WEATHER & AIR

ACTIVITIES BOOKLET

Cooperative Research
Centre for Southern
Hemisphere Meteorology

CRC
Southern
Hemisphere
Meteorology

This activities booklet has been prepared by
Paul Holper, from the Cooperative Research Centre for
Southern Hemisphere Meteorology.

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Cooperative Research Centre for
Southern Hemisphere Meteorology
Monash University,
3rd Floor, Building 70
Wellington Road,
Clayton, Victoria 3168
Ph: (03) 9905 9660
Fax: (03) 9905 9689

E-mail: crc@vortex.shm.monash.edu.au
http://www.shm.monash.edu.au/

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introduction

Everyone is interested in the weather. We talk about it all the time and our outdoor activities are greatly influenced by it.

For children, a hot day might mean going to the beach or swimming in a pool. Wind blows leaves and dust through the playground, bending branches and sometimes making it difficult to walk. On a cold morning, you can see your breath and skate across frosty lawns. Thunder, lightning, snow and hail all hold great attraction.

Children's own experiences of weather make a good starting point for exploring science. This booklet for teachers contains a range of experiments and activities that are fun to do and will help students learn about weather and the environment. As well as activities on weather, there are activities on the main medium of weather — air.

Most of the activities require only simple, inexpensive equipment. The activities can be used individually or as part of a comprehensive unit on the weather or air and all have:

- *simple, step-by-step instructions*
- *sample questions to help students understand what is happening*
- *an explanation of the underlying science*

Earlier activities are more suitable for younger students, while those towards the end are for secondary students. Of course, some of the earlier activities may serve as good introductions to topics for older students.

This booklet has been prepared as part of the education program of the Cooperative Research Centre for Southern Hemisphere Meteorology at Monash University.

Visit our Web site at http://www.shm.monash.edu.au/ for more information.

We hope you will find this publication helpful, relevant and interesting.

ACTIVITY 1

pushy air

This is a good demonstration that serves as an introduction to a lesson on air and its properties.

EQUIPMENT

- sheet of newspaper
- ruler

SAFETY

Ensure that students are kept back from the table and well away from the path of the catapulted ruler.

PROCEDURE

1. Place a wooden ruler or flat stick on a bench top with about a quarter of its length overhanging.
2. Give the overhanging part of the ruler a quick "karate chop" from above.
3. Rescue the ruler and replace it in the same position on the bench top, this time with the sheet of newspaper covering the non-overhanging part of the ruler.
4. Again, apply a quick "karate chop" from above.

QUESTIONS

1. What do students expect to observe before each part of the experiment?
2. Why do you think the ruler snaps during the second experiment?
3. Is it the weight of the newspaper that makes it break?

EXPLANATION

Air is all around us pushing on everything. It pushes on our skin and on the bench top. The ruler has a relatively small surface area, so the air pushing down on top of it is not enough to hold it in place when you hit it.

The newspaper has a large surface area. The force of the air acts over the whole area. The result: the air holds down the paper, which holds the ruler in place. Unable to lift quickly enough when you strike the overhanging part of the ruler, it has no option but to … snap!

FACT FILE

Air pushes down on a folded sheet of a tabloid newspaper with a force greater than a one tonne weight!

ACTIVITY 2

bottled pressure

A simple activity that graphically shows the force of the air around us.

EQUIPMENT

- plastic soft drink bottle
- funnel
- hot water
- cold water
- large bowl
- ice

SAFETY

Take care with hot water.

PROCEDURE

1. One-third fill the plastic bottle with very hot water.
2. Screw the top on the bottle, lie it down in the bowl and cover it with ice and cold water.

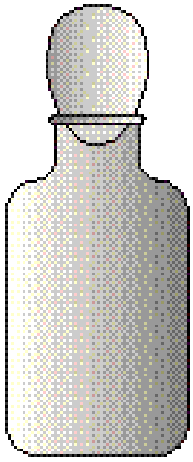
QUESTIONS

1. What do you see when the bottle is covered with ice and cold water?
2. Try to explain your observation.

EXPLANATION

The bottle is filled with steam. Once it is sealed and cooled, a lot of the steam condenses, turning back into liquid water. The pressure of air inside the bottle is now much less than the pressure exerted by the atmosphere. So the air pressure outside the bottle crushes it.

eggsperiment



In this teacher demonstration, you will use an egg to investigate changes in air pressure.

EQUIPMENT

- hard boiled egg
- matches
- paper towel
- small jar or bottle with an opening large enough to let an egg almost pass through

SAFETY

This should be done as a demonstration activity.

PROCEDURE

1. Peel the hard boiled egg.
2. Ignite a small piece of paper and drop it into the bottle.
3. Immediately place the egg gently on the opening of the bottle, small end first. The egg may "dance" and wobble on top of the opening.
4. Wait until the egg is drawn (really, pushed) into the jar.
5. Ask students to suggest ways of getting the egg out of the bottle.
6. Hold the bottle upside down with the small end of the egg in the bottle neck.
7. Tilt the bottle down until there is a small opening between the neck of the bottle and the egg.
8. Blow hard into the bottle making a closed seal with your mouth. Before you remove your mouth, tilt the bottle upside down.

QUESTIONS

1. Why did the egg drop into the bottle?
2. Why did blowing into the bottle remove the egg?

EXPLANATION

As the air was heated, it began to expand. Some of the air escaped causing the egg to wobble. When the flames went out, the air began to cool and contract. The egg sealed the bottle. Air pressure inside the bottle dropped below that of air outside the bottle. The greater air pressure on the outside pushed the egg into the bottle, equalising the air pressure inside and outside the bottle.

homemade dew and frost

Air contains water. Under cold conditions, some of this water may become visible.

EQUIPMENT

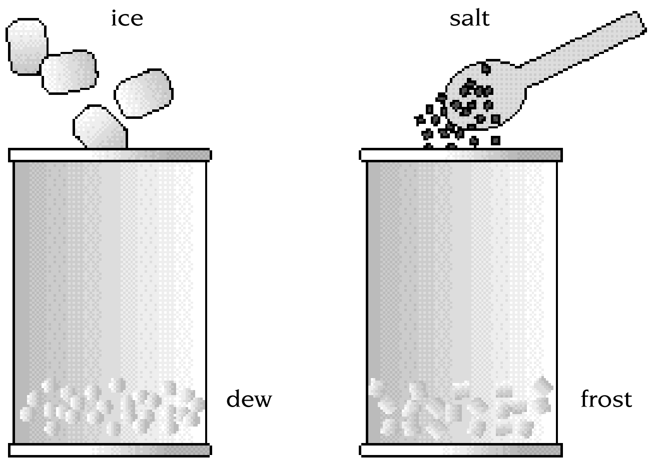
- empty can with its label removed (Ensure that there are no jagged edges.)
- ice cubes
- salt

INITIAL QUESTIONS

1. What do you notice about your breath on cold mornings?
2. On some mornings grass and leaves may be very damp even though it hasn't rained during the night. Where does this water come from?
3. What do you see on the outside of a bottle, jar or can when you take it out of the fridge?

PROCEDURE

1. Half fill the can with ice and set it aside for 10 minutes.
2. Once students have examined the moisture that has condensed on the outside of the can, add a couple of teaspoons of salt.
3. Gently swirl the contents of the can a few times and put it down. Set the can aside for 10 minutes.



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QUESTIONS

1. Why does water condense to form droplets of dew on the can?
2. What does salt do to the temperature of ice in the can?
3. What did you observe on the outside of the very cold can?
4. Why do you think that frost forms on the outside of the can when salt is added to the ice?

