



ROYAL BC
MUSEUM

Our Changing Climate

HSBC  School Visits Programs

Teachers' Guide

Grade 4



Our Changing Climate

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Program Level: Grades 4
Program Length: 90 minutes

Introduction

This program will introduce students to the causes and consequences of climate change. The program will look at weather forecasting, with hands-on demonstrations of equipment used, weather maps and types of clouds. Past and present climates of BC will be examined as well as human contributions to global climate change, the consequences of global warming and what can be done to reduce our impact on the climate.

Prescribed Learning Outcomes

This program is designed to fulfill the following prescribed learning outcomes as stated in the Ministry of Education's Integrated Resource Package.

Grade 4 – Earth and Space Science: Weather

- Measure weather in terms of temperature, precipitation, cloud cover, wind speed and direction
- Analyse impacts of weather on living and non-living things
- Determine how personal choices and actions have environmental consequences

Pre-Visit Instructions

The students must be divided into 3 groups PRIOR to arriving at the museum. If possible they should also wear nametags. Student activities will take place in the museum galleries, classroom and include a quick visit outdoors.

Background Information

The Earth's climate is changing. It has changed many times in the past and will change again. The difference between past climate changes and the one we are currently experiencing is the human impact on the change.

On average the Earth is warming. This doesn't mean that everywhere on Earth will be warmer, only that the average temperature over the entire globe will increase. Some areas will likely be cooler and if ocean currents are affected, places like Great Britain could become significantly cooler. It also doesn't mean that everywhere will experience detrimental weather changes – in some areas people may consider the change in climate an improvement.

This school program looks at the current warming trend, the causes, the consequences and what we can do to mitigate the affects of this warming. The program will also look at the difference between weather and climate.

Weather and Climate

People often confuse weather and climate. They look at a cool spring day and say “Don't tell me it's getting warmer, it's colder than this time last year.” They are confusing weather with climate. Weather is the current atmospheric conditions; it is extremely variable and can change from day to day. Any given day may be significantly cooler or warmer than the day before or the same day last year. Climate is the average of the weather over many years; it is more stable and takes years to change significantly.

Victoria has what is known as a sub-Mediterranean climate with warm, dry summers and wet, mild winters. Victoria's climate is influenced by the proximity of the ocean, which acts as a heat sink – absorbing excess heat during warm times and releasing heat during cold periods – preventing extremes in temperature. Winnipeg has a continental climate – far from the buffering effects of the ocean it experiences extremely low temperatures in the winter and high temperatures in the summer. The average January temperature in Victoria is 4° C with few days falling below freezing, and the average July temperature is 14°C for a range in average temperature of 10°C throughout the year. In Winnipeg the average January temperature is -20°C and the average July temperature is 19°C for an average temperature variation of 39°C. The weather on any given day may be the same in Winnipeg and Victoria but the climate, is very different.

Climate has changed before

Climate change is not new. The climate has been changing since the Earth was formed. British Columbia has been through periods of warming that brought tropical climates and vegetation to our shores and periods of cooling that have resulted in ice ages. Climate change is inevitable; the difference with the current climate change is the human influence on the change.

Causes of Climate Change

The Greenhouse effect

The greenhouse effect is a natural phenomenon created by the Earth's atmosphere that is necessary for life as we know it to exist. Like the glass in a greenhouse, our atmosphere allows energy from the Sun to pass through to the Earth. This energy heats the Earth which then emits the energy as long-wave infrared energy. This energy is readily absorbed by greenhouse gases in the atmosphere that re-emit the energy as heat back towards the Earth. This natural greenhouse effect prevents heat from escaping into outer

space and keeps the planet at a comfortable average temperature of 15° C. Without the greenhouse effect the average surface temperature of Earth would be approximately -18° C, too cold to support life as we know it.

The primary reason for the current global warming appears to be the increase in greenhouse gases in the atmosphere. Greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide, ozone and halocarbons. These gases, especially water vapour, carbon dioxide and methane, trap heat in the atmosphere. As their concentration in the atmosphere increases so does the heat-trapping capacity of the atmosphere and thus the temperature of the Earth.

