration
- Gas or Vapor

Do Now:
Remind students of the Incredible Journey game played at the water festival (or the Blue Traveler activity on discoverwater.org). Note that plants were a place that water could travel to in the water cycle. Ask students how water gets into plants. Most students know it is the roots. Ask how water gets OUT of plants. Show students the celery or carnation with blue dye in it. How did the dye get from the jar into the leaves or petals? What about in a tree that is 20 feet tall? How does water get from the bottom to the top?

Lesson Sequence:
1) Give each small group an empty plastic bag and twist tie. Have students examine their bag and record any observations.
2) Take students outside to an area with several plants (a variety of types is nice, and sunny areas work best). Have students carefully place the bag over several leaves of their plant (try for 2 or 3). (You may want to have a few larger plastic bags on hand for some groups who choose large trees or plants with large leaves.) Each group should count and record the number leaves in its bag, record the time, and then take a moment to estimate the total number of leaves on the plant.
3) Back in the classroom, have students predict what they think will happen and write down their predictions.
4) After 30 minutes (or whatever timeframe works for your class) carefully remove the bag from the plant leaving the leaves in place. Have students take one leaf from the plant/tree they had their bag on for identification. Make observations about how much water is in the bag. Have students estimate this volume (it may be helpful to have a few small graduated cylinders around for reference).
5) Have students do a gallery walk: comparing how much water is in each bag and the plant type to others. Discuss where the water came from and how it got there. **What is not in this diagram that is needed?**

6) Show students the paper towel tube with the cut-out circles inserted. Explain that the tube represents part of the tissues inside a plant (where the arrows are in the diagram). These are similar to veins inside our bodies. The paper circles represent water molecules.

7) Ask: **What form of water goes in to the roots?** Liquid. **What form of water is in a plant?** Liquid. Point out the water molecule near the top of the tube, explain that this represents a molecule at a pore in a leaf (stoma). **During the day, increased heat energy will cause water to move into the pore. What causes the heat energy?** Yes, the Sun is an important driver of water moving through a plant. To show water moving from the pore, pull on the top circle to draw the next circle up near the top, then tear off the top circle. Have the torn of molecule float in to the air. **What form do you think water is in now?** Vapor. **Would you be able to see it?** No it’s invisible to the eye now. Explain that this represents a water molecule changing form within a plant from liquid to gas or vapor. **Do you know what this process is called?** Transpiration. **When the Sun heats of the water molecule on the surface and changes it to a vapor it also pulls the next molecules up.**
8) Have students answer the questions; **How much water do you think would come from the entire tree in that same time? How about all the trees in your neighborhood?**  
Do you think transpiration is an important process in the water cycle? **Optional:**  
Students can fill in a data sheet similar to the one following this lesson.

9) Write Transpiration on the board and have students add this process to their water cycle diagram.

**Wrap-Up:**
Summarize today’s learning by having students explain how transpiration works. Ask them to include all of the details that they remember.

**Assessment/Check for Understanding:**
- Have students return to their water cycle diagram and fill in any missing processes that they learned about in this lesson. They should add transpiration and now be able to connect the sun as the energy driver to the water cycle.
- Have students do a quick write about the transpiration process.
Post-Festival Lesson for Water Cycle:  
Thirsty Plants

Which plant transpired the most water?  
Which plant transpired the least water?  
Estimate the mass of water YOUR plant would transpire during seven hours of sunlight. Assume a constant rate of transpiration.

<table>
<thead>
<tr>
<th>Plant Name or Description</th>
<th>Amount of water in bag</th>
<th>Number of leaves on plant</th>
<th>Number of leaves in bag</th>
<th>Minutes bag was on plant</th>
<th>Transpiration per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\text{Volume of water in bag} \times \frac{\text{Leaves on plant}}{\text{Leaves in bag}} = \text{Estimated water transpired from plant in X minutes}
\]

\[
\frac{\text{Estimated water transpired from plant in X minutes}}{\text{X minutes}} = \text{Transpiration volume per minute}
\]

\[
\text{Transpiration volume per minute} \times 60 = \text{Transpiration volume per hour}
\]
Groundwater Unit: Post-festival, Day 4

Unit Focus Question:
- How is the groundwater system connected to the water cycle?


Time Frame: 50 minutes

Standards Addressed:
- S3C1-PO1 Describe how natural events and human activities have positive and negative impacts on environments (e.g., fire, floods, pollution, dams).
- S4C3-PO1 Describe ways various resources (e.g., air, water, plants, animals, soil) are utilized to meet the needs of a population.
- S4C3-PO2 Differentiate renewable resources from nonrenewable resources.
- S6C3-PO1 Identify the sources of water within an environment (e.g., ground water, surface water, atmospheric water, glaciers).

Learning Objective(s):
Students will:
- define water sources in Arizona
- analyze the states’ water budget
- identify who the water users are in Arizona
- explore groundwater use and recharge
- differentiate renewable and nonrenewable resources.

Materials Needed:
- 2 very large round containers
- 16 smaller buckets
- 24 larger sponges and 8 smaller sponges
- Masking tape

Vocabulary:
- Renewable resource
- Nonrenewable resource
- Safe Yield
- Overdraft
Do Now:
Students should review the big ideas about the groundwater system that they learned at the water festival. Have students look at a groundwater cross section diagram (e.g. the San Pedro GW diagram in AWF power point presentation) discussing how water moves in and out of the system. Students should answer:

1. How are surface water and groundwater connected?
2. What happens when we take too much water out of river?
3. What happens if we take too much water out of the ground?
4. Can we put water back into the ground?

