keep it simple science
ABN 54 406 994 557

PO Box 2575
PORT MACQUARIE NSW 2444
(02) 6583 4333 FAX (02) 6583 9467
www.keepitsimplescience.com.au
mail@keepitsimplescience.com.au

keep it simple science
Photocopy Master Sheets

Years 7-8

The Earth

Disk filename = “10.Earth”

Site Licence Conditions

A school (or other recognised educational institution) may store the disk contents in multiple computers (or other data retrieval systems) to facilitate the following usages of the disk contents:

• School staff may print unlimited copies on paper and/or make unlimited photocopies at one school and campus only, for use by students enrolled at that school and campus only, for non-profit, educational use only.

• School staff may use the disk contents to make audio-visual displays, such as via computer networks, or by using data projectors or overhead projectors, at one school and campus only, for viewing by students enrolled at that school and campus only, for non-profit, educational use only.

• School staff may allow students enrolled at that school and campus only to obtain copies of the disk files and store them in each student's personal computer for non-profit, educational use only.

IN SUCH CASE, THE SCHOOL SHOULD MAKE PARTICIPATING STUDENTS AWARE OF THESE SITE LICENCE CONDITIONS AND ADVISE THEM THAT COPYING OF DATA FILES BY STUDENTS MAY CONSTITUTE AN ILLEGAL ACT.

• In every usage of the disk files, the KISS logo and copyright declaration must be included on each page, slide or frame.

Please Respect Our Rights Under Copyright Law

Topics Available

Year 7-8 General Science

Disk Filename	Topic Name
01.Energy	Energy
02.Forces	Forces
03.Matter	Solids, Liquids & Gases
04.Mixtures	Separating Mixtures
05.Elements	Elements & Compounds
06.Cells	Living Cells
07.Life	Living Things
08.LifeSystems	Plant & Animal Systems
09.Astronomy	Astronomy
10.Earth	The Earth
11.Ecosystems	Ecosystems

Year 9-10 General Science

Disk Filename	Topic Name
12.Waves	Wave Energy (inc. Light)
13.Motion	Forces & Motion
14.Electricity	Electricity
15.Atoms	Atoms & Elements
16.Reactions	Compounds & Reactions
17.DNA	Cell Division & DNA
18.Evolution	Evolution of Life
19.Health	Health & Reproduction
20.Universe	The Universe
21.EarthScience	Earth Science
22.Resources	Resources & Technology

Year 11-12 Science Courses

Biology

Preliminary Core
Local Ecosystem
Patterns in Nature
Life on Earth
Evolution Aust. Biota
HSC Core
Maintain. a Balance
Blueprint of Life
Search for Better Health
Options
Communication
Genetics:Code Broken?

Chemistry

Preliminary Core
Chemical Earth
Metals
Water
Energy
HSC Core
Production of Materials
Acidic Environment
Chem.Monit.&Mngment
Options
Shipwrecks, Corrosion...
Industrial Chemistry

Earth & Envir. Science

Preliminary Core
Planet Earth...
Local Environment
Water Issues
Dynamic Earth
HSC Core
Tectonic Impacts
Environs thru Time
Caring for the Country
Option
Introduced Species

Physics

Preliminary Core
World Communicates
Electrical Energy...
Moving About
Cosmic Engine
HSC Core
Space
Motors & Generators
Ideas to Implementation
Options
Quanta to Quarks
Astrophysics

All Topics Available as PHOTOCOPY MASTERS and/or KCiC

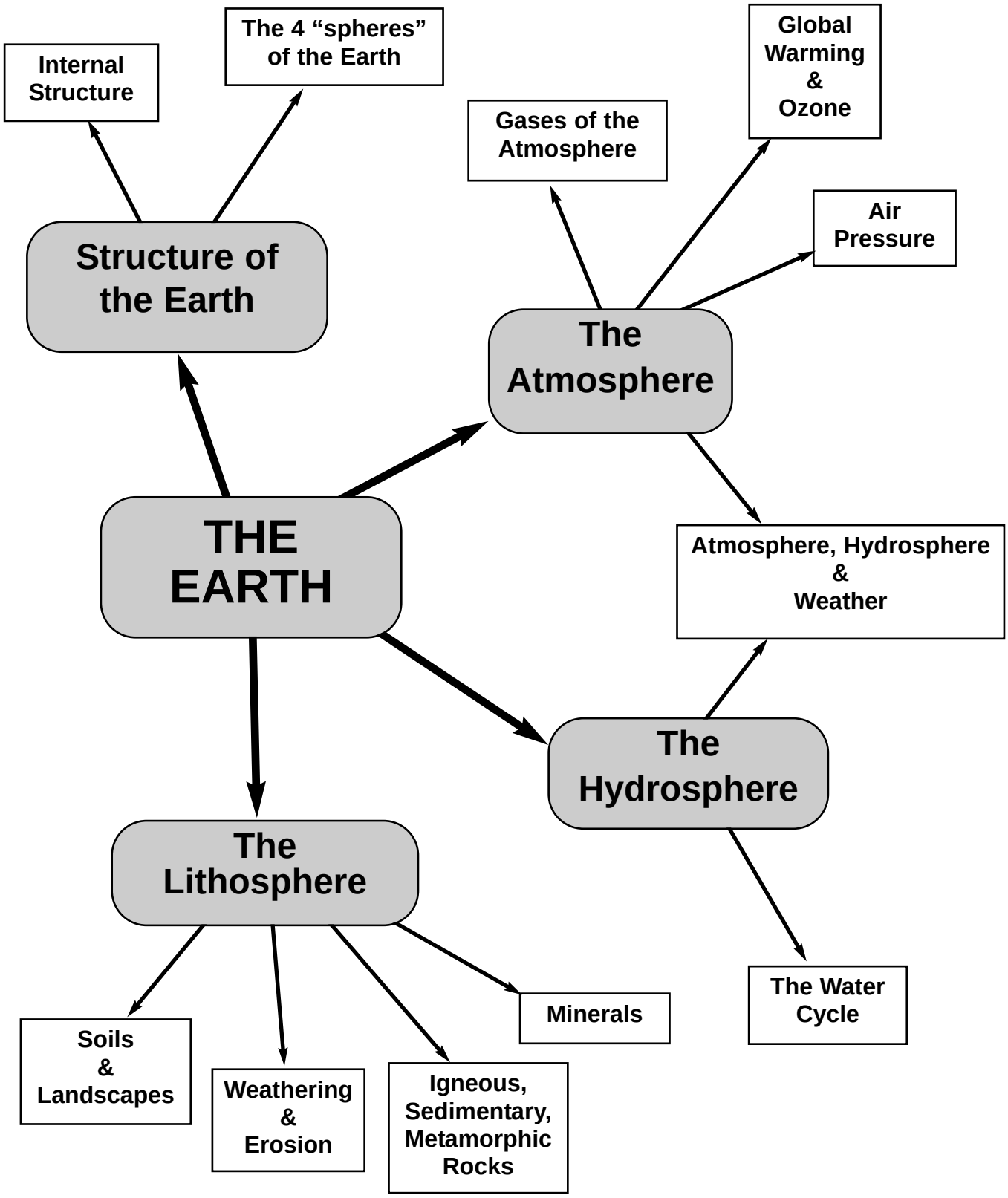
Photocopy Masters (PDF files)
Black & White, A4 portrait-orientation
for clear, economical photocopying.

KCiC = Key Concepts in Colour
Full colour, formatted for on-screen study and data projection. PDF + Powerpoint®
Powerpoint is a trademark of Microsoft Corp.

