Lesson Plan Two

Water movement and aquifers

Overview

Explore water movement and how aquifers work through a fun, hands-on experiment. This lesson plan explores where water is found in the Hawke's Bay region, and how it moves around the environment.

Teacher information

Activity components
Lesson plan 2 (this document)
Slideshow 2: Water movement and aquifers
Experiment: Mini aquifer model

Guiding questions
How does water move in the environment?
What is an aquifer?

NZ Curriculum links	*Level*	*Inquiry stages*
Science	Years 5 -8 Level 3-4	Three - Investigate and explore

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Understand

Through building knowledge about contexts and drawing on inquiry practices, I have a deeper understanding that:

- Water moves around the environment in a cycle, going through processes and moving from higher ground to the sea.

Know

I have built my knowledge of water.

I know:

- Water moves in a cycle in the environment
- Water is stored in aquifers underground. Aquifers are giant underground pockets of water.

Do

In my learning I can:

- relate natural features and processes to a model aquifer experiment
- describe the movement of water in the landscape
- identify what aquifers are and appreciate that they are an important source of drinking water for Hawke's Bay.

Background information summary

Water in Hawke's Bay, Te Matau-a-Māui, and throughout the world, is an interconnected network, which moves around in a cycle. We are still learning about the secrets of how water interacts with the earth and landscape. Fresh water is collected from aquifers, also known as groundwater, for drinking and other purposes. Some is also taken from surface water like rivers and streams.

The water cycle

Water moves in a cycle through the landscape, ebbing and flowing and sustaining life. All water is connected. Water falls from clouds as rain, hail or snow. This is known as precipitation. It then soaks into the ground or travels downhill to streams and rivers, with much of the rainfall making its way to the sea. When liquid water heats up, it evaporates and turns into water vapour, making its way back up to the clouds.

What is a catchment?

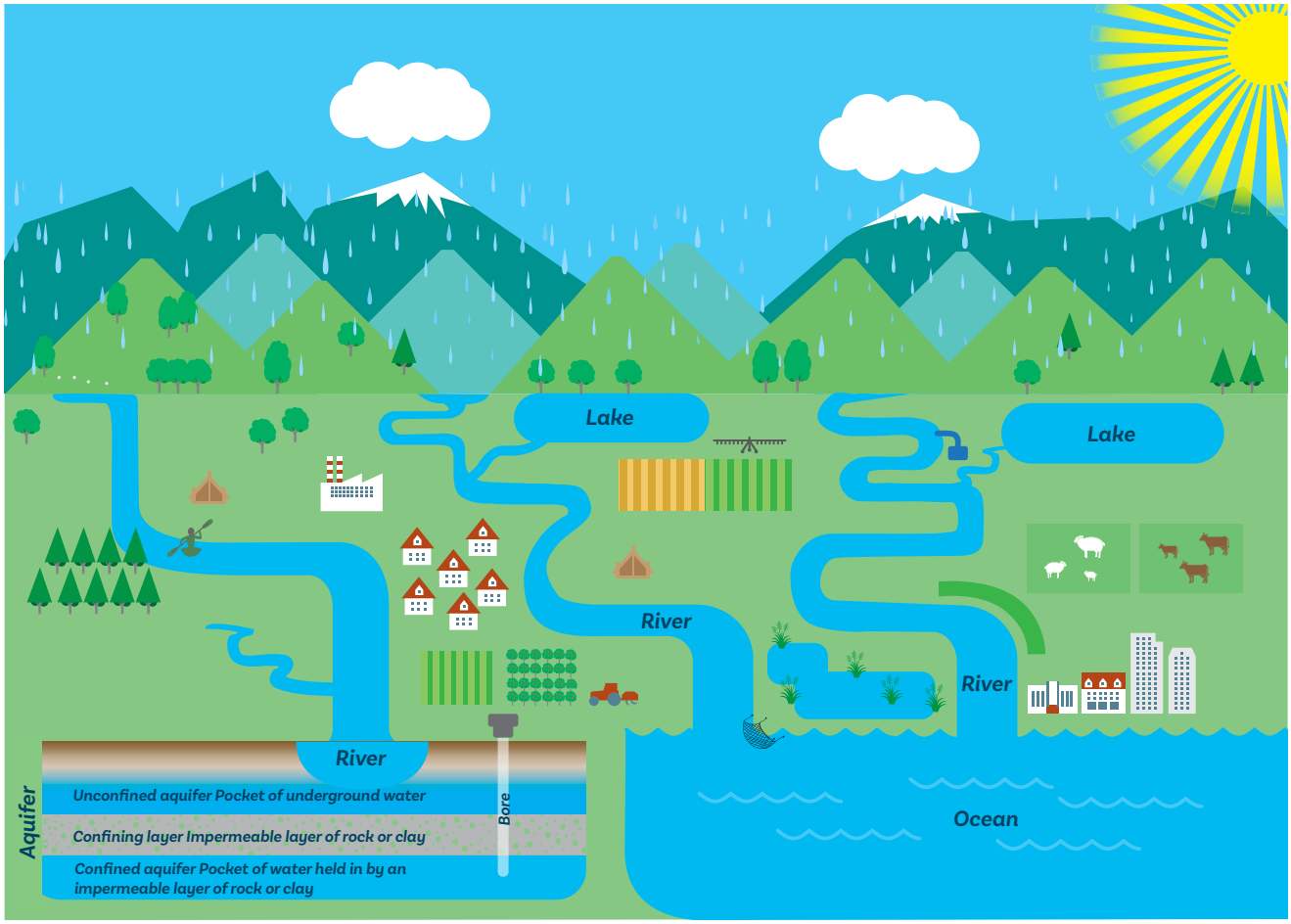
A surface water catchment, or just 'catchment' for short, is an area of land, bordered by hills, that collects water. Water travels downhill in a catchment from high in the hills or mountains, through streams and rivers. Some of this water is carried to the sea by rivers, and the rest evaporates or collects into lakes, wetlands or aquifers.

