A Droplet's Journey

Authors: Michigan Water Stewardship Program, Eaton Conservation District, based off of 'The Incredible Journey' from Project WET

Lesson Overview: This lesson exposes students to the life cycle of a rain droplet. Students will gain an understanding that water is always in motion and it's not always a linear path. Role-playing a water droplet helps students to conceptualize the water cycle as more than a predictable two-dimensional path.

Objectives: Students will be able to:

1. Describe the movement of water within the water cycle.
2. Identify the states of water as it moves through the water cycle and be able to discuss how water transitions between these states.
3. Recognize solar energy as the main driver for the movement of water on Earth.

This lesson meets the following Michigan Department of Education standards:

Next Generation Science Standards (NGSS):

- ✓ 2-ESS2-2 Develop a model to represent the shapes and kinds of land and bodies water in an area.
- ✓ 2-ESS2-3 Obtain information to identify where water is found on Earth and that it can be solid or liquid.
- ✓ 3-ESS2-1 Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
- ✓ 5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- ✓ 5-ESS2-2 Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

Recommended Grade(s): 1st, 2nd, 3rd, 4th, 5th

Recommended Subject(s): Science **Duration:** Prep time: 60 min., Activity: 30 min

Materials Required: 9 large pieces of paper, 9 square tissue boxes [empty] or other small square packaging box, student journals/worksheet and pencils, markers, large paper/whiteboard to chart the class journey, a poster of the water cycle (optional), area to move around, pipe cleaners (optional), classroom set of 9 colored beads (optional)

Suggested Vocabulary for Students: evaporation, condensation, precipitation, transpiration, infiltration, groundwater, atmosphere, run-off, solid, liquid, gas, electromagnetic energy, gravity

Background Information for Educator: Where will the water you drink this morning be tomorrow? While water does circulate from one point or state to another in the water cycle, the paths it can take are variable. Heat energy directly influences the rate of motion of water molecules. When the motion of the molecule increases because of an increase in heat energy, water will change from solid to liquid to gas. With each change in state, physical movement from one location to another usually follows. Glaciers melt to pools which overflow to streams, where water may evaporate into the atmosphere. Gravity further influences the ability of water to travel over, under, and above Earth's surface. Water as a solid, liquid, or gas has mass and is subject to gravitational force. Snow on mountaintops melts and descends through watersheds to the oceans of the world. One of the most visible states in which water moves is the liquid form. Water is seen flowing in streams and rivers and tumbling in ocean waves. Water travels slowly underground, seeping and filtering through particles of soil and pores within rocks. Although unseen, water's most dramatic movements take place during its gaseous phase. Water is constantly evaporating, changing from a liquid to a gas. As a vapor, it can travel through the atmosphere over Earth's surface. In fact, water vapor surrounds us all the time. Where it condenses and returns to Earth depends upon loss of heat energy, gravity, and the structure of Earth's surface.

Water condensation can be seen as dew on plants or water droplets on the outside of a glass of cold water. In clouds, water molecules collect on tiny dust particles. Eventually, the water droplets become too heavy and gravity pulls the water to Earth. Living organisms also help move water. Humans and other animals carry water within their bodies, transporting it from one location to another. Water is either directly consumed by animals or is removed from foods during digestion. Water is excreted as a liquid or leaves as a gas, usually through respiration. When water is present on the skin of an animal (for example, as perspiration), evaporation may occur. The greatest movers of water among living organisms are plants. The roots of plants absorb water. Some of this water is used within the body of the plant, but most of it travels up through the plant to the leaf surface. When water reaches the leaves, it is exposed to the air and the sun's energy and is easily evaporated. This process is called transpiration. All these processes work together to move water around, through, and over Earth.

The water is very unevenly distributed across the earth. Nearly 70% of the Earth is covered in water. Of that, 97% is salt water that we cannot use as drinking water. Of the 3% that is fresh water, nearly 2/3 is locked away in ice caps and glaciers. That leaves nearly 8 billion humans, plus all the plants and animals on Earth with about 1% of easily accessible water hidden in the atmosphere, rivers, lakes, and groundwater to sustain ourselves with.

Lesson Procedure:

Introduction:

- ~ Go over the water cycle and ask students to identify the different places water can go as it moves through and around Earth. Write their responses on the board.
- ~ Categorize the places water can move through (the students responses) into nine stations: Clouds, Plants, Animals, Rivers, Oceans, Lakes, Ground Water, Soil, and Glaciers. Write these names on large pieces of paper and put them in locations around the room or yard. (Students may illustrate station labels.)

