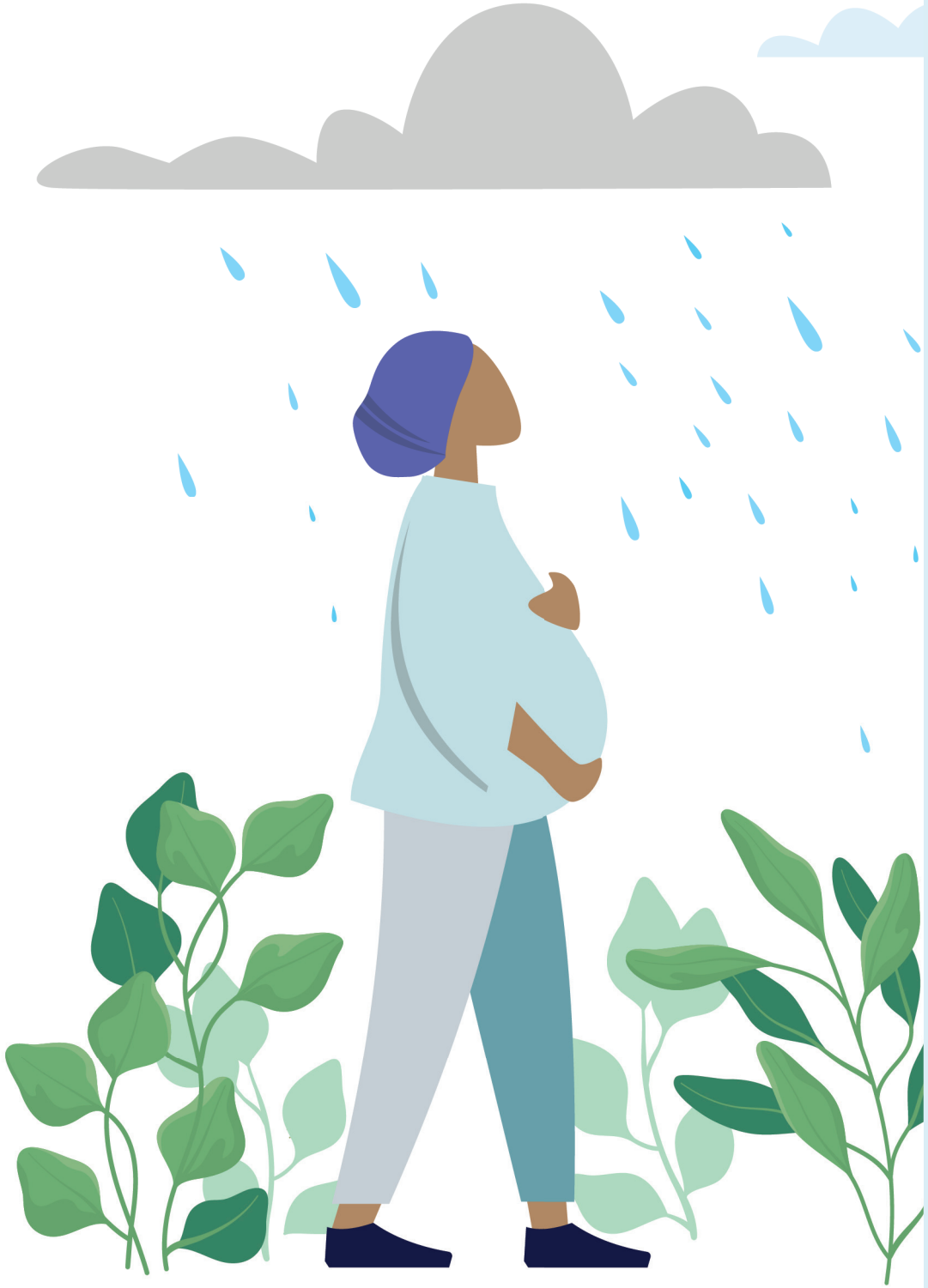

PRIMARY + STEM

Teaching Resource

ACTIVITY: Water Cycle

ACTIVITY OVERVIEW

Water is essential to life on Earth and is encountered by children in lots of everyday experiences, including drinking, washing, flushing toilets, rain, clouds and watering plants. Here in Australia, we are affected by the extremes of both floods and droughts, making water education relevant to all families. It is a unique place to grow up, with some years focused on saving precious water and other years struggling with massive destruction caused by floods.