Aquifers

Aquifers are areas of underground rock and sediment saturated with water. There are two main aquifers in Hawke's Bay: Heretaunga aquifer (Hastings/Napier area) and Ruataniwha aquifer (Central Hawke's Bay area). The Ruataniwha aquifer is sometimes referred to as acting in a similar way to a 'giant bathtub' as it is contained by mountain ranges and is drained by one release point - the Tukituki River.

Seven smaller aquifers are also present in Hawke's Bay| Te Matau-a-Māui: Mahia, Nuhaka, Wairoa, Esk, Poukawa, Papanui/Ōtāne, Waipukurau/Waipawa. Much of the water landing on the ground seeps through to supply the underground aquifers.

Surface water and ground water



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Mountains to sea/ ki uta ki tai

Water flows from mountains to the sea: ki uta ki tai. Water travels downhill in a catchment from high in the hills or mountains, through streams and rivers, and eventually to the sea.

Papatūānuku (the Earth Mother) feeds us with wai (water): this is a metaphor - the earth gives people water, like a mother feeds her pēpi (baby).

Groundwater, springs and surface water

Groundwater and surface water are not separate bodies of water. In fact, they are great friends, sharing water between them.

Stretches of rivers are called "reaches". In some areas, river water flows underground, feeding the aquifer. A river reach like this, loses water from the river into the aquifer. This is known as a 'losing reach.' In other areas, aquifers release water into rivers.

This can happen in two ways:

1. The water can enter the river through the ground under the water (this is known as the riverbed). This means the reach of river gains water from the aquifer under the ground, so it's called a "gaining reach".
2. Springs are areas where water naturally flows out of the ground to become surface water. This surface water then becomes or joins a stream or river.

Drinking water supply from aquifers

Hawke's Bay's water is supplied from bores or wells which draw water from aquifers, like the Heretaunga Plains underground water system.

Other relevant teaching and learning resources

Science Learning Hub video:
Building an aquifer model

Science Learning Hub activity:
Building a water cycle model

Learning experience suggestions

These are suggestions only and are intended to be altered to suit your students.
There are also learning suggestions in the slideshow notes that may be of interest.

Exploring how water moves in the environment

View ***Slideshow 2: Water movement and aquifers*** with students.
After viewing, discuss how water moves in the environment and what an aquifer is.

