Activity 2: Rainfall, weather and climate

Background information

This activity reinforces students' understanding of precipitation (rainfall) as a basic component of weather and climate.

At the end of this activity students will

- Understand how hot and cold atmospheric layers create rain through a short teacher demonstration,
- Gain insight into how rainfall is measured by building their own rain gauge and taking measurements,
- Investigate the difference between weather and climate by comparing weather observations with long term averages.

Rain is an integral part of the Earth's weather, and the measurement of rainfall over long periods adds to our understanding of changing climate. In the atmosphere, water vapour condenses on dust and other particles in the air. This causes clouds and eventually rain. In the teacher demonstration below we create water vapour in a jar, and allow it to condense on small indentations on the jar's lid to mimic the creation of rainfall in the atmosphere.

Teacher demonstration

What you need

- Glass jar with a metal lid
- Hammer and nail
- Boiling (or near boiling) water
- A few cubes of ice, enough water to cover the lid and a pinch of salt

What to do

1. Ask your students what needs to happen to make rain? Instruct them to write a paragraph or draw a picture to explain.
2. Using the hammer and nail, make five small indentations in the top of the jar lid (be careful not to punch through the lid).
3. Pour the boiling water into the jar (about ¼ to ⅓ full)
4. Place the lid upside down on top of the jar (but make sure the air cannot escape).
5. Place the ice, a pinch of salt and a small amount of water into the lid.
6. Watch what happens. Ask your students to record what they see.
7. As the steam cools near the lid, water vapour forms. After a few minutes 'rain drops' fall from the lid.
8. Ask students to compare what they saw in the experiment to what they wrote down before the demonstration. Has their explanation changed? How was the experiment similar to the way rain forms in the real world?
9. As a group, draw a diagram explaining the process of rain formation.

Make a rain gauge worksheet

What you need

- Glass jar (or drinking glass) with vertical sides and a flat bottom
- Ruler
- Permanent marker
- Sticky tape
- Cardboard
- Scissors

What to do

1. Draw a rectangle on a piece of cardboard. Your rectangle should be 2cm wide and 10cm long (see figure 1).
2. Cut out the rectangle.
3. Using your ruler, mark the distance along the edge at regular intervals (say every 5mm). Make sure the bottom edge is 0cm.
4. Line up the cardboard ruler next to the jar, making sure the bottom of the ruler is at the very base of the jar.
5. Tape the ruler to the jar.

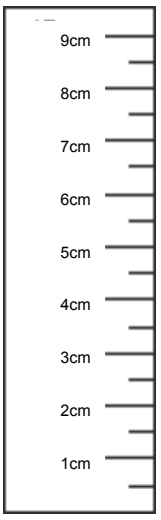

Figure 1

A rain gauge for dry areas

For areas that receive only a few millimetres of rain in each downpour, it is a good idea to make a rain gauge that magnifies the scale of measurements on the side of the jar. It is then much easier to measure small amounts of rain.

What you need

- An empty glass jar, with vertical sides and a flat bottom
- A plastic kitchen funnel, somewhat wider than the jar
- Masking tape for marking measurements

What to do

1. Measure the area of the top of the funnel and the area of the bottom of the jar. Work out how many times larger the area of the top of the funnel is compared with the area of the bottom of the jar. (Ideally 4 or 5 times is best, so choose your jar and funnel with this ratio in mind).
2. Mark a scale of measurements in millimetres on the masking tape, magnifying the scale according to the ratio calculated above. If, for example, the area of your funnel is 4 times larger than the area of your jar, mark and label the first millimetre on your scale of measurements 4 mm up from the bottom of the jar. Mark and label the second millimetre on your scale 8 mm up from the bottom of the jar, and so on.
3. Stick the masking tape to the outside of the jar (0 mm at the bottom of the jar). Cover the masking tape with clear tape so that it is waterproof.
4. Secure the funnel in the top of the jar with two pieces of masking tape, so that it can be easily removed to empty the jar.

To use your rain gauge:

1. To take effective measurements, you should place your rain gauge outside, away from trees and buildings. You may wish to place it inside an open-topped box so that it is not knocked over by wind or curious animals.

