Why is the Central Valley sinking, and what can we do about it?

How does pumping groundwater contribute to the Central Valley sinking?

Seeds to Solutions™

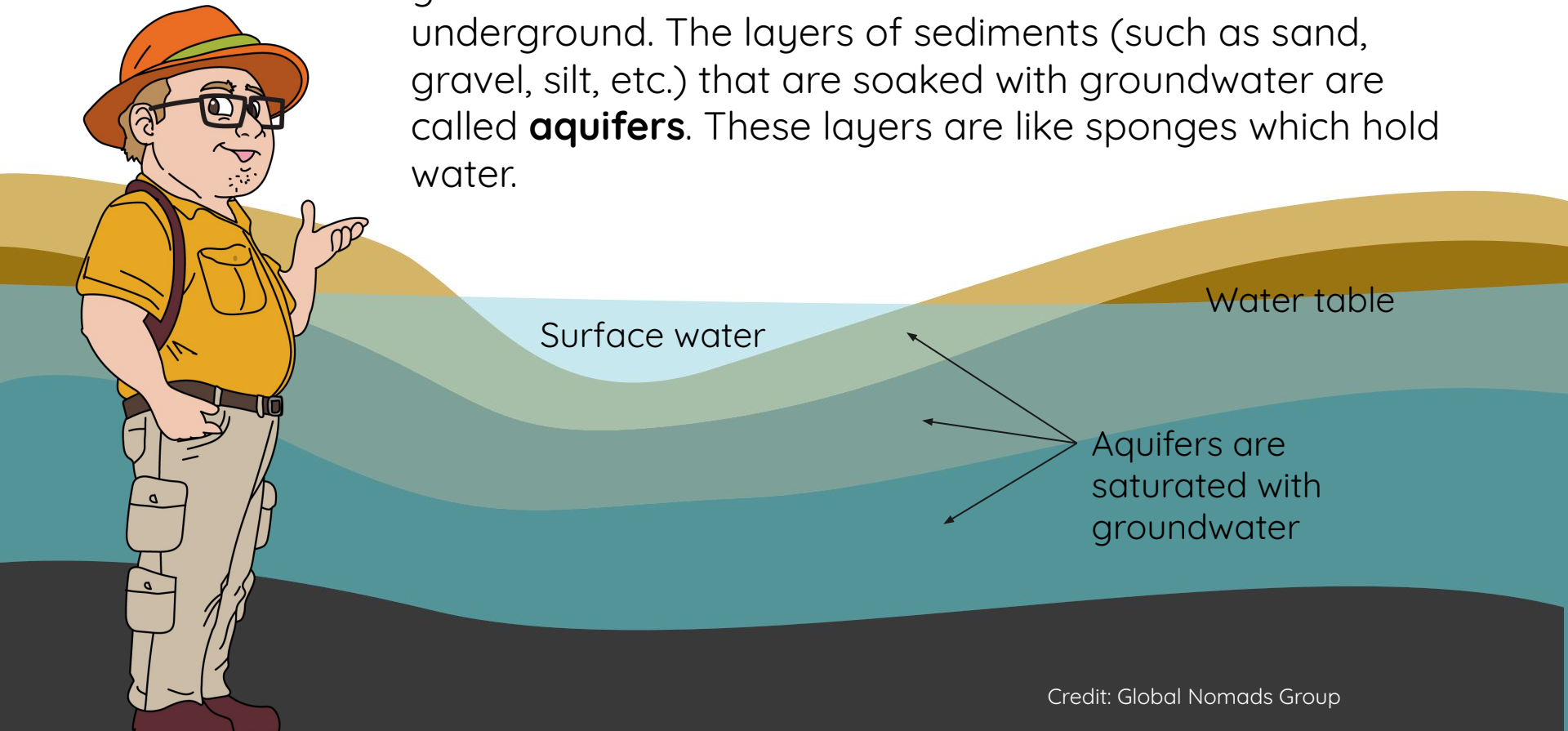
Class Session 1

Hey there, researchers. Since we're talking rocks and groundwater today, meet Carl. He's a hydrogeologist. He studies the ways that water (hydro) moves through the earth (geology).

Hey there! As a hydrogeologist, I use math to model how water moves through different areas. Part of my work is to estimate how much water there is underground at the moment. This way, water agencies know how much water they will have now and in the future.