"Mind-Map" Outline of Topic

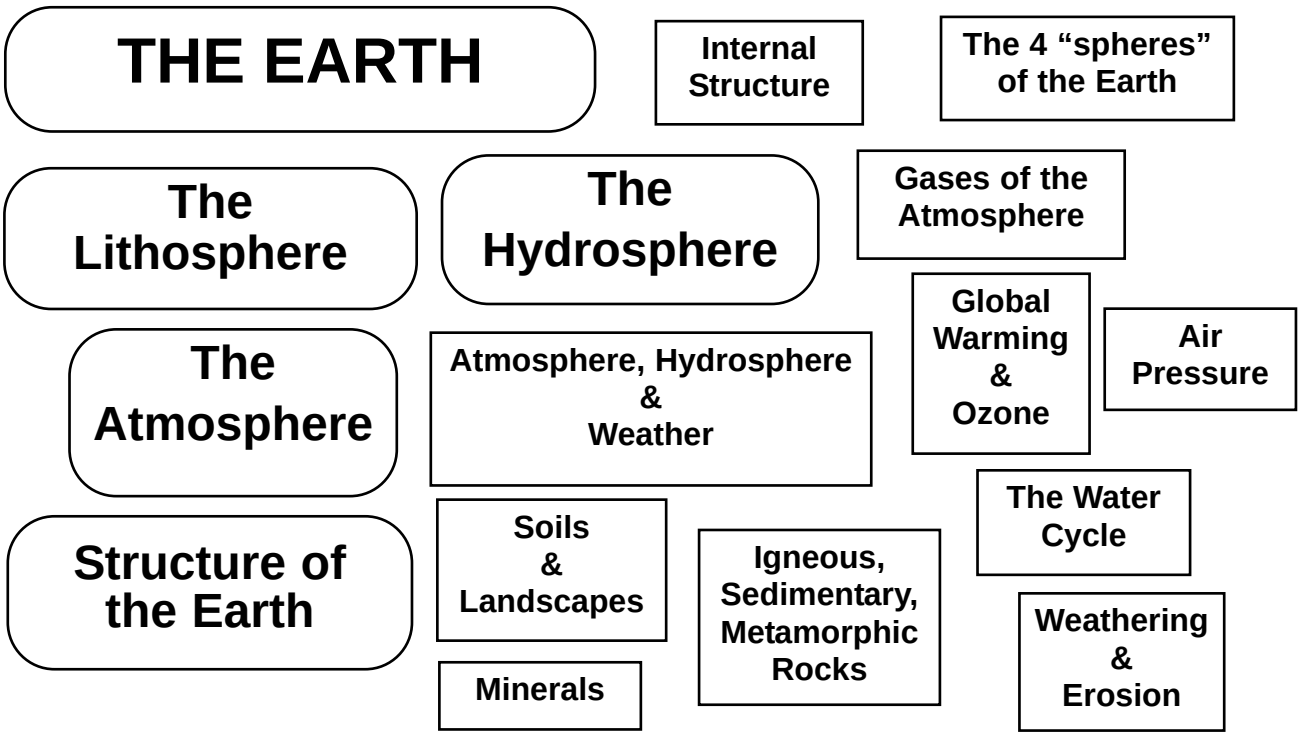
This topic is an introduction to Earth Science.

Earth Science includes studies of rocks and minerals, earthquakes and volcanoes, the weather and the oceans. Earth Science looks at the structure of the Earth itself, and how landforms, and even oceans and continents, come and go over time.

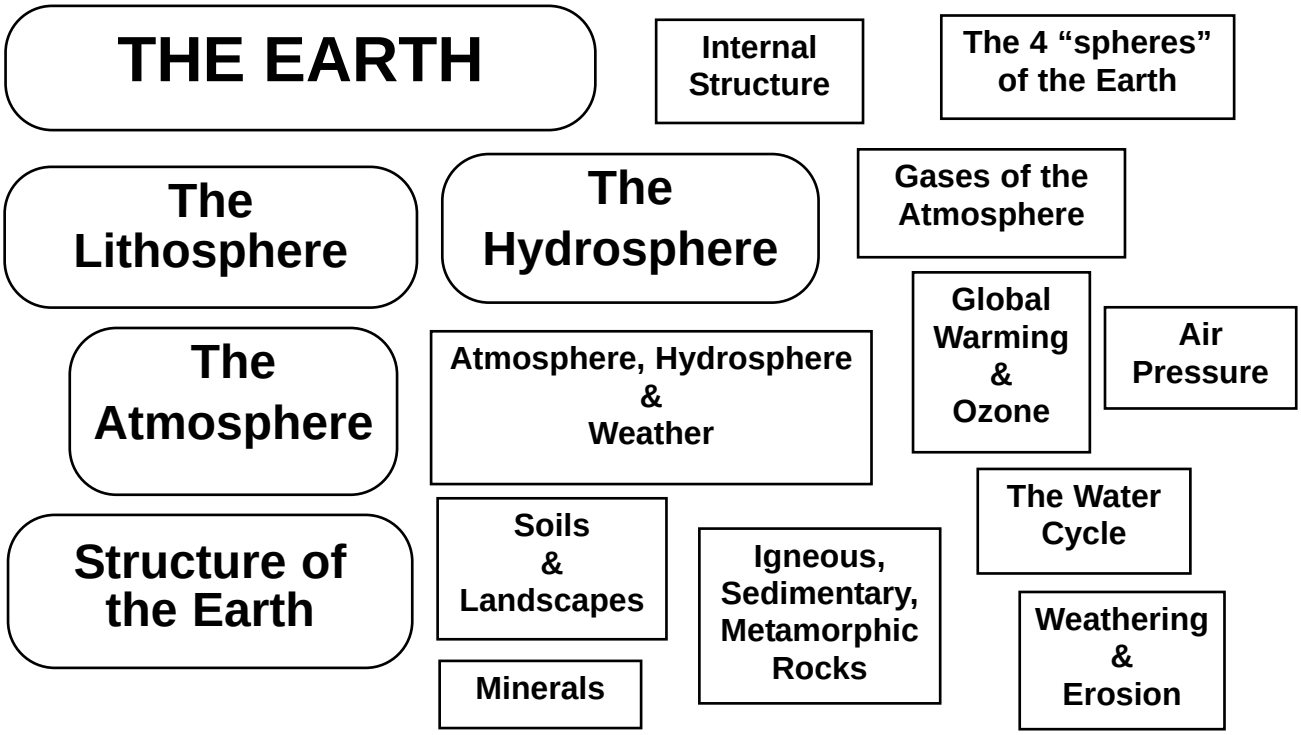


keep it simple science

Make your own "Mind-Map" TITLE PAGE.
Cut out the boxes. Sort them into an appropriate lay-out on a page of your workbook, then glue them down. Add connecting arrows and colour in.



Make your own "Mind-Map" TITLE PAGE.
Cut out the boxes. Sort them into an appropriate lay-out on a page of your workbook, then glue them down. Add connecting arrows and colour in.



keep it simple science

The Structure of the Earth

You already know that the Earth is a planet which orbits our star, the Sun. The Earth is a ball of rock, largely covered by water, and surrounded by a layer of air. Now it is time to learn some more detail.