This activity links Earth's weather and water cycle, the importance of fresh water to living things, and the basic chemistry concept of states of matter. Water is an ideal material to introduce students to solids, liquids, and gases. It shows clear changes in state due to changes in temperature and will provide students with fundamental chemistry knowledge. In addition, this activity allows students to observe the growth of a plant from seed, which uses key scientific skills.

SYNOPSIS

Water is essential to life on Earth and is encountered by children in lots of everyday experiences, including drinking, washing, flushing toilets, rain, clouds and watering plants. Here in Australia, we are affected by the extremes of both floods and droughts, making water education relevant to all families. It is a unique place to grow up, with some years focused on saving precious water and other years struggling with massive destruction caused by floods.

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Foundation – Year 2

- Living things have a variety of external features and live in different places where their basic needs, including food, water and shelter, are met. (VCSSU042)
- Observable changes occur in the sky and landscape; daily and seasonal changes affect everyday life. (VCSSU046)
- Earth's resources are used in a variety of ways. (VCSSU047)

Year 3 – 4

- A change of state between solid and liquid can be caused by adding or removing heat. (VCSSU059)
- Earth's surface changes over time as a result of natural processes and human activity. (VCSSU062)

Year 5 - 6

- Solids, liquids and gases behave in different ways and have observable properties that help to classify them. (VCSSU076)
- Changes to materials can be reversible, including melting, freezing, evaporating, or irreversible, including burning and rusting. (VCSSU077)
- Sudden geological changes or extreme weather conditions can affect Earth's surface. (VCSSU079)
- The growth and survival of living things are affected by the physical conditions of their environment. (VCSSU075)

ACTIVITY, MATERIALS AND INSTRUCTIONS

Activity - Planet cup

Add the ingredients to make your own baby planet in a cup, with just the right temperature, air, and water like here on planet Earth. Observe the water cycle and plant growth in your classroom.

Materials for 30 students

- Plastic cup (or glass jar) x 30
- Cotton balls x 90
- Seeds (one cup full will be enough for a whole class). Lawn seed is great for quick growth and reliability, but if studying plant life cycles is your aim, then a bean seed (e.g. broad bean, lima bean, kidney bean) makes it easier to see the plant parts and can be replanted in pots/garden where growth of flowers and seeds can be observed.
- Water
- Pipettes (optional, but fun for kids to use to add water to the cotton balls)
- Marker (to write names)
- Cling-film (to seal planet cup)
- Elastic band (to fit around top of cup)

Instructions

1. Use marker to write your name on the side of your plastic cup.
2. Place three cotton balls in base of cup.
3. Sprinkle one pinch of seeds into cup.
4. Add a small amount of water, so that cotton balls are damp.
5. Cover cup with cling film and secure with elastic band (note - younger students may need help with this step).
6. Keep planet cup in a warm place initially, then move to a sunny spot once seeds sprout. Don't shake the baby planet!

Your planet cup will not need watering. The water placed inside the cup will evaporate into water vapour, condense back into drops of water on the inside surfaces (cling film or sides of cup), then fall like rain back down into the cotton balls. You will only need to remove the cling film when the plant grows as tall as the cup, at which time you can plant it in your garden.

What predictions can we make about the growth of our planet cup plants? What do we observe happening in our planet cups? Record our observations. What other questions about water or plants do we have after this activity? Is this a fair test? Can we compare the growth of plants in the different planet cups? (Did everyone use the same amount of water, cotton balls and seeds?)

