Teaching Notes
Inside Bubble Earth: Climate Change

Introduction

Shapes in the Dark – page 4

Students might like the opportunity to tell their own shape-in-the-dark story, either fiction or from personal experience.

Shining the Light – page 6

The image shown on page 7 is not a true representation of Earth as a bubble. The edge of the atmosphere is not as clearly defined as shown. Deciding where the bubble ends would make an interesting research project. These two sites have good information:

https://niwa.co.nz/education-and-training/schools/students/layers
https://www.ducksters.com/science/atmosphere.php

Modelling the layers of the atmosphere can be done using different coloured solutions. The one in the photo has different coloured jellies showing that the division between one layer and the next is not easy to determine.

The following website uses different density liquids:

https://kidsactivitiesblog.com/115002/teach-kids-earths-atmosphere/

1 Beginnings

Bubbles Big and Small – page 8

Complete this table to give details of the development of each animal.

Animal	Egg or Uterus?	Born or hatched?	Warm-blooded or cold?
Rabbit			
Whale			
Kiwi			
Octopus			
Turtle			
Elephant			
Shark			
Worm			
Bat			

Activity: One of the photos on page 9 shows the membrane inside an egg. You can get see the whole of the membrane if you dissolve away the hard shell using vinegar. This site tells you how to do it:

https://scienceworksmuseum.org/eggshell-vinegar-science-experiment/

Climate – page 9

Listed below are 10 news reports that could be about weather or climate. Separate them into two lists, one labelled weather, the other labelled climate.

1. The temperature tonight will drop to -3ºC.
2. Heavy rain is expected over the coming week.
3. The average temperature last year was two degrees above average.
4. We predict there will be fewer frosts this winter.
5. Overnight Wanaka had the heaviest snow of the winter.

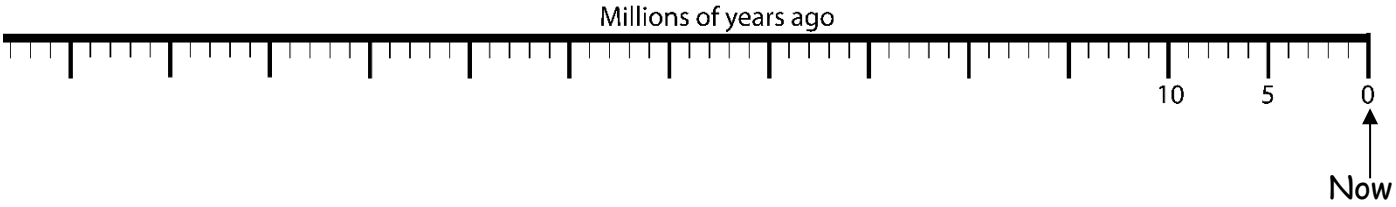
6. Homes have been evacuated in Westport due to flooding of the Buller River.
7. Ground water levels in Northland are lower than anytime over the last decade.
8. Fox Glacier has retreated almost one kilometre in the last 10 years.
9. It always rains during school holidays.
10. Last week strong winds destroyed trees that have been growing for 100 years.

A Climate Survival Story – page 8

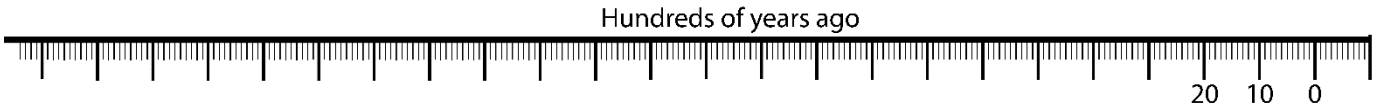
This section discusses several events:

- 66 million years ago when the dinosaurs became extinct.
- The hottest time tuatara survived which was 20 million years ago.
- The coldest time tuatara survived which was 20,000 years ago.
- Now.
- The year 2222

In this exercise you will use timescales to represent these events. First, we'll use the scale which has markers at every million years. Fill in the rest of the numbers 15, 20, 25… Then put labelled arrows pointing to each of the events. The label for Now has already been done.

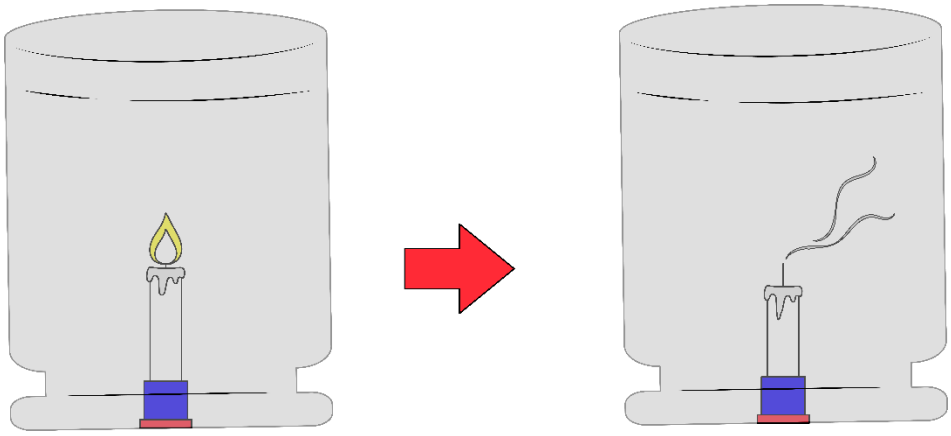


You probably found putting in 20,000 years ago tricky, and 2222 was impossible. To show these we need to expand a small part of the scale so that we can see the hundreds of years. This is shown below. Fill in the rest of the numbers 30, 40, 50 … Put in Now and 20,000 years ago: remember 10 lots of a hundred years is a thousand. Then try 2222.