EXPLANATION

The ice cools the can and the air in contact with it. As the air cools, water from the air condenses as dew. Adding salt to ice cools the temperature to below freezing point (0°C). Now, rather than dew forming, crystals of ice, known as frost, form.

Tiny droplets of dew often form at night on cold surfaces such as grass and leaves. In deserts, dew may be the only form of moisture available to plants and animals.

On clear, still nights the temperature at ground level can fall to below 0°C. When this happens, water vapour can turn into solid crystals of frost. Frost can be very damaging to crops such as wheat.

Frost doesn't usually occur on cloudy nights. Clouds trap heat, acting like a blanket. Frost occurs more often in valleys than higher areas because cold air is dense and flows down valley slopes.

When warm, moist air rapidly cools, tiny droplets of water may form and stay suspended in the air. This is fog. Fog is sometimes called low cloud. Warm sea breezes often produce fog when they move over colder land surfaces. Fog is often thickest in valleys and low-lying areas.

EXTENSION ACTIVITIES

Examine frost under a microscope. Describe what you observe.

Frost can cause great damage to crops. Find out how frost harms plants and where it generally occurs. How do farmers try to combat frost?

FACT FILE

Jack Frost is a fictional elf-like character, part of a Scandinavian legend. According to Norse mythology, the son of the god of the winds was Jokul (meaning icicle) or Frosti (frost). It is Jack Frost who is supposedly responsible for the patterns formed by frost.

ACTIVITY

5

a PET cloud

Make your own cloud in a bottle.

EQUIPMENT

- large clear plastic PET bottle with cap. The label should be removed.
- water
- matches

PROCEDURE

1. Pour a little cold water into the bottle.
2. Screw on the cap and shake the bottle.
3. Squeeze and release the bottle a few times. (Does anything happen inside the bottle?)
4. Open the bottle and drop a lit match into it. (The match will go out when it hits the water.)
5. Screw on the cap and shake the bottle.
6. Squeeze and release again.

QUESTIONS

1. Why does shaking the bottle help the experiment?
2. Why do you think the smoke from the match helps the cloud form?

EXPLANATION

When water condenses, the droplets may form clouds. Particles of dust assist the formation of droplets. Without tiny particles in the air, clouds would not form.

Droplets in clouds are small enough to be supported by the air. When they join together to form larger droplets that can no longer be supported and rain falls. It takes about one million cloud droplets to make an average size rain drop.

EXTENSION ACTIVITY

Repeat the activity using hot water. Does it work better?

FACT FILE

Cloud particles consist of tiny droplets of liquid water or ice. The size of these particles ranges from approximately 5 to 75 microns (0.005 to 0.075 mm).

make your own zinc cream

Zinc oxide is the main ingredient in many sun protection products. Here is a recipe, based on one from the Anti-Cancer Council, for making your own zinc cream. Ingredients are available from pharmacies.

EQUIPMENT

- 50 ml liquid paraffin
- 10 g emulsifying wax
- 20 g zinc oxide powder
- measuring cup, spoon
- kitchen or laboratory balance
- two bowls (one heat-proof, that can be placed inside the other)
- hot water
- small container with lid, for each student
- ice cream sticks
- food colouring

SAFETY

The first four steps should be done by the teacher.

PROCEDURE

1. Half fill the large bowl with hot water. Place the smaller bowl inside the larger one. (This will be enough for a whole class.)
2. Add paraffin and wax to the smaller bowl and stir while the mixture melts.
3. Gradually add zinc oxide and stir until smooth.
4. Place a scoop of warm zinc cream into each student's container.
5. Add a drop of colouring to the zinc cream. Constantly stir the cream with the icy pole stick until it is cool.

EXPLANATION

Zinc oxide works as a barrier, blocking most of the sun's harmful ultraviolet radiation.

SPF, the sun protection factor, indicates the amount of protection a sunscreen gives us from the sun. The more zinc oxide in a sunscreen, the greater the protection it provides.

Zinc cream has the highest SPF rating as it has the greatest amount of zinc oxide.

FACT FILE

For information and teaching resources on the Anti-Cancer Council's SunSmart program, phone (03) 9279 1111.

ACTIVITY

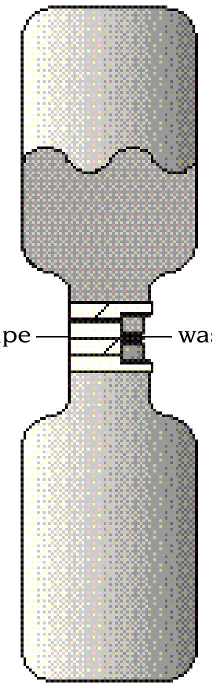
7

bottled up tornadoes

In this activity you will make your own tornado in a bottle.

EQUIPMENT

- two 2-litre PET bottles with the labels removed
- water (you might like to add some colouring)
- paper towel
- flat, metal washer with the same circumference as the mouth of the bottles and duct tape. (Alternatively, buy a ready-made plastic bottle neck joiner.)



SAFETY

PET bottles used by younger children should have their plastic rings removed.

PROCEDURE

1. Make sure that the plastic rings are removed from the necks of the bottles.
2. Half fill one bottle with water
3. Dry the opening of the bottle with paper towel then place the washer over it.
4. Place the second bottle upside down on top of the washer.
5. Carefully secure the bottles together with tape.
6. Turn the bottles upside down so that the bottle containing the water is on top.
7. Observe what happens.
8. Now hold the lower bottle with one hand and the upper bottle with the other hand.
9. Support the lower bottle while quickly moving the top of the upper bottle in a clockwise circle.
10. Stand the bottles upright, with the empty bottle remaining underneath.

QUESTIONS

1. What did you expect to observe when the bottle containing water was placed above the empty bottle?
2. What did you observe after you moved the top bottle in a circle?
3. Why do you think that spinning the top bottle made a difference to how quickly the water flowed?

EXPLANATION

The water inside the upper bottle swirls, forming a funnel shape as it pours into the lower bottle. You have probably seen this happen when you let water out of a bath. The funnel formed by the swirling water is called a vortex (a whirling mass of air or water). The vortex formed in the water is the same shape as the vortex formed by a tornado (a violently rotating funnel cloud that touches the ground). Tornadoes are also called twisters. They range in size from a few metres across to about a kilometre wide.

A tornado looks like a swirling funnel hanging below a thundercloud. The swirling air that forms the funnel of a tornado appears to begin at the bottom of a dark, puffy, cumulonimbus cloud and moves down to the ground. Tornadoes can cause great damage as winds may reach speeds of more than 800 kilometres per hour.

EXTENSION ACTIVITY

Investigate whether the direction of spinning affects the rate at which water flows from the top bottle to the bottom one. Does the water move more quickly if the top bottle is spun more quickly?

FACT FILE

During the 1960s, a thunderstorm and a rapidly moving cold front produced a tornado in Sydney. It was about 600 metres high and 50 metres wide. As it passed through Cremorne, wind speeds reached 210 kilometres per hour. In little over a minute, a million dollars' worth of damage had been done. The tornado uprooted trees, lifting them into the air. It also destroyed roofs and caused windows to explode and car boots to fly open.

More tornados form on the flat plains east of the Rocky Mountains in the United States than anywhere else on Earth.

This thermometer demonstrates the way in which substances expand and contract when heated and cooled.

