scitech

Schools' Weather Wall

Scitech Weather Kit

scitech.org.au

7NEWS REGIONAL WA

Schools' Weather Wall

Welcome to the Scitech Weather Kit

This kit was produced by Scitech for the use of schools participating in the 7NEWS Regional WA Schools' Weather Wall program. It provides teachers and students with weather measuring instruments and resources which can be used to help achieve learning outcomes in science, mathematics, geography, health, and physical education. The kit is yours to keep at the completion of your involvement in the program to continue the learning experiences of your students.

The four pieces of equipment provided in the kit are used to measure, estimate, or identify:

- **Temperature**: maxima-minima thermometer
- **Rainfall**: rain gauge
- **Wind direction**: compass
- **Cloud cover and types**: sky chart

The accompanying written information in the weather kit was developed with generous assistance from the Bureau of Meteorology. It is divided into three sections:

Section One – Introduction for teachers

This section includes ideas on how to incorporate the weather instruments into a teaching program, and suggested activities based on the relevance of weather to everyday life. It also includes information about weather warnings and UV radiation.

Section Two – How to use the instruments

Instruction sheets describing how to use each piece of equipment provided in the kit.

Section Three – Further information

Information about other learning programs and educational resources that will allow further exploration of the topic of weather.

We hope you enjoy the 7NEWS Regional WA Schools' Weather Wall program, which will provide a great learning resource you can continue using into the future. The following page has the instructions for submitting your weather data via the Scitech website on your allocated day. If you have any inquiries about any aspect of the program, please contact us:

Tel: (08) 9215 0740 • Email: bookings@scitech.org.au

Good Luck!

On your allocated reporting day, you need to submit your results by logging on to the Scitech website. Please submit your results between 12:30pm and 2:30pm.

- Go to the Scitech website *www.scitech.org.au*
- Click on ‘Educators’ in the top right-hand corner and select ‘Learn’.
- Scroll down and select ‘Initiatives’.
- Scroll down to Schools’ Weather Wall section. Click on ‘Find out more’.
- Once you are on the Schools’ Weather Wall page, scroll down and click on ‘Submit a Report’. You will be directed to the data submission form.

You will be asked to submit measurements for maximum/minimum temperatures and rainfall once a week. Any information you collect on clouds and wind direction is for your own use. If you have not managed to collect all your readings, don’t worry, just enter what you have. As rainfall is measured over a 24-hour period, you will need to empty your rain gauge 24 hours before you expect to check it, e.g., empty it at 11am on Tuesday if you report on Wednesdays.

Recording and reporting happen on the same day, your allocated day. Your school’s weather measurements are then read during the weather segment of 7NEWS Regional WA that evening. For example, if your allocated day is Wednesday, you need to empty your rain gauge and reset your thermometer around 11am on Tuesday. Then, measure your weather results about 11am on Wednesday. Report the data via the Scitech website before 2:30pm Wednesday. 7NEWS Regional WA will broadcast your results on Wednesday night. Your minimum will be from Tuesday night and your maximum temperature will be from Tuesday afternoon or Wednesday morning depending on which day is hotter.

Your school will be participating in the 7NEWS Regional WA Schools’ Weather Wall once a week all term, which means that your students will have several chances to see their names on 7NEWS Regional WA!

Section 1

Introduction for teachers

Schools' Weather Wall

Suggested activities

The following scenarios give you ideas about how the weather instruments might be incorporated in a learning program. Various real-life situations are listed first. Other scenarios are then listed by subject.

In real life

🐟 **Fishing and the weather:** Can the fishing fleet go out to sea? Consider the wind speed and direction, swell and currents, and how long the conditions are likely to last. Think about how the weather might affect the catch. Is it worth taking the boat and crew out?

🏃 **Comfort level in sport:** Athletic performance is affected by the weather. Consider how uncomfortable exercise is in hot, humid weather. Certain combinations of conditions – such as high temperature and humidity, or strong winds from a certain direction – can lead to the postponement or cancellation of events. The conditions might pose too high a risk or assist athletes unfairly. The conditions in a stadium can be quite different to outside. The structure might create extra shade but might also trap heat. See if you can measure these differences.

⛷ **'Right' conditions for sport:** Skiers and surfers tend to be very aware of weather conditions. What combination of weather elements, such as temperature and wind speed and direction, are "right" for your favourite sport?

Emergency services: Firefighters and other emergency services staff are aware that the weather is an important influence on the severity of natural disasters such as bushfires, floods, tropical cyclones, and gale force winds. What are the main weather factors that determine the severity of these events, and what can you do to prepare?

🌱 **Agriculture:** Farmers are generally aware of the profound effect that the weather has on their livelihood. What sort of conditions are best to plant a crop, to spray for insects or fungal outbreaks, to cut and bale hay, or to shear sheep? What are the upper and lower limits of temperature, wind speed or rainfall for different farming activities?

