



Conserving Water In the Desert

Lesson 1: The Water Cycle

Enduring Understanding

All water on earth is recycled in four stages: (1) Evaporation, (2) Condensation, (3) Precipitation, and (4) Collection, and continuously moves through this cycle.

Essential Question

What are the stages of the water cycle and what are the processes or energy sources that stimulate the movement of water through its various stages.

Background Information

As stated in the Enduring Understanding, water on Earth is recycled in four stages: (1) collection, (2) evaporation, (3) condensation, and (4) precipitation. Plants play a major role in the water cycle. Plants' roots hold the soil in place so precipitation can percolate into the ground to recharge underground aquifers. Roots of the plant absorb underground water and move it through its xylem (vein-like cellular system) up to the leaf's surface. The leaf is where most photosynthesis takes place in the plant, and excess water is able to discharge through the stomata of the leaf to be evaporated into the atmosphere. This process is called transpiration.



The processes or energy events that stimulate the next step in each of the stages of the water cycle:

- **Evaporation:** Heat energy from the sun (or other source) stimulates movement in water molecules, breaking the bond between them. The molecules then leave the liquid and evaporate into the air, taking the form of water vapor.
- **Condensation:** The water vapor must be cooled in order for the water vapor to convert back into a liquid; the water molecules also need solid matter such as dust, smoke or salt particles, called *condensation nuclei*, upon which to condense.
- **Precipitation:** The mass of water vapor molecules that have condensed into liquid droplets then stick together by the property of *cohesion*. This collection of liquid water molecules is called *coalescence*, which forms clouds. Once there is a substantial collection of water molecules colliding and creating enough movement and weight, precipitation will fall from the atmosphere to the ground.
- **Collection:** Water will collect on the surface of the Earth or percolate into the ground when it is heated by sun to its liquid state.

Note: For further, more detailed explanations of each of the water cycle stages, see the United States Geological Survey website:

<http://water.usgs.gov/edu/waterproperties.html>

Lesson Plan

Materials for all activities

BB = Indicates materials included in Botany Bin

- BB Bill Nye the Science Guy: Water Cycle DVD
- BB The Magic School Bus Wet All Over: A Book About the Water Cycle
- BB The Water Cycle book by Rebecca Harman (Upper Grades)
- BB The Water Cycle book by Craig Hammersmith (Lower Grades)

Activity #1: Water cycle terrarium

Materials

BB = Indicates materials included in Botany Bin

- BB Student Worksheet Water Cycle Terrarium, one per student
- Small pebbles, approximately 1 cup per student
- Charcoal, approximately 1 cup per student
- Sand, approximately 1 cup per student
- Soil, approximately 1 cup per student
- 2-3 small tropical plants per student
- Jar with lid (3-5" mouth) or plastic clam shell (large salad sized)

Procedure

Warm up

View the part of the *Bill Nye the Science Guy: Water Cycle* DVD related to the water cycle, or have students go to the following link to view the water cycle:

<http://water.usgs.gov/edu/watercycle-kids-beg.html>

To view a graphic example of transpiration in plants, go to the following link:

Transpiration: <https://www.youtube.com/watch?v=U4rzLhz4HHk>

The bin also contains two books on the water cycle, one for lower grades and one for upper grades that you can use in place of the video clips or to enhance the students' understanding.

Discuss the water cycle as viewed on the video clips.

Next tell the students they will demonstrate knowledge of the water cycle by creating a simulation of the cycle and identifying the four stages of the cycle. Discuss how plants used in the water cycle model will demonstrate how water is absorbed by a plant's roots, how transpiration (sometimes referred to as evapotranspiration) takes place, and the importance of plants and their roots in aiding percolation of surface water into the groundwater system.

- Put materials out for students to assemble their terrariums. Demonstrate how to assemble:



- Layer first the pebbles, then the sand and the soil on top.
Demonstrate how to plant the plants.
- Water thoroughly, but do not allow water to puddle in the bottom.
- Cover with lid lightly.
- After the students have assembled their terrariums, have one-half of the students place their terrariums in a fairly warm and sunny place in the classroom. The other half should place their terrariums in a cooler area of the classroom that receives less light and warmth than the sunny area.
- Have students fill out the Prediction section of the Student Worksheet Water Cycle Terrarium. Then have them observe their terrariums daily for one week, recording their observations on the Gathering Data section of the Student Worksheet. At the end of the data-gathering period, have students answer the questions in the Reasoning section of the worksheet.

Discussion

Have each student from the sunny group share data collected on the worksheet with a partner from the shady group. Using inquiry questions when they are finished sharing, lead a whole group discussion about observations and conclusions recorded by the two different groups. As you lead the discussion, have the students name each of the stages of the water cycle and infer what energy source or process stimulated the next stage in the cycle.