ACTIVITY

8

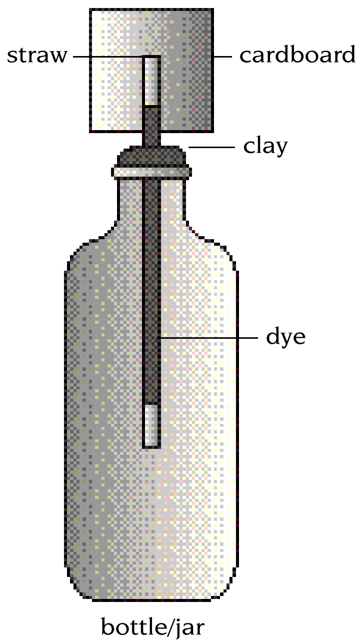
make your own thermometer

EQUIPMENT

- bottle
- straw
- plain cardboard
- small piece of clay or 'blu tack'
- two bowls half-filled with water
- cup of dyed water, containing a little cooking oil

PROCEDURE

1. Stand a thin straw in a cup containing dyed water. Tightly place your finger over the top end of the straw.
2. Lift the straw out, ensuring that some dyed water is trapped within the straw. Place the straw into the empty bottle. Ask your partner to put the clay around the top of the bottle and straw. The die should be suspended in the straw even when you lift you finger off.
3. Carefully attach the cardboard to the straw with sticky tape.
4. Fill a bowl with warm water and another with iced water.
5. Place the bottle and straw into the bowl of warm water. Wait for five minutes and then carefully mark on the cardboard the height reached by the dye.
6. Now put the bottle into the bowl which has water and ice in it. After five minutes, mark the height of the dye.



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QUESTIONS

1. What did you observe when you put the bottle in the bowl of warm water. Can you explain your observation?
2. What did you observe when you put the bottle in the bowl of iced water. Can you explain this observation?

EXPLANATION

A thermometer is an instrument used to measure temperature. Temperature measures how hot (or cold) a material is. The higher the temperature of a material the faster its particles move. As particles move faster they spread apart and make the material expand. As a material cools its particles move closer together and it will contract.

The cooking oil is used in this activity to reduce the rate of evaporation from the straw.

EXTENSION ACTIVITIES

Measure the temperature in the classroom throughout the day and each day for a week. What changes do you notice?

By using a "real" thermometer, draw on a new piece of cardboard a temperature scale so that you can read temperatures with your home-made thermometer.

FACT FILE

Air expands by about 7 per cent when it warms from 0°C to 20°C.

ACTIVITY 9

wet sweat

Why do we perspire (sweat) on a hot day? Why do dogs pant?

EQUIPMENT

- container with water

PROCEDURE

Wet the palm of one hand, keeping the other hand dry. Wait for 10 or 20 seconds. Now blow air over your wet palm.

QUESTIONS

1. Which hand feels warmer? The wet one or the dry one?
2. What effect did blowing air across your wet palm have on how warm your hand felt?

EXPLANATION

Evaporation has a cooling effect as the evaporating liquid draws in heat from its surroundings. The faster, more energetic particles in the liquid change into a gas, leaving behind cooler, less energetic particles.

Heat energy is consumed as the liquid vaporises.

Evaporation of water from a panting dog's mouth and tongue helps cool the animal.

FACT FILE

When humidity is very high (that is, air contains large quantities of water vapour), perspiration evaporates too slowly to cool the body. This is why days of high humidity can be most uncomfortable.

ACTIVITY

10 measuring pressure

Make your own barometer to measure the rise and fall of atmospheric pressure.

EQUIPMENT

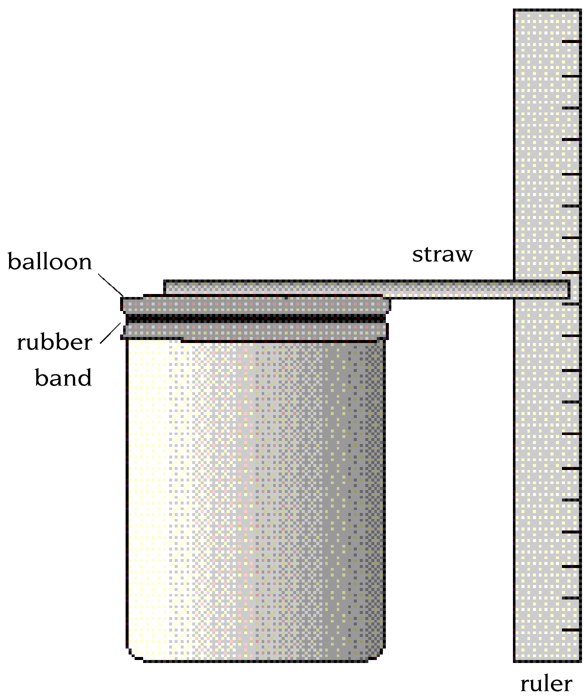
- jar
- large piece of balloon rubber
- strong rubber band
- short drinking straw
- adhesive tape
- cardboard and paper

SAFETY

Ensure that there is no danger of the elastic snapping.

PROCEDURE

1. Stretch the balloon rubber over the jar and secure it with a strong rubber band.
2. Tape the end of the straw to the centre of the balloon



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QUESTIONS

1. Support the ruler upright in front of the end of the straw. The ruler's "zero" measurement should be at the bottom.
2. Note the height on the ruler that the end of the straw aligns with at various times during the day.
3. Record the reading at the same time for at least a week.
4. How do you think that this instrument measures air pressure?

EXPLANATION

Air has weight. It exerts pressure on us and on everything around us. The pressure of the atmosphere on our body would crush us if it were not counterbalanced by the equal internal pressure of the fluids inside our body.

Air pressure at sea level fluctuates around 1,013 hectopascals (hPa). It can drop to 970 hPa during severe storms. In a high pressure system it can reach 1040 hPa.

As air pressure rises, it forces the balloon down into the jar, making the end of the straw rise. The jar works on the same principle as an aneroid barometer, which contains a sealed box with most of its air removed. Any change in pressure will make the box shrink or expand. Levers magnify these changes, causing a pointer to move on a dial.

EXTENSION ACTIVITIES

Collect weather charts each day and check to see whether the changes in pressure that you record match those recorded by the Weather Bureau.

Compare your pressure readings with those from a barometer.

FACT FILE

The barometer was invented in the 1600s. To test the instrument two French scientists carried it up a mountain. They found that as they climbed the pressure readings dropped. This was proof that the barometer was working properly.

On weather maps, lines joining places which have the same air pressure are called isobars.

steeling oxygen

How much oxygen is there in air? Find out by using steel wool to remove the oxygen from a container of air.

EQUIPMENT

- glass bowl
- beaker or glass
- water
- steel wool (buy the cheapest steel wool available!)
- water-proof pen

PROCEDURE

1. Jam steel wool into the bottom of the beaker so that it stays in place when the beaker is inverted.
2. Pour water over the steel wool and then pour it out of the beaker.
3. Fill the bowl with water to a depth of about two centimetres.
4. Place the inverted beaker in the water in the bowl, allowing the water to enter the beaker.
5. Mark the height of the water on the outside of the beaker with the water-proof pen.
6. Leave the beaker in the water for a couple of days.
7. Mark the height of the water inside the beaker with the pen

QUESTIONS

1. How high did the water rise inside the beaker?
2. What fraction of the volume of the air in the beaker was taken up by the rising water?
3. Why did the water rise in the beaker?
4. What is the percentage of oxygen in air?
5. List the uncertainties in measuring the percentage of oxygen in air by this experiment.

EXPLANATION

As iron rusts, it absorbs oxygen, forming iron oxide. As oxygen is removed from the air, water rises in the beaker to take its place.

FACT FILE

Oxygen is the second most abundant gas in air, being responsible for 21 per cent by volume. Nitrogen occupies 78 per cent of air by volume.