Urban environment: People living in metropolitan areas are affected by weather in different ways to those in rural and regional Australia. Town planners need to be aware of rainwater drainage where concrete and tarmac cover the ground, of wind loads on buildings, and of heat trapped in big cities. Forecasts of smog, which are more likely in certain weather conditions, need to be issued so that people with asthma can take precautions. Warnings of black ice, snow and fog must also be issued for drivers and pilots.

Human psychology: Changes in the season can have an impact on our moods. Some people suffer from Seasonal Affective Disorder (SAD), which has been linked to long, dark winters. This is important for those planning to work in Antarctica, for instance, where winter is one long night with little daylight.

By subject

The following suggestions are grouped according to subject area and are intended only as a guide. It includes suggestions on how to use the resources included in this kit across different subject areas.

Science

- Describe the correct use of scientific instruments.
- Examine the effects of weather on the playground.
- Use the equipment to collect weather data.
- Using the instruments provided as a starting point, design your own weather instruments.
- Compare your weather data with that of the Bureau of Meteorology. Refer to newspapers, television, radio and the Internet.

Science – Biology

- Measure the weather in various locations outside, noting the differences. This introduces the concept of microhabitats: sheltered areas, sunny exposed areas, close to the ground, higher in the air, burrows, etc.

Science – Physics

- Investigate how water, wind and temperature affect each other (i.e. evaporation and latent heat).
- Devise experiments to monitor meteorological conditions over time.

Geography

- Think about the association between the weather and farmers and gardeners. Think about soil temperature, and the differences in growing habitats for plants and animals. How does the weather affect plants on the small and large scale?
- Use the Bureau guidelines for issuing a farmers and graziers warning and a brown rot warning (see Section 2 and 3 for more information). Compare your measurements with the guidelines.

Technology

- Write a program to calculate the averages of collected weather data and present the information graphically.

Mathematics

- Learn how to read different scales on the equipment and associated charts while collecting data.
- Complete statistical analyses of collected data.
- Compare measured temperatures with Bureau of Meteorology readings reported in newspapers and on television, radio and the Internet. Find out where your closest Bureau of Meteorology observation point is and try to work out why there might be differences. Are the Bureau's real-time observations reported on the Internet?
- Compare the forecast maximum and minimum temperatures with those actually measured. Think about the accuracy of the forecasts and the measurements. Does the accuracy of the forecasts improve as you get closer to the actual day?
- Collect and compile observations over a period of time and create tables, graphs and charts. Use the information to make your own predictions and compare them to what actually happens.

Physical Education

- Measure the wind speed and direction and the temperature in both goal areas, and in the grandstands. This can be applied to a variety of sports such as football, soccer and basketball, both indoor and outdoor.
- Develop a general understanding of "reading" the weather, with and without equipment, for camps and field trips.

Languages other than English

- Learn the language of weather and the equipment, then use the language in conversation or writing.
- Collect readings using the equipment and compile a report on the findings in another language.
- Learn the local indigenous names for the seasons and weather events.

English

- Write and present the collected data.
- Describe the weather in writing.
- Describe how you used the equipment in writing.

Humanities and Social Sciences

- Research key historical figures in meteorology.
- Investigate how weather impacts community decision making – where we live, the type of houses we build, planning and preparing for weather emergencies are all important decisions we have to make based on weather data.
- Explore local indigenous weather knowledge and its role in environmental conservation and sustainability.

Weather warnings for crops

The weather not only affects human comfort levels, it can also have a serious impact on agricultural crops. Warm, humid conditions can make you feel lethargic, but they also facilitate fungal diseases that reduce crop yields and spoil fruit. The Bureau of Meteorology in Victoria issues warnings when conditions favor the fungal diseases brown rot and black spot.

For an outbreak to occur, fungal spores must be in contact with liquid water on the fruit or leaves for a period of time. That time varies with temperature – the higher the temperature the less time it takes for an outbreak to occur.

For a light infection (brown rot) to occur, the fruit or leaves must be wet for 140 degree hours – that is, the number of hours of wetness multiplied by the mean temperature in degrees Celsius. This is known as the ***Mills period***. The Mills period for a moderate fungal infection is 200 degree hours, while for a heavy infection (black spot) it is 300 degree hours.

In deciding whether to issue a weather warning for fungal outbreaks, the mean temperature is relatively easy to forecast. Estimating how long the fruit or leaves will stay wet is more difficult, partly because trees will dry unevenly. Some latitude must be allowed in estimating the period of wetness.

It can, however, be assumed that after an initial wetting, fruit or leaves stay wet while the relative humidity is near or more than 80 per cent. There is a good chance that the relative humidity will stay near 80 per cent into the night if clouds persist after sunset.