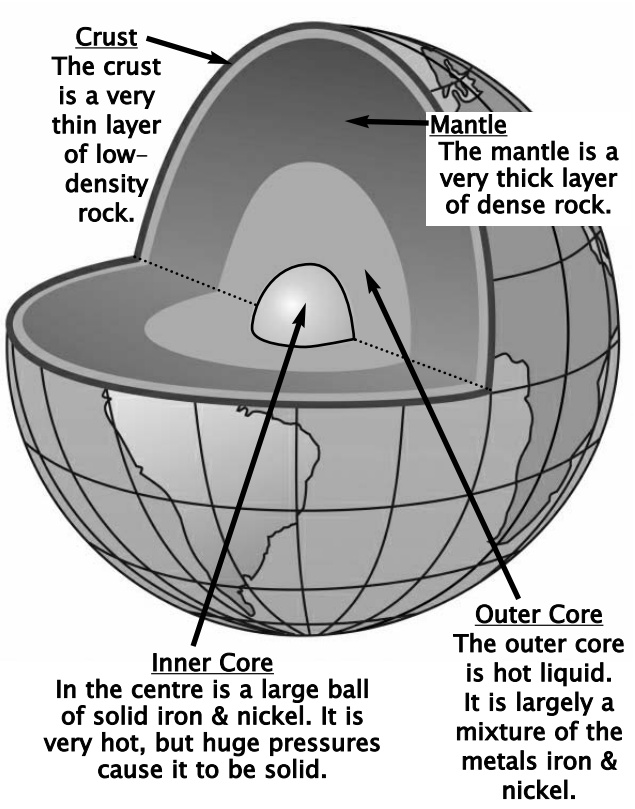
Inside the Solid Earth

Ignoring the oceans and the air for a while, we begin with the solid Earth.

Scientists have always been interested in earthquakes. By learning about earthquakes it was hoped that we might learn to predict them, and so avoid some of the deaths and destruction that they cause.

About 100 years ago, the study of earthquakes (called "Seismology") became advanced enough that scientists began studying the way that earthquake shockwaves travel through the Earth.

From this, it became clear that the solid Earth is not totally solid, and has a layer structure, as shown.

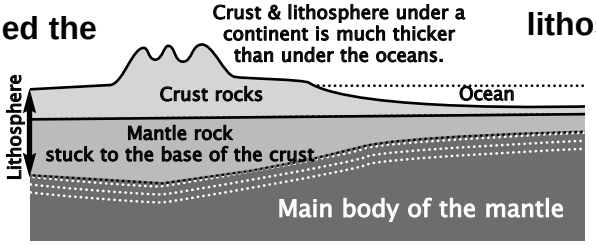


The Lithosphere

But wait, the story gets more complicated!

Attached to the bottom of the crust is a layer of mantle rock which has "welded" itself to the crust rocks above.

This 2-part layer is called the lithosphere.



The thickness of the lithosphere varies. Under the oceans, it can be about 5 km thick and is mostly crust rocks with very little mantle rock attached. Under the continents the lithosphere is over 100km thick.

Compared to the 6,400 km diameter of the Earth the lithosphere layer is an extremely thin shell on the outside.

Below the lithosphere is a "slippery layer" of the mantle.

We now know that the lithosphere "floats" on the main body of the mantle, and is broken up into large chunks of lithosphere, called tectonic plates.

The plates slowly move around, sliding across the "slippery layer" of mantle rock.

In later topics you will learn about the tectonic plates and how they slowly move around and change the continents, oceans and mountain ranges of the Earth.

keep it simple science

The Four "Spheres" of Planet Earth

The surface layers of rocks, water and air are home to ourselves and all the other living things we share this planet with. We can think of our "home" as having 4 "spheres", or parts.

The Atmosphere

("atmos" = vapour)

The atmosphere is the layer of air which surrounds the Earth.

It is the atmosphere in which all our weather occurs.

We need to breathe the oxygen gas of the air.

Other gases are vital to protect us from dangerous radiation from the Sun.

The Hydrosphere

("hydro" = water)

The hydrosphere refers to the water layers on the surface of the Earth.

As well as the oceans, the hydrosphere includes the polar ice-caps, all the lakes and rivers, and even the underground water.

The Lithosphere

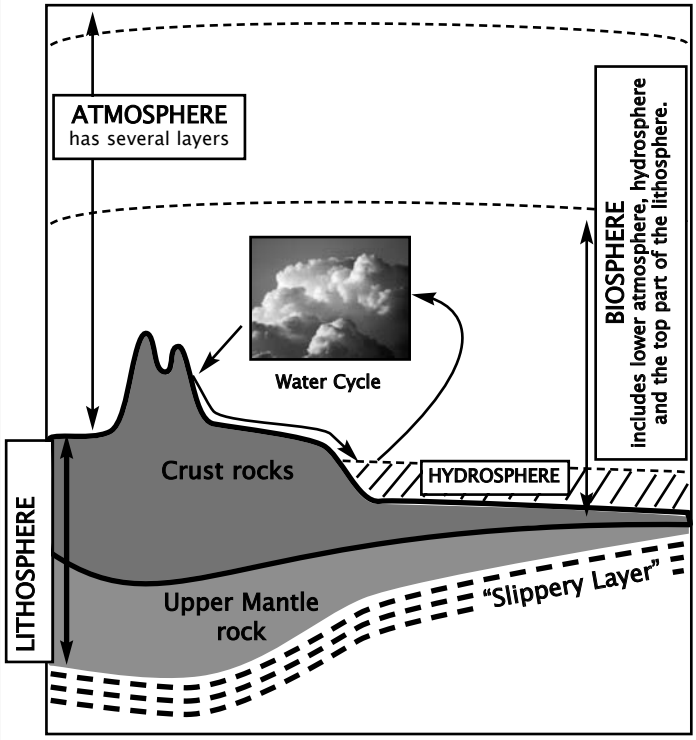
("lithos" = rock)

The lithosphere was described previously. It is the thin, outer "skin" of the solid Earth.

The lithosphere is made up of the crust layer (low-density rocks) with a layer of the upper mantle attached.

This 2-part "skin" is separated from the main body of mantle rock by a "slippery layer" on which the lithosphere floats.

On the top of the lithosphere is a thin layer of soil which we depend on for growing our food.



The Biosphere will be studied in a later topic

The Biosphere ("Bios" = life)

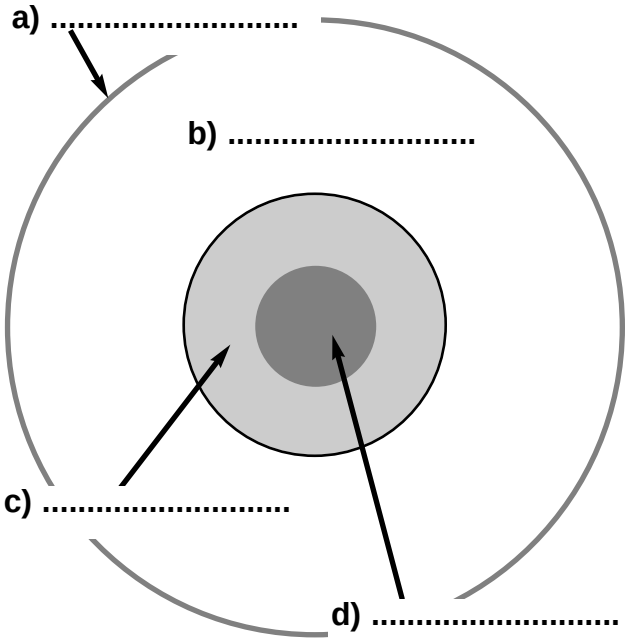
The biosphere refers to those parts of the Earth where <u>living things</u> are found. The biosphere overlaps the other "spheres" because living things fly and drift in the atmosphere, swim in the hydrosphere and burrow into the top of the lithosphere.

keep it simple science

Worksheet 1
Earth's Structure

Student Name.....

Label the diagram and answer the questions



e) What study led scientists to an understanding of the internal layers of the Earth?

f) Which layer is liquid?

g) What is the part in the middle made from?

h) What is "lithosphere"?
Which parts of the Earth are combined to make it?

Worksheet 2
The "Spheres" of the Earth

Student Name.....

