Pacific Battleship Center

USS IOWA

Educational Resource

Mini Water Cycle activity

Objective:
Students will learn how thermal energy is transferred and how this transfer of energy establishes and drives the water cycle.

Grades: 3rd - 8th grades.

NGSS Core Disciplinary Ideas: ESS2.A, ESS2.C, PS1.A, PS3.A, and PS3.B.

Vocabulary Words:

- Thermal Energy
- Conduction
- Convection
- Radiation
- Evaporation
- Condensation
- Precipitation
- Water Cycle

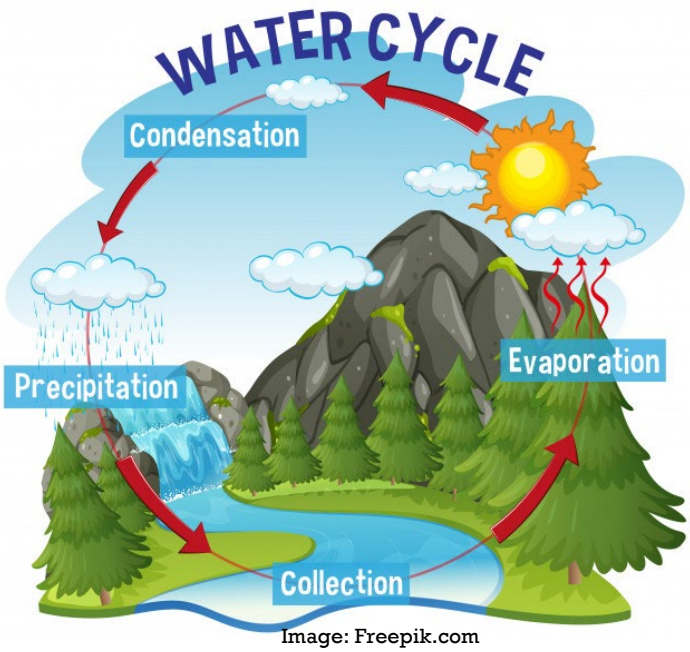


Image: Freepik.com

Materials:

- 1 Clear plastic lunch bag
- Water
- Blue food coloring
- Permanent marker
- Tape

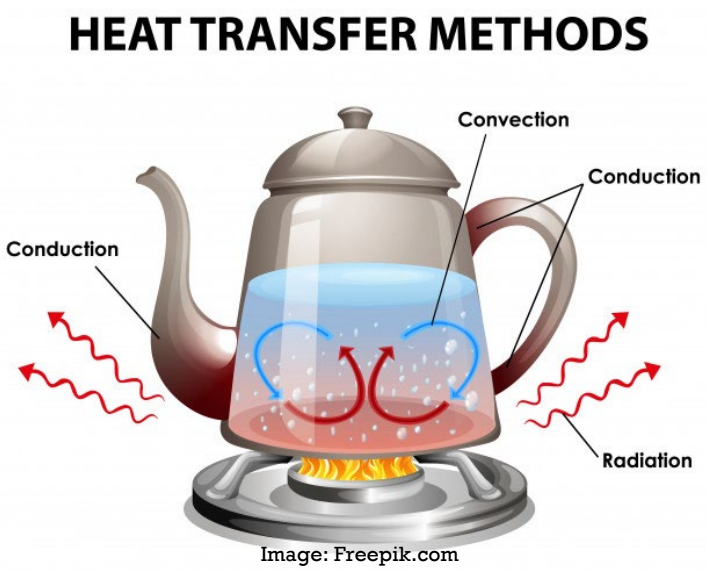
Background Information:

The Law of Conservation of Energy states that energy can neither be created nor destroyed, just transformed. Energy can exist and transfer between several different forms, including mechanical, electrical, nuclear, and thermal, to name a few. The Sun and the thermal energy it exudes is a huge energy source for our planet. Not only does the sun provide the energy needed for plant and algae growth, the base of our planetary food web and main oxygen sources, but it drives our water cycle as well!

How is thermal energy transferred from one source to another? There are three primary ways heat is transferred:

1. Conduction: The transfer of heat between still matter that is physically touching. Example: Leaving a spoon in your hot chocolate cup and the spoon becomes warmed from your hot drink.

2. Convection: Heat transferred between matter by moving water or wind/gas currents. These currents are driven by differences in density due to temperature. Hot water or air is less dense and rises while cold water or air is more dense and sinks, making circular currents.
   Example: Turning your house or car heater on in the winter. The warm air currents flowing from your heater warm the air in your house or car.



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3. Radiation: Heat transferred through electromagnetic waves.

Thermal energy radiating from the sun establishes Earth's water cycle. Surface waters in our various bodies of water absorb electromagnetic waves from the sun, causing the water to increase in temperature. Surface waters can absorb so much radiation that it causes the water to undergo a change of state, transitioning from liquid water to a gaseous state, water vapor. The transition from liquid to vapor is a process known as evaporation. The newly formed water vapor is less dense than the surrounding air due to all the thermal energy it has absorbed and creates a wind current, rising up into the atmosphere.

As water vapor rises away from its source, it starts loosing thermal energy to the surrounding air through convection. As it cools in temperature, the water vapor turns back into liquid water droplets, forming a cloud. This process is called condensation. When the cloud is completely saturated with water droplets and it cannot hold anymore, it releases the droplets as rain. The rain will fall back to Earth under the force of gravity and will either be absorbed into the ground and plant life or collect in another body of water. Once the water has absorbed enough thermal radiation from the sun, it can evaporate and start the whole cycle over again!

For an animated explanation, watch The Water Cycle by NOAA.

Activity Instructions:

Make your own mini water cycle in a plastic lunch bag and observe the water evaporating, condensing, and precipitating.

1. Using your permanent marker, draw a water line, cloud, and sun on the outside of your plastic lunch bag.
2. In a cup, add three drops of blue food coloring to ¼ cup of water and mix.
3. Pour the blue water into the baggie and seal.
4. Tape the filled bag to a window that faces the sun for at least part of the day.
5. Record observations every hour. Pay close attention to the level of the water in the bag, if you see any fogginess forming, or any water droplets near the top.

Conclusions:

Was there any evidence the blue water changed states between liquid and vapor in your bag? If so, what evidence did you see? Did you notice any difference in your bag depending on whether the sun was shining directly on it or if it was shaded? If you did, what were the differences and what could have caused them?

Further Investigations:

How will climate change affect the water cycle? Think about thermal energy, temperature, and evaporation before checking out this article from Ocean Explorer, NOAA.

Sources:

http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/water-cycle.htm

https://oceanexplorer.noaa.gov/edu/learning/7_water_cycle/activities/global_warming.html

https://oceantoday.noaa.gov/watercycle/