Living Things – page 15

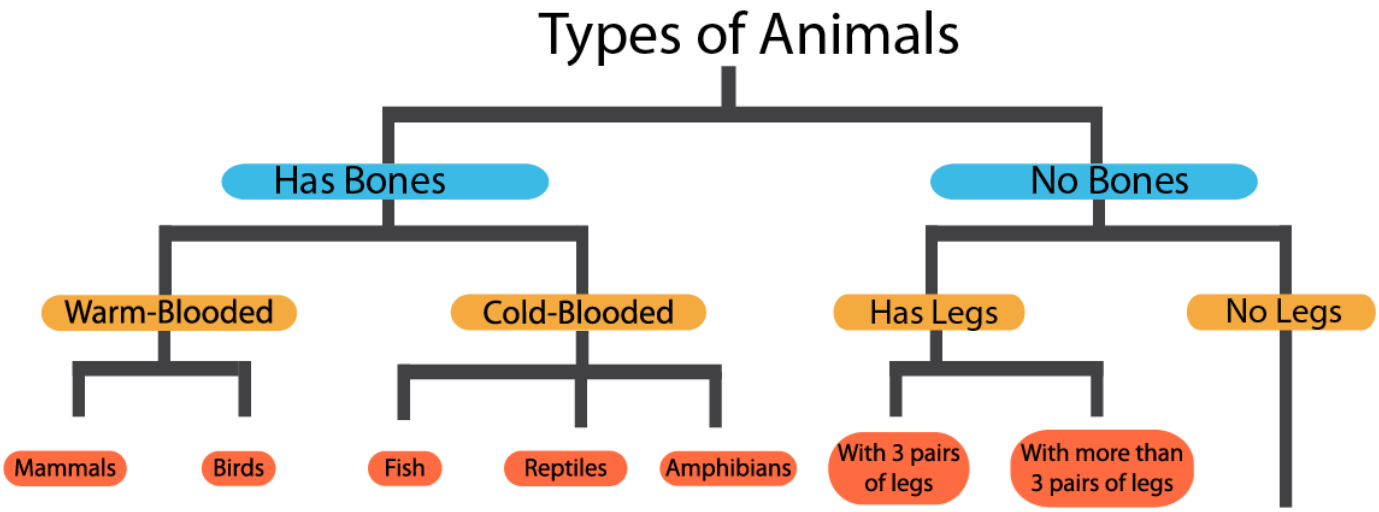
Activity: Part of Joseph Priestley's experiment can be done without killing a mouse. Light a candle and put a jar over it as shown below.



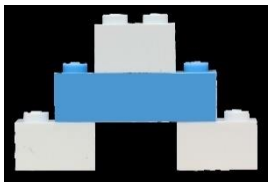
Doing the experiment in a saucer of water will give you some idea of how much of the air is oxygen. This site gives the details:

https://www.mombrite.com/burning-candle-in-water-experiment/

This next exercise is intended to reinforce the wide range of organisms that are animals. Reproduce the table below and draw two animals under each arm and label them. Do not use the animals that are shown in the book.



Building Blocks – page 18



This page shows a model of a water molecule formed using Lego blocks. Try to build the other molecules using Lego. You could miss out the grey bonding bricks, like the molecule shown alongside, which is ammonia – formula NH_3.