12 what's the temperature?

This simple but very effective activity introduces students to making scientific measurements and to collecting and interpreting data. The object of the exercise is for students to measure air temperature.

EQUIPMENT

- thermometer for each pair of students

SAFETY

Handle thermometers carefully. Students shouldn't try to clean up the mess if a thermometer breaks. Use a mercury spill-kit or throw sulfur over the mercury and clean it up wearing gloves and using a brush and pan. Don't touch mercury; it is a poisonous metal.

PROCEDURE

1. Begin by each student measuring the temperature of the air in the classroom. Students may need instructions in reading a thermometer.
2. Each pair of students should make 10 temperature measurements around the school grounds, carefully noting the location of each measurement. Each measurement should be recorded in a table.
3. One of the measurements must be at a pre-defined, shady site, one metre above the ground.
4. At one of the other locations, the pair should measure the temperature of air a few centimetres above the ground, one metre above the ground and at least two metres above the ground (higher, if possible).
5. Back in the classroom, students should decide which one or more of their measurements best shows the outside air temperature, and explain their selection.
6. All temperature measurements at the common site should be collected and tabulated.

QUESTIONS

1. How do you explain differences between the recorded temperature at the site where everyone made a measurement?
2. How would you use the measurements from the common site to work out what the temperature was there?

continued

3. What locations give a good indication of the outside air temperature?
4. What locations should you avoid when measuring outside air temperature?

EXPLANATION

To obtain a reliable, useful measurement of air temperature, the thermometer should be placed in a shady location well away from objects such as buildings and trees, which may affect the temperature nearby. For example, a brick wall that has been in sunlight will trap a great deal of heat that can warm the air in contact with it.

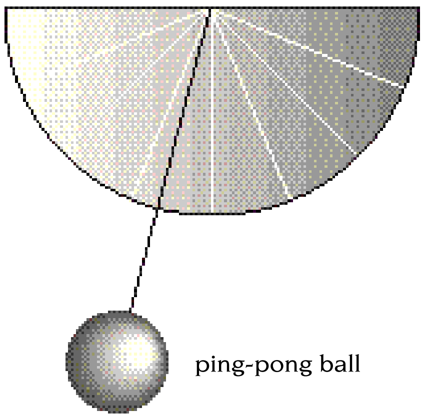
A thermometer placed in direct sunlight will absorb energy and may show a temperature well above the true air temperature.

FACT FILE

Recordings of temperature and humidity are usually made in a wooden box known as a Stevenson screen. This ensures that the thermometers are in shade while allowing a free flow of air. The box also shields the thermometer from hot and cold objects.

measuring wind speed

Measuring wind speed can be done with minimal equipment and surprising accuracy.



EQUIPMENT

- strong thread or thin fishing line — about 40 cm long
- ping-pong ball
- large protractor
- glue and tape
- thick cardboard (for mounting protractor)

PROCEDURE

1. Mount the protractor with tape to the cardboard, curved side pointing down.
2. Tape or glue the thread to the ping-pong ball.
3. Tie or glue the other end of the thread to the centre of the protractor.
4. When the wind blows the thread off centre, read the angle on the protractor.
5. Convert this angle to the wind velocity in this table.
6. Use your instrument outside and away from buildings to measure wind speed. At the same time, use the Beaufort wind scale to write down your observations about the strength of the wind.

String angle (degrees)	90	80	70	60	50	40	30	20
Wind speed (km/h)	0	13	19	24	29	34	41	52

QUESTIONS

1. What is wind?
2. Can wind be useful to us?
3. What damage can wind do?
4. Does your instrument give a measurement of wind speed that agrees with the measurement using your observations and the Beaufort wind scale? Can you suggest any improvements to the instrument?

continued

BEAUFORT WIND SCALE

Beaufort number	Description	Wind Speed (km/hr)	Effect
0	Calm	Less than 2	Smoke rises vertically
1	Light air	2–5	Smoke drift shows wind direction, wind vanes don't move
2	Light breeze	6–12	Wind felt on face, wind vane moved
3	Gentle breeze	13–20	Leaves and small twigs in motion,hair disturbed,clothing flaps
4	Moderate breeze	21–30	Dust and loose paper moved,small branches move
5	Fresh breeze	31–40	Small trees with leaves begin to sway, wind force felt on body
6	Strong breeze	41–51	Large branches move, umbrellas difficult to use, difficult to walk steadily
7	Moderate gale	52–63	Whole trees in motion,inconvenience felt when walking
8	Gale	64–77	Twigs broken off trees,difficult to walk
9	Strong gale	78–86	People blown over, slight structural damage including tiles being blown off houses
10	Whole gale	88–101	Trees uprooted,considerable structural damage
11	Storm	102–120	Widespread damage
12	Hurricane	Greater than 120	Widespread devastation

EXPLANATION

Heat from the sun warms air and makes it rise. This occurs mainly in tropical regions, near the equator, where the sun's energy is most intense. As warm air rises, cool air rushes in to take its place. We feel this movement of air as wind.

During the day in summer, land is generally warmer than the sea. This temperature difference can set up cooling daytime sea breezes, which can penetrate many kilometres inland. At night, breezes may blow in the opposite direction, from the land to the sea.

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Similar daily changes in temperature occur over irregular terrain and cause mountain and valley breezes. Other winds induced by local phenomena include whirlwinds and winds associated with thunderstorms.

EXTENSION ACTIVITIES

Can you devise another simple instrument for measuring wind speed?

FACT FILE

The strongest wind ever reliably measured on the surface of the Earth was 362 km/hr, recorded on Mt Washington in the United States on 12 April, 1934. Much stronger winds, however, occur near the centre of tropical cyclones.

colours of the sky

Why is the sky blue? Why are sunrises and sunsets red? Find out with this simple, but effective activity.

EQUIPMENT

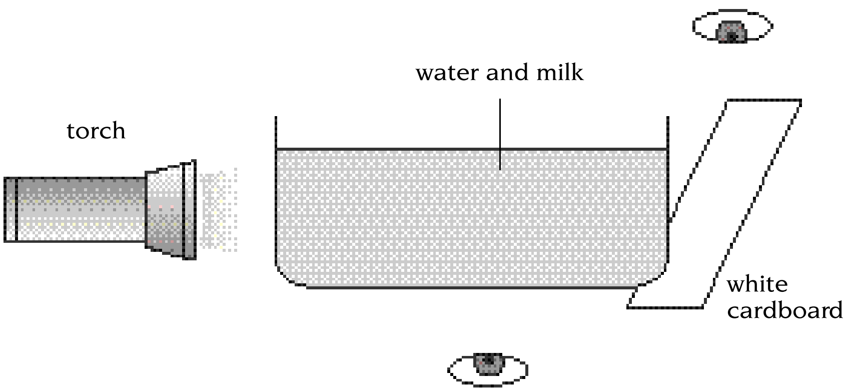
- clear glass 2-litre bottle or container
- powerful torch or projector
- milk (powdered milk will work well too)
- white cardboard

SAFETY

Never look directly at the beam from the projector. Use a white card to view the light passing through the tank.

PROCEDURE

1. Fill the bottle with water.
2. Illuminate the bottle with the torch or projector.
3. Add milk a small amount at a time, gently stirring the mixture until you just observe from the far end of the container a beam shining through the liquid.
4. Look at the light beam from the end of the container and then from the middle.
5. A card placed in front of the light at the end of the tank may help students see the colour. The room should be darkened.