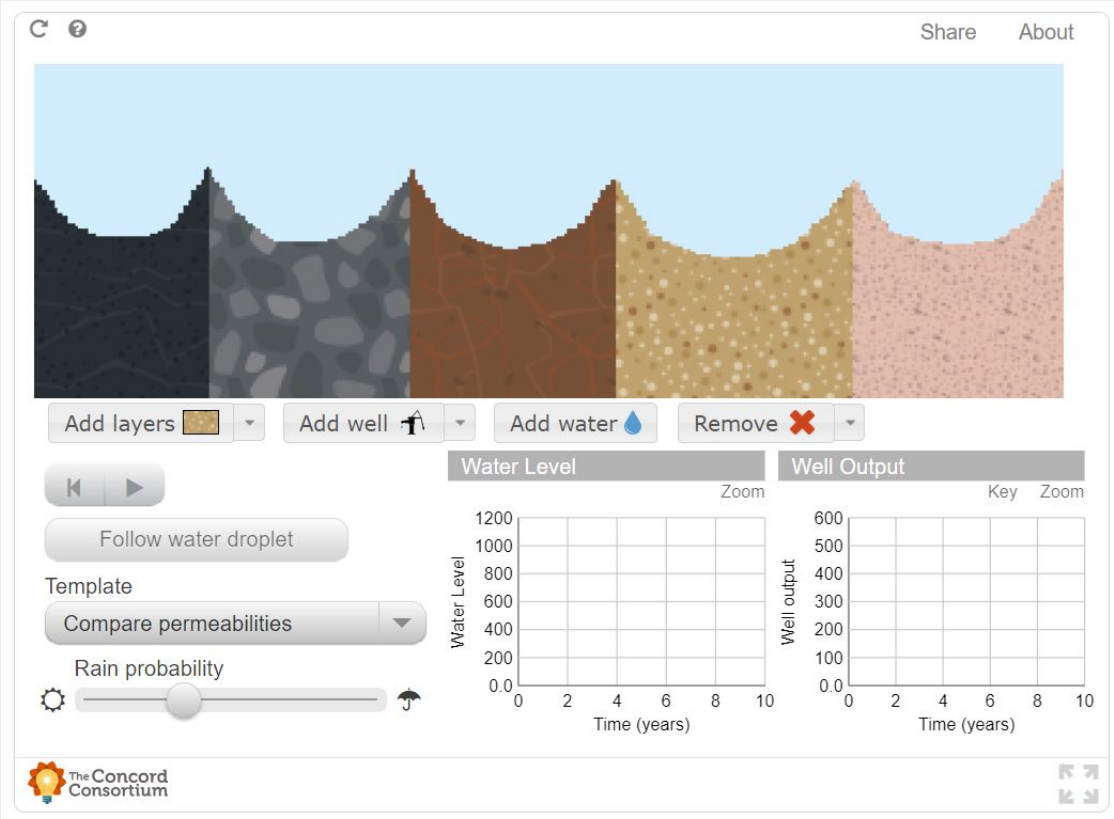
Now, have you ever dug a hole at the beach? If you dig deep enough, a layer of water starts pooling at the bottom. That's **groundwater**. The amount of groundwater is 20 to 30 times larger than all U.S. lakes, streams, and rivers combined!

And it’s not just by the beach: below our feet, there is groundwater. The **water table** is the level of the water underground. The layers of sediments (such as sand, gravel, silt, etc.) that are soaked with groundwater are called **aquifers**. These layers are like sponges which hold water.



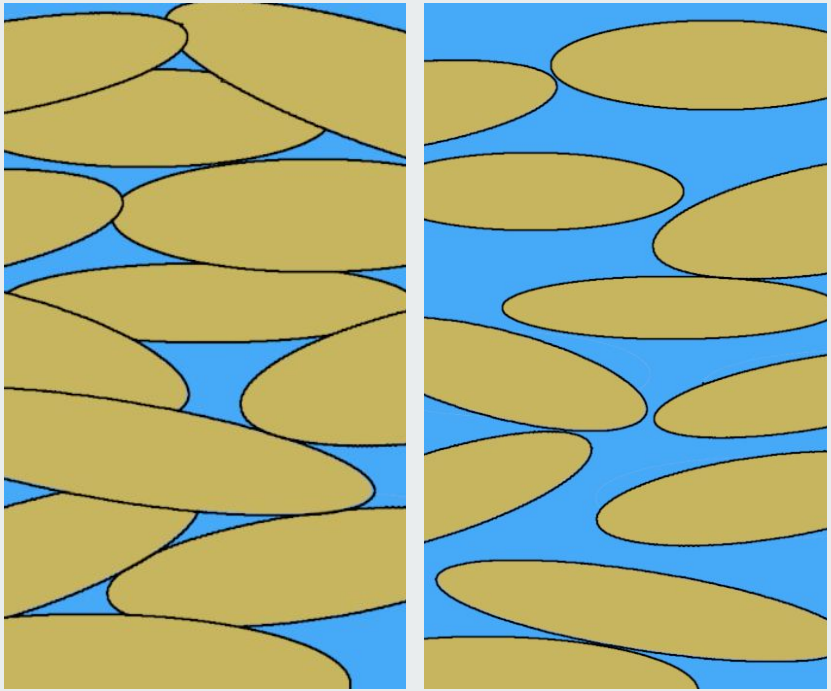
Credit: Global Nomads Group

Use this groundwater simulation to explore the movement of water into aquifers.