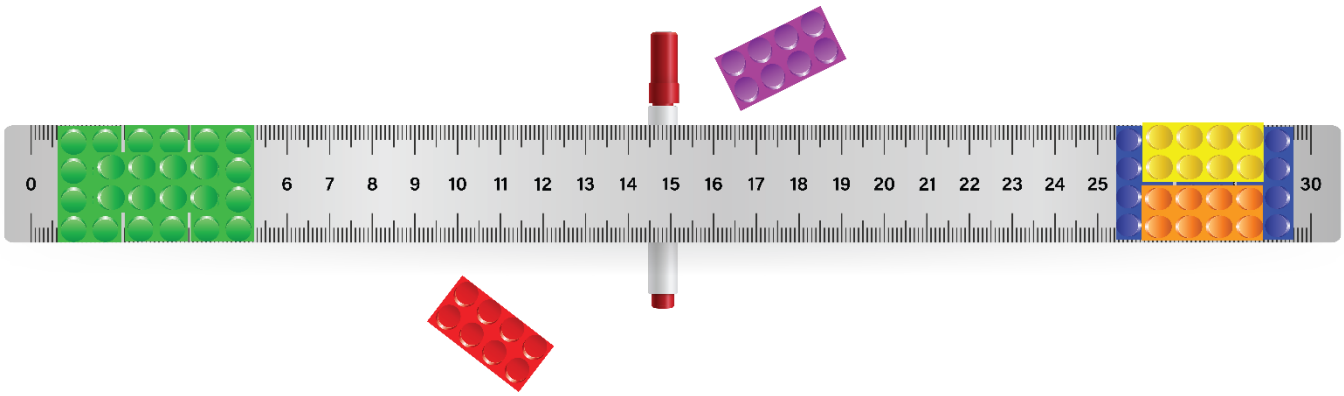
Carbon – page 21

This is another activity using Lego. You'll need 20 or so blocks of four different colours: one colour represents plants; one represents animals; one represents volcanic activity; one represents burning of fossil fuels. Depending on what blocks you've got, it could be: green for plants; red for animals; white for volcanoes; black for burning fossil fuels.

Form a seesaw using a ruler and a cylindrical object such as a vivid pen. Put the cylinder under the middle of the ruler. With a bit of care you may be able to get it to balance; it doesn't matter if you can't – near enough will do. The left side represents carbon dioxide being taken out of the atmosphere; the right side is carbon dioxide being put into the atmosphere.

The table on the following page gives a brief history of the changes in Earth's atmosphere over geological time. You could model each, perhaps drawing the seesaw in the table. You could even make a video of the seesaw changing from one condition to the next.

This illustration shows the general arrangement.



Earth forms without any living things, just lots of volcanoes spewing CO_2 into the atmosphere.	
Plants develop the ability to use the CO_2 and replace it with O_2.	
Plants are so successful that they fill the land and sea. Many of them end up as the fossil fuels, coal oil and natural gas.	
As the amount of O_2 in the atmosphere increases, animals develop in all sorts of shapes and forms to use the O_2.	
Eventually there comes a stage where there is a balance between the amount of CO_2 going into the atmosphere and that taken out.	
Then one of the species of animals – humans – learns to dig up fossil fuels to burn them for energy. The amount of CO_2 in the atmosphere rises very quickly causing climate change.	
The number of humans increases from one billion to eight billion in just a hundred years. Deforestation begins where forests are cleared so that enough food can be produced. This requires more energy from fossil fuels.	
Humans become aware of the need to change their behaviour and work towards returning Earth to a state of balance.	

Light – page 22

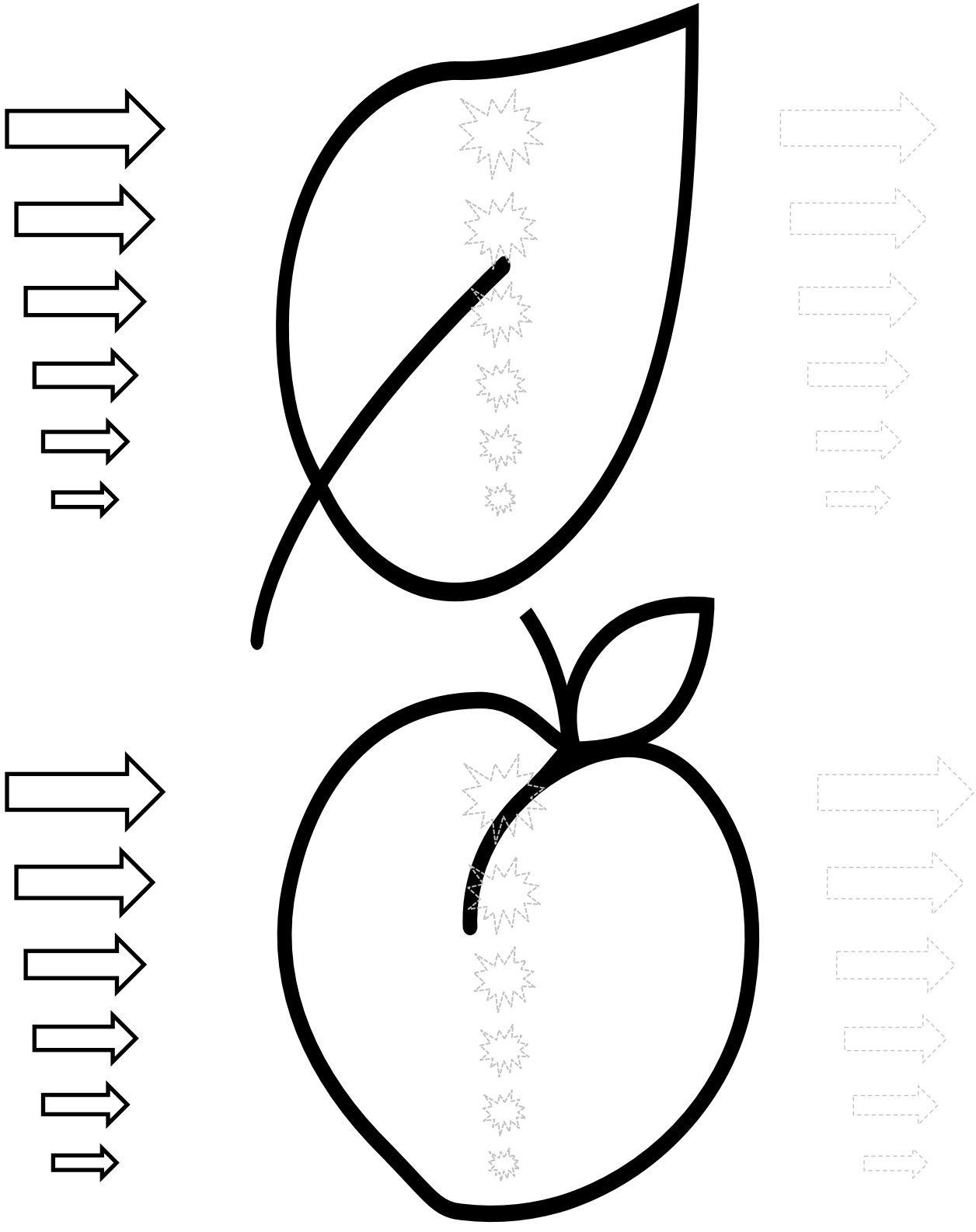
This is a colouring exercise. It is like the bottom image on page 24 where squadrons of photons are approaching a green car. Some crash and give their energy to the car. Some reflect and move on which we see as the colour of the object.