Fill in the blank spaces.

The layer of gases around the Earth is called the a)..... All our b)..... occurs here.

We rely on the air for c)..... to breathe, and to shield us from dangerous d)..... from the Sun.

The watery parts of the Earth are called the e)..... This includes the oceans, and also all the f)..... and ..... and underground water. It also includes the ice in glaciers and the polar g).....

The Lithosphere is a 2-part layer comprising the h)..... and the upper part of the i).....

The lithosphere "floats" on the rock underneath. It is broken up into a number of pieces called "j)..... plates" which can move around.

The parts of the Earth where living things are found is called the k)..... This overlaps the other 3 "spheres", because living things are found in all three.

keep it simple science

The Atmosphere ("atmos" = vapour)

The atmosphere is mainly a mixture of gases.
The clouds are made up of microscopic droplets of liquid water,
and there may be some solid particles of dust in the air,
but nearly all of the atmosphere is gas.

Gases of the Atmosphere

About 99% of dry air is made of just 2 gases:

Nitrogen (N_2)

Nitrogen makes up almost $^4/_5$ of the air. We breathe it in all the time, but it does us neither good nor harm.

Oxygen (O_2)

Oxygen makes up about $^1/_5$ of the air. It is very important for living things.

The other 1% contains a variety of gases, including:

Argon (Ar)

Argon is the most common of the "inert gases". There is also Neon (Ne), Krypton (Kr) & others.

Carbon Dioxide (CO_2)

CO_2 makes up only about 0.04% of air, but it is vitally important to living things and to the Earth's climate.

Oxygen & Carbon Dioxide

These gases are so important that you need to know more about them.

Oxygen

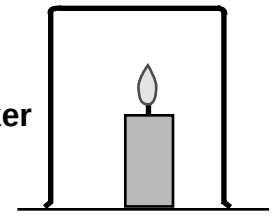
Oxygen makes up about $^1/_5$ of the air. We breathe so that we can take in oxygen. Without it, a human will die within a few minutes.

Oxygen is a chemical element. Its chemical symbol is "O", but it normally exists as 2 atoms joined together, so we write its chemical formula as O_2.

Oxygen is needed for things to burn.

Try this experiment:

Place glass jar or beaker over a lit candle.



Soon, the candle goes out.
Why?
Because all the oxygen in the air inside the beaker has been used up. Without oxygen, the burning cannot continue.

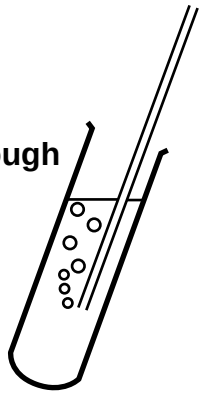
Cellular respiration is (chemically) the same as burning the glucose. It must have oxygen to continue.

Carbon Dioxide

Carbon dioxide makes up only a tiny fraction of the air, about 0.04%. Its chemical formula is CO_2, which means it is made of molecules containing 1 carbon atom and 2 oxygen atoms.

CO_2 can be identified by its reaction with limewater.

Try this:
Use a drinking straw to gently blow bubbles through a test tube of limewater.



Soon, the limewater becomes cloudy as it reacts with the CO_2 in your breath.

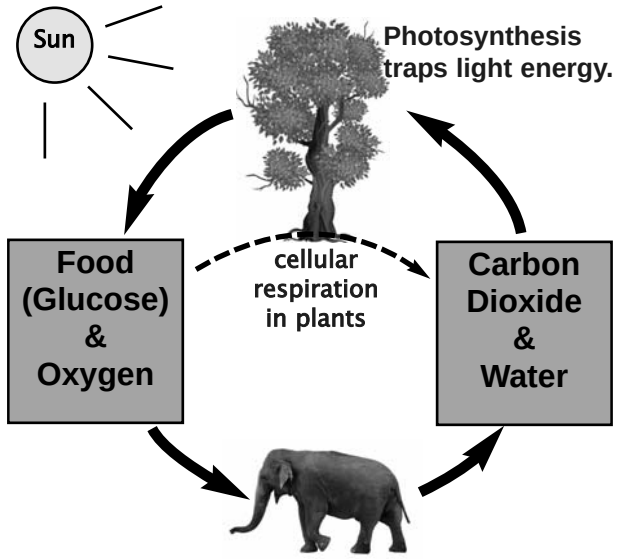
CO_2 is the only gas which reacts with limewater this way, so this test can be used to identify this important gas.

	Air We Breathe In	Air We Breathe Out
Oxygen	20 %	16 %
Carbon Dioxide	0.04 %	4 %

keep it simple science

The Carbon Dioxide - Oxygen Cycle

You are reminded of the processes of Photosynthesis and Cellular Respiration in living things.
Together, they connect a great cycle of nature.



What is really happening is that the energy of the Sun is powering all living things.

The O_2 and CO_2 simply get re-cycled.

Food (containing glucose) is made, destroyed and re-made over and over.

Photosynthesis makes all the food and oxygen on Earth.

The reason that CO_2 levels are low compared to oxygen, is that the plants are very efficient at absorbing CO_2 for photosynthesis.

Carbon Dioxide & Global Warming

Burning fossil fuels (coal, petroleum) produces huge amounts of CO_2.

Measurements show that the level of CO_2 in the air has increased significantly over the past 100 years or so.

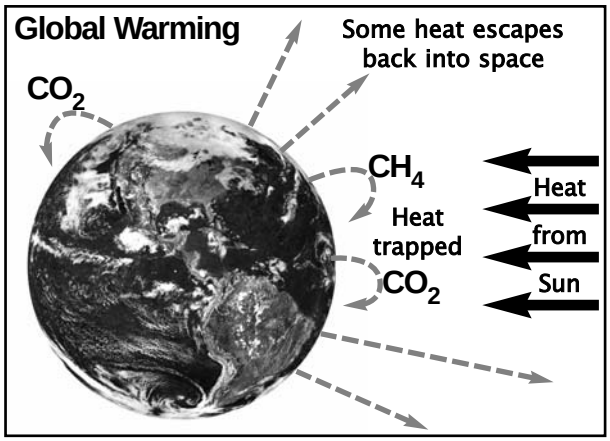
Check your family's latest electricity bill:
it will tell you how many tonnes of CO_2 have been released to make your electricity.

The Earth absorbs the heat from the Sun, and the surface warms up. As the surface warms, some of the heat radiates back into space, so the Earths cools again.

CO_2 and methane "trap" some of the heat which would normally escape into space. This "Greenhouse Effect" is now believed to be causing the whole world to warm up.

As well as CO_2, another "greenhouse gas" called methane (CH_4) is also increasing in the air.

Methane is released when forests are cleared and wetlands are drained for grazing. Although only tiny amounts of methane are in the air, its effect is very powerful.



This "Global Warming" is causing climate change so that weather patterns may be disrupted and many natural environments may be destroyed in the next century.

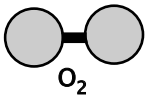
The sea ice around the north pole is beginning to melt. If the ice caps melted completely, the sea level could rise by more than 100m.

keep it simple science

Ozone

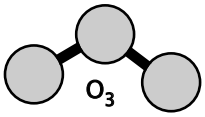
Ozone is a different form of oxygen, with chemical formula O_3.

Normal Oxygen



Ozone forms naturally in the thin air about 25 km high. There are only ever tiny amounts of it, but its presence is essential for life on Earth.

Ozone



Importance of Ozone

Ozone is much more chemically reactive than oxygen, and is very dangerous if breathed in. At ground level, ozone is a nasty, dangerous air pollutant.

However, in the upper atmosphere it serves a vital function for land-living plants and animals... it absorbs dangerous ultra-violet (UV) radiation from the Sun.

