The Wonderful Water Cycle

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Time:
(3) 45 minutes classroom sessions

Level:
Grades 3-5
Standards selected for grade 4

Goals:
This lesson will help students to gain a better understanding of how the water cycle works, and the role of watersheds in the water cycle.

Objectives:
Students will be able to

1. Reproduce a simple model of the water cycle, after appropriate instructions have been given

2. Explain in detail what a watershed is, and the main jobs of the watershed

3. Discuss 2 ways they are dependent on their local watershed

4. Identify 2 ways their individual behavior impacts the watershed and water cycle in general

Materials listed with each individual lesson plan.

Correlations to Core Curriculum:

4th Grade

- Standard 1: Students will understand that water changes state as it moves through the water cycle.
    - Objective 2: Describe the water cycle
        - Indicator d: Construct a model or diagram to show how water continuously moves through the water cycle over time.
        - Indicator e: Describe how the water cycle relates to the water supply in your community.

Background Information:

What is the Water Cycle?

The water cycle has no starting point, but we'll begin in the oceans, since that is where most of Earth's water exists. The sun, which drives the water cycle, heats water in the oceans. Some of it evaporates as vapor into the air; a relatively smaller amount of moisture is added as ice and snow sublimate directly from the solid state into vapor. Rising air currents take the vapor up into the atmosphere, along with water from evapotranspiration, which is water transpired from plants and evaporated from the soil. The vapor rises into the air where cooler temperatures cause it to condense into clouds.

Air currents move clouds around the globe, and cloud particles collide, grow, and fall out of the sky as precipitation. Most precipitation falls back into the oceans or onto land, where, due to gravity, the precipitation flows over the ground as surface runoff. A portion of runoff enters rivers in valleys in the landscape, with streamflow moving water toward the oceans or terminal lakes. Runoff, and groundwater seepage, accumulate and are stored as freshwater in lakes.

Not all runoff flows into rivers, though. Some of the water infiltrates into the ground and replenishes aquifers (saturated subsurface rock), which store huge amounts of freshwater for long periods of time. Some infiltration stays close to the land surface and can seep back into surface-water bodies (and the ocean) as groundwater discharge, and some groundwater finds openings in the land surface

Did you know?

While not everyone lives next to a pond or stream, we all live in a watershed. A watershed is the land area from which surface water drains into a common stream channel, lake, reservoir, or other body of water.

http://extension.usu.edu/waterquality/htm/watershedinformation

and emerges as freshwater springs. Yet more groundwater is absorbed by plant roots to end up as evapotranspiration from the leaves. Over time, though, all of this water keeps moving, some to reenter the ocean, where the water cycle "ends" ... oops - I mean, where it "begins."
http://water.usgs.gov/edu/watercyclesummary.html

How to Make a Mini-Water Cycle (Closed System)

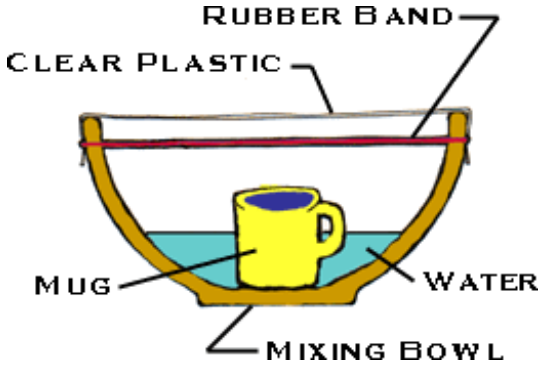
You will need a large plastic or metal bowl, a smaller mug or bowl, salt, water, a small rock or marble, and a large elastic band.

Start by filling the large plastic or metal bowl with a few inches of salt water. (The ratio of salt to water doesn't matter too much. Use a few tablespoons of salt to a few inches of water for a good representation.) This represents the ocean. Next, place the mug or bowl into the center of the large bowl with saltwater. Make sure not to spill any water into the mug! Cover the large bowl with plastic wrap, and secure the plastic to the bowl with a large rubber band. Place the marble or rock in the center of the plastic wrap. This will help the water drop into the mug, rather than back into the 'ocean.'