TEACHING OBJECTIVES

This topic helps students understand more about everyday things that they encounter in their lives. Where does rain come from?

Where do the puddles go? How do plants stay alive and grow? What's really happening when ice melts? Although you can use this activity with students from Foundation to Year 6, the curriculum context will vary through the year levels.

Foundation – Year 2

Water as a resource

Introduce this activity by questioning students about where they see and use water in their daily lives. Where does our drinking water come from? Does everyone get water this way? (Some students may have family/ friends in regional areas with only tanks.)

The activity will prompt further thinking and discussion about water in our lives and how it moves around our planet.

Depending on your school location, students may have experience with water saving measures, or none. We need to look after Earth's resources, which include clean and drinkable freshwater. How can we use less water in our daily lives?

Weather

Why does it rain? What changes in our school day when it rains? From this simple introduction, to a familiar weather experience - students at this age can be given a basic understanding of the water cycle:

- condensation (cloud formation)
- evaporation (water drying up)
- precipitation (rain/hail/snow)

Extensions – can be linked to current events of flooding or droughts, combine with the Geography Curriculum and look at floods and/or droughts that have affected regions of Australia recently.

Growth and life cycle of plants

Students investigate the needs and life cycle of plants using this activity. A reminder that large bean seeds are easiest for students to observe growth, rather than smaller seeds. Students can make predictions and record observations – for example, doing a sketch of seed at day 1,3,5 (Also links to Maths Curriculum - days of the week, comparing sizes with informal measurements).

What does the seed need to grow into a plant? Can you predict what changes we will observe in the seed as it grows? Where should I put the planet cup to get the best seed growth? (It will need warmth before it needs light, as light is only important once the green parts of the plant grow.)

Years 3/4

Rainfall and flooding

This activity can also lead to discussions about rainfall, flooding and changes to Earth's surface, due to water. Flooding usually happens after large amounts of rain have fallen in the catchment area of a river. Water fills the usual river channel, as well as the surrounding soil. This means that extra water moves on top of this usual level. Students may be aware of changes in local rivers/creeks that happen after large rainfall. People have changed the surface and shape of the land, which can affect flooding. Places where water used to just soak into the soil have now been covered with roads and houses and this changes the movement of water over the land.

Are there places near our school that sometimes flood? What happens in our local area when there is a lot of rain? What do you think the local creek/river area looked like 100 or 1000 years ago?

States of matter

Students in Years 3 and 4 can conduct this activity during studies of chemistry and states of matter, with water changing between liquid and gas inside the planet cup. They should be able to explain the changes in state happening with the water inside the planet cup. Water on Earth is found in three states: solid (ice), liquid and gas (vapour). Links to the water cycle, where the vocabulary includes evaporation (liquid to gas, things dry up), condensation (gas to liquid, cloud formation), and precipitation (the water falls from the clouds to the ground).

Do I need to add more water to my planet cup? How do the drops of water get on the top and sides of the cup?

Reinforce students' understanding of states of matter by mixing cornflour and water in approximately 2:1 ratio to form the peculiar substance, oobleck. Is it a solid or is it a liquid? Observe properties of oobleck that are like solids and liquids. Observe a material that does not fit neatly into the solid or liquid categories. Refer to Oobleck activity sheet for more information.

Years 5/6

States of matter

Students in Years 5 and 6 can conduct this activity during studies of states of matter, with water changing between liquid and gas inside the planet cup. They should be able to explain the changes in state of water inside the planet cup. Water on Earth is found in three states: solid (ice), liquid and gas (vapour).

Do I need to add more water to my planet cup? How do the drops of water get on the top and sides of the cup?

Reversible and irreversible changes

The change of water from ice to liquid to vapour is an example of a reversible change. When heat is added to the liquid water in our planet cups, it changes into water vapour (gas). Then, as heat is removed from the planet cup the water vapour loses energy and changes back into liquid drops of water.