Introducing aquifers

View slides 7-10 of ***Slideshow 2: Water movement and aquifers.***

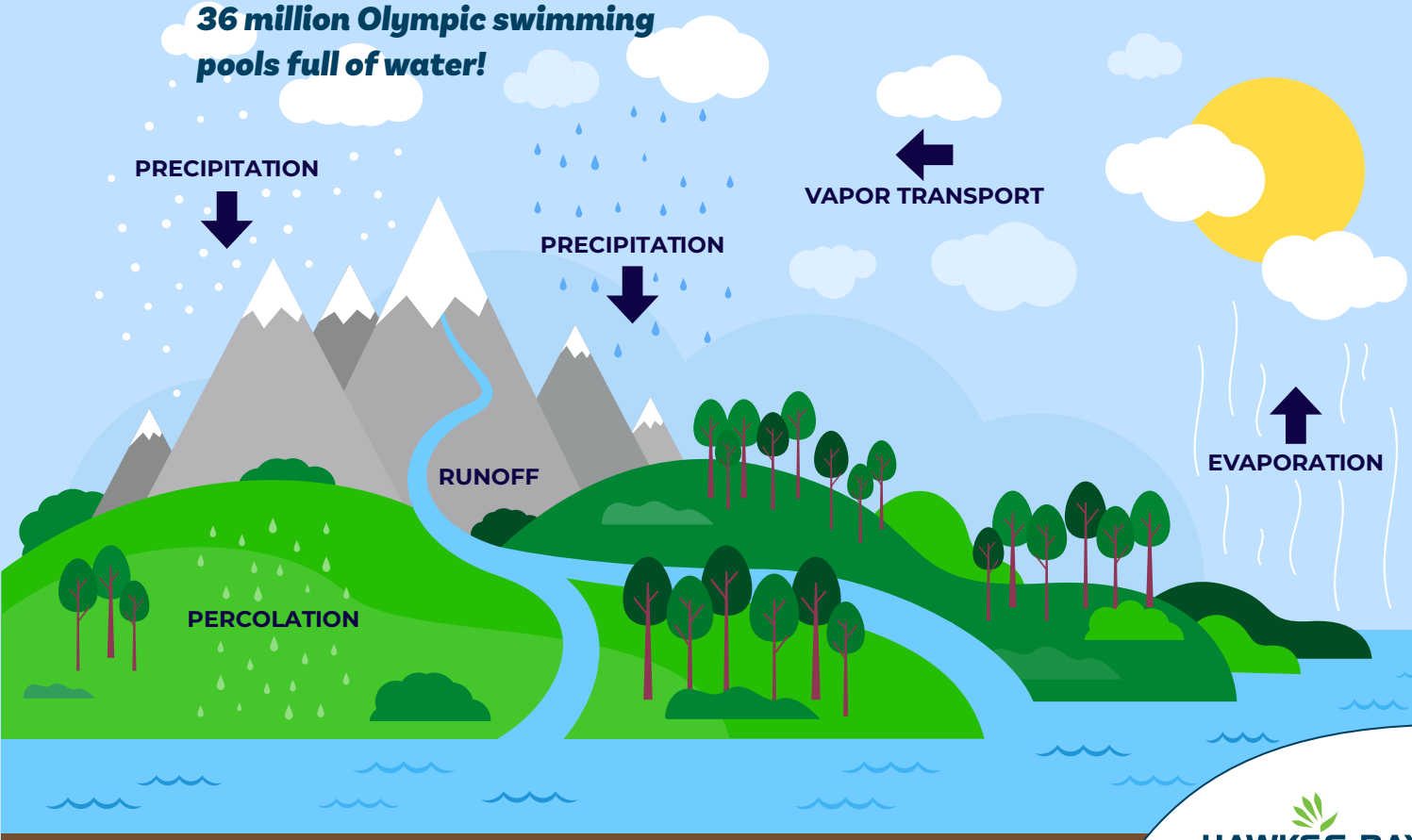
Catchments and the water cycle

Introduce the concept of a catchment: an area of land that is bordered by hills that collects water.

