

# Physics: Water Cycle



## MAIN IDEA

Investigate the three main processes of the water cycle through a hands-on experiment highlighting how sunlight and water temperature play important roles in these processes.

## SCIENCE BACKGROUND

Energy is all around us and is the ability to do work or cause change. It comes in many different forms and although invisible, we can see energy at work when it affects matter, which is anything that has mass and takes up space. There are four states of matter: solid, liquid, gas and plasma. For solids, the molecules, or tiny chemical building blocks, have little energy and are compacted together to maintain their shape. Liquid molecules have more energy and are able to move positions while still sticking together. Gas molecules have a lot of energy, bounce off each other and are able to fill an entire space. Plasma is similar to a gas but is even more energized as the molecules are charged, or ionized. Plasma occurs naturally on Earth in the form of lightning flashes however is rather rare in comparison to other states. Temperature, pressure and motion change a molecule's energy levels and thus can lead to physical changes of the molecules causing them to transition between states of matter.

Transitions of energy between states of matter is easily observed in the main processes of the water cycle, which includes evaporation, condensation and precipitation. Evaporation is the transition of a liquid to a gas or vapor by heating up the liquid. For the water cycle, evaporation plays a key role in with 90% of the water vapor, the gaseous form of water, coming from oceans, lakes and rivers. The other 10% comes from plant transpiration, or evaporation from plants (think of a plant sweating). Condensation is the transition of a gas into a liquid by cooling the gas. In the water cycle, when the warm, moist air rises in the atmosphere, it then cools transforming back into a liquid to form little water droplets. These little water droplets condense on small particles in the air such as dust or pollen forming clouds. As more water vapor condenses in the cloud, the molecules begin to collide and coalesce, or combine, to form larger water droplets. Eventually these water droplets become heavier than the air lifting them up and gravity takes over, resulting in precipitation, or in this example rain. Precipitation is not limited to rain and can also occur in the form of hail, sleet or snow, to name a few.

The sun is vital for the water cycle on Earth. It provides the necessary energy, through heat, to cause evaporation to occur. Closer to the Equator, the sun's energy is stronger, which causes increased evaporation and more humid air, creating a tropical climate complete with ample sunlight, beautiful clouds, and plenty of drenching rainstorms.

## MATERIALS

Cups – 3

Measuring Cup

Permanent Marker

Sandwich sized re-sealable zipper storage bags

Tape

Water – 1 ½ cups

Optional: Food coloring

Optional: Paper and Pencil



## ACTIVITY PROCEDURE

*In this experiment, you will see the water cycle in action over three different water temperatures: cold, warm and room temperature. Access to a freezer and microwave is helpful to chill and heat the water.*

**STEP 1:** Use a permanent marker to draw the following on three (3) re-sealable zipper storage bags: sun and clouds at the upper half closest to the zipper and waves of the ocean at the bottom.

**STEP 2:** In three (3) separate cups, pour ½ cup of water into each. Label a cup “cold”, another “normal”, and the last “warm” using the tape and marker. *Optional: Add food coloring to the water to help visualize the process.*

**STEP 3:** Place the “cold” cup of water in the freezer for fifteen (15) minutes.

**STEP 4:** Place the “normal” cup of water to the side so the water will be at room temperature.

**STEP 5:** Heat up the “warm” cup of water. If using a microwave safe cup, you can warm it up for 30 seconds using the microwave.

**STEP 6:** Pour the cold water into the decorated plastic bag and label “cold”, pour the warm water into another decorated bag and label “warm”, and pour the room temperature water into the last decorated bag and label “normal”.



**STEP 7:** Find a window that receives a lot of sun and attach the plastic bags using tape with the zipper facing up. Position the bags so that they hang in the middle of the window and be in direct sunlight. If a sun-lit window is not available you can place the bag in a sunny area outside.

**STEP 8:** Check the bag every thirty (30) minutes and observe. As time passes you should see water droplets inside the bag towards the top (clouds). This is the water at the bottom evaporating and condensing at the top. As it gets warmer due to the sun the water droplets may get bigger and eventually slide back down to the bottom, this is demonstrating precipitation. Consider the following:

- ✓ Which bag does condensation (water droplets) form in first?
- ✓ When do water droplets (precipitation) form for each bag?
- ✓ Do you think that adding ice to the water would affect condensation?
- ✓ Could conducting the experiment at another time of day change your observations?



*Optional: Record your observations and note variables such as exact time and temperature outside. Make a graph and compare your results.*

## EDUCATIONAL STANDARDS

### Grade 2

Big Idea 8: Properties of Matter

SC.2.P.8.4 - Observe and describe water in its solid, liquid, and gaseous states.

### Grade 3

Big Idea 9: Changes in Matter

SC.3.P.9.1 - Describe the changes water undergoes when it changes state through heating and cooling by using familiar scientific terms such as melting, freezing, boiling, evaporation, and condensation.

### Grade 5

Big Idea 7: Earth Systems and Patterns

SC.5.E.7.1 - Create a model to explain the parts of the water cycle. Water can be a gas, a liquid, or a solid and can go back and forth from one state to another.

Big Idea 7: Earth Systems and Patterns

SC.5.E.7.2 - Recognize that the ocean is an integral part of the water cycle and is connected to all of Earth's water reservoirs via evaporation and precipitation processes.

### Grade 7

Big Idea: 11: Energy Transfer and Transformations

SC.7.P.11.1 – Recognize that adding heat to or removing heat from a system may result in a temperature change and possibly a change of state.

## ADDITIONAL RESOURCES

### Energy and the States of Matter

<https://kidskonnnect.com/science/matter-energy/>

### Water's States of Matter

<https://www.youtube.com/watch?v=tuE1LePDZ4Y>

### Water Cycle Interactive, USGS

<https://water.usgs.gov/edu/watercycle-kids-adv.html>

### The Water Cycle: Heating the Ocean, NASA

<https://gpm.nasa.gov/education/videos/water-cycle-heating-ocean>