Have all students fill out the Communicating Findings section of the Student Worksheet.

[NOTE: The students in the sunny group should be able to see the water cycling in larger quantities than the shadier group, leading them to conclude that the sun or heat stimulates the evaporation process. In addition, both groups should note that the terrariums cooled overnight without the sun's energy and that lack of heat energy from the sun cooled the vapor and created the condensation].



Name: _____ Date: _____

Student STEM Practices Worksheet

Lesson 1: Water Cycle Terrarium, 4th-6th Grade

Objectives

Construct a model or diagram to show how water continuously moves through the water cycle over time.

Instructions: Using the materials that are provided by your teacher, you will create a miniature ecosystem (terrarium) that will demonstrate the water cycle.

You will be viewing different videos on the water cycle to help you create your ecosystem. Half of the class will place their terrariums in a warm and sunny place, the other half in a cool, more shaded area of the classroom. You will record your observations over a week.

1. Gathering Data:

Questions I have: _____

My Prediction: _____

| Circle: Sunny or Shady | Day 1 sunny shady | Day 2 sunny shady | Day 3 sunny shady | Day 4 sunny shady | Day 5 sunny shady | Day 6 sunny shady | Day 7 sunny shady |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Write: location and appearance of water | | | | | | | |
| Sketch: water collection and state of the water: (solid, liquid, gas) | | | | | | | |



2. Reasoning:

Analyze your data and explain what happened.

Draw a picture of your terrarium; include location and state of water (solid, liquid, vapor). Label all four stages of the water cycle on your drawing. Explain your data. Can you explain the processes that stimulate the next step in each of the stages of the cycle.

3. Communicating Your Findings:

Using what you know about the water cycle, explain what was taking place in your terrarium. Then, find a partner whose terrarium was in a different area than yours and share your observations with that student. Discuss the differences between the two terrariums. Draw a picture of the differences and explain what happened. Be sure to label all four stages of the water cycle. Draw a picture.

Activity #2: Water cycle diorama model

Materials

- BB Student Worksheet Water Cycle Diorama, one per student
- Various art materials: blue and brown construction paper, tissue paper, blue or green cellophane, die-cut raindrops, cotton balls, markers, pens, pencils
- Scissors
- Empty shoe boxes, pieces of cardboard or file folders that can be taped open at a right angle
- Glue

Procedure

Warm-up

View a part of the Bill Nye Water Cycle video related to the water cycle, or have students go to the following link to view the water cycle:

<http://water.usgs.gov/edu/watercycle-kids-beg.html>

To view a graphic example of transpiration in plants, go to the following link:

Transpiration: <https://www.youtube.com/watch?v=U4rzLhz4HHk>

Discuss the water cycle as viewed on the video clips.

Next tell the students they will demonstrate knowledge of the water cycle by creating a three-dimensional model of the cycle and labeling the four stages of the cycle. Make various art materials accessible to students and allow them time to create their models. Remind them to label their model and to use the rubric to guide their work.

Assessment

Have a “gallery walk” where all the dioramas are displayed. Number the models so they will be assessed blindly. Assign students 4-5 diorama models to assess, using the rubric on the Student Worksheet Water Cycle Diorama.



Name: _____ Date: _____

Student STEM Practices Worksheet

Lesson 1: Water Cycle Diorama, 4th-6th Grade

Objectives

You will view video clips and read various materials about the water cycle, and then create a 3-D model to share with the class. You will then assess one another's dioramas.

1. Gathering Data:

Questions I have: _____

- Using what you have learned from the videos and books, sketch a picture of the water cycle in the box below; label the four stages.
- Then, using your picture as a model and the materials provided by your teacher, create a 3-D model of the water cycle; label each stage and other parts of your diorama relevant to the water cycle. Be prepared to explain your diorama.
- Use the Water Cycle Rubric on the following page when preparing your picture and 3-D diorama. You will be evaluated on that rubric.

Drawing of Water Cycle:

Each diorama should be labeled with a number so that evaluations of the dioramas are done blindly (without the evaluator knowing whose diorama it is).

Water Cycle Rubric

| Student Diorama Number | | | | | | | |
|--|--|--|--|--|--|--|--|
| Diorama of water cycle is neat and organized | | | | | | | |
| Diorama is labeled with 4 stages of water cycle | | | | | | | |
| Diorama is easy to read and interpret | | | | | | | |
| Water cycle is depicted accurately | | | | | | | |
| Explanation of water cycle is clear and complete | | | | | | | |

- 1 – Incomplete, lacks one or more stages or labels
- 2 – All four stages are included and labeled
- 3 – All four stages are included and labeled / some added information
- 4 – All four stages are included and labeled / substantial information added
- 5 – All four stages are included and labeled / contains substantial information and added details



2. Reasoning:

Analyze your data and explain what happened. You may draw a picture.