Activity:

- ~ Tell students that they are going to become water molecules moving through the water cycle.
- ~ Assign an even number of students to each station. After the students are standing near their station, have them work together to identify the different places water can go from their station in the water cycle. Discuss the conditions that cause the water to move. Explain that water movement

depends on energy from the sun, electromagnetic energy, and gravity. Sometimes water will not go anywhere. After students have come up with lists, have each group share their work with the class. The die for each station can be handed to that group and they can check to see if they covered all the places water can go.
    - Suggested dice included, however you can make your own or adjust as needed.
- Students should discuss the form in which water moves from one location to another. Most of the movement from one station to another will take place when water is in its liquid form. However, any time water moves to the clouds, it is in the form of water vapor, with molecules moving rapidly and apart from each other.
- In this game, a roll of the die determines where water will go. Students line up behind the die at their station. Students roll the die ONE time and go to the location indicated by the label facing up. If they roll "stay", they move to the back of the line. (They only get 1 roll per turn. They need to go where the dice tells them regardless of if they like the location they got, or if they have already been there.) When students arrive at the next station, they get in line. When they reach the front of the line, they roll the die and move to the next station (or proceed to the back of the line if they roll "stay").
- Students should keep track of their movements. This can be done by having them keep a journal or notepad to record each move they make, including stays. A worksheet has been included as an option. For younger students, have them record only the name of the stations they go to. For older students, have them write down the explanation as well.
    - If your play area is small (ex: a clustered classroom) have half the class play the game while the other half watches. Onlookers can be assigned to track the movements of their classmates. In the next round the onlookers will play the game, and the other half of the class can record their movements.
- Tell students the game will begin and end with the sound of a bell (or buzzer or whistle). Begin the game! Continue for a set amount of time, or until all students have reached 10 stations.

Wrap up/Assessment:

- After the game has been completed, and every student has gone to [at least] 10 stations, have them tally up their total time spent at each station. As a class, record the total number of visits to each station. Which station was occupied the most? The least?
- In their journals/worksheet, have them record the waters state of matter and how it changed. For example, if station 1 was lake, and station 2 was clouds, the student would write "liquid to gas, evaporation". And if station 3 was ocean, the student would write "gas to liquid, precipitation".

Adaptations/Extension/Enhancements:

- At each station, have a paper bowl filled with a colored bead. Give each student a pipe cleaner to use as a bracelet. As they travel throughout the water cycle, have the students add a bead to their bracelet as something they can take home/discuss later. Each station will have it's own color, for example: white-clouds, brown-soil, green-plant, light blue-river, black-ocean, neon blue-lake, red-animal, grey-glacier, yellow-groundwater.
- Write a story about a water droplet taking their journey. For example:
  Lake -> Clouds -> Ocean -> Cloud-> River -> Ocean -> Clouds -> Glacier
- Have students investigate and write about how water may become polluted and cleaned as it moves through the water cycle.

- ~ Have students compare the movement of water during different seasons and at different locations around the globe.
- ~ To speed things up when there are long lines at each station (especially ocean and cloud), you can make two of the same dice for each station. You can also make students partner up and travel together and take turns rolling the dice and recording the outcome.

Additional Resources:

- ~ MWSP website: www.miwaterstewardship.org
- ~ Project WET lesson plan supplements: https://www.projectwet.org/resources/materials/discover-incredible-journey-water-through-water-cycle
- ~ Map of Michigan watersheds: https://www.michigan.gov/documents/deq/lwm-mi-watersheds_202767_7.pdf
- ~ Interactive water cycle: https://water.usgs.gov/edu/watercycle-kids-adv.html
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Our MWSP logo represents the two hands of Michigan - both the upper and lower peninsulas - and caring for our water resources and water quality. The green hand symbolizes all vegetation and crops in our state and the tan hand symbolizes soils. The lighter blue water signifies the vast surface water throughout the state and the darker blue water denotes groundwater.

A Droplet's Journey

As told by: _____

1. Start at station: _____, and while I was there I _____

   _____

2. I traveled to station: _____, and while I was there I _____

   _____

3. I traveled to station: _____, and while I was there I _____

   _____

4. I traveled to station: _____, and while I was there I _____

   _____

5. I traveled to station: _____, and while I was there I _____

   _____

6. I traveled to station: _____, and while I was there I _____

   _____

7. I traveled to station: _____, and while I was there I _____

_____

8. I traveled to station: _____, and while I was there I _____

_____

9. I traveled to station: _____, and while I was there I _____

_____

10. I traveled to station: _____, and while I was there I _____

_____

11. I traveled to station: _____, and while I was there I _____

_____

12. I traveled to station: _____, and while I was there I _____

_____

13. I traveled to station: _____, and while I was there I _____

_____

Personal Tally: *Ground Water* _____ *Plant* _____ *River* _____ *Clouds* _____

Ocean _____ *Lake* _____ *Animal* _____ *Glacier* _____ *Soil* _____

You are water in soil!

Water is absorbed by plant roots.

Go to PLANT

You are water in soil!

The soil is saturated, so water runs off into a river.

Go to RIVER

You are water in soil!

Water is pulled by gravity; it filters into the soil.

Go to GROUNDWATER

You are water in soil!

Heat energy is added to the water, so the water evaporates and goes up to Into the clouds.

Go to CLOUDS

You are water in soil!

Heat energy is added to the water, so the water evaporates and goes up to Into the clouds.

Go to CLOUDS

You are water in soil!