For example, the forecast is for rain from 3pm with cloud cover until after sunset. There is a reasonable possibility that the relative humidity will stay around 80 per cent until at least midnight. If the forecast mean temperature for the period is 16 degrees Celsius, then the forecast Mills period is 16 x 9 = 144 degree hours. This would justify a brown rot warning.

Farmers and graziers warning/alert

Cold, wet and windy weather can have a disastrous impact on livestock, particularly freshly shorn sheep, as well as young animals such as lambs and calves.

From September to April, the Bureau of Meteorology can issue a farmers and graziers warning when the weather poses a potential threat to livestock.

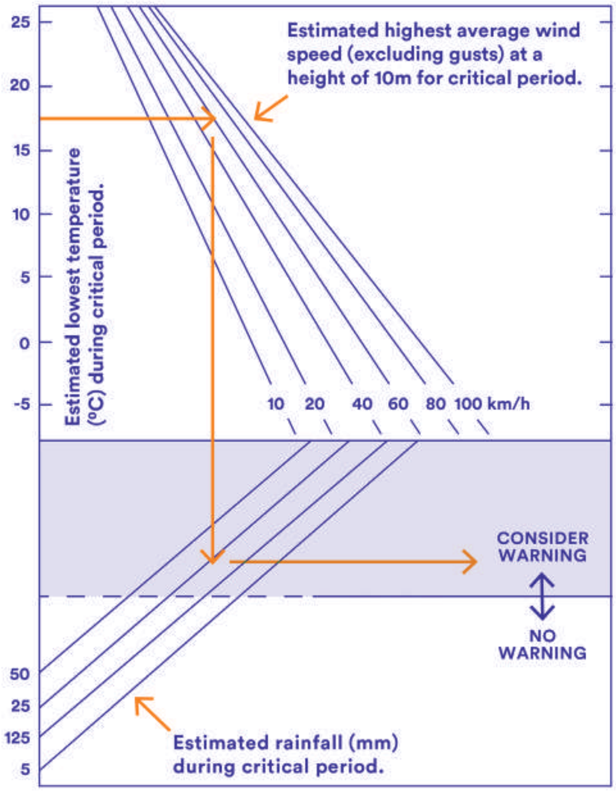
How does the Bureau decide when to issue a warning?

Warnings are issued at the discretion of senior forecasters, but there are various guidance tools at their disposal, such as the chart shown on the next page.

The chart – known as a nomogram – takes into account temperature, wind speed and rainfall during the critical weather period.

The example on the graph (red arrows) shows that with an estimated lowest temperature of 15 degrees Celsius, an estimated highest average wind speed of 20 kilometres per hour, and an estimated rainfall of 25 millimetres during the critical period, the forecaster should consider issuing a warning.

Another factor taken into account is that the most significant livestock losses occur when a spell of warm, dry weather is followed by the outbreak of cold, wet and windy conditions with a chill factor of 230 or more.



The following combinations of wind, rain, and temperature produce a chill factor of 230:

Temperature (°C)	10	10	15	15	20
Wind (knots)	10	15	10	15	15
Rainfall (mm)	10	8	20	17	30

However, when conditions are already cool, in early spring for example, a brief cold outbreak does not pose a serious threat. A warning would only be justified with prolonged periods of severe weather.