How do I change the water back to a solid/liquid/gas? Do we see these reversible changes happening anywhere else around us? (Cloud formation, fog on mirrors, or seeing your breath on a cold morning.)

Extreme weather

This activity can also lead to discussions and research about rainfall and flooding or droughts. You can choose to focus on events that have been happening locally or explore things that students may have observed in the news recently. Think about impacts of floods (this also links to the Geography curriculum).

How do floods/droughts affect living and non-living parts of the environment? (Think about things like people, animals, plants, buildings, roads, and soil.)

How can we make things better for people who live in flood/drought areas? (Could link to the Design & Technology Curriculum and creating designed solutions for a specific flood/drought situation.)

Growth and survival of plants

In small groups, students design an experiment to see how changes in heat, light and water affect the growth of their plants.

Place the planet cups in different locations to find out how factors affect the growth of the seeds:

- cupboard (dark)
- fridge (dark + cold)
- extra water
- under constant light
- in a really warm place

Students will make predictions and compare results at the end of the experiment. Record daily changes with drawings, photos or measurements, depending on the type of skills you are wanting to practise.

What do seeds really need to grow and survive?

DISCUSSION SECTION AND KEY THEMES

Here on Earth, we have water in three different forms – ice, liquid water and water vapour. Water moves around the Earth in these three different forms, particularly changing between liquid and water vapour. How does it change from ice into liquid or into gas in the air around us? We need to understand how heat changes water to help us understand the water cycle.

The water cycle

Where once we believed that Earth was the only place with water to support life, we now know that water is also found on other planetary bodies.

Mars has polar ice caps, and trace amounts of water vapour have been detected on Venus, Jupiter, and Saturn. Ice has also been found on moons and asteroids.

What makes Earth unique is not only because we have copious amounts of water as ice, and water in the ocean which covers almost ¾ of our planet; but that we also have plenty of invisible gaseous water in the atmosphere.

It is the interchange between liquid water and invisible gaseous water in the water cycle – evaporation, condensation, and precipitation, that plays a crucial role in the planet's weather.

Water is found from the atmosphere all the way down to the ground and below. Liquid water is found in rivers, lakes, and even in puddles along the street. When energy (heat) is added to liquid water it changes into water vapour. This is called evaporation and is the way that water becomes a gas in the air around us. As you move further away from the surface of the Earth, heading up through the atmosphere and into space, it gets colder. Water molecules lose energy as they cool down and up above the Earth's surface the water vapour changes back into liquid water. This is called condensation, and those tiny drops of liquid water make up clouds. When enough drops of water join, they become too heavy to stay up in the sky and rain falls. This is called precipitation and includes all forms of water that fall from the sky including rain, hail, sleet and snow. Once liquid water has fallen back to the ground it can be evaporated again, frozen into ice or move around the surface of the Earth in liquid form.

Drawing a diagram to illustrate the water cycle is helpful.

Chemistry background

Everything around us that takes space is called matter. Scientists who study matter are called chemists. Some words that chemists use are atoms and molecules, the smallest amounts of something that you can have. Scientists love to sort things. We sort matter into groups that we call states of matter. The most easily observable states of matter are solids, liquids and gases.

States of matter

Solids have a fixed shape and volume. A chair is still chair-shaped and takes up a chair amount of space, whether it is under or on a table.

Liquids have a fixed volume but change shape depending on what they are held in. 1 cup of water in a bowl will be a different shape to 1 cup of water in my drink bottle.

Gases do not have a fixed shape or volume. Gases change shape to fill up all the space they can find.

Gas inside my car will be car-shaped. Gas in a sealed bag is bag-shaped, but can be released and spread throughout a room, becoming room-shaped. We generally can't see gases with our eyes.

