Overview

In this activity, students will be introduced to the hydrologic cycle, how water collects and gets used in California, and how scientists measure the water cycle.

Objectives

By the end of this activity, students will be able to:

- Define the parts of the hydrologic cycle
- Describe how water resources in California change seasonally
- Identify ways scientists measure the water cycle

Subjects

Science

Grade level

K-12th

Length of activity

20-40 min

Activity location

Inside or outside classroom

Materials

Option 1: One copy of the water cycle poster with cards

Option 2: One copy of the water cycle poster per group of 4 with cards

California's Hydrologic Cycle

Introduction

The hydrologic, or water cycle is the movement of water on, above, below, and through the earth's surface. Processes of the hydrologic cycle include precipitation, runoff, evaporation/ evapotranspiration, and condensation.

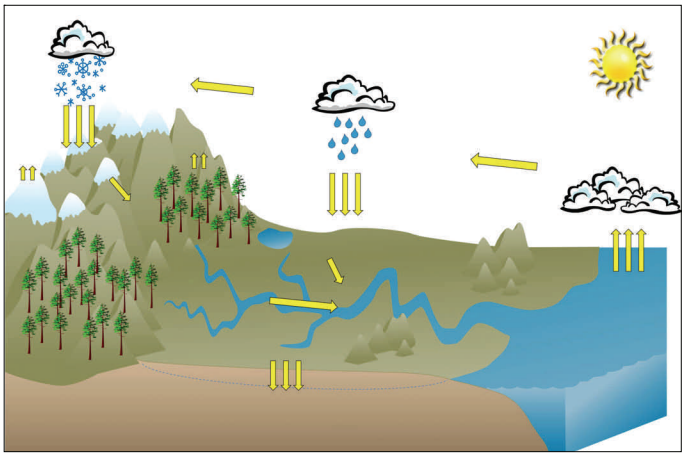

Fig 1. A schematic cross section of California's landscape and hydrologic cycle.

Processes occurring within the hydrologic cycle are important for both human and ecological systems. For most of California, humans and other living things rely on the annual accumulation and melt-off of the Sierra Nevada snowpack. The Sierra snowpack acts as a free reservoir feeding traditional reservoirs and streams. Ecosystems of the Sierra rely on the snowpack as a means of water supply, such as fish populations who rely on snowmelt for migration upstream to spawning grounds.

The mechanisms that drive the hydrologic cycle determine whether precipitation falls as rain or snow, which drives how quickly precipitation flows into streams or infiltrates the groundwater, which dictates water availability for plants and reservoirs, which determines types of vegetation and water supply for humans.

An explanation of the hydrologic cycle as it occurs in California:

Water vapor can be added to an air mass by **evaporation** from the ocean, fresh water bodies, wet land surfaces, or by transpiration from plants. The Pacific Ocean provides a large reservoir of water for evaporation to occur.

Once water vapor has evaporated off the earth's surface, the resultant air mass must undergo cooling in order to condense.

Condensation is the change of the physical phase of water from the gas to the liquid phase and generally refers to the formation of clouds in the atmosphere, but can also occur in the formation of dew and frost.

Once the dew point has been reached, water vapor will then condense and form water droplets and, if this process of condensation continues, precipitation results. **Precipitation** is the general name given for any form of condensed water that falls to the earth's surface. Some common examples of precipitation include rain, snow, sleet, and hail.

The majority of the precipitation California experiences on an annual basis occurs during the winter and spring. Winter storms form over the Pacific Ocean and travel eastward towards the coast and into the Central Valley typically in the form of liquid rainfall. As storms move east out of the valley, and encounters a mountain range, the air mass is forced to rise.

As the air mass rises, it expands and cools, called the **orographic effect**. This effect plays a major role in the hydrologic cycle in the Sierra Nevada, resulting in large unloading of precipitation onto the Sierra Nevada. As storms are forced further up in elevation, the air mass cools further and precipitation falls as snow. The geographic area that this change occurs is referred to as the **rain-snow transition**. Below the rain-snow transition, the land is dominated by precipitation in the form of rain. Above the transition, snow dominates the precipitation phase.

A mixture of rain and snow account for much of the precipitation at the rain-snow transition. Snow dominated areas serve as a major reservoir for California water supplies. Whether you live in The San Francisco Bay Area, greater Los Angeles area, or the Central Valley of California, your drinking water comes, either directly or indirectly, from the Sierra Nevada snow pack.

The following are additional process occurring within California's hydrologic cycle:

Runoff is the movement of water over the land surface. When runoff reaches a stream, it is called **stream flow**, or the flow of surface water contained in a stream channel.

Water that does not flow to the stream channel as overland flow goes into the ground as **infiltration**. This water is referred to as groundwater. Groundwater plays a very important role in recharging streams in the Sierra Nevada, providing water to plants, as a storage reservoir, and recharging streams and aquifers in the Central Valley.