There are natural sources of these gases such as volcanoes, marshes and animal respiration; however an increasing amount of greenhouse gas comes from human activities. Burning of fossil fuels such as coal and oil release carbon dioxide in large amounts, growing rice, raising livestock and dumping garbage in landfills produces large amounts of methane and nitrogen-based fertilizers used on our crops release nitrous oxide. The destruction of vast expanses of the Earth's forests removes trees that would otherwise absorb huge amounts of carbon dioxide, removing it from the atmosphere. Worldwide 2.4 acres of forest are destroyed every second. That adds up to 214,000 acres a day or 78,000,000 acres – an area the size of Poland – each year.

Consequences

More severe weather events

As the average global temperature increases there will be more extremes in weather, for example more torrential rains and flooding, more droughts and more storms. As temperatures warm, more water evaporates from lakes, streams, and oceans putting more water vapour in the air which will result in more rain in some regions. Many regions will experience droughts as temperatures rise. Precipitation although abundant may be concentrated in a relatively short period of time resulting in flooding followed by summer drought. An example of recent extreme weather is the summer storms of 2004 that caused extensive flooding and millions of dollars in damage in Edmonton and Peterborough.

Flooding

Flooding of coastal regions

As the world warms glaciers and polar ice caps will melt and the water contained in them will enter the oceans raising the level of the sea.

The melting of the ice at the North Pole will have little effect on sea level because the ice at the North Pole is already in the ocean. Since there is no land at the North Pole all the ice there is sea ice. The ice caps of Greenland, the South Pole and other areas are a different story however – these are on land so as they melt the water from them will raise the world's sea level.



Melting glaciers around the world will also add to this rise. Although melting ice will cause a rise in sea level, thermal expansion of seawater will probably contribute more to sea level rise in the next century. As water warms it expands and only a slight expansion of the huge amount of water in the oceans will lead to a rise in sea level.

Sea level rise will vary significantly throughout the world because some areas, like SW Vancouver Island, are still re-bounding from the weight of ice during the last ice age. As a result the sea level in Tofino actually dropped by 13 cm in the 20th century because the land is rising faster than the sea. In Prince Rupert the sea level has risen 12 cm in the last century and in Victoria 8 cm. Although these rises don't seem extreme they are significant in some areas. Estuaries and tidal marshes that are rich habitats and nurseries for many species of marine life could be flooded and destroyed. In some areas these tidal marshes will not be replaced further up shore because of dykes, sea walls, cliffs etc. Storm surges and heavy wave action will push further inland damaging docks, wharves, and buildings near the water. Fresh water aquifers that are close to shore will be inundated with salt water and become useless for drinking or irrigation and low lying areas like Bangladesh and many small islands will have extensive areas flooded. Drainage and sewage systems in some coastal towns will also be affected.

Flooding due to excess run-off

As the temperature rises evaporation increases leading to increased precipitation. Because of the increased temperatures most of this precipitation will fall as rain even in regions that typically receive snow in the winter. Rather than being stored in the mountains as snow and ice to be released slowly over the late spring and summer the water will run off the mountains into the valleys all at once and cause flooding and landslides as slopes become water logged and give way. Since there will be less snow to melt throughout the drier seasons we will see more summer droughts in some areas. This flood of water may also destroy valuable aquatic habitat such as salmon spawning areas and summer drought may cause some streams to dry up or be reduced to the point where they can no longer support some species.



Drought

Although some areas will experience more rain this will often be concentrated in a short period of time and be followed by droughts in the summer. British Columbia has experienced several years of below normal rainfall and the effect on forests is showing in increased numbers of forest fires and increased mortality of some moisture-loving species such as Western Red Cedar.

Forest fires can potentially cost millions of dollars in fire fighting costs, destruction to property, loss of jobs, loss of valuable timber and loss of tourism dollars.