Let’s zoom in on the sediments that makes up an aquifer! **Permeability** is how easily water moves through a material. If something is really permeable, water can pass through it easily, like a sponge that soaks up water fast. But if it's not very permeable, water can't pass through easily.

The more permeable the sediment, the more easily water seeps into the aquifer.



Credit: Global Nomads Group / Katinka Lennemann

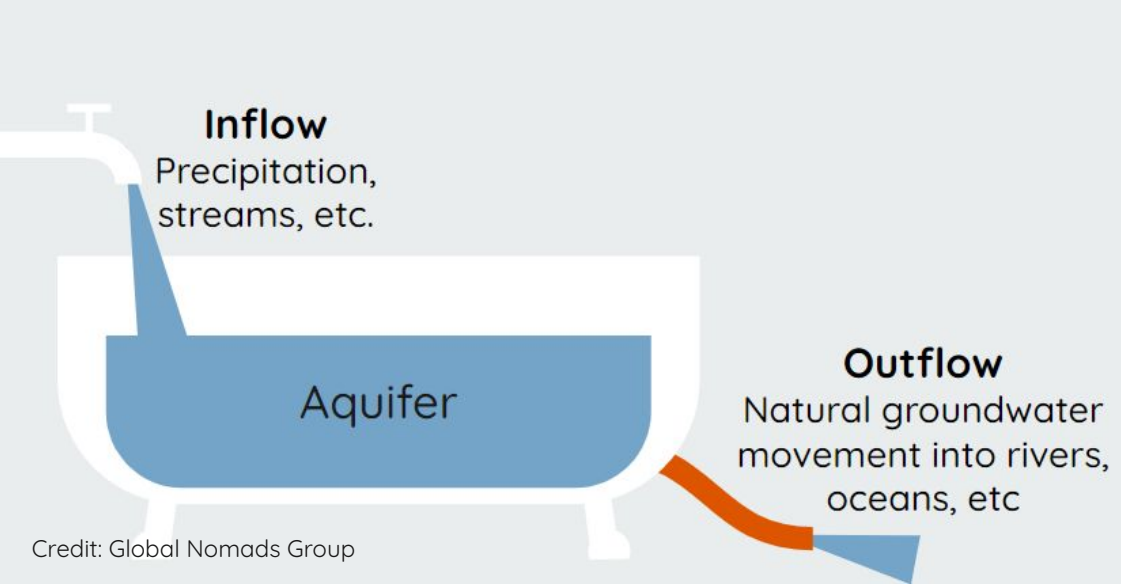
Non-permeable rock: spaces are not connected, so water cannot flow as well.

Permeable rock: spaces are connected, allowing water to flow.

What limitations do you think the groundwater model had? In other words, what information do you think is missing from this model?

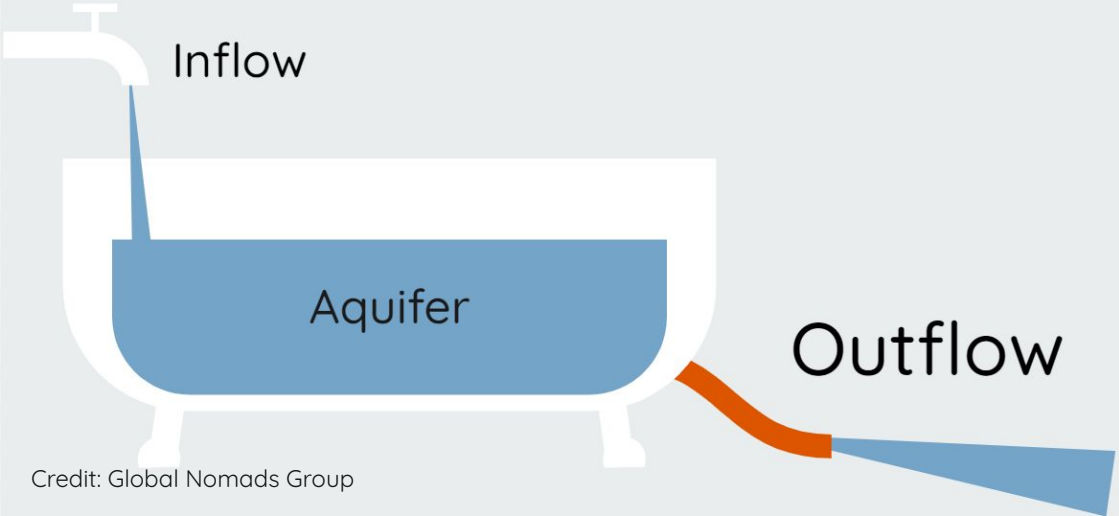
Water can flow in and out of aquifers. **Aquifer inflow** comes from precipitation like rainfall and snowfall, as well as streams. **Aquifer outflow** might flow naturally out of an aquifer into the ocean, rivers, and streams. Or it might be pumped out of the aquifer.

