



ACTIVITY: Weather monitoring

ACTIVITY OVERVIEW

Weather is a topic that is important to people all over the world and in many parts of our lives. We rely on weather forecasts to help us work out what to wear, how to get to school and where to play. Many adults are dependent on certain types of weather to be able to work efficiently and comfortably. But how accurate are the weather forecasts we are given?

By making our own weather observations and comparing these to the Bureau of Meteorology forecast, we can learn about the collection of data, as well as verification and analysis of results. Many different instruments are used to collect weather observations, as well as data obtained from environmental satellites, orbiting Earth.

Weather observations and forecasting provide links between several areas of the curriculum, including Digital Technologies, Science, Mathematics, Geography and Sustainability.

SYNOPSIS

Weather is a topic that is important to people all over the world and in many parts of our lives. We rely on weather forecasts to help us work out what to wear, how to get to school and where to play.

Many adults are dependent on certain types of weather to be able to work efficiently and comfortably. But how accurate are the weather forecasts we are given?

By making our own weather observations and comparing these to the Bureau of Meteorology forecast, we can learn about the collection of data, as well as verification and analysis of results.

Many different instruments are used to collect weather observations, as well as data obtained from environmental satellites, orbiting Earth. Weather observations and forecasting provide links between several areas of the curriculum, including Digital Technologies, Science, Mathematics, Geography and Sustainability.

Foundation – Year 2

- Recognise and explore patterns in data and represent data as pictures, symbols and diagrams (VCDTDI014)
- Collect, explore and sort data, and use digital systems to present the data creatively (VCDTDI015)
- Explore how people safely use common information systems to meet information, communication and recreation needs (VCDTCD018)

Year 3 – 4

- Recognise different types of data and explore how the same data can be represented in different ways (VCDTDI020)
- Collect, access and present different types of data using simple software to create information and solve problems (VCDTDI021)
- Explain how student-developed solutions and existing information systems meet common personal, school or community needs (VCDTCD025)

Year 5 – 6

- Acquire, store and validate different types of data and use a range of software to interpret and visualise data to create information (VCDTDI028)
- Explain how student-developed solutions and existing information systems meet current and future community and sustainability needs (VCDTCD034)

ACTIVITY, MATERIALS AND INSTRUCTIONS

Activity – Weather monitoring

How accurate is the weather forecast made each week? The Bureau of Meteorology considers many factors when predicting our weather. But are the predictions reliable?

Instructions

Take a week's weather forecast and made your own measurements to compare.

This could be as simple as taking five minutes each day to discuss what you can see in the sky, or more involved activities, such as recording temperature, windspeed and rainfall.

1. Go to the Bureau of Meteorology website (<http://www.bom.gov.au>). Find the weekly forecast for your local area by choosing your state, forecasts, and the closest location to your school. For example, here is the Scoresby forecast (<http://www.bom.gov.au/vic/forecasts/scoresby.shtml>).
2. Choose part/s of the forecast that your class will monitor during the week. This may include the picture, maximum or minimum temperature, chance of rainfall, windspeed, or particular weather words found in the forecast (e.g. fog, storm, hail).

What you can monitor will depend on equipment available at your school. If you are lucky enough to have a weather station, you can choose any of these weather observations!

Other suggestions are:

- Picture – ask students to do a drawing of what the sky looks like that day, using tablets students take photos of the sky at the same time each day.

- Temperature – using thermometers, students record the temperature during the school day, if you have a min/max thermometer you will be able to record the temperature extremes. Temperature is recorded in degrees Celsius (°C).
- Rainfall – using a rain gauge (that you empty every day), record daily rainfall, you could even make your own rain gauges using instructions like these - <https://www.youtube.com/watch?v=QOzdcM-YZ2U> (but make sure you wait for the jelly to set before you put the rain gauge outside). Daily rainfall is measured in millimetres (mm).
- Windspeed – we measure windspeed using an instrument called an anemometer. If you don't have anemometers at your school, we can make our own using a ping-pong ball, protractor and string. Here's one way to make them - <https://www.canada.ca/en/environment-climate-change/services/sky-watchers/teacher-corner/build-your-own-anemometer.html> (Note - if you don't want to use needle and thread, you can use hot glue to secure the string to the ping-pong ball). Windspeed on the land is usually measured in kilometres per hour (km/h), while windspeed on the water is measured in knots.
- Weather words – you may like to refer to information from the Bureau of Meteorology here <http://www.bom.gov.au/info/wwords/>

3. Record your results throughout the week.

This could be done as a class on the board, in students' books or diaries, in an online shared class document, or as individual student spreadsheets.