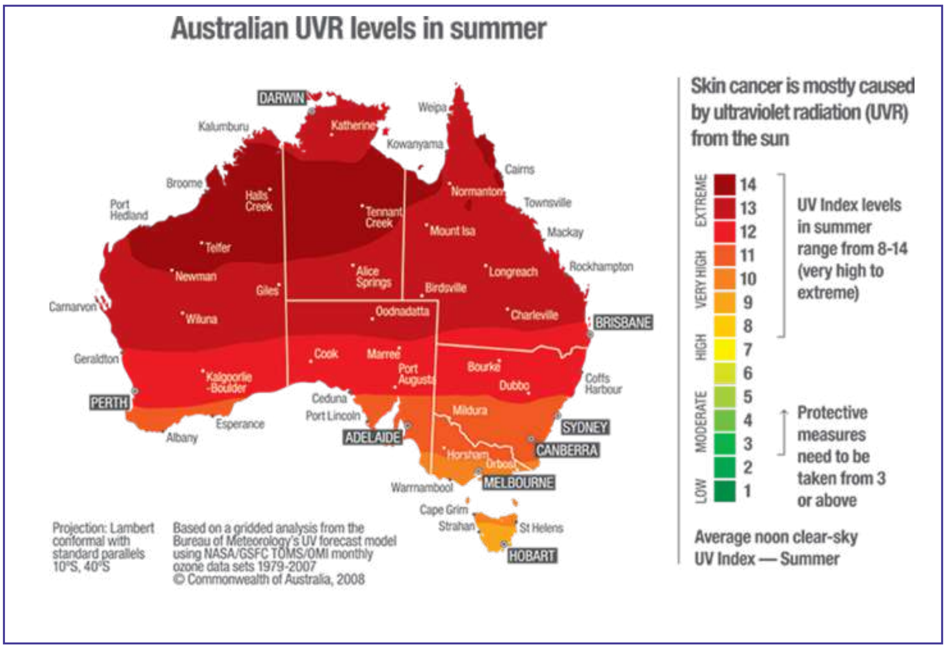
Ultraviolet radiation

Ultraviolet (UV) radiation emitted by the Sun is short-wave radiation just past the blue end of the visible light spectrum.

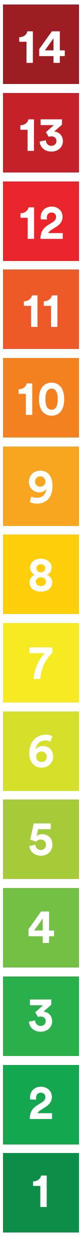
UV radiation is often divided into three sub-sections – UVA, UVB and UVC. The Earth's atmosphere blocks UVC radiation and all but a small amount of UVB, so the ultraviolet radiation at the Earth's surface is mostly UVA and UVB. UVB is the most harmful for humans.

There are many important reasons to be aware of the UV radiation at the earth's surface:

- The risk of skin cancer grows with every sunburn.
- Protecting the skin during the first 18 years of life is likely to reduce the risk of skin cancer by more than 50 per cent.
- Doctors associate eye cataracts with UV exposure.
- You can sunburn even on cloudy days. In some cases, UV radiation can penetrate clouds, mist and fog.
- Staying in the shade does not provide complete protection. A lot of UV radiation does come directly from the Sun, but some also bounces around as it is scattered by the atmosphere.
- Sunburn is not connected with the sensation of heat. You can still get serious sunburn in winter, despite feeling cold.
- Fresh snow reflects up to 80 per cent of the Sun's rays. Snow, water and concrete "mirrors" significantly increase sunburn. Skiing enthusiasts should be particularly careful to protect their eyes and skin.



UV levels



UV Index:	More than 9
Danger category:	**Extreme**
SunSmart info:	Extreme UV can cause unprotected skin to burn after just 12 minutes. (The Australian Cancer Society)
UV Index:	7 to 9
Danger category:	**Very high**
SunSmart info:	UV radiation can still be very high on days when there are clouds. Don't be fooled by a cloudy sky. (The Australian Cancer Society)
UV Index:	3 to 6
Danger category:	**High**
SunSmart info:	If levels are high, most people can get a nasty sunburn even when the temperature is less than 27 degrees Celsius. (The Australian Cancer Society)
UV Index:	Less than 3
Danger category:	**Moderate**
SunSmart info:	Moderate UV levels can still be present when it is cold, such as at the snow. (The Australian Cancer Society)

Section 2

How to use the instrument

Recording the daily maximum and minimum temperature

This is a digital maxima-minima thermometer. It is used to make multiple temperature measurements.

How to Use the Digital Thermometer:

1. Make sure you find a good, safe place to put your thermometer to measure the air temperature – somewhere off the ground and not in direct sunlight. Against a wall or a tree is a good place to set it.

2. Follow the instructions on the back of the box to set up your digital thermometer:

   STEP 1 : Remove the protective film from the LCD screen.
   STEP 2 : Open the battery compartment at the back of the device and remove the tab covering the battery terminal.
   STEP 3 : Reset the settings by pressing the red CLEAR button on the front face of the thermometer.
   STEP 4 : Ensure that the temperature reading is set to degrees Celsius by pressing the °C/°F button on the side of the device. You can check that the thermometer has been set to degrees Celsius by looking at the temperature reading on the LCD screen.

   You should now be ready to start taking temperature readings.

3. When reading the thermometer you can take three measurements – the current temperature, the daytime maximum and the nighttime minimum.
   - Current temperature: this is shown on the digital LCD screen at the bottom of the device.
   - Daytime maximum: this is shown on the **left-hand** column of the thermometer. You can read this temperature by measuring the height of the digital bar on the °C scale. This temperature reading shows the *highest* temperature recorded since the clear button was pressed.
   - Nighttime minimum: this is shown on the **right-hand** column of the thermometer. You can read this temperature by measuring the height of the digital bar on the °C scale. This temperature reading shows the *lowest* temperature recorded since the clear button was pressed.