Think of an aquifer like a bathtub. Imagine inflow as the things that fill the bathtub and outflow as the things that drain the bathtub.



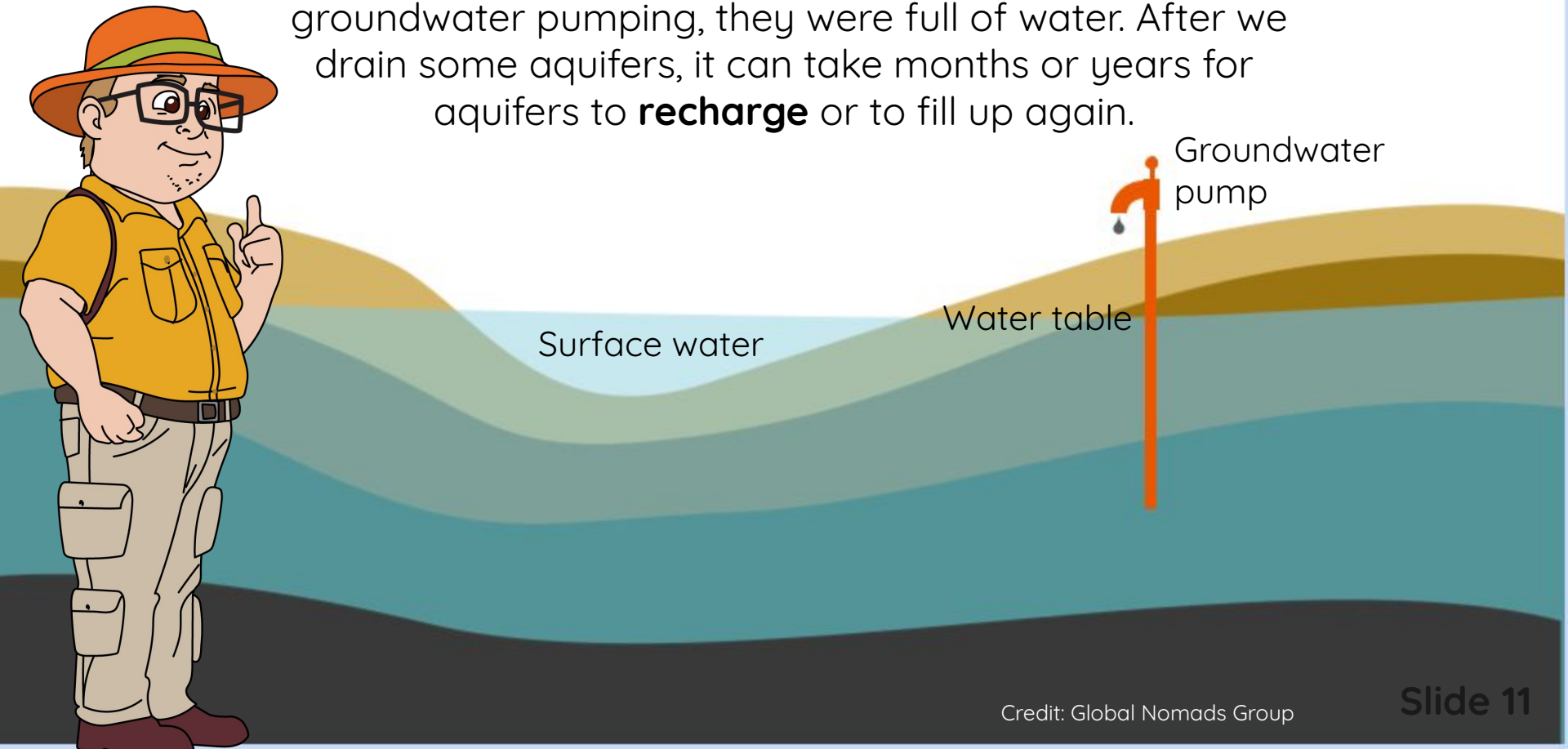
Credit: Global Nomads Group

What do you think happens to water levels when aquifer inflow **is less than** aquifer outflow?