Discuss the water cycle with students. Rain or snow falls onto hills, mountains and the landscape. This water then moves downhill collecting in wetlands, lakes, streams, rivers with some going underground to become groundwater. Much of this water eventually ends up in the sea. In the sea or lakes, water heats up and evaporates, moving as a gas up to clouds or sitting in the air as mist. More than 90 billion cubic metres of rain falls in Hawke's Bay each year- that's about

36 million Olympic swimming pools full of water!

Explain that an aquifer is an underground layer where the ground material contains a lot of water. It's a bit like an underground sponge, holding water. The material within an aquifer can be sand, gravel, clay or silt, or porous rock (rock that allows water to get into it).



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Outdoor exploration of the water cycle

Head outside and observe any water movement happening in the local environment, e.g., rain, puddles, evaporating water, streams flowing. Reflect on which stages of the water cycle this movement relates to (e.g., precipitation, condensation, evaporation etc).

Where does drinking water come from?

Where do students think that their drinking water comes from? Think, pair, share ideas.

Water can be collected from rooftops (rain), rivers, springs, or aquifers for treating to provide drinking water for communities. Hawke's Bay's town water is supplied from bores or wells which draw water from aquifers, like the Heretaunga Plains underground water system.

It's important that we keep aquifers and rivers clean and unpolluted so that we can safely drink treated water from them. Sometimes rural and urban activities that happen above ground can affect the quality of our surface water. Some of this water can then go underground and affect the quality of the groundwater. Other activities like irrigation and town water supply can reduce the amount of water stored underground in aquifers. This is known as water quantity.

Experiment: Mini aquifer model

Learn how an aquifer works. Ideally this is done in small groups so everyone has a good view of water movement.

Equipment needed

- Plastic container, aquarium or reuse a takeaway container
- 2 cups sand *(enough to cover a 1-2cm depth of the container)*
- Measuring cup
- Small, clean rocks or gravel
- Spray bottle full of water
- Nozzle from spray bottle
- Stocking or mesh
- Rubber band
- Modelling clay, clay or similar waterproof material *(optional)*
- Tape
- Food colouring *(optional)*

Setting up your aquifer model

1. Place a layer of sand on the bottom of the container or aquarium. Layer this with clean gravel or rocks of different sizes. If desired, layer modelling clay or clay across the top of the sand layer on one side of the container to represent a barrier to water.
2. Place the spray bottle tube upright in the layers to represent a well underground, with the nozzle above the 'soil' layer.
3. Slope the gravel so it is higher on one side of the container. Top with a layer of larger gravel.
4. When you have a sloped hill of sand and gravel ready, pour or spray water over the model and watch where water moves to.
5. Add a few drops of food colouring to the top of the gravel pile and again spray water onto the model. Watch what happens to the food colouring. This could represent a pollutant such as fertiliser and demonstrates how it can enter groundwater or surface water.
6. Questioning and prompting

Prior to experiment

Before starting, pose the questions:

Where do you think water will flow in the container?

Where is the aquifer going to be found in the model?

What will happen when the 'well' extracts water from the aquifer?

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During the experiment

During the experimenting, pose questions to prompt scientific thinking, such as:

- What do you notice about where the water flows? (Water runs downhill with the force of gravity. Water will settle at the bottom of the container in between sand grains like it does in an aquifer.)
- Where do you think the aquifer is?

After the experiment

Thinking about water representations in the model - examine how the model reflects what happens in the environment.

- How does the water in the model relate to water in the environment?
- Depending on how the model is configured, which parts of the model represent a river; a wetland, lake or ocean; aquifer?
- When pumping out water (using the spray nozzle) what happens to the water?