The arrows below show photons of visible light approaching a green leaf (top) and a red plum (bottom). Colour in the photons – see page 23 for the colours.

The dotted splats in the leaf and plum show where photons might have crashed. Colour in only those circles where you are sure that coloured photon would crash.

The dotted outlines to the right are for you to colour in those photons that have reflected – this will be the colour of the object.

Finally colour in the leaf and the plum.



Greenhouse Effect – page 26

This activity investigates the greenhouse effect using jars to represent different atmospheres. Ice cubes are placed in trays of dirt. Each is covered with a different jar.

From the left these are a clear plastic Marmite jar (recycling number 1), a glass jam jar, a white plastic pill container (recycling number 2). The jars should be approximately the same size. In any experiment we should keep everything the same except for the thing we are investigating, which in this case is the light properties of the different materials. The dirt is there to give the photons something to crash into. It will also absorb the water which forms when the ice melts.

The clear plastic and glass jars let through all sunlight except for UV. The white jar reflects all photons except infrared and thermal which it lets through. The clear plastic jar lets out more thermal photons than the glass. From this information you should be able to predict which ice cube will melt fastest.

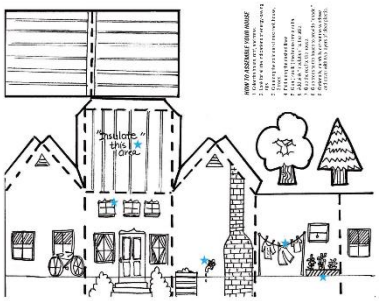
Make sure they are all getting the same amount of full sunlight. Find out which ice cube disappears first and compare this with your prediction.

2 Causes & Cures

A very useful resource for this chapter is available from the Energy Star group. A screen dump of the first page is shown alongside. Altogether there are 35 pages of activities suitable for young students.
To obtain this resource google using this phrase:

How big is your carbon footprint? Energystar

The link should be the first below the ads.
It is a pdf file. What happens when you click the link will depend on your browser. It may open the pdf file or just download it to your computer for you to open.
Below is a screen dump of one of the many resources.



Another set of resources especially designed for the New Zealand curriculum is provided by Genesis, the energy company. Their website schoolgen.co.nz is filled with resources for teachers, students, and parents.

A good place to start is:

https://www.schoolgen.co.nz/teachers/resources/

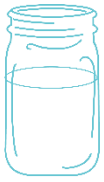
Fossil Fuels and Carbon Dioxide – page 28

Candles are made from paraffin wax which is obtained from coal or oil. This means a candle is a fossil fuel. The carbon atoms in a candle come from CO_2 taken out of the atmosphere by photosynthesis millions of years ago. When we burn a candle, we release the carbon back into the atmosphere through the burning reaction:

$$\text{fossil fuel} + O_2 \Rightarrow CO_2 + H_2O$$

We can't see the CO_2 because it is a colourless gas. However, there are ways we can make the water and the carbon visible.

Note: do not have the candle burning more than is needed to perform this activity.



Any candle will do, but a tea light is reasonably safe and cheap.

You will also need a jar half filled with cold water.

Hold the jar above the flame about three times higher than the flame. You should see water condense on the outside of the jar. This water comes from the burning reaction.

Breathe on the jar and you'll also get condensation. This comes from the respiration reaction in your body.

$$\text{glucose} + O_2 \Rightarrow CO_2 + H_2O$$

Burning and respiration are almost the same reactions.

We can't show the carbon dioxide but we can show the carbon by lowering the jar into the top of the flame. The black stuff that forms on the bottom of the jar is mostly carbon. It forms because the cold jar stops the carbon joining with oxygen to form carbon dioxide. This reaction is:

$$\text{fossil fuel} + O_2 \Rightarrow C + H_2O$$

This reaction occurs whenever there is not enough heat or oxygen for the carbon to fully burn. The soot that forms in a chimney comes from this reaction. So too is the black smoke you often see coming out of the exhaust of diesel-fuelled vehicles.