UV radiation damages living cells and can cause deadly skin cancers. Plants cannot grow properly if exposed to excessive UV.

Without the "ozone layer", UV radiation would make life on land virtually impossible.

So What's the Problem?

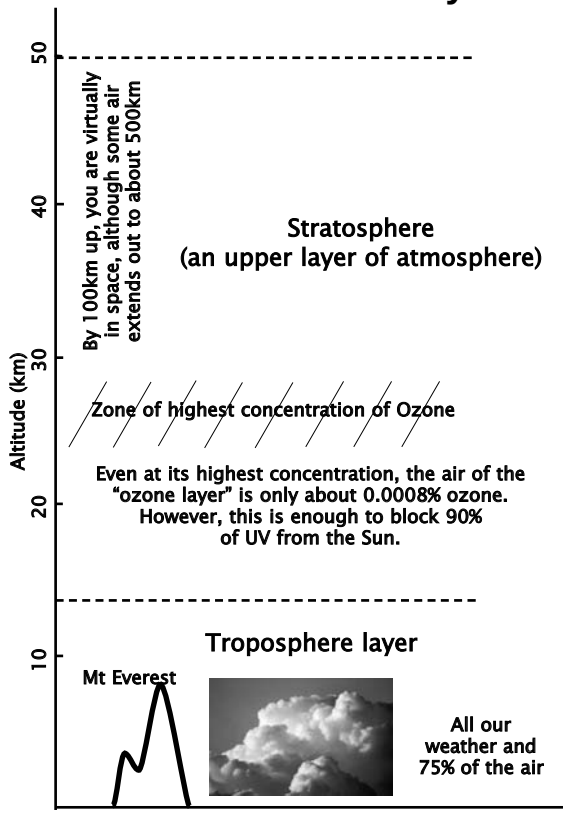
In the second half of the 20th century, our industries produced a number of chemical gases called "CFC's". These are very useful substances used in refrigerators, some fire extinguishers, aerosol cans, plastics manufacture, and much more.

By the 1970's scientists began to measure higher levels of UV radiation reaching the Earth's surface because the ozone levels were getting less.

Research revealed that the ozone was being destroyed by CFC's released into the air. CFC chemicals cause ozone to be destroyed faster than it is made.

CFC's are very long-lasting and can continue destroying ozone for 30-50 years.

Where is the Ozone Layer?



Problem Solved?

Scientists quickly searched for alternative chemicals to replace CFC's which would not harm the ozone layer.

By 1995 most countries in the world had stopped using CFC's.

The CFC released 30 years ago is still causing a loss of ozone, but the rate of loss is slowing down.

Scientists believe that ozone levels will start to increase again and eventually get back to normal.

Meanwhile, SLIP, SLOP, SLAP!!

keep it simple science

Impacts of Science

The Science and Technology of <u>electricity</u> has been one of the most important things to have happened to human society in the past 100 years or so. The impacts of this on society have been almost entirely beneficial, while the impacts on the environment have been entirely detrimental.

Benefits to Society

Large scale use of electricity has given humans many benefits and has become essential to our economy, jobs, communications, leisure and lifestyle.

Our factories rely on electricity to make all our machines, clothing, appliances, medicines, etc.

Our business & finance systems run on computers and communications powered by electricity.

We enjoy a comfortable, safe and entertaining lifestyle with electrical lights, TV, air-con, appliances, phones and all the convenient gadgets.

Damage to the Environment

Large amounts of our electricity is generated from the burning of fossil fuels, such as coal. In the early days, this created a lot of pollution and problems such as "acid-rain".

Many problems have been cleaned-up, but one HUGE problem remains... burning coal releases CO_2 gas into the atmosphere.

The levels of CO_2 have risen significantly and there is no longer any doubt about the effect: Global Warming due to a "Greenhouse Effect".

Science and Economics

Starting in the 1970's, some scientists began to warn us about some serious problems that were emerging.

Two of the most important problems concerned changes to the atmosphere.

<u>Ozone Problem Solved</u>?

This problem was described previously.

After alerting the world to the problem, scientists were able to suggest solutions, in the form of alternative chemicals to replace the destructive CFC's.

The suggested replacement chemicals were also <u>economically suitable</u>, because they caused little change to costs, jobs and production methods.

Since there was no conflict between the scientific advice and the economy, governments quickly followed the advice and passed appropriate laws. Industry rapidly complied.

<u>Greenhouse Problem Continues</u>?

Scientists have also warned us about rising CO_2 levels and the dangers of Global Warming. They have also suggested many solutions, such as switching to alternative energy supplies like solar and wind power.

Unfortunately, the solutions do not fit easily into our global economy. To immediately follow the scientific advice would cause massive changes to industries, jobs, finances and everybody's lifestyle.

That's why governments hestitate to take decisive action. The scientific advice is in conflict with the economy.

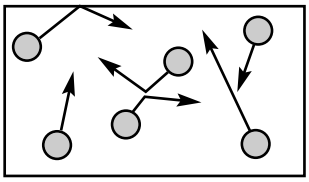
People Make Decisions

It is NOT up to scientists to make the decisions needed. It is up to every citizen to vote for leaders who will act to solve problems. Good citizens need to know about both the Science and the economic necessities. In a democracy, people get the government they deserve.

keep it simple science

Air Pressure

Remember that in a gas the particles are constantly flying everywhere at high speed.



They frequently collide with each other, and with the walls of their container. Each collision pushes on the inside of the container, or on each other. This means there is a constant push, or force, acting within the gas.

Pressure is measured as the amount of force pushing per unit of area.

The unit of pressure used most often in science is the kilopascal (kPa)

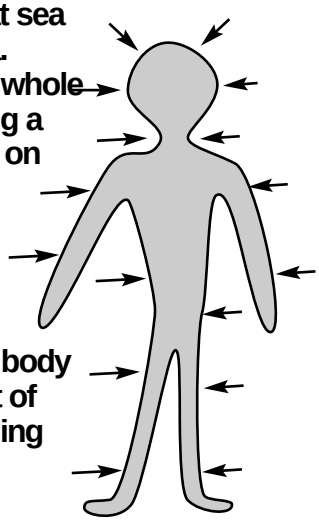
The "pascal" unit is named in honour of the great French scientist and mathematician Blaise Pascal (1623–62).

1 kPa = 1,000 N force per square metre.

Some examples of pressure values
Normal air pressure (sea level) ≅ 100 kPa
Inflated car tyre ≅ 200 kPa
Inside a scuba airtank ≅ 800kPa

Air Pressure and Your Body

Normal air pressure at sea level is about 100 kPa. Over the area of your whole body this is like having a 100kg mass pressing on you.



How come you don't feel squashed?

Simply because your body has the same amount of pressure inside, pushing outwards.

Air pressure decreases with altitude. If you go up in an aircraft, or drive up a high mountain, the outside air pressure gets less. You will feel the pressure difference in your ears, until it equalizes again.

Astronauts in space or on the Moon, where there is no air, need pressure suits to breathe, and also to protect them from the zero pressure around them. Their own "body pressure" pushing outwards would cause fatal damage without the suit.

Atmosphere v. Space

The pressure of the atmosphere is due to the weight of all the air above pressing down.

As you go higher up, there is less and less air above you, so the air gets "thinner" and the pressure gets less.

So how high up can you go before there is no air, and you are in outer space?
There is no simple answer to that!

The air gets thinner and thinner, but there are a few atoms and molecules of gas even as far up as 500km.

However, even just 3-4km up you may have some difficulty breathing.

By 20km up you'd need a pressure suit (like an astronaut's space suit) to breathe and survive the low pressure.

By 50km up there is virtually no air pressure, and by 100km you can say that you are in space.