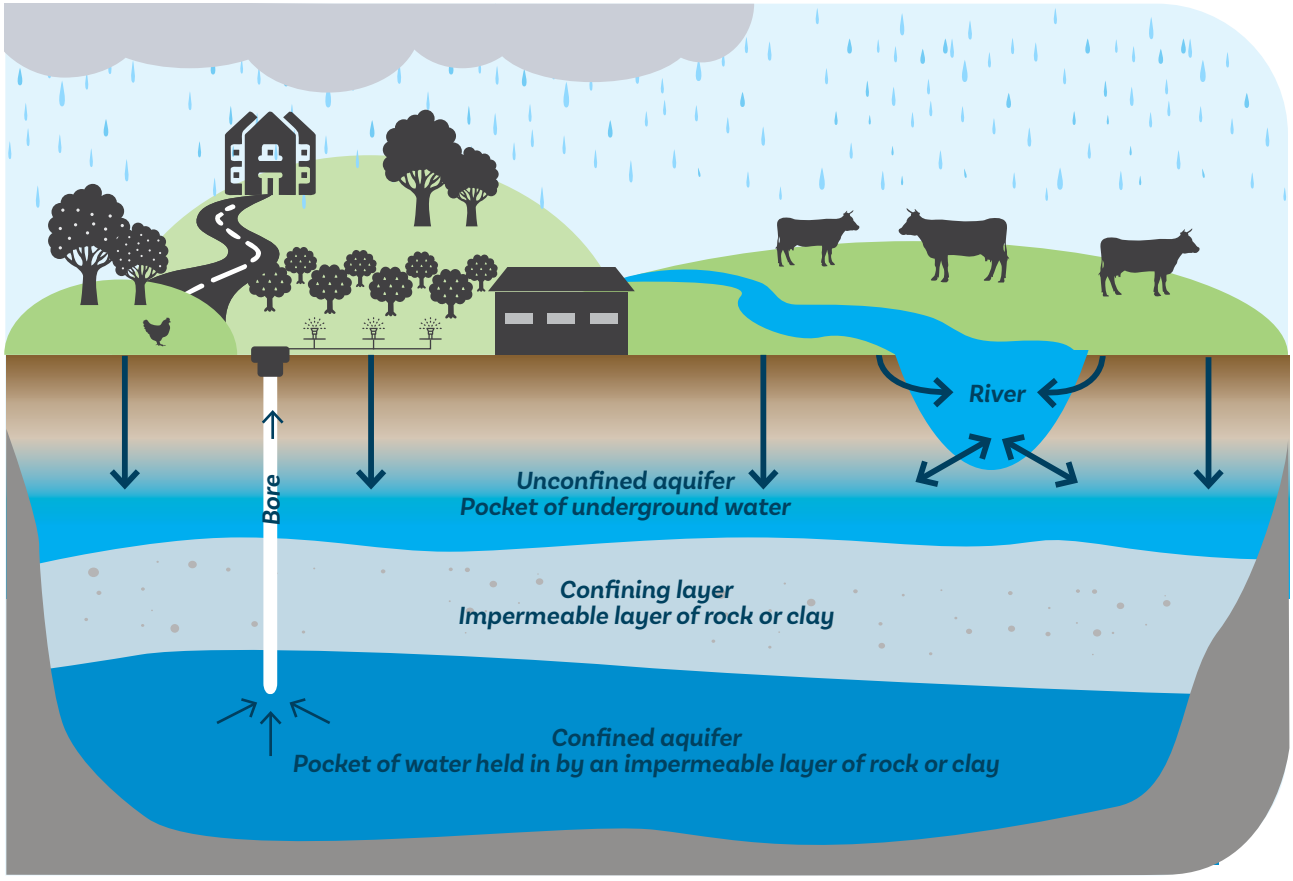
Sand represents the silt/ limestone layer in nature. The container is like the bedrock. The gravel is the gravel of course! The spray bottle is the rain and water moving underground is the groundwater. Water sitting above the gravel is surface water like rivers and streams.

Which part of the model was the aquifer represented by?

The water at the bottom of the container, within the sand and gravel represents the aquifer. The water below the clay layer is like a confined aquifer. The water in the sand without the clay above is similar to an unconfined aquifer. The spray nozzle acts like a well, bringing water from the aquifer up to the surface for use by people.

Explain that aquifers like this provide most of Hawke's Bay's drinking water.

Using groundwater from a bore to irrigate a crop



Reflecting on learning

- How did the model demonstrate how an aquifer works?
- What did you learn about how water moves in nature?
- Why is it important to look after and protect aquifers?

Extending learning

Investigate the water cycle further through the following fun experiments and activities:

- Build a water cycle with this Science Learning Hub activity.
- Investigate water in your local area using the Hawke's Bay Regional Council GIS mapping tools: View the river and flow levels near you in the River levels and flows map. See rainfall levels in the rainfall map. Find your catchment in the catchment map.

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