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QUESTIONS

1. What colour does the light beam appear to be when viewed from the end of the tank?
2. What colour is the light when viewed from the side of the tank?
3. From your observations, can you suggest why the sky is blue?
4. Why is the sky a red-orange colour at sunset and sunrise?

EXPLANATION

From the side of the tank the beam looks bluish-white and from the end it looks yellow-orange.

The sun produces white light, which is made up of all colours: red, orange, yellow, green, blue, indigo and violet. Light is a wave and each of these colours has a different frequency and therefore a different wavelength of light.

When light collides with gases in the earth's atmosphere the light is scattered. Blue light has a short wavelength and scatters more than red light. The light reaching our eyes from the sky is blue. At sunrise and sunset, sunlight passes through far more air before reaching us. As the blue light has been lost through scattering, what we see is white light minus the blue; that is, red light.

EXTENSION ACTIVITIES

Move your eyes along the container. Do you notice a gradual colour change?

Try the activity using a piece of cardboard with a hole punched in it to produce a sharper light beam.

Investigate the effect of placing a polarising film in the light path.

Find out what happens to ultraviolet light from the sun.

FACT FILE

Seen from the side in a darkened room, the light beam from a projector appears blue, because of the smoke and dust in the air scattering the light.

ACTIVITY

15

icy air

As snow falls over polar regions, every now and then a tiny pocket of air forms. Eventually the snow turns into ice, trapping the air within it. The deeper the ice, the older the air that it contains. Scientists are extracting cores of ice, removing the air and analysing it to build up an accurate picture of what the Earth's atmosphere has been like over the past 300,000 years.

EQUIPMENT

- ice cubes
- hand lens
- water
- plastic container and lid (an ice cream container works well)

PROCEDURE

1. Carefully observe the ice with the hand lens.
2. Add a drop of detergent to the top of the ice block.
3. Fill the plastic container with hot water.
4. Place the ice block on the container lid and watch the ice as it melts.

QUESTIONS

1. Draw what you observed when you looked at the ice with the hand lens.
2. Describe what you observed as the ice melted.
3. Can you think of a way of extracting the air from the ice block so that it doesn't mix with air in the classroom?

EXTENSION ACTIVITY

Suggest some ways in which scientists could work out the age of air trapped in ice at various depths beneath the surface.

FACT FILE

Between 1989 and 1993 American and European scientists drilled more than 3 kilometres through Greenland's ice sheet to the bedrock below to learn about atmospheric changes throughout history.

getting warmer

In this activity you will examine how different materials absorb energy from the sun.

EQUIPMENT

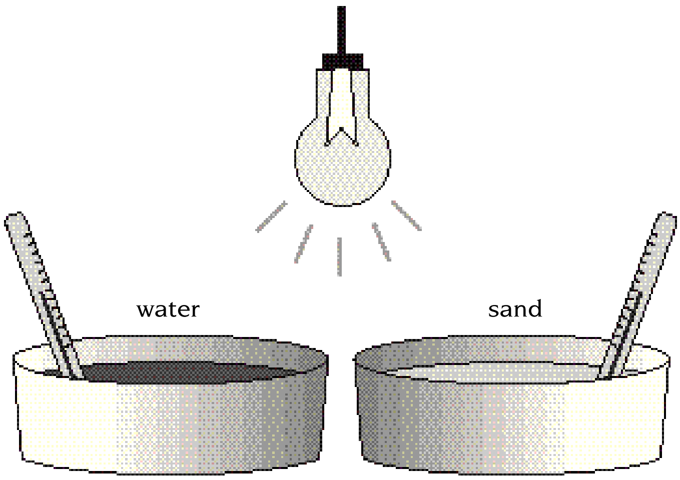
- desk lamp, reading light or 100 watt globe
- stand and clamp
- two shallow bowls or similar containers
- dry sand or soil
- two thermometers

SAFETY

Take care that you don't touch the hot globe.

PROCEDURE

1. Pour water to a depth of about 2 cm into one bowl.
2. Put the same depth of dry sand in the other bowl.
3. Place a thermometer in each bowl, with the bulb just below the surface.
4. Put the bowls next to each other and clamp the globe about 5 cm above where the bowls touch.
5. Draw up a table and add data during the experiment:
6. Record the temperature in each bowl before the lamp is turned on.
7. Turn on the lamp. Leave it on for five minutes. Record the temperature in each bowl after each minute.



8. After five minutes, turn off the lamp. Continue to read the temperature in each bowl after each minute for another five minutes.
9. Draw a graph to show how the temperature changed in each of the bowls. You can plot the temperatures in both bowls on the same graph.

Time (minutes)	Temperature of water	Temperature of sand
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

QUESTIONS

1. What was the temperature increase during heating in the:
   a) water?
   b) sand?
2. How did the temperature changes in the water compare with those in the sand?
3. Which heats up more quickly during the day — water (such as lakes or the sea) or land? Which cools more quickly when sunlight is absent — land or water?
4. Which would be warmer on a hot afternoon —air above the sea or air above nearby land?
5. Use your graph to try to predict how long it would have taken the sand and the water to cool to their original temperatures.

continued overleaf

continued

EXPLANATION

Much of our weather is due to water and land absorbing different amounts of energy from the sun.

Different substances absorb heat at different rates. Even different colours absorb different amounts of heat. A black brick, for example, will warm more quickly in the sun than a lighter coloured brick made of the same material.

Ice and snow, for example, reflect a great deal of the sun's energy back into the atmosphere. Soil and sand absorb much of the sun's energy.

EXTENSION ACTIVITIES

Repeat the experiment using soil. How does the temperature change compare with sand? Can you suggest an explanation if you notice any difference?

Repeat the experiment with the water bowl, this time gently stirring the water throughout the 10 minutes. How does stirring affect the temperature changes? Suggest an explanation for any change that you observe.

Why do people in hot countries favour light coloured clothes? Are dark clothes better in cold weather?

ACTIVITY 17

wet air

Measure the humidity in the classroom and school ground.

EQUIPMENT

- two thermometers
- cotton wool
- rubber band

SAFETY

Handle thermometers carefully. Students shouldn't try to clean up the mess if a thermometer breaks. Use a mercury spill-kit or throw sulfur over the mercury and clean it up wearing gloves and using a brush and pan. Don't touch mercury; it is a poisonous metal.

PROCEDURE

1. Wrap the cotton wool around the bulb of a thermometer. Secure it with a rubber band.
2. Dip the wrapped bulb in water.
3. Gently fan the wet bulb thermometer until the temperature reaches a minimum.
4. Compare the reading of the wet-bulb thermometer and the dry-bulb thermometer.
5. Record the difference in the two readings.
6. Read the relative humidity from the chart. The numbers on the side of the chart represent the dry bulb temperature. The numbers at the top represent the difference between the dry and wet bulb temperature. Measurements are in °C. The point at which the row and the column intersects is the percentage humidity in the air. For example, if the dry bulb temperature is 20ºC, and the wet bulb depression is 5.5ºC, then the humidity is 55 per cent.
7. Repeat the exercise elsewhere, such as in the school ground.

QUESTIONS

1. Why does the wet bulb thermometer register a lower temperature than the dry bulb thermometer?
2. When is humidity higher — when the temperature difference between a wet bulb and dry-bulb thermometer is high or low?

EXPLANATION

Humidity is a measure of the amount of water vapour in air. If air temperature is 20°C, each cubic metre of air can contain up to 17 g of water vapour. If there is only 8.5 g of water vapour per cubic metre at 20°C, we say the relative humidity is 50%.

continued overleaf

ACTIVITY 17

continued

Humidity can have a strong influence on how comfortable we feel. Combinations of high temperature and high humidity can be very uncomfortable. Physical activity and exposure to direct sunlight can also increase heat stress.