Forests stressed by drought – in driest areas forests are replaced by grasslands

Fish-bearing streams may dry up or flow will be reduced to the point where the streams will no longer support fish. Salmon spawning streams may become too warm for survival of eggs and young and flows may be reduced to the point where adults cannot migrate up the stream to spawn.

Water shortages for agricultural, domestic and industrial use.

Infestations of pests

Pests that are usually killed by cold winters (e.g. Mountain Pine Beetle) will increase as winters get warmer. The Mountain Pine Beetle has always been around but has become a major forest pest only in the last decade or so. In the past, populations were kept in check because the winters were cold enough to kill large numbers of the larvae that were over-wintering in trees. With warmer winters the winter mortality has declined resulting in an increase in the population.

Invasion of harmful warm-climate species and diseases

As northern regions get warmer, warm-climate pests and diseases may be able to expand their ranges.

Warming seas

Besides the thermal expansion of the seas causing flooding there are other consequences of warming seas. As seawater warms various marine species will move and/or change their migration routes. For example as the oceans warm, cold water species such as salmon will be forced further north where the water is still cold enough. This shift in range will result in the loss of salmon fisheries in the southern part of their current range, loss of food source for bears, birds and other animals in southern spawning streams and loss of nutrients for forest and aquatic ecosystems.

What can be done?

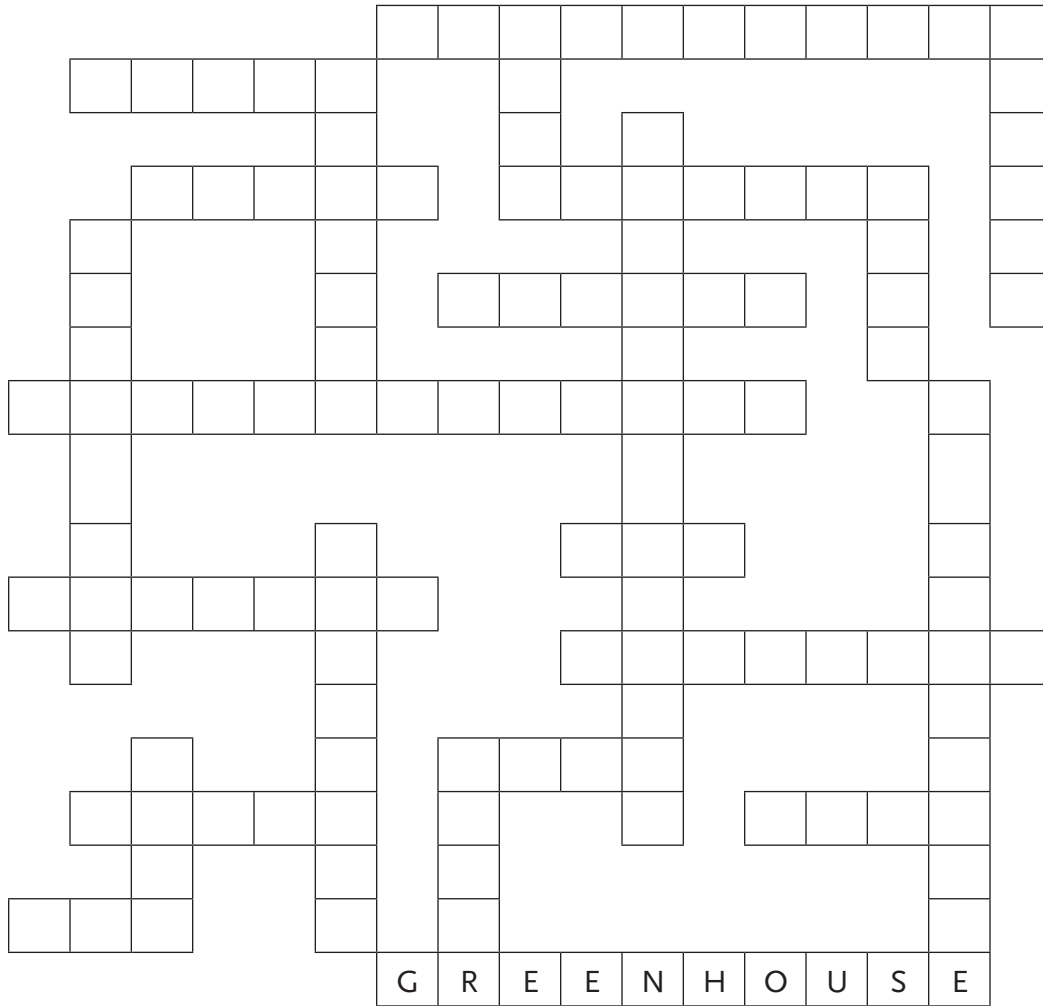
The major way that humans are contributing to global warming is by the production of heat-trapping greenhouse gases, primarily through the burning of fossil fuels. The most important thing we can do to mitigate the effects of global warming is to reduce the production of these greenhouse gases. Some ways this can be accomplished are:

- Alternative power sources – wind, geothermal, solar, hydroelectric, etc. for generation of electricity, running vehicles, heating homes.
- More efficient vehicles – hybrid, electric, hydrogen fuel cell, smaller vehicles, better gas mileage.
- Make sure your vehicle is well tuned and uses fuel efficiently.
- Drive less often – Take public transportation, ride a bike, walk, shop locally.
- Use electricity more wisely – Turn off lights when not needed, turn down thermostats slightly.
- Plant a tree – Trees absorb CO₂, removing it from the atmosphere.
- Recycle – When you recycle less material ends up in landfills so less methane is produced. It also takes much less energy to make something from recycled material than from scratch hence fewer emissions are produced.



Climate Change Puzzle

Name: _____



Fit the words below into the spaces in the puzzle. Each word will only fit in its correct spot.

3 letter words

air
oil

4 letter words

coal snow
heat wind
rain

5 letter words

flood solar
cloud water

6 letter words

global
storms

7 letter words

drought
methane
weather

8 letter words

extremes
infrared
sea level

10 letter words

greenhouse

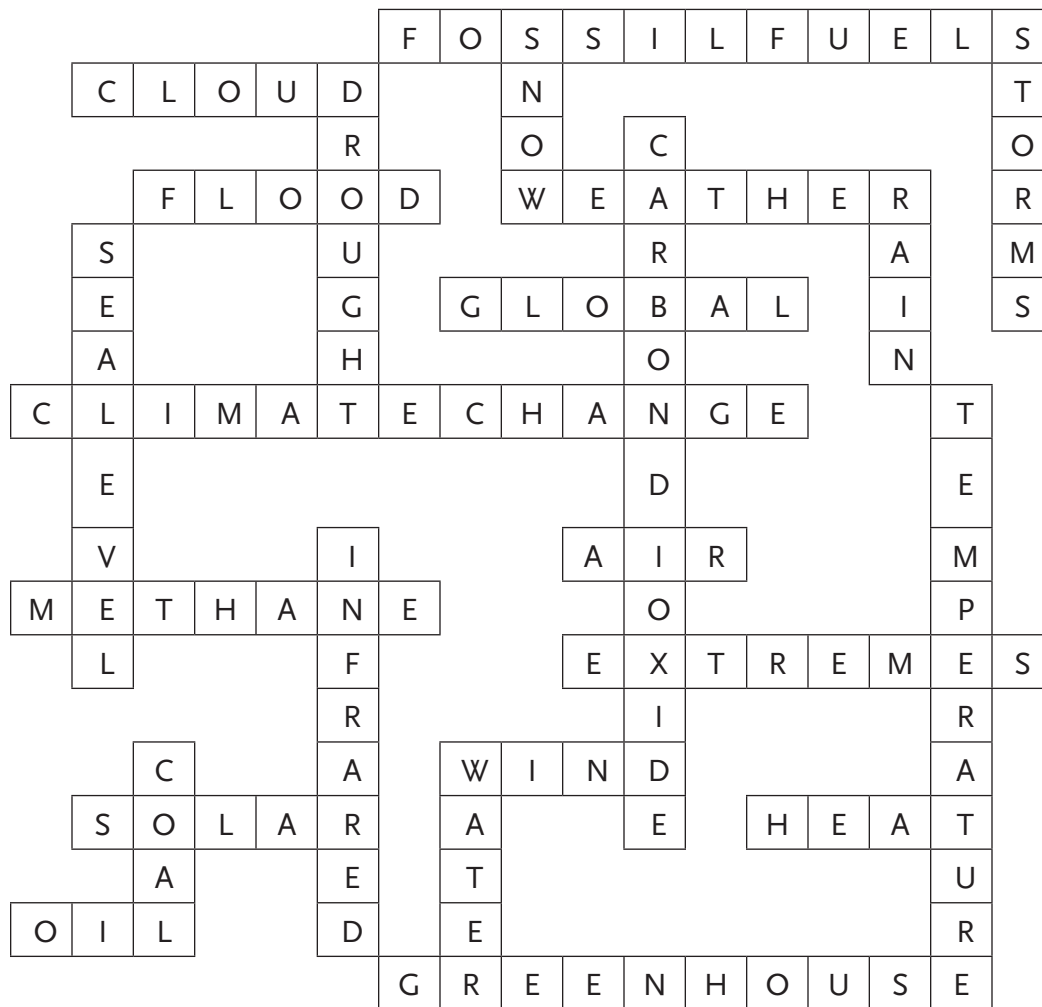
11 letter words

temperature
fossil fuels

13 letter words

carbon dioxide
climate change

Climate Change Puzzle Answers



Fit the words below into the spaces in the puzzle. Each word will only fit in its correct spot.

3 letter words

air
oil

4 letter words

coal snow
heat wind
rain

5 letter words

flood solar
cloud water

6 letter words

global
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7 letter words

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methane
weather

8 letter words

extremes
infrared
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10 letter words