Lesson Sequence:

- Have students list the four water resources that are used in Arizona and analyze the percentage of each that is part of Arizona’s water budget (ADWR pie chart can be found in the AWF power point presentation).
- Have students list major water user groups in their community and how they use water. Ask students to arrange the water users, from highest to the lowest use.

Go outside for the activity portion of the lesson that will focus on groundwater supply.

1) Fill 2 very large containers with water about ¾ full and mark the water level on the side of each container with tape. Label one container surface water and the other container groundwater. These two sources are where most of Arizona’s water supply comes from.
2) Start with the groundwater container. Tell students the line that the tape represents is the average groundwater level over the last 100 years.
3) For the surface water container, tell students that the line represents “baseflow” or the average amount of water in a river during the driest time of the year.
4) Tell students they are going to simulate changes in an aquifer and a river over 3 time periods (100 years ago, 50 years ago, and the present, Round Scenarios PW 2.0 pg. 250). Each 30-second round represents a time period. In each round, students represent different water users.
5) For each round, one group of students encircle each container positioning themselves an equal distance from the water source. When the round starts, students fill their sponges with water from the sources: pumping from the groundwater or diverting from the river.
To represent water consumption, have them squeeze the water out of the sponges into the smaller buckets. Students refill their sponges as many times as they can before time runs out.

6) Begin Round 1 by reading the 100 years ago scenario and assigning the 4 water users around each container. They will use the smaller sponges.

7) At the end of each round, mark and label the new water levels on each container. Also, measure the amount of water that was taken out (from all of the small buckets) during that round. This represents the annual water use. Then pour the water back in to the container to begin another round.

8) Repeat the above steps for Round 2 adding 5 or 6 new water users to the existing Round 1 water users around each container and reading the 50 years ago scenario. The new water users will use the bigger sponges representing the age of technology.

9) At the end of Round 2 tell students that the annual water use (the amount of water that was taken out) for this round represents “safe yield” or the amount of water that comes back in to the system each year. Therefore, it’s the amount we can take out without making the system out of balance.

10) Repeat the above steps for Round 3 adding 5 or 6 new water users around each container to the existing Round 1 and 2 water users and reading the Current scenario. They will use the larger sponges.

11) How much water was taken out during Round 3? This represents the annual water use currently. Have we gone over safe yield? Yes. What does that mean? That we are starting to use more water than is put back in our natural system. What might happen over time? We might dry up our river. We might overdraft (take more out than can be put back in) our groundwater system.

12) In which Round or Rounds was the water supply renewable? Rounds 1 and 2. In which Round or Rounds was the water supply nonrenewable? Round 3

Wrap-Up:
Have students define what a renewable resource is and list examples. Have students define what a nonrenewable resource is and list examples. Is groundwater a renewable or nonrenewable resource? It can be a renewable resource if we only take out what can be put back in a year. We call this safe yield. Is river water a renewable or nonrenewable resource? It can be a renewable resource if we only take out what can be put back in a year. We call this maintaining baseflow.

Assessment/Check for Understanding:
- Have students write a reflection paragraph describing water management that ensures that we have enough water every year.
- Brainstorm ways that our community could add to their water supply.

© 2011 by the Project WET Foundation. Used with permission.
Use Water Wisely Lesson Plan

Water Conservation Unit: Post-festival, Day 5

Unit Focus Questions:
- Why do we conserve water?
- How can we conserve water?


Time Frame: 30-40 minutes

Standards Addressed:
- S4C3-PO4 Describe ways in which resources can be conserved (e.g., by reducing, reusing, recycling, finding substitutes).

Learning Objective(s):
Students will:
- recognize that everyone contributes to and is responsible for the quality and quantity of the water we share.
- analyze everyday actions to determine if they positively or negatively impact water quantity and/or quality.
- give examples of actions (Best Management Practices) that individuals can take to promote water conservation and protection.

Materials Needed:
- Computers or chrome books

Vocabulary:
- Conservation

Do Now:
Have students list in their notebooks ways they use and interact with water throughout their day (examples: drinking, swimming, watering plants, brushing their teeth).

Lesson Sequence:
1) Students will play the “Water Detectives” activity in the Use Water Wisely identifying water wasters and water savers in a neighborhood where water is being used in many ways. This can be done individually or in small groups.
Use Water Wisely Lesson Plan

2) Have students go to Discoverwater.org online. Click on the button titled Use Water Wisely then the button on the right titled Water Detectives Activity.

3) Students click on a highlighted picture where a description of a water user will pop up. Students choose if that water user is a wise water user or a water waster.

4) Once they have found all 23, their score along with the total of wise water users and water wasters pops up. Click on exit when completed.

Wrap-Up:
Having completed the Water Detectives activity, discuss as a class what students found surprising, interesting, and what they already knew. Have students answer the following questions in groups:
- Are you a wise water user?
- What could you do to conserve more water?

Assessment/Check for Understanding:
- Have students think about the best management practices they have learned about throughout the water festival unit and pick one that they can incorporate in their daily lives. Have them create a plan which can be a written paper, a digital infographic, an informational brochure, a poster, or another format chosen by the teacher or students.