Make sure that you record the forecast information for each day, leaving space to add your observations.

4. Compare your results to the predictions.

Was the forecast the same as predicted by the Bureau of Meteorology? If not, do you have any ideas why it might have been different? Was the forecast for your exact location or somewhere nearby? Did you see rain clouds but not have any rainfall during the week? Did you measure the temperature at the warmest/coldest time of the day? How accurate were your measurements? Do you get much wind around your school buildings?

HOW TO USE THIS ACTIVITY WITH YOUR STUDENTS

Foundation – Year 2

Use this activity as an interesting and relevant way to teach children about the way that we represent data, collect data, and verify (check) data.

The Bureau of Meteorology (BOM) is full of people who love learning about weather and want to share that information with us. One of the jobs that the BOM does is to give us a forecast (or prediction) for what the weather will be like in the place we live this week. This helps us to plan what outdoor activities we do during the week (e.g. inside/outside sport for PE class, can I play tennis on the weekend, should we go to the beach on Sunday, do I hang my washing inside or outside, what time should I walk the dog, can we walk to school, will we have a wet day timetable). Lots of people across Australia rely on this information. Is it accurate? Is the predicted weather what actually happens?

Younger students can approach this activity using the picture symbols we see associated with weather, such as the combinations of sun, cloud and rain that are drawn to summarise each day's expected weather. Students

will need to draw or choose a weather symbol that shows the weather they have observed each day. This can be done individually, in groups, or as a whole class.

After data collection, compare the students' observations with the predicted weather. Were there any big differences? Did anyone get wet walking home from school? Who are the people who are most affected by the weather every day? This could link to a discussion about jobs that are affected by weather, perhaps students could share information about their parents' work. Jobs like gardening, construction, farming, crossing guards are affected by the weather.

Extend this activity by asking students to present their own weather forecasts to the class. This activity could be filmed or done as live presentations. Prompt students to include:

- a picture that matches your favourite type of weather (could be on paper or projected on screen),
- one activity that you like to do in this weather
- one item of clothing that you would usually wear during this weather (optional – bring the item to school to show the class)

Years 3/4

Use this activity with your Year three and four students to explore the representation, collection and use of data.

What does the BOM tell us about the weather each day? Why are these things important? People experience different weather every day, in locations across Australia. We all use data from the Bureau of Meteorology to help plan our weekly outdoor activities.

Students should record details for clouds, temperature, rainfall, and wind direction. This information can be recorded in table format, next to the predicted weather conditions from the BOM website.

Wind direction can be determined if you know which direction is north. When we talk about wind direction, we are talking about the direction that the wind comes from. A north wind blows from the north to the south. Wind direction can be determined using students with long hair. If the wind blows hair into your face, you are looking away from the direction that the wind comes from. If your hair is blown completely off your face, you are facing the wind. You can also try to work out wind direction by licking your index finger, then holding it up with your eyes closed. The side of your finger that feels the coldest is the direction that the wind is coming from.

In a link with maths, students in Years three and four can graph the temperatures or rainfall observed throughout the week.

Explore the questions at the end of the activity with your students. There are lots of different jobs where people have to check that the provided information is accurate (e.g. editors, auditors, fact-checkers during election time, scientists). Accuracy of data online is of particular interest now, as people can put anything they like on a website, and we need to be able to work out which information is true and accurate.

Comparing weather data around the world

- <https://worldweather.wmo.int/en/home.html>

Use the World Weather Information Service to find today's weather in different cities of the world.

Students can search for the weather in locations where their family members or friends live. What place would students like to visit for a holiday? Who has chosen the hottest place? Who has chosen the coldest place? Who will need to pack their wet weather gear?

Years 5/6

Use this activity with your Year five and six students, to cover content from Technology, Maths and Science areas, as all include data collection, analysis, and communication.

Students work in small groups to monitor different aspects of the weather throughout a week, comparing each day's observations with those predicted by the Bureau of Meteorology at the start of the week. Groups can record – cloud cover, maximum temperature, minimum temperature, wind direction, wind speed.