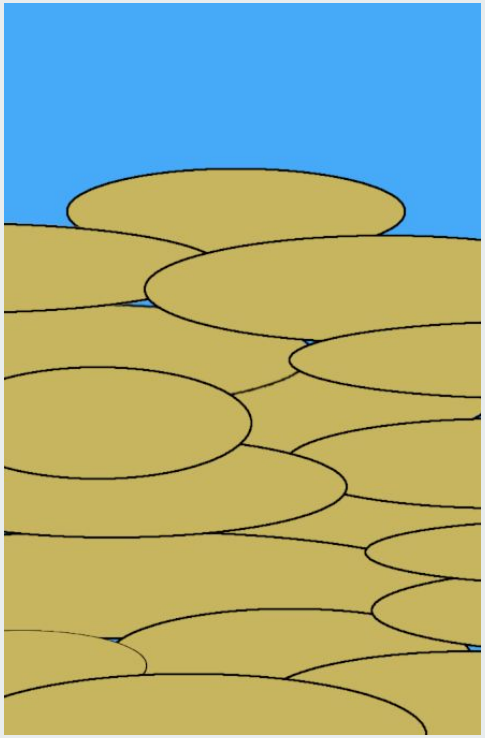
Credit: Global Nomads Group

The Central Valley is made of many layers of aquifers that aren't very permeable! Before we started groundwater pumping, they were full of water. After we drain some aquifers, it can take months or years for aquifers to **recharge** or to fill up again.



Credit: Global Nomads Group

Some aquifers **never** fill up again. Once they have been depleted, the soil particles stick together and the ground compacts. This is an issue because then groundwater storage space is permanently lost.



Credit: Global Nomads Group / Katinka Lennemann

Class Session 2

Last time, we explored aquifer permeability and how it relates to aquifers through the Concord Consortium model. What other materials are permeable?

Let’s model aquifer permeability with water and sponges.

Let’s consider:

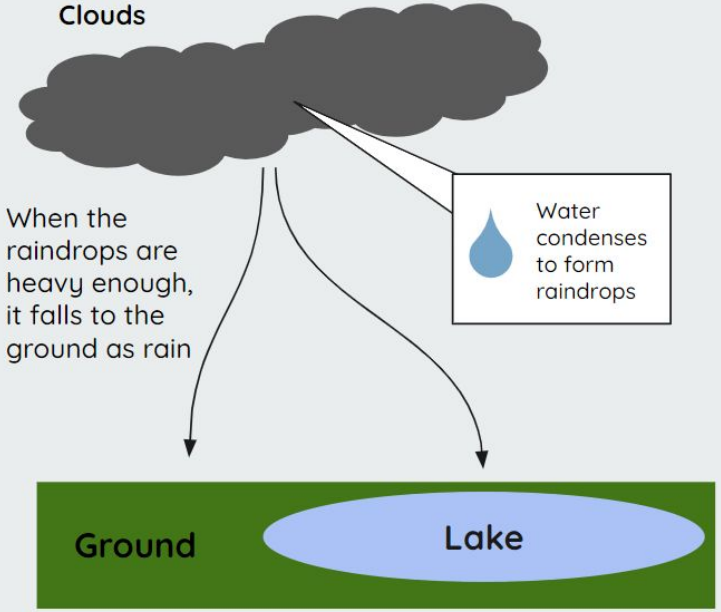
- How much water do you think the sponge will be able to hold? (mass or volume?)

- What do you think would happen to the wet sponge if we left the saturated sponge out for several days to dry out?

- What did you **notice** and **wonder** about the dried out sponge?
- How do you think this might apply to groundwater pumping?

Use the USGS interactive map to look at where subsidence is happening in California.

Updated model



SAMPLE MODEL OF RAINFALL

Write or draw inside the **arrows** to show the movement of water in and out of the ground.

Signs and symbols to help explain what is happening:

Arrows = useful in showing connections or movement

Text boxes = allow you to explain parts of the model

Key = helps others understand symbols and ideas

Zoom in windows = allow you to show others what is happening at a smaller scale

Timelines = allow you to show changes over time

Credit: Global Nomads Group / Katinka Lennemann

Let’s revisit the Driving Questions Board. What questions have you answered? What new questions do you have now?

What changes in rain patterns or snow patterns have you noticed in recent years? What might be affecting these patterns?

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