Here is an example of how you may conduct your school's temperature measuring. Place the thermometer in your chosen location in the afternoon before your reporting day. Once setup, press the CLEAR button to start the recording. At 2pm the following afternoon, record the minimum and maximum temperatures. **Be sure to submit your results through the Scitech School's Weather Wall webpage before 2:30pm.**

How to measure rainfall using a rain gauge

Find a place outside for the rain gauge where there will be no run-off of rainwater from trees, roofs or signs. There is a minimum distance official rain gauges must be from obstructions such as these. If a nearby tree is five metres tall, the rain gauge must be at least twice the distance (10 metres) away.

Your rain gauge can be set up in three ways, but make sure it is safe from theft and damage (such as being trodden on).

- To make a freestanding rain gauge, place the cylinder inside the black holder so the spike points up. This gives a flat base.
- To fix the rain gauge to an object such as the top of a fence, secure the black holder to the vertical surface before inserting the cylinder.
- To put the gauge at ground level, reverse the black holder so the spike points down (main picture) and stick it into the ground.
- At 9am each day, record the rainfall, referring to the scale (in millimetres) on the cylinder, then empty the cylinder. If you catch hail or snow, wait for it to melt before taking a reading.

Tips

- Make sure the rain gauge is in a safe location.
- Make sure you take readings with the rainwater at eye level to avoid errors of parallax.

How does it work?

A rain gauge measures rainfall (in millimetres) over a set period, usually 24 hours. Official rain gauges have a housing to protect the measuring cylinder inside. The top of the housing has a larger surface area than the top of the measuring cylinder and catches more rain than the cylinder would. The extra rainwater collected makes it easier to read the measuring cylinder and improves accuracy. A simple mathematical formula is used to correct the rainfall total to allow for the extra rainwater collected.

Precipitation

Rain - Rain droplets vary in size from 0.5 millimetres to more than 5 millimetres in diameter. Rain normally falls from nimbostratus or altostratus clouds.

Drizzle - Drizzle droplets are smaller than 0.5 millimetres and generally fall from stratus clouds or fog.

Showers - Showers are precipitation that varies in intensity, generally falling from cumulonimbus or large cumulus clouds.

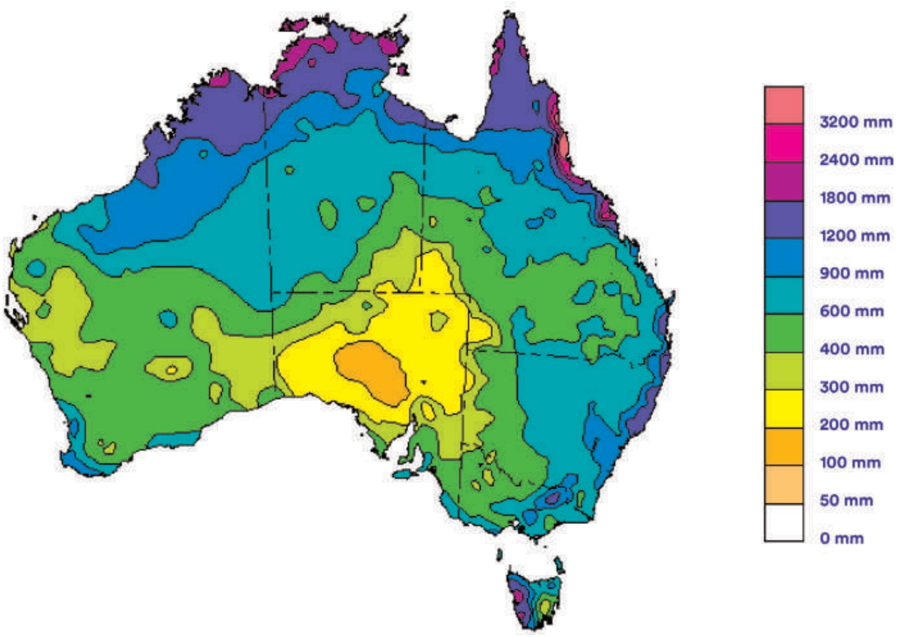
Snow - Snow forms when water vapour turns to ice without first condensing into a liquid. Snowflakes are composed of microscopic water crystals that cluster together in groups of 50 or more. When the temperature is low enough (say, minus 40 degrees Celsius), snow can fall from clear blue skies.

Hail - Hail is formed when water droplets freeze in high, very cold clouds.

Hailstones grow bigger as they are coated with successive layers of ice. This can occur when they are pushed up and down through the atmosphere by strong updraughts and downdraughts. Hailstones can also get bigger when they bang into each other and stick, forming conglomerate hailstones.

Hailstones are usually only as big as a pea, but cricket ball-size hailstones have been known to fall in Australia, such as during the Sydney hailstorm of 14 April 1999.

