Lesson Plan 8

Earth and space sciences (The changing Earth)

Year Level: 5/8

Key learning area: Science

Meteorology - What is it?

Objectives

By the end of this lesson the student will:

- be able to define the term *meteorology*
- understand the importance of meteorology
- understand the causes of weather
- understand how we forecast the weather
- play a game which highlights why it rains
- write a short story describing a weather balloon's trip.

Background

To begin with, let's examine some of the things that combine to give the weather you experience each day.

The atmosphere

The ingredients that make up weather and which are essential to sustain life on earth are:

- heat from the sun (solar radiation)
- the atmosphere
- moisture.

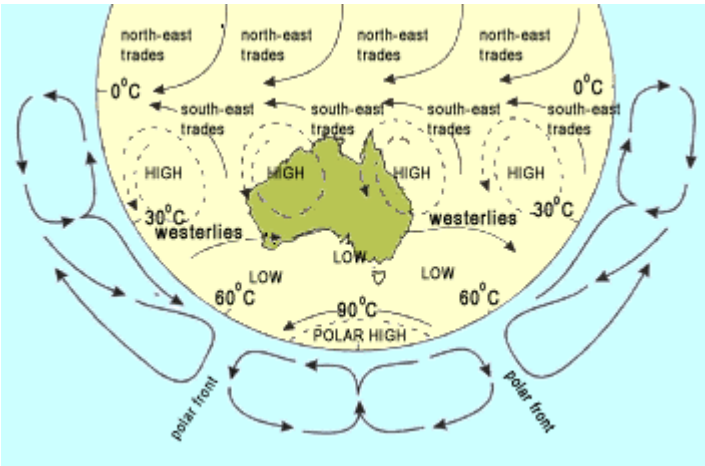
Weather occurs in the troposphere, the layer of air about 10 -15km thick, above the surface of the earth.

Atmospheric circulation

The driving force behind our weather is the general circulation of the atmosphere caused by unequal heating of the earth's surface. By looking at the main circulation patterns in the southern hemisphere we can begin to understand the seasonal changes of climate in Australia.

The sun drives the system. Remember the basic principle: warm air rises and cool air falls. This principle applies on a global scale. Energy from the sun causes uneven heating of land and sea surfaces near the equator and evaporation from tropical oceans. The heated air rises to the top of the troposphere and moves slowly away from the equator. On the way it gradually loses heat and starts to sink back towards the earth's surface at around 25°-30° of latitude (see figure 1).

Figure 1 *General air circulation over Australia*



Wind and pressure systems of the world

The differences in air temperature and pressure over the world cause wind. The air at the equator is much warmer than air at the poles. Warm air expands and rises, creating an area of low pressure; cold air is dense and sinks, creating an area of high pressure. But because the earth is spinning on its axis, the wind patterns become more complex. Between the areas of high and low pressure winds form the patterns shown
in Figure 1. The circulation of these winds and the passage of high and low pressure cells have a major influence on Australia's climate at different times of the year.

Points to remember

- The sun warms the earth's surface and this warms the air above.
- The earth's surface is warmed most near the equator, and least at the poles.
- The air above land is warmed more than that above water.
- Warm air expands and rises, creating an area of low pressure; cold air is dense and sinks to create an area of high pressure.
- Winds occur because the atmospheric pressures try to 'even themselves out'.
- The rotation of the earth causes the high and low pressure wind spirals.
- In the southern hemisphere, air from high pressure systems spirals anticlockwise and outwards, but spirals clockwise into low pressure systems.

The above text is courtesy of
NSW Agriculture (2000), Weather and Climate in Farming - Managing Risk For Profit, pp. 1-2.

The tilt of the earth's axis

Another important point to remember is that the earth revolves around the sun and it is tilted on its axis by an angle of 23°. The earth's axis always points to the same area in space (as viewed from a distant star). Thus, in December, when the southern hemisphere is tipped towards the sun, more direct sunlight and long hours of daylight cause warmer weather than in June, when the southern hemisphere is tipped away from the sun.

Resources and Actions

Class discussion

Use the following information and questions to have a class discussion. Modify lesson as required. Record student's current knowledge and highlight how much they know about meteorology. Write their responses on the board and then review and give best answer. Ask them to complete the worksheet.

Print off the student worksheet and weather balloon traces (see http://www.bom.gov.au/lam/Students_Teachers/Worksheet8.shtml and http://www.bom.gov.au/lam/Students_Teachers/blntrck.shtml) and copy one for each student.

Ask the students if they know what we call the science of weather/study of weather/study of atmospheric phenomena.

Questions and solutions

1. The science of weather has a special name - can anyone tell me what it is?

    Meteorology

2. What do we call a person who works in it?

    Meteorologist

3. What is weather and with what do we measure it?

    Weather is a description of conditions over a short period of time - a "snap shot" of the atmosphere at a particular time.