This activity will take up a few minutes each day and require longer class time for the data sharing and comparison at the end of the week. Year five/six students can make their own rain gauges and anemometers to record the rainfall and wind speeds (see links to instructions above). Note – if you do not have time or equipment to monitor temperature, rainfall, and wind, you can access daily information from the BOM for different locations. You will need to remember to do this once per day. This is an example of Melbourne observations <http://www.bom.gov.au/vic/observations/melbourne.shtml?ref=hdr>

Weather observations used to be made using instruments operated by people, with results recorded by hand into books. Now, this information is recorded digitally, by automatic equipment placed in weather stations all over the world.

Data recorded in these weather stations (like temperature, wind speed, rain since 9am) is recorded online and we can access this information easily.

Students record weather observations in a table that includes BOM predictions.

Students can produce line or bar graphs to compare predicted and actual temperatures over the week.

Checking the weather predictions/forecast is a way of validating data (checking that it is accurate). People are going to be annoyed if the weather forecast is not close to what happens, as many jobs rely on fine weather outdoors, so scientists and mathematicians at the BOM have developed complicated models to help predict what we will experience, based on what has happened in the past.

Should we build a wind turbine at your school? Here is an opportunity to link weather observations to alternative electricity sources. Wind power uses movement energy from the wind to make a magnet move inside a coiled copper wire (inside a turbine), which transforms this energy into electrical energy that can travel along wires to our homes.

Research areas around Australia that are suitable for wind farms. Coastal areas are very popular, as they have predictable wind speeds and directions. Those huge white wind turbines usually start spinning when the wind speed is around 15 kilometres per hour.

Should your school have a wind turbine to generate electricity? (Maybe solar panels would be better!) Can you measure wind speeds greater than 15 km/h? Maybe some areas of your school are windier than others? What would your school look like with its own wind farm?

If you haven't already made your own ping-pong anemometers, use the instructions given earlier. Anemometers can be used to measure wind speeds around your school.

DISCUSSION SECTION AND KEY THEMES

KEY THEMES

Collecting weather data

In Australia, the Bureau of Meteorology collects daily weather observations from its weather stations. A weather station contains instruments to measure elements including temperature, humidity, rainfall, sunshine, wind, and cloud.

Weather stations are located all over Australia, regularly providing us with observations. Some weather stations are automatic, sampling weather elements and sending data back to a central database, while some weather observations are still conducted by people. Many people have their own instruments to measure temperature and rainfall at home. At some weather stations hydrogen-filled balloons are released into the atmosphere, so that conditions can be observed at heights above ground-level.

Australian digital weather records can be accessed through the Climate Data Online page of the Bureau of Meteorology website (<http://www.bom.gov.au/climate/data/>).

This data allows us to look at changes over time in the weather of Australian locations.

You can search for a location using name or map, then view records of rainfall, temperature, and daily solar exposure.

Online weather information

Weather observations and forecasts for places all over the world are easily found online. This means that anyone with internet access can find weather information for their own local area or anywhere else in the world. A good source of world weather data is the World Weather Information Service, <https://worldweather.wmo.int/en/home.html>.

Weather forecasting

The scientists that observe and predict our weather are called meteorologists. They use observations, computer models and their experience and knowledge to make these predictions. Observations of the weather are taken throughout different parts of the atmosphere, including land-based weather stations, weather balloons, research aircraft, satellites, buoys, and ships.

In Australia, we have our own computer weather model, called Australian Climate Community Earth Systems Simulator (ACCESS). Past and present weather observations are entered into the model, which then uses a huge number of mathematical calculations, based on the laws of physics in the atmosphere, to predict what is most likely to happen next.

Meteorologists also use their own scientific knowledge and experience at specific locations to add to the weather forecast for their region. For example, meteorologists working in Melbourne would have a good understanding of areas affected by sea breezes off Port Phillip Bay, as well as those suburbs likely to experience less rainfall than others, due to local topography (shape of the land).

Forecasts are usually given for seven days ahead, as this is the limit of reliability of the computer models.

What is a computer model?