12-month rainfall analysis (millimetres), 1/7/99 to 30/6/00



How to identify cloud type using a cloud chart

First estimate how much of the sky is covered by clouds. The official unit of cloud cover is oktas, or eighths of the sky.

When the sky is completely covered by cloud (overcast), the cloud cover is eight oktas. When the sky is clear the reading is zero oktas.

As a guide, tear a piece of white A4 paper into eight equal-size pieces. To judge what a cloud cover of four oktas might look like, scatter four of the pieces on a full sheet of blue A4 paper.

Cloud types

To identify the type of cloud, go outside and refer to the enclosed *Sky Chart*. There can be more than one cloud type present at one time.

- Check if there are any large **cumulonimbus** or storm clouds (M, N, O, P on Sky Chart) – the large, fluffy clouds that are easy to recognise. These clouds can appear quickly and, with dark bases, indicate stormy conditions.

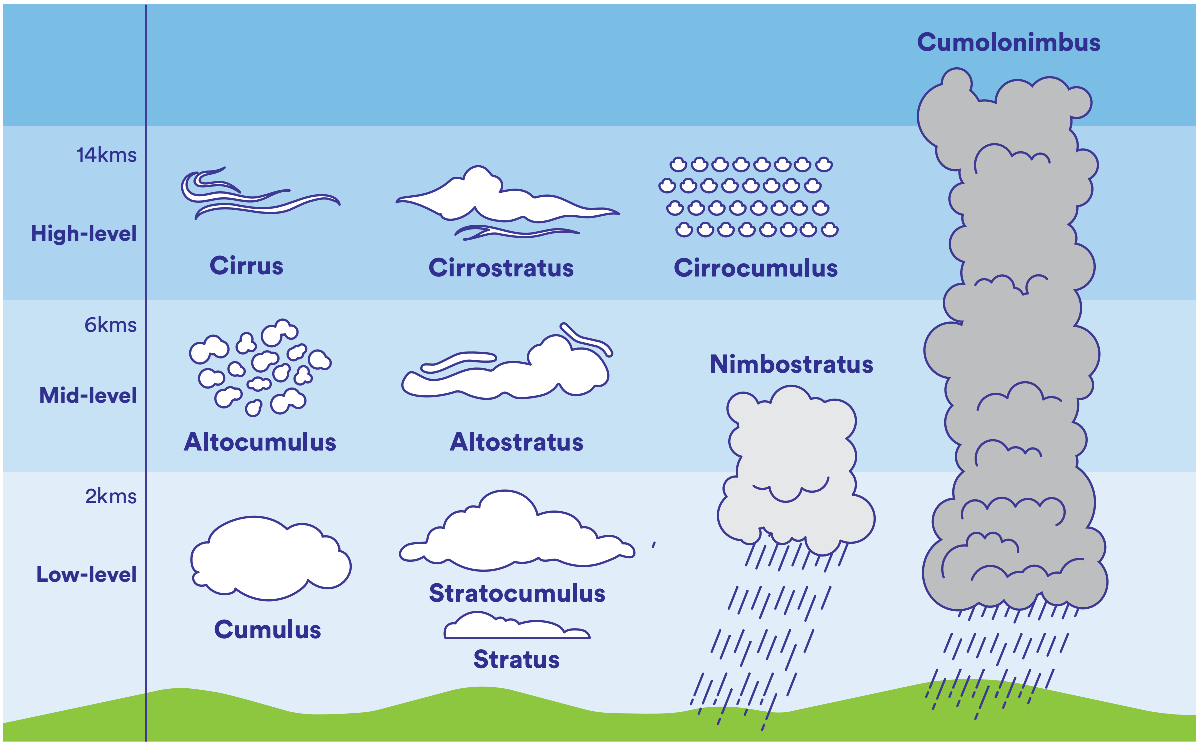
Next look at the clouds according to how high they are above the ground. Use nearby landmarks such as tall buildings, hills, and mountain ranges as a guide to height.

- **Start with low-level clouds** – those up to about 2.5 kilometres high. You can often see the most detail in these clouds and can watch them change shape or move across the sky.
  The three main types of low-level clouds are **stratus** (clouds in a layer), cumulus (clouds in lumps or clumps, I, J and K) and **stratocumulus** (layer of cumulus or clumpy clouds, L).

- **Mid-level clouds** are from 2.5 to 6 kilometres above the surface.
  The three main types are **altostratus** (clouds in a layer, A), **altocumulus** (clouds in lumps or heaps, B, C and D) and **nimbostratus** (stratus clouds producing rain). These clouds can appear to move slowly if they are above low-level clouds.