    RAIN - rain gauge
    TEMPERATURE - thermometer
    WIND - anemometer/wind vane
    PRESSURE - barometer
    CLOUD - satellite pictures/visual observations
    HUMIDITY (water content) - wet bulb thermometer.

    As weather occurs in the air above us, we need to measure temperatures through this air. We send up balloons and track the way they move by radar to get wind information and we use an instrument called a radiosonde to measure air pressure, temperature and humidity at different levels through the atmosphere. This information is vital as it indicates cloud type and height, whether we can expect rain, the likely maximum temperature, whether we can expect thunderstorms etc.

    Show examples of meteorological instruments.

    Pictures may be used if you cannot get actual instruments. A kit may be obtained from the Bureau of Meteorology. Contact the Public Relations Officer at the Head Office in Melbourne for more detail. Tel.(03) 9669 4564).

4. Why is weather important?

    It affects all human activity:

    1. farming

    2. aviation

    3. shipping

4. builders/outdoor workers

5. daily activity- what we wear, where we live, what we do , how we live

6. leisure - picnics, fishing, boating, sport

7. warnings of severe weather - tropical cyclones, floods, fire, severe thunder storms, droughts, wind warnings

8. Climate statistics - (climate is just the long term average of weather conditions at a particular place).

9. What grows where.

10. Environment, pollution.

5. What causes weather?

Weather is just the result of the coming together of different masses of air which have different temperatures, pressures and contain different amounts of water. How all these air masses interact with each other, on both the large and small scale, produces weather. How these large air masses move is a result of:

1. the sun - heats up the air and causes it to rise (like a hot air balloon).
2. the revolution of the earth around the sun and the axis of the earth.
3. the spin of the earth - causes circulation of the air masses.
4. the oceans - provides a source of water.

6. Air from different regions have different characteristics. e.g. would you expect air from the polar regions to be colder or warmer than air from the equatorial regions? Would you expect air blowing over oceans to contain more water than air coming over land?

How all these air masses interact with each other on both large and small scale - produces weather. Another important factor is the effect of land formations. e.g. mountains versus valleys, coast versus inland, dry areas versus areas near water - each area produces its own type of weather. We would expect air from polar regions to be colder than air from equatorial regions. We would also expect air blowing over oceans to contain more water than air blowing over land due to greater evaporation occurring over water.

7. How do we forecast the weather?

We try to build up "snap shots " of the weather at given times - this shows how the weather systems are moving. Then we try to determine what the weather pattern will be like at some specific time in the future and predict what type of weather will accompany that pattern. We use observations and satellite pictures (satpix) to build up a current picture, and our knowledge of how the atmosphere works to make a prediction. However, this is so complex we do not always get it right. Nowadays, we use computers and mathematics to try to take the guesswork out of forecasting.

Show charts and satellite pictures (see http://www.bom.gov.au/weather/national/charts/ and http://www.bom.gov.au/weather/satellite/).

8. Write a short story about being a weather balloon. Use one of the weather balloon traces (http://www.bom.gov.au/lam/Students_Teachers/blntrck.shtml) to help in describing the trip up to the point where you burst and fall back to Earth.

Students should use the information provided on the weather balloon traces to help them write an imaginative but relevant story. You may need to go through one of the traces with the class so that they understand how to read them. Ask them to mention the factors that are measured by a weather balloon in their story.

The Rain Game - Does anyone knows why it rains?

You'll need:

Lamp
Moist cloth (one for each 'water' child)
Electric fan (optional)
Chairs

(Lower Primary only) Divide the class up into 2 groups - water and air.

Air plays under the sun (use a lamp) - what happens when you play in the sun?

Air gets hot and dry, so that when it passes over water(water children to be on floor waiting to be picked up by air children), it picks some up to cool itself down (air holds hands with water and pretends to be much cooler - water could carry a damp cloth or tissue to wipe air's brow). Prove this by putting a wet towel in front of a fan - what does the air feel like after it passes through the towel compared to before?

Air now carries water with it and may be forced to climb up a mountain (use a chair), as air drags water with it (air tries to lift water onto chair), it gets tired, and so drops the water - What do we see when this happens? Rain.

The amount of rain depends on how much water the air is carrying and how quickly it is forced to drop it.

Extension activity

What role does the Bureau of Meteorology play in predicting and monitoring natural disasters? (See the Bureau's charter: http://www.bom.gov.au/inside/services_policy/serchart.shtml).

Time

To complete all questions approx. 50 - 60 minutes.

The game 10 - 15 minutes.

Assessment Task

1, 3, 4, 5, 7 & 8.