HUMIDITY CHART

	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	11	12	13	14	15	16
40	97	94	91	88	85	82	80	77	74	72	69	67	64	62	60	57	55	53	51	48	44	40	37	33	29	26
39	97	94	91	88	85	82	79	77	74	71	69	66	64	61	59	57	54	52	50	48	44	40	36	32	28	25
38	97	94	91	88	85	82	79	76	74	71	68	66	63	61	58	56	54	51	49	47	43	39	35	31	27	24
37	97	94	91	87	85	82	79	76	73	70	68	65	63	60	58	55	53	51	48	46	42	38	34	30	26	23
36	97	94	90	87	84	81	78	76	73	70	67	65	62	60	57	55	52	50	48	45	41	37	33	29	25	21
35	97	93	90	87	84	81	78	75	72	70	67	64	61	59	56	54	51	49	47	44	40	36	32	28	24	20
34	97	93	90	86	84	81	78	75	72	69	66	64	61	58	56	53	51	48	46	44	39	35	30	26	23	19
33	97	93	90	86	83	80	77	74	71	69	66	63	60	58	55	52	50	47	45	43	38	34	29	25	21	17
32	97	93	90	86	83	80	77	74	71	68	65	62	60	57	54	52	49	46	44	42	37	32	28	24	20	16
31	96	93	90	86	83	80	77	73	70	67	64	62	59	56	53	51	48	45	43	41	36	31	27	22	18	14
30	96	93	89	86	83	79	76	73	70	67	64	61	58	55	52	50	47	44	42	39	34	30	25	21	17	13
29	96	93	89	86	82	79	76	72	69	66	63	60	57	54	52	49	46	43	41	38	33	28	24	19	15	11
28	96	93	89	85	82	79	75	72	69	65	62	59	56	53	51	48	45	42	40	37	32	27	22	18	13	9
27	96	92	89	85	82	78	75	71	68	65	62	59	55	52	50	47	44	41	38	36	30	25	21	16	11	7
26	96	92	88	85	81	78	74	71	67	64	61	58	55	51	49	46	43	40	37	34	29	24	19	14	9	5
25	96	92	88	84	81	77	74	70	67	63	60	57	54	50	47	44	41	38	36	33	27	22	17	12	7	3
24	96	92	88	84	80	77	73	69	66	62	59	56	52	49	46	43	40	37	34	31	26	21	15	10	5	
23	96	92	88	84	80	76	72	69	65	62	58	55	51	48	45	42	39	36	33	30	24	18	13	8	3	
22	96	92	87	83	79	76	72	68	64	61	57	54	50	47	44	40	39	36	33	30	22	16	11	5		
21	96	91	87	83	79	75	71	67	63	60	56	52	49	46	42	39	35	32	29	26	20	14	8	3		
20	96	91	87	83	78	74	70	66	62	59	55	51	48	44	41	37	34	30	27	24	18	12	6			
19	95	91	86	82	78	74	70	65	61	58	54	50	46	43	39	35	32	29	25	22	15	9	3			
18	95	91	86	82	77	73	69	65	60	56	52	49	45	41	37	34	30	27	23	20	13	7				
17	95	90	86	81	77	72	68	64	59	55	51	47	43	39	35	32	28	24	21	17	10	4				
16	95	90	85	81	76	71	67	62	58	54	50	46	41	37	34	30	26	22	18	15	8	1				
15	95	90	85	80	75	71	66	61	57	52	48	44	40	36	31	27	24	20	16	12	5					
14	95	90	84	79	74	70	65	60	56	51	47	42	38	33	29	25	21	17	14	9	2					
13	95	89	84	79	74	69	64	59	54	49	45	40	36	31	27	23	18	14	10	6						
12	94	89	83	78	73	68	63	57	53	48	43	38	34	29	24	20	16	11	7	3						
11	94	88	83	77	72	66	61	56	51	46	41	36	31	26	22	17	13	8	4							
10	94	88	82	77	71	65	60	54	49	44	39	34	29	24	19	14	9	5								

EXTENSION ACTIVITIES

How is humidity related to weather conditions?

Design an experiment to use wool to measure humidity. Test the experiment by comparing your measurements with the wool to humidity measurements from meteorological instruments.

FACT FILE

Cows lying down, appearance of large numbers of frogs and snails, wool swelling and straightening, pine cone scales becoming pliable, and your hair getting longer: these may all be signs of high humidity.

clouds that warm, clouds that cool

What effect do clouds have on the temperature at the Earth's surface.

EQUIPMENT

- thermometers
- cloud chart

PROCEDURE

Use a thermometer in a shady location about a metre above the ground well away from buildings to measure the temperature on clear and cloudy days over several weeks. Along with the temperature measurement, note the time and date. You should take measurements during both day and night.

Use a cloud chart (photos of different cloud types) to record the type of cloud present. Estimate too the fraction of the sky covered by cloud. An easy way is to observe how many eighths of the sky is cloudy. For example, if half the sky contains clouds, you would describe the cover as 4/8. If clouds occupy only a fraction of the sky, you would write 1/8.

Record your results in a table like this:

Date	Time	Temperature	Cloud type	Cloud cover

QUESTIONS

1. Examine your data to see if you can work out what influence clouds have on surface temperatures.
2. Are there some types of clouds that seem to increase surface temperatures? Which types?
3. Are there some types of clouds that seem to lower surface temperatures? Which types?

EXPLANATION

Clouds are named according to their height, shape and colour. There are low clouds (below 2 kilometres), medium clouds (2-7 kilometres) and high clouds (above 7 kilometres). There are also clouds that stretch long distances through the atmosphere. Because the air is so cold, high clouds are normally made up of tiny ice particles.

Cirrus are high, white, feathery clouds. They are made up of ice crystals and don't bring rain.

Clouds with a woolly appearance are called cumulus. Sometimes they are small low-level clouds. They can also be present during thunderstorms, reaching heights of 15 kilometres. Cumulus clouds often produce rain.

Stratus are low grey clouds. If the air is very still, tiny water droplets can fall to the ground as drizzle.

In general, high clouds warm the Earth's surface and low clouds have a cooling effect.

El Niño and rainfall

Sometimes, for no apparent reason, the Pacific Ocean near America warms. Normal ocean currents and winds change. The oceans to the north-east of Australia cool. El Niño is here!

The table opposite presents information on El Niño and rainfall for the years from 1947 to 1992.

The "SOI", or southern oscillation index, is a measure that scientists use to establish whether El Niño is present and how strong it is. A negative SOI value indicates an El Niño. The lower the value of the SOI, the stronger the El Niño event. If the SOI value is positive, it means that there was no El Niño event in that year.

The rainfall column of the table gives the total annual rainfall for Canary Island in northern Victoria. (It's not actually an island but a place about 30 km south of Kerang and 90 km north of Bendigo.)

QUESTIONS

1. How many years was the SOI less than –5?
2. Write down the rainfall for each year that the SOI was less than –5.
3. Calculate the average rainfall for all these years in which the SOI was less than –5. This is the average rainfall in years when El Niño was present.
4. How many years was the SOI greater than 5?
5. Write down the rainfall for each year that the SOI was greater than 5.
6. Calculate the average rainfall for all these years in which the SOI was greater than 5.
7. From your answers to questions 3 and 6, what do you notice about the impact of El Niño on rainfall at Canary Island in northern Victoria?