- **High-level clouds** are a more than 6 kilometres above the ground and tend to be pale and white. They are usually thin and made of ice crystals.
  The three main types of high-level clouds are **cirrus** (cloud wisps, E, F and G), **cirrocumulus** (ice clouds in ripples, H) and **cirrostratus** (flat layers of ice clouds) that look similar to altostratus but are lighter and let more sun through. They can also produce solar and lunar halos.

Type of Clouds



Clouds

What is the point of naming cloud types and estimating cloud cover?

Well, for pilots it is essential for safety reasons and for the comfort of passengers to know the height, type, and size of clouds they might encounter.

Clouds can reduce visibility and can also indicate what is going on in the atmosphere, particularly with regard to winds.

Clouds can indicate the speed and direction of winds, turbulence, and vertical mixing of the air. For example, some **middle-level clouds** produce rain that evaporates before it hits the ground. This rain, or *virga*, tells pilots that a lot of cold air is moving down through the atmosphere, producing turbulent conditions near the ground that may make landing and take-off dangerous.

Notification of **low cloud** and **fog** is especially important for airlines and passengers because pilots can't see where they are going during take-off and landing. In Australia, aircraft are not allowed to take off or land when visibility is poor, and this can cause delays in departures and the diversion of flights.

Other low-level clouds such as **cumulonimbus** or storm clouds are often associated with turbulent winds, and airlines prefer to avoid them by a long way. There is also the chance of damage from hail and lightning, as well as the danger of icing of aircraft wings.

Ice on the aircraft can reduce lift and thrust due to the change in aerodynamics, can change the balance of the aircraft, can interrupt communications if ice forms on the radio antennae, and can reduce visibility if ice forms on the windscreen.

Icing can occur if the aircraft travels through extensive cloud in which the temperature is 0 to minus 20 degrees Celsius. The rain in the clouds collects on the aircraft and freezes.

How to measure wind direction using a compass

Wind direction indicates where the wind is coming from, not where it is going to. So, a southerly wind blows from the south to the north.

To determine wind direction:

- First turn your body until you can feel the wind at your back.
- Now hold the compass flat, level with your waist, and watch as the red arrow swings around to point north.
- Rotate the compass (without turning your body) until the red arrow is hovering above the green north pointer printed on the base of the compass.
- So, what direction is the wind coming from? The answer is the number ***or*** letter closest to your belly button. In the picture (right), the wind is coming from the southwest – a *south westerly* wind.

Sometimes the wind changes direction quickly, making it hard to work out direction. Official wind readings are taken 10 metres above the ground because objects near the ground make the wind swirl and eddy. These winds are different to the prevailing wind.

Tips

- Keep the compass away from other magnetic materials.

How does it work?

Compasses contain a magnetic material that aligns itself in a north-south direction. Iron is particularly well known for having this property. The earth has a core full of iron that gives the planet the magnetic north and south poles. These differ slightly from the geographic north and south poles.

Wind

We cannot see the wind, but we quite often see what it is doing or what it has done.

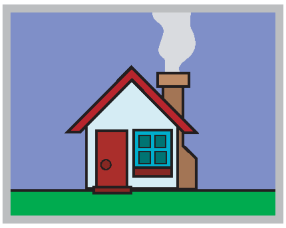
Wind in tropical cyclones and tornadoes can cause enormous damage, but most of the time the wind is gentle rather than destructive.

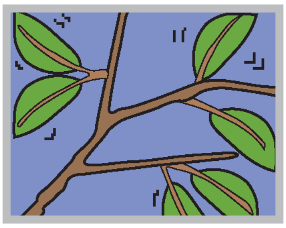
Knowing about the wind is important for many reasons:

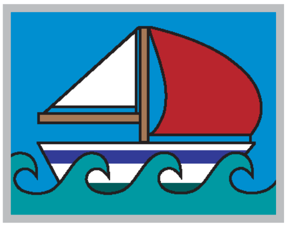
- For the safety of passengers in aircraft, of building workers in high places, of fishermen at sea, and of residents in cyclone-prone areas.
- It helps to fly kites, fills the sails of yachts, and influences sports events.
- For forecasting the weather – to predict when a sea breeze will provide relief on a hot day, or how quickly pollution will be carried away from cities.

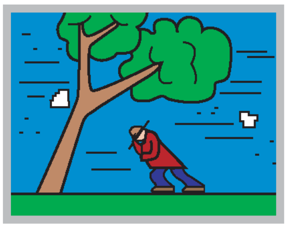
Beaufort wind scale

On the Beaufort scale, wind speeds are divided into 12 categories, each of which describes the physical effect of the wind. This can also be found on the back of your Sky Chart.









0: Calm (< 1 km/h, < 1 knot)
Smoke rises vertically.

1: Light air (1-5 km/h, 1-3 knots)
Wind direction shown by smoke-drift, but not by wind vanes.

2: Light breeze (6-11 km/h, 4-6 knots)
Wind felt on face; leaves rustle; ordinary vanes moved by wind.