2. Draw a table like the one shown below (or make a table in a spreadsheet program).

Date	Time	Rainfall (mm)	Cloud cover (Full, half, slight or clear)

3. Record measurements at the same time each day for a month. Remember to empty your rain gauge each day.

4. Record your measurements in the table.

5. At the end of the month, add up all the rainfall values, and count the total number of observations you made. Use the formula below to calculate the average (mean) rainfall per recording over the month.

   Average rainfall per recording = $\frac{\text{Sum of all the rainfall values}}{\text{Number of recordings}}$ = _____ mm

6. In your table find the highest rainfall value and the lowest rainfall value you recorded and write these below.

   Highest rainfall = _____ mm Lowest rainfall = _____mm

7. The Bureau of Meteorology has rainfall observations like these recorded over long periods. Compare your values to the Monthly Climate Statistics Reference Sheet (see page 18), which lists some of these rainfall statistics for Melbourne for each month of the year.

8. Using the Monthly Climate Statistics Reference Sheet, find the long term records for the month you have taken measurements for and write the values below.

   The average long-term rainfall for _____ is _____mm
   (month) *(amount)*

   The highest daily rainfall for _____ is _____mm
   (month) *(amount)*

Questions

1. Did you record more or less rainfall than average? How did your highest rainfall compare with the highest daily rainfall recorded by the Bureau of Meteorology?
2. How did your average rainfall compare with the highest average rainfall? How did it compare with the lowest average rainfall?
3. What differences would you expect to see in rainfall at different times of the year?
4. Are average values or daily values better for predicting weather? Explain.

Monthly Climate Statistics Reference Sheet for Melbourne (Rainfall)

Reproduced from the Bureau of Meteorology (http://www.bom.gov.au/climate/averages/tables/cw_086071_All.shtml)
Statistics for other Australian sites may be obtained from http://www.bom.gov.au/climate/averages/tables/ca_site_file_names.shtml.

Current as at 07 May 2009 02:33:17 EST
Site: 'MELBOURNE REGIONAL OFFICE' [086071]; Records start date: 1855; Last Record: 2009
Latitude: 37.81 Degrees South; Longitude: 144.97 Degrees East; Elevation: 31 m; State: VIC

Statistic Element	January	February	March	April	May	June	July	August	September	October	November	December
Average (Mean) rainfall (mm)	47.6	47.3	50.2	57.3	56.2	49.2	47.7	50.2	57.9	66.2	59.5	59.2
Highest daily rainfall (mm)	108	113.4	90.2	80	51.2	44.2	74.4	54.4	58.7	61	72.6	99.6
Date of Highest daily rainfall	29-Jan-63	3-Feb-05	5-Mar-19	23-Apr-60	15-May-74	22-Jun-04	12 Jul 1891	17 Aug 1881	23-Sep-16	21-Oct-53	21-Nov-54	4-Dec-54
Highest average rainfall over a month (mm)	176	238.2	190.7	195	142.5	116.8	178.4	110.8	201.6	193.3	206.1	197.4
Year of Highest rainfall	1963	1972	1911	1960	1942	1991	1891	1939	1916	1869	1954	1993
Lowest average rainfall over a month (mm)	0.3	0.5	3.7	0	3.8	8	9.4	12.4	12	7.5	6.5	1.7
Year of Lowest rainfall	1932	1965	1934	1923	1934	1858	1979	1903	2008	1914	1895	1972
Median monthly rainfall (mm)	37	32	38.6	49.6	55.2	42.7	45.4	49.2	52.6	67.3	53	51.5
Average (Mean) number of days of rain	8.3	7.4	9.3	11.4	13.9	14.1	15.1	15.6	14.7	14.1	11.7	10.4
Average (Mean) number of days of more than 1mm of rain	5.6	5	6.1	8	9.7	9.5	9.8	10.5	10.4	10.3	8.3	7.2
Average (Mean) number of days of more than 10mm of rain	1.4	1.4	1.5	1.6	1.4	1.1	1	0.9	1.5	1.8	1.8	1.6
Average (Mean) number of days of more than 25mm of rain	0.5	0.4	0.4	0.4	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.5