greenhouse

11 letter words

temperature
fossil fuels

13 letter words

carbon dioxide
climate change

Climate Change Word Search

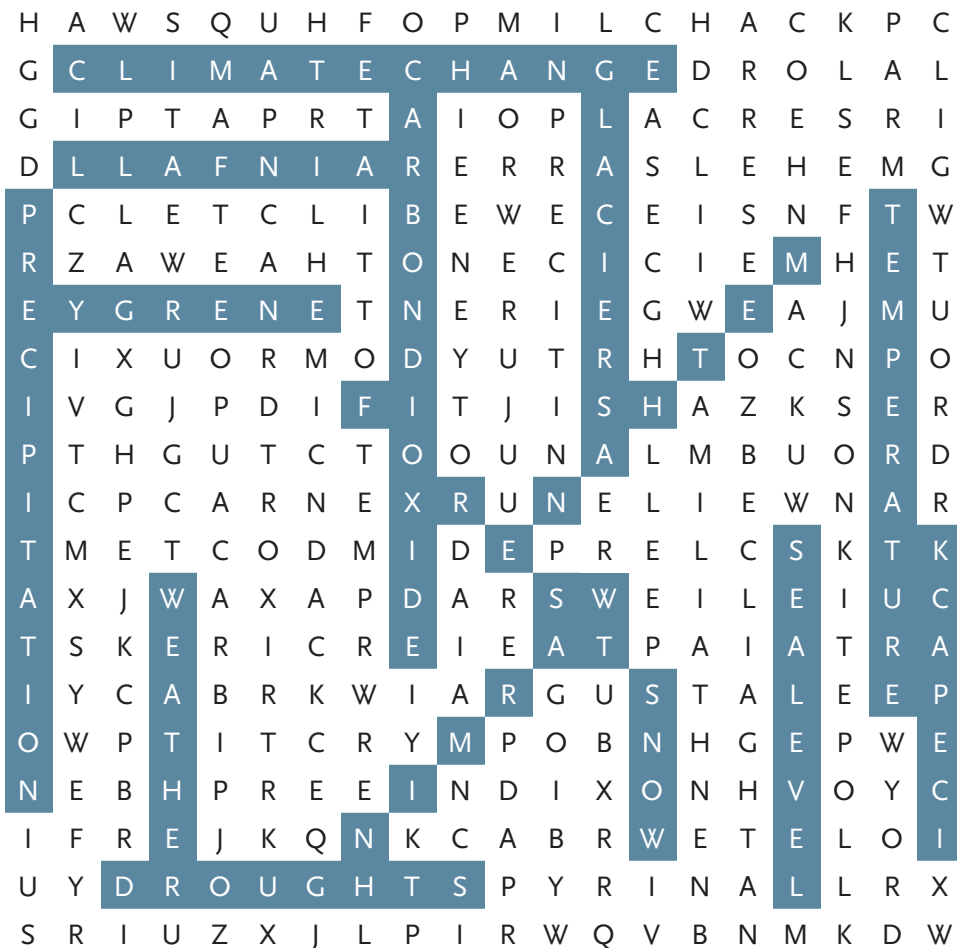
Name: _____

H A W S Q U H F O P M I L C H A C K P C
G C L I M A T E C H A N G E D R O L A L
G I P T A P R T A I O P L A C R E S R I
D L L A F N I A R E R R A S L E H E M G
P C L E T C L I B E W E C E I S N F T W
R Z A W E A H T O N E C I C I E M H E T
E Y G R E N E T N E R I E G W E A J M U
C I X U O R M O D Y U T R H T O C N P O
I V G J P D I F I T J I S H A Z K S E R
P T H G U T C T O O U N A L M B U O R D
I C P C A R N E X R U N E L I E W N A R
T M E T C O D M I D E P R E L C S K T K
A X J W A X A P D A R S W E I L E I U C
T S K E R I C R E I E A T P A I A T R A
I Y C A B R K W I A R G U S T A L E E P
O W P T I T C R Y M P O B N H G E P W E
N E B H P R E E I N D I X O N H V O Y C
I F R E J K Q N K C A B R W E T E L O I
U Y D R O U G H T S P Y R I N A L L R X
S R I U Z X J L P I R W Q V B N M K D W

Find the following words in the puzzle above.

- | | | |
|----------------|---------------|-------------|
| Carbon Dioxide | Glaciers | Sea Level |
| Climate Change | Ice Pack | Snowfall |
| Droughts | Methane | Temperature |
| Energy | Precipitation | Warming |
| Forests | Rainfall | Weather |

Climate Change Word Search – Solution



Find the following words in the puzzle above.

- | | | |
|----------------|---------------|-------------|
| Carbon Dioxide | Glaciers | Sea Level |
| Climate Change | Ice Pack | Snowfall |
| Droughts | Methane | Temperature |
| Energy | Precipitation | Warming |