Technically, there are still a few gas molecules, but the pressure is effectively zero. You are in the vacuum of space.

keep it simple science

Worksheet 3
Atmospheric Gases

Student Name.....

Match each description to a list item (A,B,C,etc)

Description	List Item
1. Most abundant gas of the atmosphere.	.....
2. Gas which absorbs UV radiation.	.....
3. Process which plants use to make their food.	.....
4. Gas which turns limewater cloudy.	.....
5. Main "greenhouse gas".	.....
6. Gas needed by plants to make food.	.....
7. Gas released by photosynthesis.	.....
8. Gas needed for cellular respiration.	.....
9. Chemical which destroys the ozone layer.	.....
10. Another "greenhouse gas", apart from CO_2.	.....

List Items (Not all will be used. Some may be used more than once.)

A. Nitrogen
B. Methane
C. Oxygen
D. Argon
E. Carbon Dioxide
F. Ozone
G. Photosynthesis
H. CFC
I. Cellular Respiration

Worksheet 4
The Atmosphere

Student Name.....

Fill in the blank spaces.

Almost $^4/_5$ of the air is made up of the gas a)..... Most of the remainder is b)..... gas, which we breathe in, to use for cellular c).....

The last 1% of the air is a mixture of many gases including d)..... (the most abundant of the minor gases)

Although it makes up only 0.04% of air, the gas e)..... is very important to living things. It is absorbed by plants for f)..... by which they make food. This process releases g)..... gas, so these gases are recycled over and over.

Carbon dioxide is important for world climate. It traps some of the h)..... which would normally radiate into space. This is called the "i)..... Effect".

Humans have increased the amount of CO_2 in the air, mainly by the burning of j)..... fuels such as k)..... and ..... As CO_2 levels rise, the world is warming up. This is called "l)..... Warming".

Ozone is a form of m)..... gas. It forms in the high atmosphere, where it absorbs dangerous n)..... rays from the Sun. For many years humans were using chemicals called o)..... (abbreviation) which destroy ozone.

Gases push in all directions. This force (per unit of area) is called p)..... Air pressure q)..... as you go upwards in the atmosphere. Above about 3-4km you may have difficulty r)..... By about 20km up, you'll need a s)..... suit, and by about 100km up you are in t).....

keep it simple science

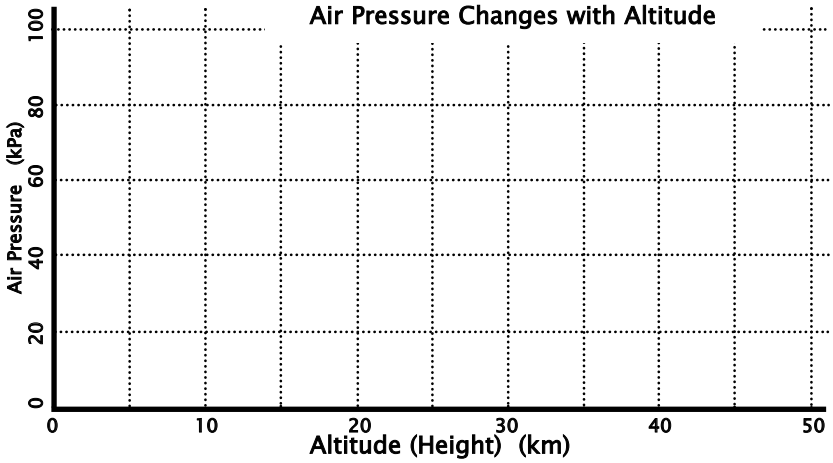
Worksheet 5
Graphing Skills

Student Name.....

The data table shows the air pressure at increasing heights above the Earth's surface.

Graph the data on the grid as a series of points, then join them with an even curve.

Height (km)	Air Pressure (kPa)
0	100
5	57
10	25
15	15
20	8
25	4
30	2
40	1
50	0 (almost)



Questions

1. What does "kPa" stand for?.....

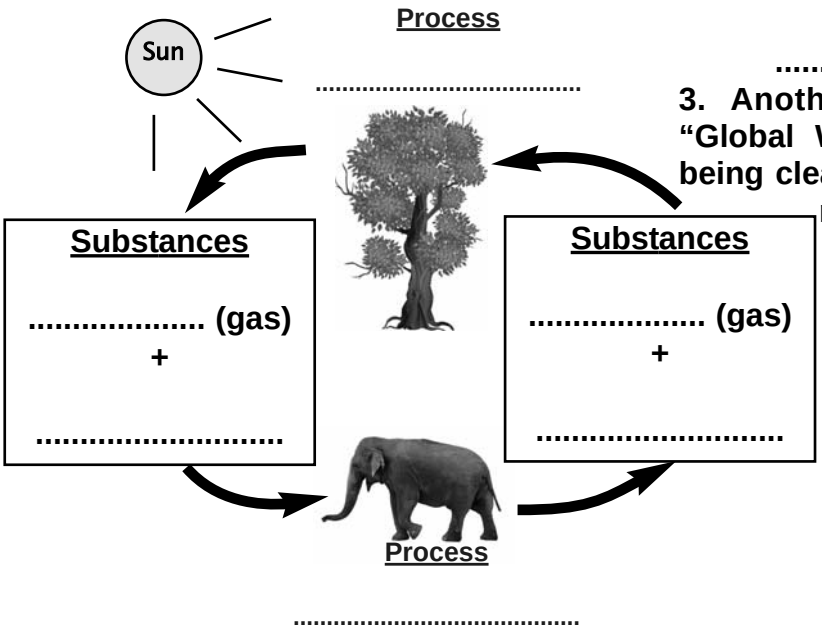
2. Some people have breathing difficulties if air pressure drops below about 70 kPa. About what altitude will this happen? .....

3. What is the air pressure on Mt Everest, almost 9km high? .....

Worksheet 6
Carbon-Oxygen Cycle

Student Name.....

This diagram represents one of the cycles of nature, with the tree representing all plants and the elephant representing all animals.



1. Fill in the names of the processes, and the substances, in the spaces around the diagram.

2. Which of the gases in the diagram is involved in "Global Warming"?

.....

3. Another human-caused factor in "Global Warming" is that forests are being cleared in many places, to create more farming & grazing land.