A model is a representation of something that happens or exists in real life. We use the word model to represent small versions of objects (e.g. model trains, Lego models), but models can also be computer programs, a collection of instructions that are used to represent a process that happens in real-life. A computer model is a collection of mathematical equations that, together, are able to give a prediction – in this case, of the weather. The computer model needs people to input data, such as past and present weather observations (e.g. temperature, wind speed, cloud cover), then this is used in the equations to make calculations about what is most likely to happen next. You can read more about computer models at this website <https://www.sciencenewsforstudents.org/article/explainer-what-computer-model>.

Universal weather symbols

Weather symbols are a language used to communicate different weather conditions. Symbols, or icons, are made to be easy to understand. You don't need to read full sentences about a day that is sunny with light winds, as this can be represented by a picture of a sun. Some symbols are not used in all locations, for example, we are unlikely to see a snow or cyclone symbol in Melbourne.

Common meteorological instruments

- Thermometer – measures air temperature in degrees Celsius (°C)
- Barometer – measures air pressure in hectoPascals (hPa)
- Anemometer – measures wind speed in kilometres per hour (km/h)
- Wind vane – measures the direction that the wind is coming from (e.g. north, south, east, west)
- Rain gauge – measures rainfall in millimetres (mm)

- (Note – snow depth is recorded rather than snowfall, as it is difficult to collect falling snow)
- Ceilometer – measures the height of clouds above ground-level
- Cameras – may be used to provide additional information about weather conditions
- Lightning/thunderstorm detector – records strong radio waves, which are produced by lightning strikes
- Hygrometer – measures relative humidity as a percentage (%)

QUESTIONS AND ANSWERS

How do scientists use drones to research weather?

There are two useful ways that scientists use drones to research the weather. One way is by attaching meteorological instruments to the drone (or UAV – unmanned air vehicle), then collecting data while flying. Meteorologists also use drones to take aerial photos or videos. For example, after flooding or storms, it can be helpful to survey the damage by flying drones over difficult terrain, to assist in predictions for future events.

Do satellites help with forecasting the weather?

There are thousands of satellites in orbit around Earth right now, with some of these making meteorological observations. Satellites take measurements of reflected light and infrared temperatures in the atmosphere.

Satellites also record images of Earth, showing us the beautiful swirling cloud patterns that we are shown during weather forecasts.

From these images, scientists can also calculate wind speeds and direction.

Information from satellites is sent to Earth as a series of numeric codes. The computers on Earth assemble this code into images or measurements of weather conditions.

Geostationary satellites orbit directly over the Equator, moving at the same speed as Earth is rotating. This means that they are constantly observing the same part of Earth, although these satellites cannot see the poles.

Polar orbiting satellites pass over the north and south poles, with an individual orbit path. Over a day, these satellites can almost completely observe the surface of Earth twice.

Australia has access to satellite data from China, Europe, Japan, and the USA. To receive all this data, the Bureau of Meteorology has to have high bandwidth internet and special satellite data reception sites. We also have a dedicated fibre optic line from Japan, to obtain data from the Himawari-8 satellite, a geostationary satellite that can record images at 0.5 – 2km resolution.

How important is maths in meteorology?

Maths, as well as physics, helps meteorologists understand how the atmosphere works. There are mathematical equations used to predict things like wind speeds, temperatures, and movement of clouds. Meteorologists work with averages, maximums, minimums, different units, big and small numbers. Physics helps to explain movement and forces affecting our atmosphere, with physics equations also relying on an understanding of maths. To make weather predictions meteorologists put together many different equations into their computer models and input historical weather observations to give us (usually) accurate forecasts. Yes, maths is very important.

How do the automatic windscreen wipers on my car work?

Cars with automatic wipers have a rain sensor system, which is located near the rear-view mirror, on the inside of the windscreen. The system shines an infrared light into the windscreen.

If the glass is dry, most of the light is reflected onto the sensor by the front of the windscreen.

If there is water on the windscreen, the light is scattered by the drops of water and less light bounces back to the sensor.

When the amount of light being reflected to the sensor gets below a set amount, the electronics in the sensor turn the wipers on.

The computer program in your car can change the speed of the wipers to the faster one if it senses that less light is being received between wipes. It will adjust back to the slower speed, or even stop wiping, if more light is being received back at the sensor again. It's helpful to drivers to have this feature to assist during wet-weather driving.

Can animals predict the weather?

Scientists are still studying links between the weather and animal behaviour.

It is likely that the enhanced senses of animals (e.g. hearing, smell) can sometimes make it seem like they can predict the weather.