Gases have the most amount of energy of these three states. Think about bangs, pops, fizzes and explosions. All of these involve gas, with energy pushing the gas out to fill all the available space.

If we add energy to solid water (ice) it will melt into liquid water. If we add energy to liquid water it will evaporate into a gas (water vapour). If we take energy away from water vapour it will condense into liquid water. If we take energy away from liquid water it will freeze into ice. We can use our hands to model the movement of water molecules to help us understand these changes in state (*see instructional video).

The main change of state that we need to understand when we are learning about the water cycle is the change of state from liquid to gas (evaporation) and the reverse change from gas to liquid (condensation).

Reversible and irreversible changes

Changes of state, such as ice melting or water condensing, are reversible. These materials can be changed back to their original forms. We can take away energy (heat) from liquid water and return it to solid ice. We can add energy (heat) to liquid water and return it to a gaseous state. Other reversible changes include when materials have just been mixed together, like adding food colouring to water, or aluminium drink cans that can be recycled by melting the metal back into liquid form.

These reversible changes can be compared to irreversible changes, like when ingredients are mixed and heated to bake a cake. We cannot reverse the cooking of eggs and the change in chemical composition of the cake when ingredients combine to make gases and solids that give cakes a soft and spongy texture.

Growth and survival of plants

Seeds contain food for the baby plant to use for growth and development and the first shoot of the plant. Bean seeds (eg. broad beans, lima beans, kidney beans) are great for looking inside. If you soak the beans for a few hours, you can pull apart the seed, look inside the seed coat (outside layer) and discover the little shoot inside, plus the cotyledon (the food for the baby plant). Students can see these parts with their eyes, but also may enjoy using magnifying glasses to investigate.

The shoot will grow from the seed. This is the first little stem poking out of the seed, the little bit of green that you observe. While the shoot grows upwards (towards light), we can also see the roots growing down into the cotton balls. If you have seeds that have started to grow next to the edge of the cup you will get a good view of these parts. The roots will hold the

plant in place and take in water in our planet cups. When you plant a seed in your garden, the roots will also take nutrients into the plant.

The stem will support the plant, so that it can stay up. The stem has special tubes that carry water and nutrients through the plant.

Once leaves have grown on the seedling (baby plant), then the plant can begin to make its own food using the sun. This is called photosynthesis. The green colour of most leaves help them use just the right parts of sunlight inside their cells.

The full life cycle of a flowering plant includes growth of flowers (the parts that enable reproduction) and fruit (which contains the seeds). You will not be able to observe this much of the life cycle in the planet cup. However, if you replant bean seedlings into soil you will be able to follow the life cycle further.

Conditions for growth are important for survival of plants. This activity allows you to easily investigate different amounts of heat, light and water. Students can design their own experiments, including use of controls, to find out how these different factors affect growth of seeds. For example, if testing the effect of different amounts of water on seed growth you will start with different volumes of water measured into each planet cup. Planet cups will all need to be kept in a location with similar heat and light, so that the experiment tests only one variable.

QUESTIONS AND ANSWERS

How does it hail or snow?

When water falls from clouds it can be solid or liquid, depending on the temperature of the air that it falls through.

- Rain – falls through warmer air all the way to the ground, remaining a liquid
- Snow – falls through only cold air all the way to the ground, remaining ice crystals
- Hail – is formed in thunderstorms, where water is pushed back up into really cold parts of the atmosphere. More drops of liquid water freeze onto the hailstone, which can grow bigger and bigger as the thunderstorm updrafts keep it in the air.

We don't get a lot of snow in Australia, compared to other parts of the world. It is usually too warm in most parts of the country, with ideal snowfall temperatures around 0 – 2 degrees Celsius.

What are clouds made from?

Clouds are made from tiny drops of liquid water that have condensed high up in Earth's atmosphere. Condensation happens when water vapour loses energy and changes state from a gas into a liquid. Students can experience condensation when bathroom mirrors fog up (warm water vapour hits cold mirror surface, losing energy and condensing back into liquid water), or when you breathe out on a cold morning and see a cloud (warm water vapour in your breath meets the cold air, loses energy and condenses into liquid water drops).