| Forests | Rainfall | Weather |

Build Your Own Weather Station

(Adapted from <http://www.miamisci.org/hurricane/rainmeasure.html>)

The Miami Museum of Science and Planetarium

Make an anemometer

Materials

five 3 ounce paper Dixie cups	paper punch
two straight plastic soda straws	small stapler
a pin	sharp pencil with an eraser
scissors	

Procedure

Take four of the Dixie cups. Using the paper punch, punch one hole in each, about a half inch below the rim.

Take the fifth cup. Punch four equally spaced holes about a quarter inch below the rim. Then punch a hole in the centre of the bottom of the cup.

Take one of the four cups and push a soda straw through the hole. Fold the end of the straw, and staple it to the side of the cup across from the hole. Repeat this procedure for another one-hole cup and the second straw.

Now slide one cup and straw assembly through two opposite holes in the cup with four holes. Push another one-hole cup onto the end of the straw just pushed through the four-hole cup. Bend the straw and staple it to the one-hole cup, making certain that the cup faces in the opposite direction from the first cup. Repeat this procedure using the other cup and straw assembly and the remaining one-hole cup.

Align the four cups so that their open ends face in the same direction (clockwise or counter clockwise) around the centre cup. Push the straight pin through the two straws where they intersect. Push the eraser end of the pencil through the bottom hole in the centre cup. Push the pin into the end of the pencil eraser as far as it will go. Your anemometer is ready to use.