4 Consequences

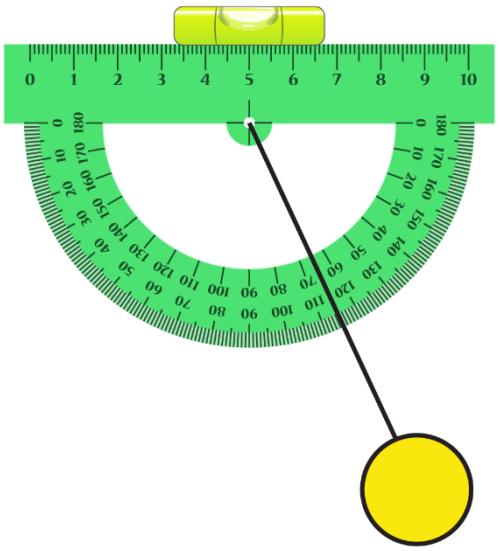
Extreme Weather Events – page 40

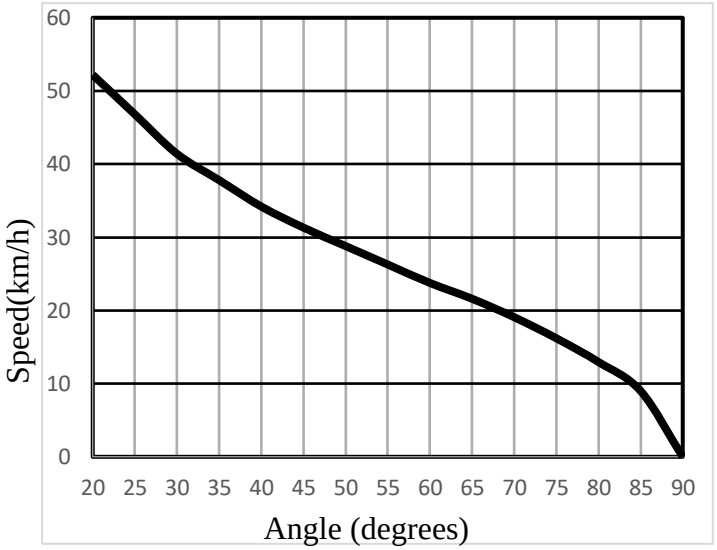
Weather experts have ways of determining if a weather event is extreme or not and it all depends on measurement. Making a rain gauge is reasonably simple and there are plenty of websites with suggestions. Here is one made out of a plastic drink bottle:

https://www.education.com/science-fair/article/DIY-rain-gauge/

Wind gauges are much more interesting and can be tested straight away, as there is almost always some wind. The following link gives a simple one. Below the link is a diagram of the apparatus and a calibration graph which gives the wind speed in km/h.

https://www.education.com/science-fair/article/earth-s4cience_building-anemometer/





Ocean Acidifcation – page 42

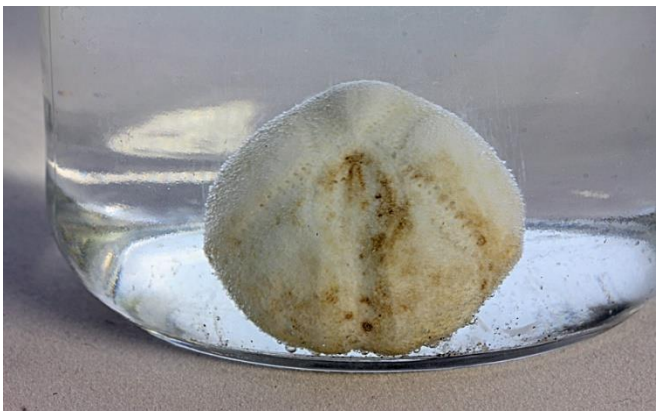
This activity uses white vinegar so that the effects of acidification become obvious in just a few minutes instead of the months or even years it takes for carbonic acid.

You can use any hard animal shell: garden snail, pipi, scallop, mussel, kina, crab, lobster, coral … pretty much anything you can pick up off a beach. Do NOT use bones – they are not made from calcium carbonate.

The photo below left shows a sea urchin shell placed in a jar of white vinegar. Small carbon dioxide bubbles appeared almost immediately, growing bigger as the reaction continued until a stream of bubbles stretched up to the surface.

Later in the reaction, the shell was so thin it was lifted to the surface as shown in the second photo. Eventually the only stuff left was dirt and sand that had been attached to the shell.

If you use a crab or lobster shell you'll be left with a soft skin that covered the calcium carbonate. This is chitin, a protein that many animals such as insects use as their outer covering.



5 At the End

Growing Plants – page 48

Here is a way in which you can reuse newspapers to create growing pots for plants. A local community paper is the right size. You'll need scissors and something to help roll the paper – a herb jar does well.

Once the paper is rolled, close one end while the jar is still in place, squashing the edges until they're tight. Remove the jar and stand the roll in an egg container. Repeat this for as many plants as you want – six is a good number.