What is a drought?

We say that there is a drought in an area when there is not enough water to meet normal use over a long period. You can't have a drought after just a week of no rain.

The Bureau of Meteorology studies months of rainfall data, comparing to what has fallen in the past. Some parts of Australia do not have regular rainfall and can experience many years of drought conditions.

What is dry ice? Is it the same as frozen water?

Dry ice is made of carbon dioxide, not water. Dry ice is used to keep things cold and for fun special effects like fog or mad scientist laboratories in movies. Solid carbon dioxide is –78 degrees Celsius, it is so cold that it can burn your skin like boiling hot things. Carbon dioxide changes state in a different way to water. On Earth carbon dioxide does not occur in liquid form. When energy (heat) is added to solid carbon dioxide (dry ice) it changes directly from a solid into a gas. This is called sublimation.

Is everything solid or frozen at 0 degrees Celsius?

No, and even water isn't always solid at 0 degrees! Different materials will freeze at different temperatures, it depends on how their molecules are arranged. Carbon dioxide freezes at –78 degrees Celsius - much colder than water. We can even lower the freezing point of water to make it stay liquid at 0 degrees. If we add salt to water, it is harder for the water molecules to crystalise (to join and change into a solid), as the salt molecules get in the way. Salty water is still liquid at 0 degrees - this is why salt is sprinkled on icy roads to stop them from freezing.

What is the steam that we see coming out of the kettle?

Steam that we can see coming out the top of a kettle, or from a boiling pot on the stove, is actually made up of tiny drops of water. It is not water vapour, a gas. Remember that we can't see water in a gas form with our eyes. Water vapour that evaporates from the liquid water (in the kettle or the pot) meets the cooler surrounding air, loses energy and condenses from gas into the liquid form.

Why do some people have rainwater tanks?

In Australia, lots of families have rainwater tanks. Some people (usually not in cities) use this for all their fresh water (for drinking, washing, cooking). Many people in the cities, who have water that comes in pipes to their houses, also have rainwater tanks. City people usually collect water to use on their gardens or sometimes to flush their toilets. Some parts of Australia do not have regular rainfall and people are trying to use less water from rivers, lakes, and dams.

How much rain do places in Australia get each year?

There is a big range of rainfall totals over different areas of Australia. A great place to learn more about this is from the Bureau of Meteorology.

Daily, weekly, monthly, or yearly rainfall totals can be found for many locations around the country. This can be a great resource to use after flood events or as part of a combined science/geography topic.

What do I need to know about being safe in floods?

The SES (State Emergency Service) provides good information to help you out in different emergency situations. The main thing to stress to kids is to not enter floodwater, and to stay away from creeks, canals and especially stormwater drains.

How big is a water molecule?

Water molecules are tiny – we cannot see them with our eyes. One water molecule is about 0.27 nanometres across (a nanometre is one billionth of a metre). This is so small that it is hard for us to understand! We can try another way – how many water molecules are in a drop of water? Scientists have calculated that there are more than 1.5 sextillion molecules in just one drop of water (a sextillion has 21 zeros – 1,000,000,000,000,000,000,000).

OUTSIDE OR SUPPLEMENTARY READING

Melbourne Water

- https://www.melbournewater.com.au/water-data-and-education/learning-resources-and-tours

Bureau of Meteorology

- http://www.bom.gov.au/climate/rainfall/

Victoria State Emergency Service (SES)

- https://www.ses.vic.gov.au/plan-and-stay-safe/emergencies/flood

TOPIC WORDS

- evaporation
- condensation
- precipitation
- water cycle
- weather
- seed
- plant
- life cycle
- shoot
- freshwater
- cloud
- solid
- liquid
- gas
- reversible

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