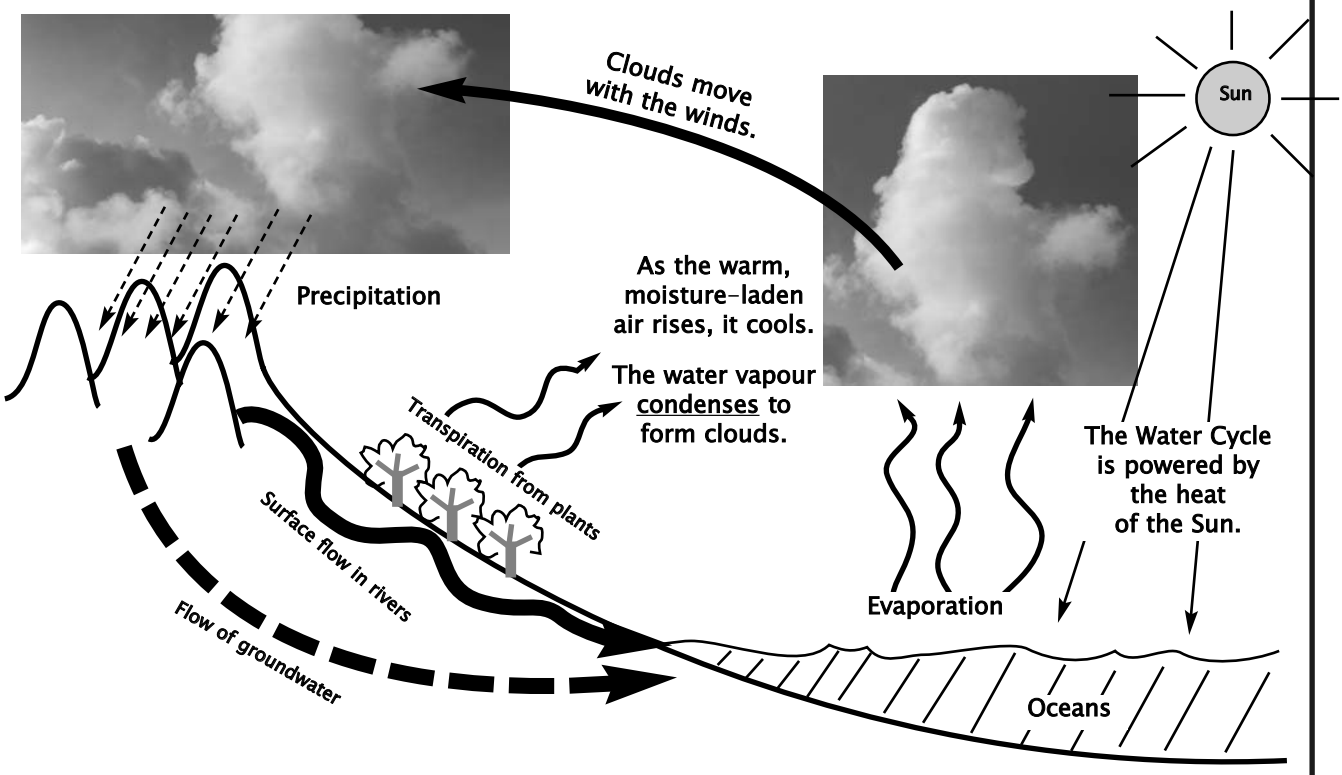
Suggest how this might contribute to Global Warming.
(Your answer will link to the diagram)

keep it simple science

The Hydrosphere ("hydro" = water)

The hydrosphere includes the oceans, lakes and rivers, underground water and the ice-caps and glaciers. Almost 98% of the water on Earth is salty water in the oceans, and most of the remaining 2% is frozen solid. We depend on only about 0.3% of the hydrosphere for our drinking water and for our crops and livestock, as well as for cleaning and industrial uses. Luckily, there is a natural cycle which constantly replenishes our fresh water supplies.

The Water Cycle



Evaporation

liquid ⟶ gas

The Sun drives the whole water cycle by providing the heat to evaporate water, mainly from the oceans. The water evaporates, but the salt stays behind.

Condensation is the change gas ⟶ liquid which occurs as the moist air rises and cools. Clouds are made up of tiny droplets of liquid water. The droplets are so small that they remain suspended in the air. If they grow larger, they may then fall as rain.

Precipitation includes all the ways that water gets to the surface from the atmosphere... rain, hail and snow.

Transpiration

Plants absorb water from the soil into their roots. Water is then drawn upwards through the xylem tubes to the leaves, and evaporates from the stomates. (microscopic pores in the leaf)

This process is called Transpiration. It keeps plants cool, and ensures a good flow of water and soil minerals to the leaves for photosynthesis.

The process also moves huge quantities of water into the atmosphere from vegetated areas.

keep it simple science

Atmosphere, Hydrosphere & Weather

The day-to-day weather, and the long-term climate, are controlled by both atmosphere and hydrosphere.

Air Pressure and Weather

Most of our winds, storms and weather patterns are due to air pressure effects in the atmosphere.

In some places, a huge "bubble" of the air (maybe 1,000 km across) can warm up. This "bubble" expands so that the air particles become further apart and the air pressure becomes lower than the surrounding air.
This is a "low pressure cell".

Meanwhile, in another place the air is cooling and contracting. The air particles are forced closer together, so the pressure rises... a "high pressure cell".

Both pressure systems begin to rotate because of the spin of the Earth, so circular winds blow around each "cell".

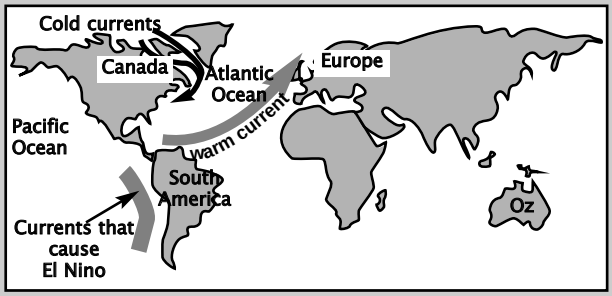
Low pressure cells often bring storms and rain (and cyclones) while "highs" tend to bring fine, dry weather. Both create the winds that blow around them, and from one to the other.

Oceans and Climate

Ocean currents can have a huge impact on climate.

On opposite sides of the North Atlantic Ocean the climates are very different. In north-east Canada the climate is so cold that agriculture is very limited. At the same latitude in Europe it is cold in winter, but summer is mild and many crops are grown.

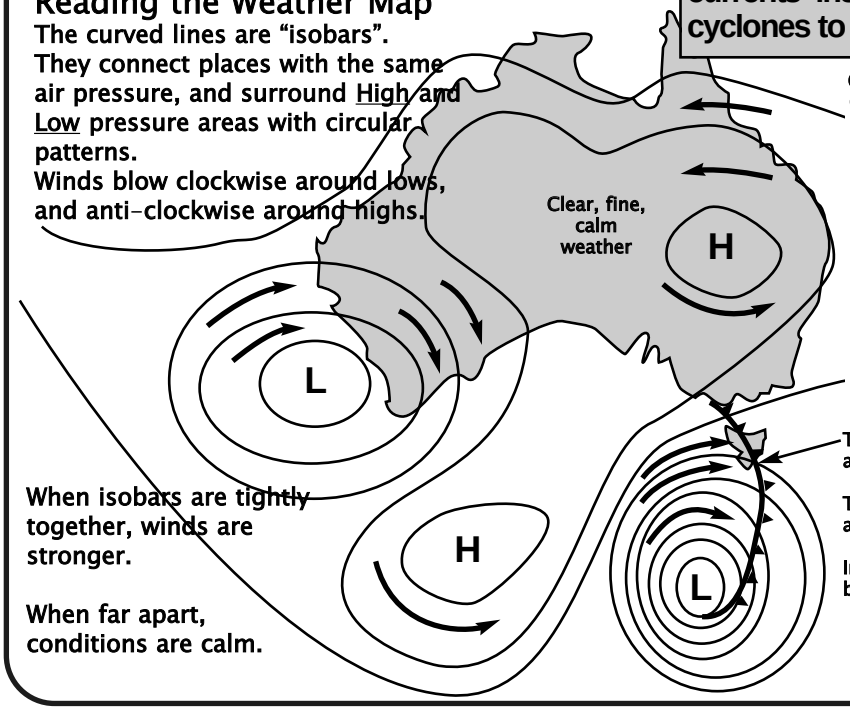
The difference is the warm ocean current which warms the climate of Europe. Frigid cold currents chill coastal Canada.



In the Pacific Ocean, warm currents near South America cause wind patterns which bring prolonged droughts to Australia. This is called "El Nino". In most years there are cold currents instead, and these bring rain and cyclones to the Australian coast.

Reading the Weather Map

The curved lines are "isobars".
They connect places with the same air pressure, and surround High and Low pressure areas with circular patterns.
Winds blow clockwise around lows, and anti-clockwise around highs.



When isobars are tightly together, winds are stronger.

When far apart, conditions are calm.