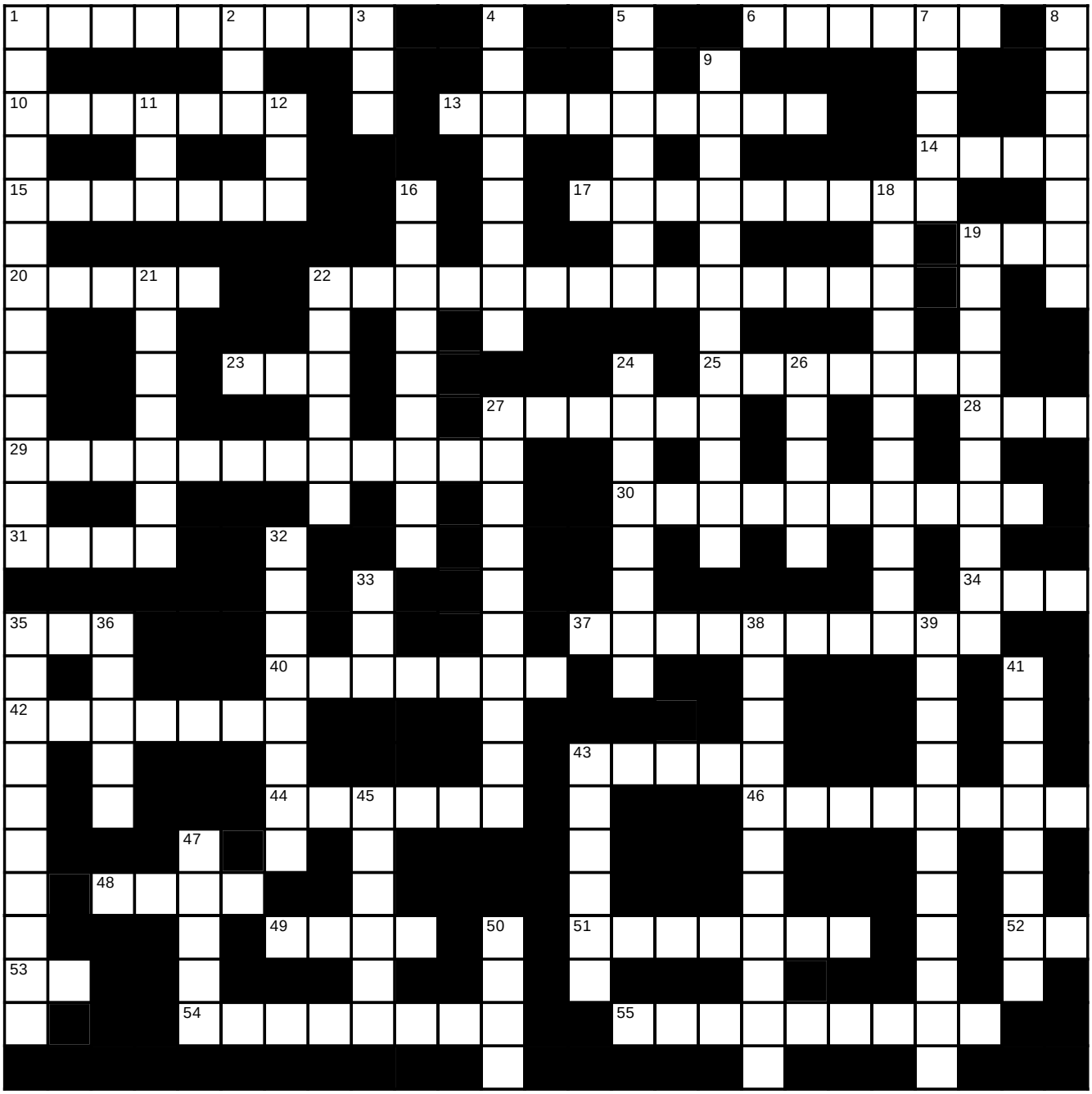
Use a spoon to add a growing mixture – potting mix, seedling mix, or just ordinary soil – leaving some space at the top. Use a pen to make a 2 cm deep hole. Drop the seed in the hole and cover. Add