Water remains on the surface of the ground (perhaps in a puddle, or adhering to a soil particle).

Stay at SOIL

You are water in a plant!

Water leaves the plant through the process of transpiration.

Go to CLOUD

You are water in a plant!

Water leaves the plant through the process of transpiration.

Go to CLOUD

You are water in a plant!

Water leaves the plant through the process of transpiration.

Go to CLOUD

You are water in a plant!

Water is used by the plant and stays in the cell.

Stay at PLANT

You are water in a plant!

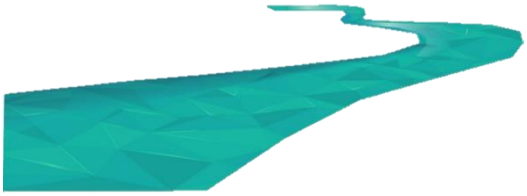
Water leaves the plant through the process of transpiration.

Go to CLOUD

You are water in a plant!

Water is used by the plant and stays in the cell.

Stay at PLANT



You are water in a river!

Water flows into a lake.

Go to LAKE

You are water in a river!

Water is pulled by gravity; it filters into the soil.

Go to GROUNDWATER

You are water in a river!

Water flows into the ocean.

Go to OCEAN

You are water in a river!

An animal drinks water.

Go to ANIMAL

You are water in a river!

Heat energy is added to the water, so the water evaporates and goes up to the clouds.

Go to CLOUDS

You are water in a river!

Water remains in the current of the river.

Stay at RIVER

You are water in a cloud!

Water condenses and falls on soil.

Go to SOIL

You are water in a cloud!

Water condenses and falls as snow onto a glacier.

Go to GLACIER

You are water in a cloud!

Water condenses and falls into a lake.

Go to LAKE

You are water in a cloud!

Water condenses and falls into the ocean.

Go to OCEAN

You are water in a cloud!

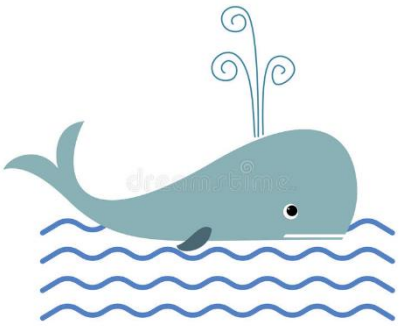
Water condenses and falls into the ocean.

Go to OCEAN

You are water in a cloud!

Water remains as a water droplet clinging to a dust particle.

Stay at CLOUD



You are water in an ocean!

Water remains in the ocean.

Stay at OCEAN

You are water in an ocean!

Water remains in the ocean.

Stay at OCEAN

You are water in an ocean!

Water remains in the ocean.

Stay at OCEAN

You are water in an ocean!

Heat energy is added to the water, so the water evaporates and goes up to the clouds.

Go to CLOUDS

You are water in an ocean!

Water remains in the ocean.

Stay at OCEAN

You are water in an ocean!

Heat energy is added to the water, so the water evaporates and goes up to the clouds.

Go to CLOUDS

You are water in a lake!

Water flows into a river.

Go to RIVER

You are water in a lake!

Water is pulled by gravity; it filters into the soil.

Go to GROUNDWATER

You are water in a lake!

Water remains within the lake or estuary.

Stay at LAKE

You are water in a lake!

An animal drinks water.

Go to ANIMAL

You are water in a river!

Heat energy is added to the water, so the water evaporates and goes up to the clouds.

Go to CLOUDS

You are water in a lake!

Water remains within the lake or estuary.

Stay at LAKE

You are water in an animal!

Water is excreted through feces and urine.

Go to SOIL

You are water in an animal!

Water is excreted through feces and urine.

Go to SOIL

You are water in an animal!

Water is respired or evaporated from the body.

Go to CLOUDS

You are water in an animal!

Water is respired or evaporated from the body.

Go to CLOUDS

You are water in an animal!

Water is incorporated into the body.

Stay at ANIMAL

You are water in an animal!

Water is respired or evaporated from the body.

Go to CLOUDS

You are water in the ground!

Water filters into a river.

Go to RIVER

You are water in the ground!

Water filters into a lake.

Go to LAKE

You are water in the ground!

Water filters into a lake.

Go to LAKE

You are water in the ground!

Water stays underground.

Stay at GROUNDWATER

You are water in the ground!

Water stays underground.

Stay at GROUNDWATER

You are water in the ground!

Water stays underground.

Stay at GROUNDWATER

You are part of a glacier!

Ice melts and water filters into the ground.

Go to GROUNDWATER

You are part of a glacier!

Ice evaporations and water goes to the clouds (sublimation).

Go to CLOUDS

You are part of a glacier!

Ice melts and water flows into a river.

Go to RIVER

You are part of a glacier!

Ice stays frozen in the glacier.

Stay at GLACIER

You are part of a glacier!

Ice stays frozen in the glacier.

Stay at GLACIER

You are part of a glacier!

Ice stays frozen in the glacier.

Stay at GLACIER