The movement of water from the liquid phase at the earth's surface to the gas phase in the atmosphere is accomplished through two main pathways: 1) Water evaporates from surface water bodies (**evaporation**); and, 2) Water is transpired from plants (**transpiration**). Together, this process is called **evapotranspiration.**

Sublimation is the process by which snow evaporates directly into the atmosphere without ever melting.

Materials

Option 1 (one poster per class): Print out 1 - 40X26" color copy of the water cycle poster or largest size that will fit in your school's laminator. Print and cut out 1 set of word cards and objects. Use sticky tack or tape to attach items to poster.

Option 2 (one poster per group of 4-5 students): Multiply materials by 4 or however many sets you wish to make.

Activity Description

PART 1—Hydrologic Cycle Poster

Option 1

1. Attach poster to a chalkboard or other sturdy place. Attach water cycle objects and arrows according to Fig. 1.
2. Gather class around poster. Ask students what they think this poster represents. Start by introducing or reviewing the hydrologic (or water) cycle, adding the title card to the top of the poster. Ask students about the different regions of California, adding these cards at the bottom of the poster.
3. Tell students that they are going to reconstruct the cycle using cards printed with different words. Have students get into groups of 3 or less depending on how many word cards you are going to use. Tell students to quietly work in groups to determine where their part of the cycle fits on the poster, using the back of the card as a clue. Pass out 1 card to each group.
4. Pointing to evaporation over the ocean, ask students if they think their group has the correct card that goes there. If the group is correct, have them explain that part in their own words, if possible. Then have them read the card out loud and place onto poster. Add additional explanations as necessary.
5. Repeat step 4 with condensation > liquid and solid precipitation. An analogy to use when explaining evaporation and condensation is what happens to the bathroom mirror when you take a hot shower. Hot water from the shower evaporates into the air, then condenses onto the cold mirror or window. The water cycle happening in your bathroom!
6. Once these easier cards are displayed, ask students if they know where theirs should go. Assist with the more difficult parts. Consult answer key for one option in regards to the placement of cards.
7. Once all parts have been attached, begin discussion of California water resources, asking the following questions:
    - ⇒ During which seasons does most precipitation occur in CA? (Fall through spring)
    - ⇒ Which season has the least precipitation? (Summer) Why do you think this is? (Drier, warmer, Mediterranean climate)
    - ⇒ Where does CA get its water in summer if it does not rain? (Reservoirs, groundwater, melting snowpack)
    - ⇒ What proportion of water that we use in CA comes from the Sierra Nevada snowpack, take a guess? (80%)
    - ⇒ Why is water so important for CA? (Yes, humans and animals need it, industry, FARMING - 50% of the food America eats is grown/raised in CA!

Option 2

1. Using 1 poster and set of cards per group, students break into groups of 4-5 and reconstruct the entire hydrologic cycle. This can also be done as a running relay outside of the classroom.
2. Discuss the parts of the cycle beginning with evaporation, asking students to justify why their cards are in the respective places. Have them move parts to the correct places if necessary.

PART II— How scientists measure the hydrologic cycle

1. Using the power point presentation provided with this lesson, go through the slides with the class, pointing out ways scientists measure the water cycle.
2. Use any classroom materials to illustrate water cycle measurement, such as a school weather station, thermometer or garden rain gauge.
3. Reinforce reasons that scientists need to accurately know how much water is available for plants, humans and animals.

Assessment

⇒ Have students use colored pencils, markers or crayons to draw the hydrologic cycle on a sheet of paper.

⇒ Ask students to come up to the board to write a definition of one part of the cycle.

⇒ Turn poster around. Remove one card (object or word card) from the poster. See if students can determine which part is missing.

⇒ Remove word cards from poster and move object cards and arrows around slightly. Pass out word cards again and repeat exercise.

⇒ Ask students to remind you of different ways scientists measure the water cycle.

Extensions

⇒ Use the internet to research some of the instruments scientists use to measure the water cycle.

⇒ Use the internet to look up local or national weather records and forecasts. Determine what kinds of instruments/computers it takes to make weather predictions.

Resources

USGS The Water Cycle - Water Science for Schools

http://ga.water.usgs.gov/edu/watercycle.html

UNITED STATES HISTORICAL CLIMATOLOGY NETWORK

http://cdiac.ornl.gov/epubs/ndp/ushcn/ushcn.html

NRCS Water and Climate Information

http://www.wcc.nrcs.usda.gov/snow/

SSCZO web site infrastructure page

https://snri.ucmerced.edu/CZO/infrastructure.html

California State Science Standards

K-8th grade

Kindergarten: 1.b, 3.a, 3.b, 3.c

1st: 1.a, 1.b, 3.b, 3.c, 4.a

2nd: 3.c, 3.e, 4.d

3rd: 1.e, 1.f

5th: 3.a, 3.b, 3.c, 3.d, 3.e, 4.b, 4.c, 4.d

6th: 2.a, 2.b, 4.a, 4.c

7th: 7.b, 7.d

8th: 5.d

High school

Earth Science: 6.b, 9.a, 9.c

Investigation and Experimentation: 1.m