Allow the model to sit in direct sunlight or under a heat lamp for 30-45 minutes. At this point, condensation should be forming on the plastic wrap, and should be starting to drip into the mug (simulating rain). To speed up the process of the 'rain,' move the large bowl to a shady area.

*Note – Depending on the amount of heat and light available, this process may take anywhere from 20 minutes to 90 minutes.

An example is to the right to give you a better idea of what your water cycle model should look like.
http://thewaterproject.org/resources/lesson-plans/create-a-mini-water-cycle



What is a Watershed?

The term *watershed* is often used in discussions about water quality or flood prevention, but most people do not really understand what a watershed is. The definition of a watershed is based on a concept with which everyone is familiar: "*Water runs downhill*." A

Watershed is a land area whose runoff drains into any stream, river, lake, and ocean. Watershed *boundary* (e.g., Fig. 1) is the divide separating one drainage area from another. Watersheds may be as small as the portion of a yard draining into a mud puddle or as large as the Mississippi River Basin, which drains 1.2 million square miles. Terms like *catchment* or *drainage basin* are also used to refer to watersheds.
http://edis.ifas.ufl.edu/ae265

Jobs/Functions of Watersheds

As water flows downhill in small to progressively larger streams and rivers, it moves over land and provides water for urban, agricultural, and environmental needs. The watershed community is made up of everyone who lives there plus all other animal and plant life. The community of humans, plants, and animals depends on the watershed and influence it in some way. Flowing water carries organic debris and dissolved organic matter that provide food and shelter for aquatic life. At the same time, water may also carry pollutants like motor oil, fertilizers, and pesticides. Numerous activities in a watershed have the potential to degrade water quality. There is no "pure" water in nature; all water is "polluted" to some extent. Even in pristine watersheds where water quality is not affected by humans, "natural" pollutant sources are abundant. These include sediment from stream bank erosion, bacteria and nutrients from wildlife, and chemicals deposited by rainfall.

A watershed has five important functions:

1. It collects water from rainfall;
2. It stores water of various amounts and for different times;
3. It releases water as runoff;
4. It provides diverse sites for chemical reactions to take place; and
5. It provides habitat for flora and fauna.

The first three functions are physical in nature and are termed hydrologic functions. The last two are the ecological functions.

Did you know?

Nearly 97% of the world's water is salty or otherwise undrinkable. Another 2% is locked in ice caps and glaciers. That leaves just 1% for all of humanity's needs — all its agricultural, residential, manufacturing, community, and personal needs

http://water.epa.gov/learn/kids/drinkingwater/waterfactsoflife.cfm

Materials:

Supplies:

- Large plastic or metal bowl
- Mug or small bowl
- Plastic wrap (enough to cover the top of the large bowl)
- Large elastic (to hold the plastic wrap in position)
- Marble or small rock
- Salt
- Water

Equipment:

- Internet access (preferable, but not required)
- Projector or SmartBoard

Lessons and Activities:

Day 1 --

Engage (10 minutes) – Introduce the topic of the water cycle by showing student the short video clip (called a Scholastic Study Jam) on the water cycle. The clip is slightly over 4 minutes long.

Scholastic Study Jam – The Water Cycle

Discuss what students learned from the video, and their background knowledge of the water cycle. Review important terms and their definitions (precipitation, evaporation, condensation) with students.

Explore (25 minutes, plus waiting time) – Explain that students will be creating a mini-water cycle, so that they can see close up how the water cycle works. Divide students into groups of 4-6 people each.

Following the procedure in the background section ('How to build a mini water cycle"), allow each group to build their miniature water cycle system. *(As an alternative, you may choose to do one water cycle system for the entire class to cut back on the quantity of materials needed.)*

After students have built their water cycle system, have them write down observations, predictions, and make scientific sketches in their science notebooks.