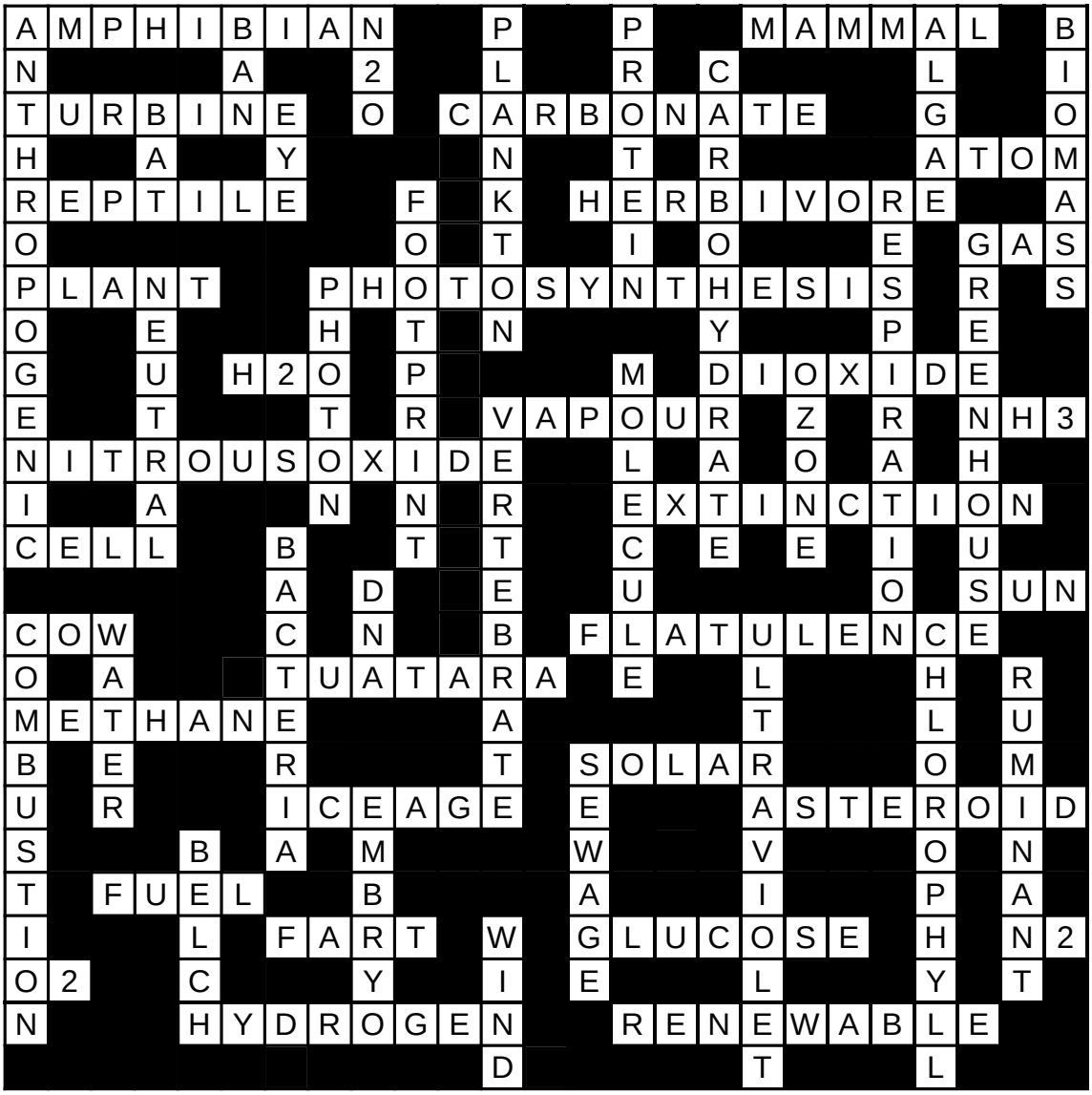
enough water so that the outside of the paper is moist but not dripping. Place the containers in a warm place, adding water every day to keep them moist.

Once the plants appear they can be planted out either in a pot or a garden. Don’t take them out of the pots. The moist newspaper will let the roots grow through. Eventually the paper will form compost.

Glossary – page 50

This crossword uses terms defined in the glossary and some common words associated with climate change.