EXPLANATION

The southern oscillation index (SOI) is determined by the difference in barometric pressure between Tahiti and Darwin. Pressure see-saws between the two locations, normally being higher in Tahiti than in Darwin. During El Niño the opposite condition prevails, taking the SOI to negative values.

El Niño's influence is usually very extensive, with rainfall being affected throughout eastern Australia.

You will find much information about El Niño at the Bureau of Meteorology's Web site: http://www.bom.gov.au/climate/ahead/

EXTENSION ACTIVITIES

Do you think that the southern oscillation index can be used to predict rainfall? If so, explain how you could produce a prediction.

continued

Explore the relationship between the southern oscillation index and rainfall by plotting a graph of rainfall versus southern oscillation index from the data in the table.

Year	SOI	Rainfall (mm)	Year	SOI	Rainfall (mm)
1947	2.3	382	1970	3.9	406
1948	–1.2	286	1971	11.0	535
1949	–1.1	331	1972	–7.4	268
1950	15.4	493	1973	7.3	812
1951	–0.7	380	1974	9.9	598
1952	–2.3	438	1975	13.6	441
1953	–6.8	360	1976	1.1	269
1954	4.1	381	1977	–9.9	231
1955	10.6	549	1978	–1.7	471
1956	10.7	635	1979	–1.9	369
1957	–3.9	289	1980	–3.1	328
1958	–3.2	481	1981	1.8	400
1959	0.0	283	1982	–13.1	123
1960	3.8	568	1983	–8.3	527
1961	0.8	381	1984	–0.1	336
1962	5.4	383	1985	0.9	395
1963	–2.0	431	1986	–2.4	379
1964	6.3	465	1987	–13.1	366
1965	–8.4	335	1988	7.8	445
1966	–4.2	400	1989	6.8	488
1967	3.2	156	1990	–2.2	278
1968	3.0	430	1991	–8.8	321
1969	–5.4	443	1992	–10.4	544

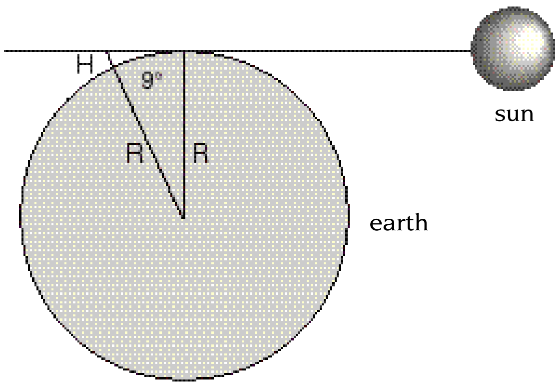
how high is the atmosphere?

In 1025, an Arabian scientist, Alhazen (965–1039), used a simple observation to estimate how far up the atmosphere extends. Of course, there is no actual top of the atmosphere, but Alhazen did not know this.

You can challenge students to think about how you would determine atmospheric height using only the tools that would have been available in the 11th century. A clue to the method used by Alhazen is that he based his estimate on the average length of twilight — that is, the time between the sun's setting and total darkness.

EXPLANATION

Alhazen measuring the average duration of twilight as 36 minutes. During this time, the Earth turns through 9 degrees (that is, ((36/60)/24) x 360 = 9)



The calculation is then a matter of trigonometry:

$\cos 9° = R/(R+H)$ — $R = 6115$ km, the value that Alhazen used for the Earth's radius

$H = R(1-\cos 9°)/\cos 9°$

$= 6115(1-0.988)/0.988$

$= 74.3$ km

Although the atmosphere has no 'top', the height that Alhazen calculated is reasonable, given that air density about 70 kilometres above the Earth is approximately 10,000 times less than at the surface.

EXTENSION ACTIVITIES

Alhazen used for the radius of the Earth a value calculated in 330 BC by the Greek philosopher, Eratosthenes. Find out how Eratosthenes estimated the Earth's radius.

How does Eratosthenes' estimate of the Earth's radius compare with the real value?

melting ice

No-one is suggesting that the world's ice sheets will melt completely. However, if the ice sheets did melt, how high would the sea rise?

EQUIPMENT

- calculator or computer
- ice blocks and water
- glass container
- marker pen

BACKGROUND

The ice sheets of Antarctica and Greenland contain massive amounts of frozen water. As this frozen water lies above land, if it melted it would run into the oceans, raising their level. Frozen water that floats, such as ice in the Arctic region, would not alter sea level if it were to melt.

Antarctica has an area of 11.97 million square kilometres and an average thickness of 2.45 kilometres. The Greenland ice sheet has an area of 1.74 million square kilometres and an average thickness of 1.50 kilometres.

The world's oceans, seas and bays have a total surface area of 361 million square kilometres.

PROCEDURE

1. Half fill the glass container with water and add a couple of ice blocks. On the outside of the glass, carefully mark the height of the water. Set the glass aside until the ice melts.
2. Calculate the volume of the Antarctic ice sheet and then the Greenland ice sheet by multiplying each ice sheet area by its average thickness.
3. Now calculate the volume of liquid water that would form if the Antarctic ice sheet and the Greenland ice sheet were to melt. To do this, you need to know that ice is less dense than liquid water. (This is why ice floats on water.) The density of ice is approximately 0.9 times the density of liquid water., so you will need to multiply the volume of the Antarctic ice sheet and then the Greenland ice sheet by 0.9.
4. You now know the volume of water released by the melting of the Antarctic ice sheet and the Greenland ice sheet. This water will spread across the total surface area of the world's oceans, seas and bays. Divide the water volume you worked out in step 3 by 361 million square kilometres, the Earth's surface water area.

continued overleaf

continued

QUESTIONS

1. What happened to the height of the water in the glass after the ice melted? Can you explain your observation?
2. How high would sea level rise if the Antarctic ice sheet were to melt? How high would sea level rise if the Greenland ice sheet melted? What would the total sea level rise be if both ice sheets were to melt?
3. Can you list any uncertainties in the calculations you have made? Are there any other factors that might contribute to, or decrease, sea level rise if the Antarctic and Greenland ice sheets were to melt.

EXPLANATION

No knowledgeable person expects the Antarctic and Greenland ice sheets to melt in the foreseeable future. However, even small increases in sea level can have major effects, especially on low-lying regions such as Pacific islands.

During the past century, sea level has risen by approximately 15 centimetres.

Any future rise in sea level caused by global warming would be due to a combination of melting of ice on land as well as expansion of water in the oceans. Liquid water, like most substances, expands as it gets warmer.

EXTENSION ACTIVITIES

Do some research to find out how high scientists believe that sea level will rise during the next century.

What are some of the impacts of rising sea level?

FACT FILE

Eighteen thousand years ago, at the peak of the last ice age, sheets of ice covered almost a third of the world's land. Because so much water was locked up in the form of ice, sea level was much lower than it is now — it was possible to walk from mainland Australia to Tasmania.

ACTIVITY

22

the ups and downs of ozone

Explore how the ozone layer has changed over the decades as well as the changes that take place during the course of a year.

BACKGROUND

High above our heads in a layer of the atmosphere known as the stratosphere is a small amount of ozone gas. This gas is made up of molecules each containing three atoms of oxygen; its chemical formula is O_3. (The formula of oxygen gas is O_2.) The 'ozone layer' absorbs harmful ultraviolet radiation from the sun.

Scientist measure ozone layer thickness by measuring how much ultraviolet radiation reaches the ground, using a Dobson ozone spectrophotometer. Ozone layer thickness is measured in Dobson units. The higher the number, the thicker the ozone layer.

The following tables presents ozone measurements made in Dobson units at the Halley research station in Antarctica by the British Antarctic Survey.