Explain that these water cycle systems need a source of light and heat (representing the sun) in order to work. The systems can be placed under a bright lamp or under direct sunlight. *(You will likely find that the lamps – if they are hot enough – will prove to demonstrate the water cycle much more quickly than putting the systems outside, depending on how hot of a day it is.)*

After students have created their models and put them under a lamp or outside, students should get a poster board and markers, and as a group, draw a model of the water cycle. Remind students to be neat and clear with their work, as these posters will be displayed in the classroom or the hall. Remind students to include the words 'precipitation,' 'evaporation,' and 'condensation' on their posters.

When students finish making their posters, they should check their miniature water cycle, and note any changes in their science notebook.

While waiting for the water cycles to begin precipitation, you may choose to show students 'Bill Nye the Science Guy: The Water Cycle' video. The video time is 23:05.

Bill Nye the Science Guy: The Water Cycle

Other options would include having students look up the definitions for water related words (evaporation, condensation, precipitation, run-off, percolation, infiltration, transpiration), or engaging students in another short activity of your choice.

The water cycle model may take anywhere from 20 minutes to 60 minutes to begin 'raining,' depending on the size of your model and the amount of light and heat it is under. You may choose to have students wait to observe the model until it is actually dripping, or you may choose to have them observe the model a few times before this begins, which will allow them to see the condensation forming over time.

When the water cycle model is 'raining' into the mug, have students observe their models and make scientific notes and sketches in their science notebook. This observation should last about 5 minutes.

Explain (10 minutes) – Discuss what students saw in their water cycle models. What was expected? What was surprising? Discuss the similarities and differences between their model and the water cycle that goes on in the world around us.

If time is available, review each process of the water cycle, and allow students to place their water cycle posters in a prominent place in the classroom or hallway.

Day 2 –

Materials:

Supplies:

- 2-4 cups filled with water
- Watershed picture (attached at the end of the lesson plan)
- Watershed Charades
    - No supplies required

The activity in the 'engage' section below has been modified from a lesson from National Geographic. For the original lesson plan, follow the link under the 'resources' section.

Engage (10 minutes) – Take students to an outdoor parking lot, and stand near a storm drain. Bring 2-4 cups of water with you. Ask students to stand around the storm drain. Slowly pour the water from the cups, and watch the water run into the drain. Ask students "Where did the water go?" Many students will say 'down' or 'into the drain.'

- Watershed Metaphors
    - Bag (such as a reusable shopping bag)
    - Funnel
    - Toy train
    - Coffee Filter
    - Canning jar and lid
    - Kitchen sink plug
    - Flower vase
    - Other materials, as desired
- Topographic Map Fun
    - 4-6 topographic maps

Equipment:

- Internet access (preferable, but not required)
- Projector or SmartBoard

Explain that all water travels downward, and it is always going somewhere. Whether it drains into a storm drain or seeps into the ground, it will eventually make its way to a river, bay, lake, or another body of water. From there, the water will move to a larger body of water, and this process will continue over time.

Explore (25 minutes) – Take students back inside. Show them a picture of a watershed. Without introducing the term 'watershed' yet, ask students what they notice about the picture. Students may notice that all of the water is running downhill and making its way to larger bodies of water, that water is found in all different places – farms, neighborhoods, business parks, etc., or they may make other observations. Encourage each answer.

After students have finished making observations about the picture, explain that this is a picture of a watershed. Explain that a watershed is a geographic area in which all the water is draining to a common point. Tell the students that they live in a watershed – in fact, everyone lives in a watershed.

Introduce the name of your local watershed. *(If you aren't sure which watershed you live in, visit http://cfpub.epa.gov/surf/locate/index.cfm and type in your zip code or the name of your city, and the site will tell you which watershed(s) you live in.)*

To better understand what watersheds are and why they are important, do as many of the following activities as you want (or have time for) in any order:

A. Watershed Charades— In groups, have students use their hands or act out a representation of the movement of water in a watershed. As an example, students could choose to place their hands side by side in a bowl shape to show the divisions of a watershed and the direction of water flow within. Another idea would be that students could demonstrate how small watersheds flow into watersheds by starting in different areas of the classroom, and then slowly 'flowing' together into a central location.