Some animals can hear lower sounds than us, called infrasonics. Cattle, elephants, birds (and maybe even dinosaurs) can hear lower sounds, like those produced by earthquakes, ocean waves, thunder, and cyclones.

Some animals, like sharks, birds, bees, and ants, can also sense changes in air or water pressure, which can give them a signal to swim deeper or fly to another location.

Here in Australia, research has shown that native blue-banded bees emerge from hibernation when desert flowers start blooming. The bees and the flowers are both responding to the high humidity in the atmosphere.

Where were the hottest/wettest places in Australia in 2021?

- Highest Australian temperature in 2021 was 47.9°C at Mardie, Western Australia.
- Hottest on record was 50.7°C in Oodnadatta, South Australia, in 1960.
- Lowest Australian temperature in 2021 was -10°C at Perisher Valley, New South Wales.
- Most 24-hour rain in Australia in 2021 was 550mm at Byfield, Queensland.

How long have people been observing and predicting weather in Australia?

Traditional weather and climate knowledge has been developed and passed down by Aboriginal and Torres Strait Islander people for thousands of years.

The Gariwerd people divide the year into six seasons, based on weather observations. For example, Gwangal moronn season (honey-bee season) has warm still days, cooler mornings, red sunrises, and golden evenings. You can read more about Indigenous weather knowledge at the Bureau of Meteorology website (<http://www.bom.gov.au/iwk/>).

Are television weather presenters actual meteorologists?

In Australia, all tv stations report the same forecast from the Bureau of Meteorology, so it doesn't really matter if the presenter is a scientist or not.

However, presenters who are trained meteorologists can add further details to a weather report or answer viewer questions.

In Melbourne, Nate Byrne (ABC) and Jane Bunn (7) are tv presenters and meteorologists. Livinia Nixon (9), Paul Higgins (ABC) and Kate Freebairn

(10) are not scientifically trained but present the weather reports for their television stations.

Why is there different weather in different places around the world?

Different parts of Earth get different amounts of daily sunlight (and therefore heat), due to the tilt that Earth has in relation to the Sun.

The poles receive the least amount of light and heat, while the equator receives the most.

Earth's axis is tilted 23.5°C, which gives us our seasons, as different parts receive more or less sunlight (and heat) at different times of the year.

Warmer and cooler parts of the atmosphere cause the movement of air, which is wind. Mountains, oceans, and forests can affect local weather conditions.

Is the weather related to climate change? What's the difference between weather and climate?

The weather is what is happening outside, in the atmosphere, over a short period of time. Weather happens today, tomorrow and this week.

Climate refers to the typical weather conditions of an area over a longer period - usually 30 years or longer.

Climate change refers to long-term changes in temperature and weather patterns. Climate change has happened many times in the past.

However, since the 1800s, climate change has been caused by people, with the main contributor identified as the extra carbon dioxide gas formed by burning fossil fuels (coal, oil and gas).

OUTSIDE OR SUPPLEMENTARY READING

How meteorologists forecast the weather (Bureau of Meteorology)

- <https://media.bom.gov.au/social/blog/1696/explainer-how-meteorologists-forecast-the-weather/>

Questions you've always wanted to ask a meteorologist (ABC)

- <https://www.abc.net.au/news/2017-03-23/bom-forecasts-and-the-questions-you-want-to-ask/8375312>

Barometers

- <https://www.abc.net.au/local/stories/2010/01/13/2791475.htm>

Animals and weather prediction

- <https://www.abc.net.au/science/articles/2010/05/18/2902595.htm>
- <https://science.howstuffworks.com/nature/climate-weather/storms/animals-predict-weather2.htm>

NASA Climate Kids

- <https://climatekids.nasa.gov/weather-climate/>

Climate change in Australia (CSIRO)

- <https://www.csiro.au/en/research/environmental-impacts/climate-change/climate-change-information>

Environmental satellites

- http://www.bom.gov.au/australia/satellite/about_satellites.shtml

TOPIC WORDS

- meteorology
- meteorologist
- weather
- observations
- data
- satellite
- measurement
- forecast
- prediction
- model
- verify



PRIMARY + STEM

**For more teaching
resources, visit**

WWW.PRIMARYANDSTEM.ONLINE

Supported by

The Invergowrie Foundation

Swinburne University

**The
INVERGOWRIE
Foundation**