TABLE 1. ANNUAL AVERAGE OZONE READINGS (DOBSON UNITS)

Year	Average ozone reading	Year	Average ozone reading	Year	Average ozone reading
1956	318	1970	307	1984	260
1957	312	1971	314	1985	247
1958	333	1972	306	1986	272
1959	309	1973	292	1987	235
1960	318	1974	301	1988	270
1961	312	1975	298	1989	246
1962	327	1976	300	1990	231
1963	319	1977	302	1991	239
1964	320	1978	301	1992	233
1965	295	1979	303	1993	225
1966	304	1980	280	1994	232
1967	310	1981	278	1995	210
1968	302	1982	276	1996	216
1969	286	1983	270		

continued overleaf

continued

TABLE 2. MONTHLY OZONE READINGS FOR SELECTED YEARS (DOBSON UNITS)

Year commencing	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Year
1957	301	284	320	394	347	332	301	280	256	312
1967	–	–	313	357	333	318	285	289	279	310
1977	290	239	251	332	360	310	305	282	253	302
1987	254	182	150	188	287	286	264	271	265	235
1992	185	152	147	206	270	284	275	277	256	233
1996	172	155	149	181	260	278	265	245	242	216

PROCEDURE

1. Draw a graph of ozone reading versus year from Table1 (with ozone reading on the vertical axis and year on the horizontal axis).
2. Draw a graph of ozone reading versus month for each year from Table 2 (with ozone reading on the vertical axis and month on the horizontal axis). Use a different colour for each year.

QUESTIONS

1. What does your first graph tell you about what has happened to the thickness of the ozone layer during the period 1956 to 1996?
2. From your second graph, what changes do you observe in recent years compared with 1957 and 1967?
3. What does the graph tell you about the timing each year of the Antarctic ozone hole?

EXPLANATION

Since the late 1970s, the ozone layer has been damaged. This means that more of the sun's harmful UV radiation is able to reach the earth's surface. This radiation can cause sunburn, skin cancer and eye diseases.

Damage to the ozone layer is caused by CFCs (chlorofluorocarbons), that in the past were used as refrigerants, in spray cans, in the plastics industry and for cleaning electronic circuit boards. Halons, used as fire extinguishing chemicals, also destroy ozone.

Ozone depletion occurs over much of the planet. The depletion over Antarctica (the Antarctic ozone hole) peaks in spring, when sunlight activates chemical reactions in which chlorine released from the CFCs rapidly destroys ozone molecules. These reactions happen on ice crystals in the very cold, high-altitude clouds above Antarctica.

continued

FACT FILE

The thickness of the ozone layer is measured in Dobson units. Divide the reading of stratospheric ozone in Dobson Units by 100 and you have the thickness in millimetres of a layer of pure ozone gas at ground level formed from all the ozone in the stratosphere at the time. For example, in August 1996, the ozone that made up the ozone layer if brought down to the ground, would form a layer of pure ozone gas just 1.72 millimetres thick if evenly spread around the world.

glossary

air
: the mixture of gases and particles that comprises our atmosphere

anemometer
: instrument that measures wind speed

atmosphere
: the air surrounding the planet

barometer
: instrument that measures air pressure

Beaufort wind scale
: a scale that uses observations of the effects of wind to estimate its speed

chlorofluorocarbons (CFCs)
: chemicals that release chlorine atoms that destroy ozone high in the atmosphere

cirrus cloud
: high cloud, delicate and feathery looking

cloud
: mass of water droplets or ice crystals caused by water vapour in the atmosphere condensing or freezing

cold front
: the boundary at ground level between a mass of advancing cold air and warmer air

condense
: change from a gas to a liquid

contract
: reduce in size

cumulonimbus cloud
: heavy, dark cloud of great vertical depth, often bringing rain

cumulus
: clouds with a woolly appearance that often produce rain

dew
: droplets of water deposited when air cools and the water vapour in it condenses

El Niño
: change in circulation patterns across the Pacific Ocean that often brings drought to Australia

evaporate
: change from a liquid to a gas

expand
: increase in size

fog
: a dense mass of small water droplets or particles in the lower atmosphere

freeze
: change from a liquid to a solid

frost
: ice crystals formed from water vapour when air cools to freezing point or below

humidity
: a measure of water vapour in the air

isobars
: lines on weather maps joining places which have the same air pressure

nitrogen
: the most abundant gas in air, comprising 78 per cent by volume

oxygen
: the second most abundant gas in air, comprising 21 per cent by volume

glossary

ozone
form of oxygen comprising molecules of O_3. The ozone layer filters out most of the harmful ultraviolet radiation emitted by the sun.

pressure
force per unit area

southern oscillation index
a measure of the presence and strength of El Niño

Stevenson screen
a white wooden box that houses and protects a range of meteorological instruments

stratosphere
layer of the atmosphere between about 10 and 50 kilometres above the ground

stratus cloud
low cloud forming a uniform layer

thermometer
instrument that measures temperature

tornado
a whirlwind or mass of rotating air with high wind speeds at its centre

tropical cyclone
region of low atmospheric pressure accompanied by violent storm conditions.

twister
see tornado

ultraviolet radiation
radiation with wavelengths shorter than visible light, but longer than X-rays

vapour
gas

vortex
rotating mass of air or water, such as water going down a plug hole.

whirlwind
small column of rapidly rotating air

wind
moving air

Links to the science component of the Victorian CSF

The following list shows how the activities in this booklet relate to learning outcomes of the Victorian Curriculum and Standards Framework.

LEVEL	STRAND	SUBSTRAND	LEARNING OUTCOME	ACTIVITY
1	Earth and Beyond	The Changing Earth	Describe how weather influences daily life.	Activity 5 Activity 6 Activity 13
2	Earth and Beyond	The Changing Earth	Describe weather conditions over a period.	Activity 4 Activity 8 Activity 10 Activity 12 Activity 13 Activity 17 Activity 18
	Natural and Processed Materials	Reaction and Change	Describe everyday changes that form new materials.	Activity 5
	The Physical World	Force and Movement	Recognise that forces act on objects in a variety of situations.	Activity 1 Activity 2 Activity 3 Activity 14
3	Natural and Processed Materials	Materials: Structure, Properties and Uses	Classify materials as solid, liquid or gas and describe their characteristics.	Activity 4 Activity 5 Activity 9
	Natural and Processed Materials	Reaction and Change	Identify and describe changes involving melting and dissolving.	Activity 4
	The Physical World	Force and Movement	Describe a range of examples of forces, including those due to liquids and air.	Activity 1 Activity 2 Activity 3
	The Physical World	Light and Sound	Identify a range of visual effects associated with light reflecting from mirrors and passing through different materials.	Activity 14
4	Earth and Beyond	The Changing Earth	Describe the causes, characteristics and effects of natural disasters involving atmospheric changes and movements in the Earth's crust.	Activity 7 Activity 10 Activity 15 Activity 19 Activity 21 Activity 22
	Earth and Beyond	The Changing Earth	Describe the structure of the Earth from the core to the atmosphere.	Activity 10 Activity 11 Activity 14 Activity 15 Activity 22
	Natural and Processed Materials	Materials: Structure, Properties and Uses	Describe, based on investigation, mechanisms of heat transfer through and between materials.	Activity 8 Activity 12 Activity 16 Activity 18 Activity 21
5	Earth and Beyond	Our place in space	Discuss events caused by the relative movements of the Sun, Moon and Earth.	Activity 20
	Natural and Processed Materials	Reaction and Change	Describe how a change in reaction conditions influences the speed and product of the reaction.	Activity 22