B. Watershed Metaphors – Place objects in a bag that represent jobs of a watershed. *(If doing this activity, make sure to review the main jobs of a watershed before beginning. For more information on this topic, see the 'background information' section of the lesson plan.)* Ideas for objects to use include a funnel, a toy train, a coffee filter,

a kitchen sink plug, a flower vase, and a canning jar and lid. One person from each group/table should select an item out of the bag. Together, the group should decide which part or job of the watershed the item represents and why. There can be more than one right answer for each object. Ideas should be shared with the class.

C. Topographic Map Fun – Show students a topographic map, and explain how to use it. Show students how to find rivers, tributaries, and other bodies of water. Pass a map out to each table group. In groups, students should find tributaries and find how they connect to rivers, rivers to larger rivers, and eventually bodies of water making it to the ocean. Students should trace these paths with their fingers, and if time is available, can share which bodies of water they followed with other groups.

Explain (10 minutes) – Debrief the activities you participated in. Relate the games/activities to real watersheds. Answer any student questions about watersheds. If time is still available, have students answer the following prompt in their science notebook: "What are watersheds? Why are they important?"

Day 3 –

Materials –

Supplies:

- 5 gallon bucket (transparent if possible)
- 5 gallons of water
- Sink or bucket to pour extra water into
- 1 cup measuring cup
- Tablespoon
- Science notebooks, writing utensils
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Equipment:

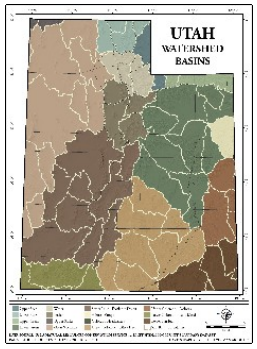
- Internet access
- Projector or SmartBoard
- Computers (1 per group, if possible)

Engage (15 minutes) – Start by showing students a transparent 5 gallon bucket filled completely with water. Explain that this bucket full of water represents all of Earth's surface mass. Remove 1 ½ gallons, leaving 3 ½ gallons of water in the bucket. Explain that what is left in the bucket represents all of the water found on Earth. Water makes up about 71% of Earth's surface. Next, remove all of the water from the bucket except 1 cup of water. *(As an alternative, you could simply remove one cup of water from the bucket and put it into another container.)* This one cup of water represents all of the freshwater (or usable water) on Earth – 2.5% of the Earth's surface. Out of this one cup, remove 5.5 ounces (11 Tablespoons) for the water that is frozen in glaciers or polar ice caps, 2.4 ounces (about 5 Tablespoons) for groundwater, and 2 more drops for the soil, atmosphere, and permafrost. You should only have about one drop of surface water left. Explain to students that this one drop is the available surface water that we can use. Alternatively, you can use the 5-gallon bucket to represent only the water on Earth. For further instructions on how to do this, see https://extension.usu.edu/files/publications/publication/NR_WQ_2005-09.pdf

Did you know?

The Environmental Protection Agency reports that there are 68 watersheds in Utah alone!

http://cfpub.epa.gov/surf/state.cfm?statepostal=UT



Explore (25 minutes) – In small groups, have students discuss and list what they are using that one drop for. Each group should write down between 10-15 ways that they are using that water. Ideas include showering, brushing teeth, watering yards, washing cars, drinking, recreation, etc. Give students about 5 minutes to complete their list.

In groups, have students use computers to visit the following link. This link will direct them to a page created by the USGS Water Science School on which they can make predictions about how much water is needed to produce common things, such as a slice of bread. Students can enter their predictions on the website, and then submit their answers to see results. When the results page comes up, it will give students an accurate depiction of how much water it takes to produce these items. This activity should take between 5-10 minutes. If some groups finish before the rest of the class, have them answer the following prompt in their science notebooks: "Which items surprised you with the amount of water they took? Which items did you predict correctly?"
USGS Water Science School – How Much Water Does it Take? (http://water.usgs.gov/edu/sc1.html)

(If multiple computers are not available for student use, this activity can be done as a class using a projector or SmartBoard.)

Explain (10 minutes) – Discuss what was learned during the explore section. Focus the discussion of deciding how we can reduce our 'water footprint.' Encourage students to come up with ideas, and then list them in their science notebooks.