After evaluating all of the water cycle displays, explain why it is important to understand the water cycle.

3. Communicating Your Findings: You may draw a picture.

Are there positive changes a person could make in any of the stages of the water cycle to utilize water more sustainably? To have cleaner water? Explain your answers.



Extensions

Extension Activity #1: Plant Transpiration 1

Materials

- BB Student Worksheet Transpiration 1, one per student
- 5-6 quart-sized baggies
- Twist ties
- Large-leafed tree

Review the information on transpiration (evapotranspiration) and tell students they will observe a tree to see if they can actually see this taking place on a tree. Take them outside and have them examine the tree to see if they can observe transpiration occurring on the leaves. Have them write their observations on the Student Worksheet Transpiration 1.

- Next, help students put baggies over 5-6 leaves on the tree. Use a twist-tie to keep each bag secure, being careful not to damage the leaf.
- Have students write a prediction about what might happen, and write it on the Student Worksheet.
- Have them record the appearance of the leaves just after the baggies are attached.
- Leave the baggies on the leaves and have them record their findings after three hours.
- Check the baggies after leaving them on overnight. Have them record their observations and complete the data chart and the Reasoning section on the Student Worksheet.
- When that is complete, have them find a partner to discuss their conclusions, and then record the conclusions they discussed onto the Communicating your Findings section of the Student Worksheet.



Name: _____ Date: _____

Student STEM Practices Worksheet

Lesson 1 Extension: Plant Transpiration 1, 4th-6th Grade

Objectives

You will be observing the transpiration of plants.

Go outdoors with your class and observe a large-leaved tree and its leaves. Can you detect transpiration taking place? Record your observations on the worksheet Gathering Data section.

After your teacher has helped you put baggies on some of the leaves on the trees, write down your prediction about what might happen. Check the baggie after three hours. Write down your observations of the leaves with baggies and the leaves without baggies. Check the tree leaves the next day. Write down your observations.

Be sure to remove the baggies from the tree after the experiment!

1. Gathering Data:

Questions I have: _____

My Prediction: _____

| | Initial | 3 Hours Later | Next Day |
|-----------------------------------|---------|---------------|----------|
| Tree leaf with no baggie attached | | | |
| Tree leaf with a baggie attached | | | |



2. Reasoning:

Analyze your data and explain what happened. You may draw a picture.

3. Communicating Your Findings:

Using what you know about the water cycle, explain what happened to your leaf. Which stage of the water cycle was demonstrated by this activity? You may draw a picture.

Extension Activity # 2: Transpiration 2

Materials

BB = Indicates materials included in Botany Bin

- BB Student Worksheet Transpiration 2, one per student
- 2 quart-sized baggies
- One 2-4" drought tolerant plant
- Two plants with high water needs (same size as plant above)

Have students first observe the plants to see if they can note any signs of transpiration.

- Next, put a baggie over the drought tolerant plant and one of the plants that has higher water needs, and secure with a twist tie or zip it shut.
- Have the students make predictions about what might take place with all three plants, and record their observations on the Student Worksheet Transpiration 2.
- Then have them record their observations three hours later and then overnight. Data should be collected on all three plants.
- Lastly, have them complete the Student Worksheet and discuss their conclusions as a whole group.

Student STEM Practices Worksheet

Lesson 1 Extension: Plant Transpiration 2, 4th-6th Grade

Objectives

You will observe the transpiration of plants with different water needs.

1. Gathering Data:

Questions I have: _____

- You will have two plants with different water needs that you will cover with baggies, and an additional plant that will not be covered.
- Put a baggie over each of two plants, and secure with a twist tie. Be careful not to damage the leaves.
- Set all plants in the same area, including the one without the baggie, so they all have the same amount of light and warmth.
- On your worksheet predict what will happen with each of your plants. Leave the baggies on the leaves for several hours. Record your findings of all three plants on your worksheet after three hours, and after leaving the baggies on overnight.

My Predictions: Plant A: _____

Plant B: _____

Plant C: (No baggie) _____

| | Initial | 3 Hours Later | Overnight |
|----------------------|---------|---------------|-----------|
| Plant A | | | |
| Plant B | | | |
| Plant C No baggie | | | |



Project Wet Curriculum and Activity Guide:

The Incredible Journey, page 155