Your anemometer is useful because it rotates with the wind. To calculate the velocity at which your anemometer spins, determine the number of revolutions per minute (RPM) by counting the number of revolutions in 15 seconds and multiplying by 4. Next calculate the circumference (in centimetres) of the circle made by the rotating paper cups. Multiply your RPM value by the circumference of the circle, and you will have an approximation of the velocity at which your anemometer spins (in cm. per minute). (Note: Other forces, including drag and friction, influence the calculation but are being ignored for this elementary illustration. The velocity at which your anemometer spins is not the same as wind speed.)

The anemometer is an example of a vertical-axis wind collector. It need not be pointed into the wind to spin. (Note: This paper cup anemometer will produce a reasonable approximation of circumferential velocity, but should not be used for any purpose other than elementary illustration.)

Make a Rain Gauge

Name: _____

What you will need:

- a wide mouth jar
- a ruler
- a tall thin glass jar or cylinder
- paper and tape
- a felt marker
- a small funnel

Procedure:

Mark the large jar with a felt pen 1 centimetre from the bottom. Fill the jar to the mark with water and then pour the water into the tall thin container and mark the level with the felt marker. This mark will indicate 10 mm of rain. Mark the tall jar half way between the bottom and the first mark, this will indicate 5 mm. Now mark the jar at 15, 20, 25 and 30 mm. The wide mouth jar will be your rain collecting container and the tall thin jar will be your measuring container.

Put your wide mouth jar outside in an open area away from buildings and trees to collect rain. Bring the jar in at the same time every day and pour the contents into the thin jar to measure the amount of rainfall. Using the thin jar to measure will increase the height of the water in the jar and make measuring the amount of rainfall easier and more accurate especially when rainfall is light. Using the graph below chart the amount of rainfall over a week or longer.

DAILY RAINFALL							
50 mm							
45 mm							
40 mm							
35 mm							
30 mm							
25 mm							
20 mm							
15 mm							
10 mm							
5 mm							
0 mm							
	M	T	W	T	F	S	S

Make a Barometer

Cut the neck off a balloon and stretch the rest of the balloon over a two-inch wide mouth jar (plastic food wrap can be used instead of a balloon). Secure it to the jar with an elastic band. Make sure it is tight.

Glue a straw to the stretched rubber balloon ensuring the end of the straw is in the exact centre of the balloon. The other end will be off the jar. In the free end of the straw (off the jar) use some glue or putty to insert a match stick or toothpick so it forms a pointer from the end of the straw.

When the glue has dried tape some paper to the wall and move your barometer so that the pointer you made points to the centre of the paper. Use a pencil to mark the spot. Check it daily and notice if the pointer has moved up or down. Up means good weather, down means stormy weather.

How Does It Work

The device you have made is a barometer, an instrument that measures air pressure. When air pressure is high the air outside the jar pushes down on the balloon, which causes the free end of your pointer to rise. If the air pressure is high it usually means nice weather. Low pressure outside the jar will cause the balloon to bulge up and your pointer will go down. Low pressure usually indicates stormy or unsettled weather.

Another way to make a barometer

What you will need:

One clear glass or plastic jar or a drinking glass	
One drinking straw	Modeling clay
Tape	Cold water
Food colouring	A ruler
Two or three elastic bands	



Procedure

- Fill the jar a little less than half full with water
- Add some food colouring to the water
- Put the straw in the jar and tape it to the inside so that the bottom is in the water but not touching the bottom of the jar.
- Suck the water halfway up the straw and pinch the straw to trap the water
- Put a small piece of modelling clay on the top end of the straw to prevent the water from draining out of the straw.
- Using the elastics attach the ruler to the outside of the jar to record the height of the water in the straw each day.

Now put your barometer in a spot that is not too draughty or sunny. Read the height of the water in the straw each day and record it. Beside each day's entry record the weather at the time you read the barometer. How does the height of water in the straw change from a sunny day to a cloudy day?

The height of water in the straw will go up when the air pressure is high and down when the air pressure is low.