Assessment:
The assessment for this unit can either be done in class or assigned as homework. In groups, students will create a presentation that meets the following criteria:

- Written for family members as an audience
- Explains what a watershed is and at least 2 jobs of the watershed
- Contains information that explains why conservation is important (at least 2 reasons)
- Between 3-5 minutes long
- Presented to at least 2 family members (signatures required)
- Presented to the class

A rubric for this assessment can be found at the end of the lesson plan. This rubric should be distributed to students before they begin

the project, so that they are aware of the grading expectations.

Extensions:

- Do the activity "The Incredible Journey" from Project Wet. This activity helps students further understand the water cycle as they become water droplets and go through the water cycle themselves. *Get Project Wet Curriculum and Activity Guide Here*
- Check out online games and activities to examine if you are a good water steward. These games allow students to make decisions about a town's water, see a virtual model of the water cycle, see what happens after water goes down the drain, and much more! Online Water Games
- Extend your time using your miniature water cycle. Have students watch their cycles over time (a week or more). Have the students make daily observations about their water cycle. At the end of the week, have students compare and contrast their water cycle model over time with the real water cycle going on in our world.
- Create a terrarium to see the water cycle in a more 'real life' setting. The water within the terrarium will cycle over time, watering the plants, and causing them to grow. If you want to learn how to create a terrarium, view the background information section in the 'What is a Forest?' lesson plan on www.utahnatureexplorers.org.
- Physical Education – Have your students engage in this fun water cycle dance! They will use ribbon sticks and movement to demonstrate each different stage of the water cycle. To view the P.E. Central Lesson plan, click here.

Resources:

Books

- *Did a Dinosaur Drink This Water?* by Robert E. Wells
- *Water, Water Everywhere* by Cynthia Overbeck Bix
- *A Drop Around the World* by Barbara McKinney
- *One Well: The Story of Water on Earth* by Rochelle Strauss

Websites

- Original National Geographic Lesson Plan: A Watershed Moment -- http://events.nationalgeographic.com/media/files/AWatershedMomentsNA.pdf
- Surf your local watershed --

