

From Snowflake to Faucet: How California Drinks Its Mountains

Learning target: I can use evidence from a passage to explain how the sun's energy and gravity move water from a mountain snowpack to the places people use it.

Reading with evidence

About 40 min

Individual

MS-ESS2-4 · practice

reading

writing

Name _____

Date _____

Period _____

Directions

Read the passage once without stopping. Read it a second time with a pencil, numbering the paragraphs 1 to 7 and marking every place where water changes state or changes location. Answer in complete sentences. When a question asks for evidence, quote or closely paraphrase the passage and give the paragraph number.

You will need: This worksheet, Pencil

From Snowflake to Faucet

[1] Every winter, storms roll in from the Pacific Ocean and climb the western slope of California's Sierra Nevada. Their air carries water that left the ocean surface as invisible vapor, lifted by energy from the sun. As the air is pushed up the mountains it cools, and the vapor can no longer stay a gas. Its molecules slow down, gather on specks of dust and sea salt, and become cloud droplets. Higher up, where the air is below freezing, the water forms ice crystals instead, and they grow until gravity wins and they fall as snow. By early April in a good year, the high Sierra snow can be several meters deep.

[2] That snow is not just scenery. It is often called California's largest reservoir: a reservoir the state did not have to build. Water managers measure it by pushing a hollow tube down to the soil, weighing the snow inside, and converting the weight to the depth of water the snow would make if it all melted at once. In a typical year the melting snowpack supplies roughly 30 percent of the water used by California's farms and cities. It works as a reservoir because it holds the winter's water in place, as a solid, until the season when people need it most.

[3] The release begins in spring. As days lengthen and the sun climbs higher, the snow surface absorbs more energy. Ice crystals gain energy, loosen from their rigid pattern, and become liquid: melting. Some water skips the liquid stage entirely; on cold, dry, sunny days, surface molecules gain enough energy to leave the snow directly as vapor, a process called sublimation. Most of the snowpack, though, melts. From here on, gravity does the work.

[4] Meltwater has two ways down. Some flows over the surface as runoff, joining creeks and then big rivers such as the American, the Feather and the San Joaquin. Some soaks into soil and fractured rock as infiltration, becoming groundwater that creeps downhill far more slowly, feeding springs and keeping

streams flowing weeks after the last snow patch is gone. This is why a Sierra creek can run strong in July under a cloudless sky: it is drinking from April's melt and from groundwater still on its way.

[5] Not all of the melt reaches the valley. The Sierra's forests are thirsty. Trees pull water from the soil and carry it up to their leaves and needles, where it evaporates and escapes through tiny pores as vapor. This transpiration, together with evaporation from wet soil, lakes and reservoirs, sends a large share of the mountain's water back into the air before it reaches a faucet. Water managers must subtract these losses when they forecast the supply downstream.

[6] The water that does arrive is caught behind dams such as Folsom and Oroville, then released into canals and pipes. Gravity still helps: canals slope gently downhill so the water moves on its own, and pumps are used only where water must be lifted uphill, such as over a ridge. Beneath the Central Valley, water that soaked in over thousands of years fills aquifers, layers of sand and gravel whose connected pores hold water that wells can reach. In a normal year groundwater supplies roughly 40 percent of the state's water; in a drought, when the snowpack is thin, the share rises and the aquifers are pumped faster than they refill.

[7] Trace the whole trip and you will see the two drivers of the water cycle take turns. The sun lifts: it powers evaporation from the ocean, melting on the mountain, and transpiration from the forest. Gravity drops and drags: it pulls snow from the clouds, meltwater down the slopes, and groundwater through the pores. In between, cooling does the quiet work of turning vapor back into droplets and crystals. The water in a glass in Fresno may have been Pacific vapor in December, a snowflake in January, a creek in May, and groundwater in June. Nothing about the trip was one-way, either: some of that water has already evaporated from a reservoir and is back in the air, ready to fall again.

Questions: cite the passage

1. According to paragraph 1, what has to happen to the air for the vapor it carries to become cloud droplets? Quote the words that describe what the molecules do.

2. Paragraph 2 calls the snowpack 'a reservoir the state did not have to build.' Using the paragraph, explain what makes a snowpack work like a reservoir.

3. Paragraph 3 describes two different ways water can leave the snowpack. Name both, give the change of state for each, and state what supplies the energy for both.

4. Paragraph 4 says a creek can 'run strong in July under a cloudless sky.' Explain how, using the two pathways named in that paragraph. Which pathway is slower, and why does that matter for July?

5. According to paragraph 5, name three ways water returns to the atmosphere before reaching a faucet. Which of the three involves living things?

6. Paragraph 2 says snowmelt supplies roughly 30 percent of the water people use in a typical year, and paragraph 6 says groundwater supplies roughly 40 percent. If a city uses 100 million liters in a typical year, about how many liters come from snowmelt and how many from groundwater? Then explain why these two numbers can both be 'roughly' right and still overlap.

7. Paragraph 6 says canals slope downhill and pumps are used only where water must be lifted uphill. What does this tell you about the role of gravity in the human-built part of the water's journey?

8. Paragraph 7 says 'the sun lifts' and 'gravity drops and drags,' and that cooling does 'quiet work' in between. Using evidence from at least three different paragraphs, sort the steps of the water's trip from Pacific vapor to a glass in Fresno into these three groups: sun-powered, gravity-powered, and cooling. Then explain why the passage says 'nothing about the trip was one-way.'

Track the water with two symbols

On your second read, draw a small sun in the margin every time the passage says water gains energy (evaporates, melts, sublimates, transpires) and a small downward arrow every time gravity moves water (falls, runs off, soaks in, flows underground). Draw a snowflake or a drop where water cools into crystals or droplets. Questions 3, 4, 7 and 8 can be answered by looking at your margin symbols.

A dry year

Imagine a winter in which the storms bring rain to the Sierra instead of snow because the air is a few degrees warmer. Using ideas from paragraphs 2, 4 and 6, write a paragraph predicting what changes for the rivers in spring, for the reservoirs in summer, and for the aquifers by the end of the year. Include one thing water managers might do differently.