3: Gentle breeze (12-19 km/h, 7-10 knots)
Leaves, twigs in constant motion; wind extends light flag.

4: Moderate breeze (20-28 km/h, 11-16 knots)
Raises dust and loose paper; small branches are moved.

5: Fresh breeze (29-38 km/h, 17-21 knots)
Small leafy trees begin to sway; crested wavelets form on inland waters.

6: Strong breeze (39-49 km/h, 22-27 knots)
Large branches in motion; whistling heard in telephone wires; umbrellas hard to use.

7: Near gale (50-61 km/h, 28-33 knots)
Whole trees in motion; inconvenience felt when walking against the wind.

8: Gale (62-74 km/h, 34-40 knots)
Breaks twigs off trees; generally, impedes progress.

9: Strong gale (75-88 km/h, 41-47 knots)
Slight structural damage occurs (chimney pots and roof tiles removed).

10: Storm (89-102 km/h, 48-55 knots)
Seldom experienced inland; trees uprooted; considerable structural damage occurs.

11: Violent storm (103-117 km/h, 56-63 knots)
Very rarely experienced on land; accompanied by widespread damage.

12: Cyclone or Hurricane (118+km/h, 64+knots)
Considerable and widespread destruction on land due to wind speed.

Section 3

Further information

Teaching and learning resources

Below you will find a series of links that give you access to real data, practical activities and climate projects that you can use in your exploration of climate and weather.

Data

Bureau of Meteorology (BOM)

www.bom.gov.au

The BOM Homepage contains all of Australia's daily weather forecasts and loads of links to information about weather, climate and ocean conditions. You can explore local weather data and observations in your area by navigating through the links in the WA drop-down menu.

BOM also hosts an education portal for teachers and students, with links to activities, experiments, and further information on climate phenomena. You can find the portal by following this link *www.bom.gov.au/lam/*

www.bom.gov.au/iwk/

Alongside the educational portal, you will also find the "Indigenous Weather Knowledge" page. This page outlines information on the intricate understanding of the environment that Aboriginal and Torres Strait Islander peoples have held for many thousands of years, describing the history of how climate has influenced cultural beliefs and practices. There are in depth explorations of the different seasons named and observed by the local Nyoongar people, as well as other First Nations groups across Australia.

www.bom-wow.metoffice.gov.uk

Finally, BOM have partnered with the UK Met Office in the Weather Observations Website (WOW), producing a platform for Australians to easily lodge and share weather observations, information and photos with others around the world. A visual map allows you to compare a wide variety of different climate measures from neighbouring Pacific Islands and countries all over the world, making it a great resource to discuss and explore how weather conditions impact different environments across the globe.

IQAir

www.iqair.com.au

This webpage shows several live weather maps, indicating wind speeds and direction, as well as temperature and air quality readings made from weather stations across the world. All participating international cities are ranked according to air pollution ratings, which are updated daily.

NASA Ozone Watch

ozonewatch.gsfc.nasa.gov/

NASA's Ozone Watch webpage contains a huge number of movies, information, climate data and activities centred around the atmosphere and the hole in the ozone layer.

Information and learning modules

EarthLabs for Educators

serc.carleton.edu/earthlabs/TheLabs.html

Provided by TERC, EarthLabs gives teachers access to nine climate focussed learning modules which contain weather and climate information, lesson plans, classroom resources and assessment materials.

HowStuffWorks

www.howstuffworks.com/nature/climate-weather

A site for people interested in how stuff works. In particular, there are heaps of articles explaining various weather and climate phenomena that can inspire students to consider the wider impact of weather on the life we live and decisions we make. As an added bonus, you can also find "Science projects for kids: Weather and Seasons" which contains links to some fun projects to further explore weather and climate.

Wikipedia Weather Portal

en.wikipedia.org/wiki/Portal:Weather

The Wikipedia portal to everything there is to know about weather – more information that you can poke a thermometer at.

Projects and activities

Australian Citizen Science Association (ACSA)

citizenscience.org.au/

The ACSA webpage has a "Project Finder" which can be used to explore all active citizen science projects being conducted in Australia. There are many projects that can be accessed, including the *Climate History Australia* project or NASA's *Cloud Observation Project* in which students can contribute the data collected through the School's Weather Wall program to real databases and observational experiments!

Exploratorium
www.exploratorium.edu/snacks
The USA's Exploratorium website hosts a collection of "Science Snacks" – a series of unique, hands-on activities, supplemented with visual and teaching resources, that explore a variety of scientific concepts, including the weather and atmosphere.

UCAR Centre for Science Education
scied.ucar.edu/learning-zone
A great website with loads great teacher resources, suggested experiments and even a 5-week unit on weather!