http://cfpub.epa.gov/surf/locate/index.cfm

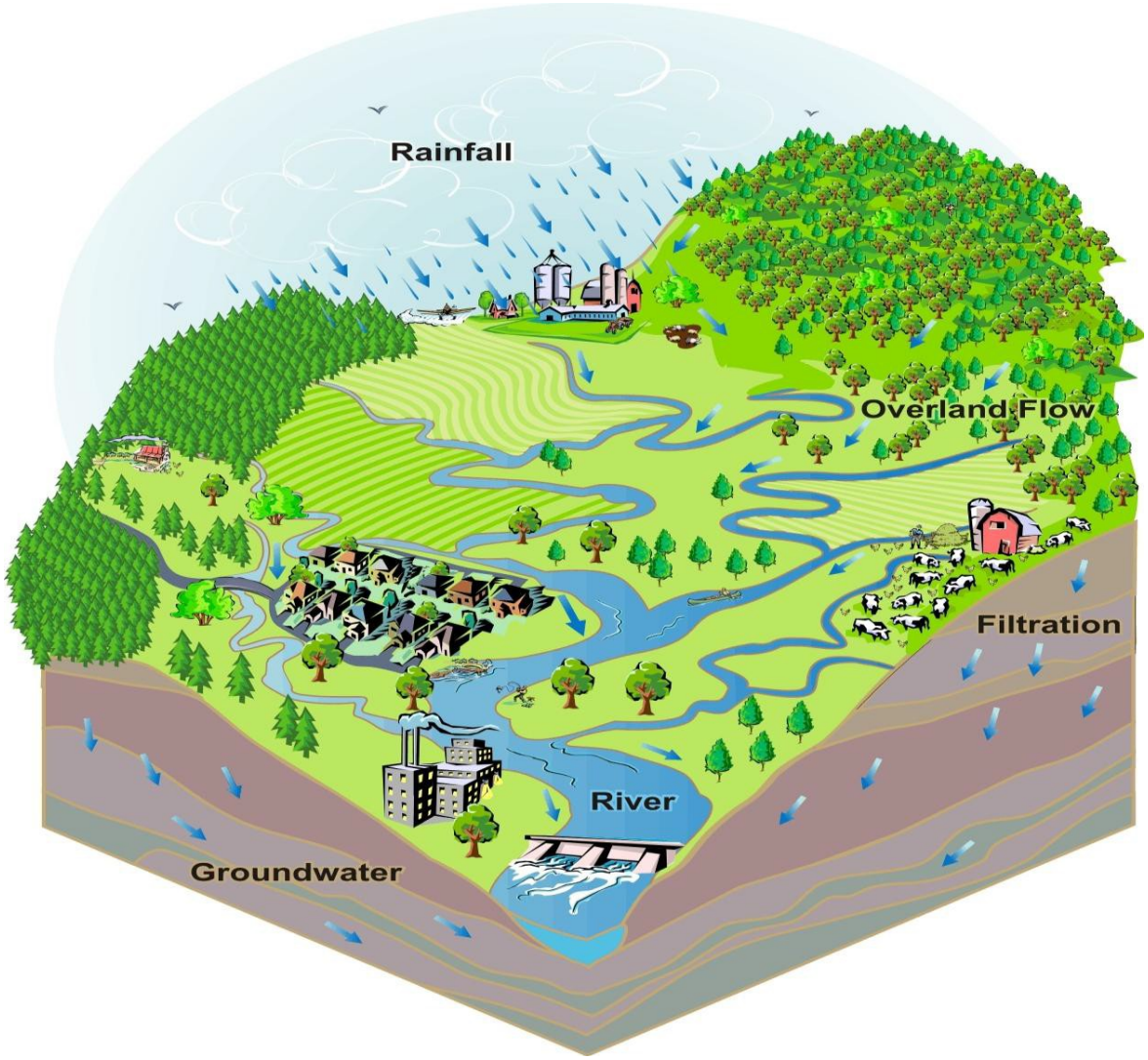
- Utah Watershed Information -- http://extension.usu.edu/waterquality/htm/watershedinformation
- Online Water Games -- http://www.miwaterstewardship.org/youthstewards/onlinewatergames
- Get Project Wet Curriculum and Activity Guide-- http://www.projectwet.org/what-we-do/publications/guides
- P.E. Central Lesson Plan (Water Cycle Dance) -- http://www.pecentral.org/lessonideas/ViewLesson.asp?ID=10119
- USGS Water Science School link-- http://water.usgs.gov/edu/sc1.html
- Bill Nye the Science Guy: The Water Cycle -- https://www.youtube.com/watch?v=YPJYPo2qhOM
- Scholastic Study Jam (The Water Cycle) -- http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/water-cycle.htm
- A Drop in the Bucket Instructions -- https://extension.usu.edu/files/publications/publication/NR_WQ_2005-09.pdf

Water Presentation Rubric

The presentation has been written for a family audience *(10 points)*	The presentation has been written for an audience other than a family audience *(5 points)*	The presentation has not been created for any specific audience *(0 points)*
The presentation is between 3-5 minutes long when presented to the class *(10 points)*	The presentation is not between 3-5 minutes long when presented to the class*(5 points)*	No presentation is given to the class *(0 points)*
The presentation was given to at least 2 family members, with signatures to prove it *(10 points)*	The presentation was give to at least 1 family member, with a signature to prove it *(5 points)*	No signatures from family members were returned *(0 points)*
The presentation explains what a watershed is in clear terms and talks about at least 2 jobs of watersheds. *(20 points)*	The presentation explains what a watershed is in somewhat clear terms and talks about at least 1 job of watersheds. *(10 points)*	The presentation explains what a watershed is in unclear terms and does not talk about any of the jobs of watersheds. *(0 points)*
The presentation contains information that explains why conservation is important, giving at least 2 reasons *(20 points)*	The presentation contains information that explains why conservation is important, giving at least 1 reason *(10 points)*	The presentation briefly mentions water conservation and protection. No details are given, or they are *extremely* limited. *(0 points)*

Student Name:

Score: /70



Picture found on www.bedfordcountyconservation.com