Across

1 An animal with bones that breeds in water and lives on land (9)

6 Humans are this type of animal (6)

10 A rotating device used in harvesting hydro and wind energy (7)

13 Calcium _____ is the main substance in shells. (9)

14 The basic building block of matter (4)

15 An cold-blooded animal with bones and lungs (7)

17 An animal that eats only plants (9)

19 One of the three states of matter. Oxygen is an example (3)

20 An organism that makes its own food through photosynthesis (5)

22 The process where light energy changes carbon dioxide abd water into food (14)

23 Formula for water (3)

25 Often the end part of the name for a substance that has two atoms of oxygen in the molecule (7)

27 Tiny droplets of a liquid that behave like a gas (6)

28 Formula for ammonia which has one atom of nitrogen and three of hydrogen (3)

29 A greenhouse gas that contains nitrogen atoms (2 words) (7,5)

30 A mass _____ is when a large number of different creatures become extinct (10)

31 The building block of all living things (4)

34 The main source of energy for Bubble Earth (3)

35 A large ruminant animal (3)

37 The release of gases through the anus (10)

40 A reptile found only in New Zealand/Aotearoa (7)

42 A greenhouse gas released by all mammals (7)

43 An important renewable energy source (5)

44 A time when the temperature of earth was much colder than normal (2 words) (3,3)

46 The dinosaurs had serious problems when one of these hit Earth (8)

48 Coal is an example of a fossil _____ (4)

49 A slang word for flatulence (4)

51 The name of the food molecule made by photosynthesis (7)

52 Formula for nitrogen gas which has two atoms of nitrogen (2)

53 Formula for oxygen gas (2)

54 A gas which could be the fuel of the future (8)

55 A source of energy that cannot run out (9)

Down

1 Caused by humans (13)

2 Make the use of something illegal (3)

3 Formula for nitrous oxide (3)

4 Tiny plants that formed oil and natural gas (8)

5 A food type that contains nitrogen atoms (7)

7 A type of p[lant that has no seeds and no roots (5)

8 A general name for anything that is or was once living (7)

9 Glucose is the simplest of this food type (12)

11 A mammal that can fly (3)

12 A part of the body that can detect visible photons (3)

16 A carbon _____ is a measure of the amount of carbon dioxide put into the atmosphere (9)

18 The opposite of photosynthesis (11)

19 The name given to the effect where the temperature is increased by gases in the atmosphere (10)

21 An activity is carbon _____ when the amount of carbon put into the atmosphere is equal to the amount taken out (7)

22 A tiny bit of light carrying energy (6)

24 A combination of two or more atoms (8)

26 A form of oxygen that is found high in the atmosphere (5)

27 General name for an animal with a backbone (10)

32 A type of living thing composed of just one cell (8)

33 Deoxyribonucleic acid (3)

35 Scientific name for burning (10)

36 A substance created during burning (5)

38 The photons that cause sunburn (11)

39 The substance that absorbs light so that photosynthesis can happen (11)

41 Mammals that chew their food a second time (8)

43 The biomass that is collected human waste (6)

45 The name given to an animal during it's development in a uterus or egg (6)

47 Slang for eructation (5)

50 One of the forms of renewable energy (4)

Further Reading – pages 54 & 55

Here are the links from these pages. A single click will take you to each site without having to type a long URL.

General

A wonderful site covering most aspects of climate change is:
https://climatekids.nasa.gov/

For a book in pdf form suitable for children visit:
https://www.unicef.org/zimbabwe/reports/child-friendly-climate-change-handbook

Two sites with New Zealand information and examples are:
https://environment.govt.nz/facts-and-science/climate-change/
https://niwa.co.nz/education-and-training/schools/students/climate-change

1 Beginnings

Bubbles
https://kids.kiddle.co/Egg_(biology)
https://kids.kiddle.co/Seed
https://kids.kiddle.co/Embryo

Climate
https://climatekids.nasa.gov/weather-climate/
https://climatekids.nasa.gov/climate-change-meaning/

Climate Survivor
https://www.doc.govt.nz/nature/native-animals/reptiles-and-frogs/tuatara/
https://climatekids.nasa.gov/climate-change-evidence/

Variation
https://eschooltoday.com/science/genetics/what-is-genetic-variation.html

Science of Climate Change

Living Things
https://www.kidsworldfun.com/learn-science/living-and-non-living-things.php

Cells
https://kids.kiddle.co/Cell

Atoms
https://kids.kiddle.co/Atom
http://www.chem4kids.com/files/atom_intro.html

Light
https://www.ducksters.com/science/light.php
https://www.explainthatstuff.com/light.html
https://www.sciencekids.co.nz/light.html

Greenhouse Effect
https://kids.niehs.nih.gov/topics/natural-world/greenhouse-effect/index.htm
https://climatekids.nasa.gov/greenhouse-effect/
https://archive.epa.gov/climatechange/kids/basics/today/greenhouse-effect.html
http://envis.tropmet.res.in/kidscorner/greenhouse.htm

Causes and Cures

Fossil Fuels
https://www.kidcyber.com.au/fossil-fuels
https://www.factsjustforkids.com/technology-facts/fossil-fuel-facts-for-kids.html
https://climatekids.nasa.gov/carbon/
https://climatekids.nasa.gov/fossil-fuels-coal/
https://climatekids.nasa.gov/air-pollution/

Carbon Footprint
http://www.parkcitygreen.org/Calculators/Kids-Calculator.aspx

https://calc.zerofootprint.net/
https://kids.lovetoknow.com/kids-activities/carbon-footprint-calculator-kids

Carbon Footprint

https://kids.kiddle.co/Methane
https://climatekids.nasa.gov/greenhouse-cards/
https://kidshealth.org/en/kids/fart.html
https://archive.epa.gov/climatechange/kids/solutions/technologies/methane.html

Renewable Energy

https://www.alliantenergykids.com/RenewableEnergy/RenewableEnergyHome
https://kids.kiddle.co/Renewable_resource
https://www.generationgenius.com/renewable-and-nonrenewable-energy-for-kids/

Hydrogen Fuel Cell

https://kids.kiddle.co/Hydrogen_car
https://www.toyota.co.jp/en/kids/eco/fchv.html
https://www.eia.gov/kids/energy-sources/hydrogen/

4 Consequences

Extreme Weather

https://www.weatherwizkids.com/weather-safety.htm
https://www.sciencekids.co.nz/videos/weather.html
https://climatekids.nasa.gov/10-things-glaciers/
https://climatekids.nasa.gov/sea-level/

Ocean Acidification

https://archive.epa.gov/climatechange/kids/impacts/signs/acidity.html
https://kids.kiddle.co/Coral_bleaching
https://climatekids.nasa.gov/acid-ocean/
https://climatekids.nasa.gov/ocean/
https://climatekids.nasa.gov/coral-bleaching/

Mass Extinctions

https://kids.earth.org/protecting-wildlife/what-is-the-sixth-mass-extinction/
https://kids.kiddle.co/Extinction