Gentle winds are blowing from the ocean onto the Queensland coast. This moist air might produce a few coastal showers, but inland would be clear and dry around a high pressure cell.

In NSW the winds would be light, and from the west to south-west. Fine conditions near a high.

The low off Western Australia is bringing moist air onto the west coast... probable rain and storms for Perth.

This symbol means a "cold front". A mass of cold air is moving across Tasmania.

The wind is strong, and probably very cold. It is also blowing off the ocean, so the air is moist.

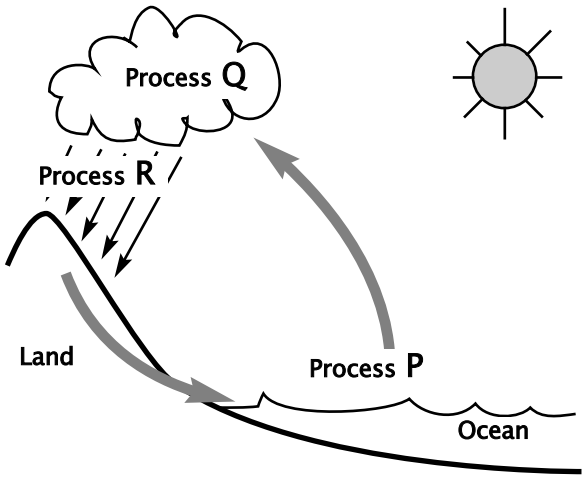
In winter, this would probably cause snow blizzards in Tasmania and Victoria.

keep it simple science

Worksheet 7
Water Cycle

Student Name.....

The "water cycle" can be represented by this diagram.



1. Name the processes P, Q & R.

P = ...

Q = ...

R = ...

2. Where does the energy come from to drive this cycle?

3. Draw another arrow on the diagram to show where the process of "transpiration" would fit into the cycle.

Worksheet 8
Air, Water & Weather

Student Name.....

Fill in the blank spaces.

Most of the water in the "Hydrosphere" is in the a)..... Some of it is frozen in the ice caps and in b)..... The remainder is in lakes and rivers or it is c)..... .....

The "water cycle" is powered by the heat of the d)..... This causes water e)....., or turn from f)..... to .....

Water also enters the atmosphere by g)....., which is evaporation from plants. This moves a lot of water from soil to the air.

As the water vapour rises, it cools and h)..... back to liquid. The tiny droplets remain suspended in the air, forming i).....

If the droplets grow large enough they will fall down as j)....., or (if frozen) they will fall as k)..... or ..... All these things are collectively called "l)....."

The cycle is completed when the water drains back to the m)..... by flowing down n)..... or seeping underground.

Weather and climate are controlled by both o)..... and .....

A lot of day-to-day weather is caused by high and low p)..... cells in the air. These cells rotate so that q)..... blows around them, bringing moist air, clouds, storms, etc.

The oceans have a big influence on r)..... For example, periods of drought in Australia are caused by warm currents in the s)..... ocean. This is called an t)"....." event. (Spanish name)

keep it simple science

The Lithosphere ("lithos" = rock)

The solid, rocky outside layer of the Earth is a very thin "skin" compared to the size of the Earth itself.
To study the lithosphere, the first step is to learn what it is made from.

Rocks are Made from Minerals

What is a rock?

Most rocks are mixtures of a variety of crystalline chemicals called "minerals". Each mineral forms crystals of a particular shape, colour and "hardness".

Quartz (or Silica)

The most common mineral on Earth is a glass-like substance called quartz.

(It's not surprising that it's "glass-like"... quartz is the main ingredient for making glass!)

Many small fragments of quartz is what we call <u>sand</u>.

If you hold a rock in sun-light and it "sparkles", that's probably because it has small crystals of quartz in it.

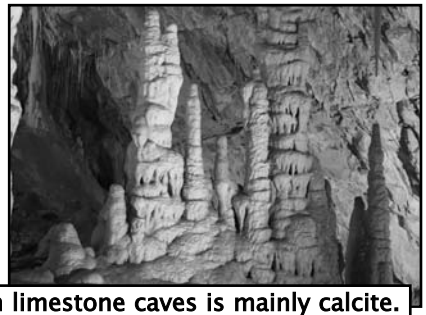
Calcite

Another common mineral is calcite.

Rocks containing calcite can be easily identified by placing a drop or two of acid on them. (A drop of vinegar will do)

If calcite is present, the acid will "fizz" with little bubbles.

Acid reacts chemically with calcite to make CO_2 gas. That's what makes the bubbles.

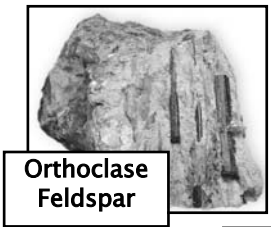


The rock in limestone caves is mainly calcite.

Silicate Minerals

The "silicates" are a large family of minerals which are all related to quartz. (Quartz is also known as "silica") 95% of rocks contain silicates.
Each particular silicate mineral is <u>quartz</u> with various chemical elements embedded in its crystal structure. This changes its colour, hardness and crystal shape.
The elements embedded in silicates are (most commonly) aluminium, calcium, magnesium, iron and potassium.

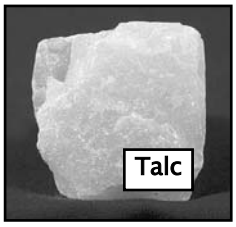
Some Silicate Minerals



Orthoclase Feldspar

Olivine

Mica



Talc

Most silicates occur mixed together in common rocks. When they occur in pure crystals they are "gems", and "semi-precious stones"

keep it simple science

The Rocks of the Lithosphere

Rocks can be mixtures of many different minerals combined in any proportions. This means that thousands of different kinds of rock are possible. However, all rocks can be classified into just 3 groups, according to how the rock was formed.

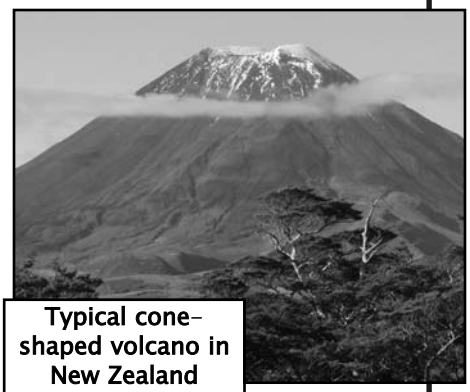
Igneous Rocks

Igneous rocks are formed from molten minerals that have cooled and solidified. These rocks are associated with volcanic activity.

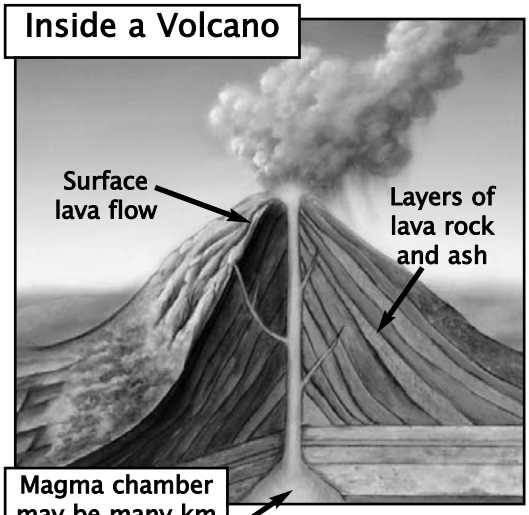
Magma & Lava

In many parts of the world, heat and movements in the lithosphere cause the rocks to melt deep below the surface.

This molten material is called "magma". Sometimes it can force its way to the surface and a volcanic eruption occurs. The molten rock that erupts at the surface is called "lava".



Typical cone-shaped volcano in New Zealand



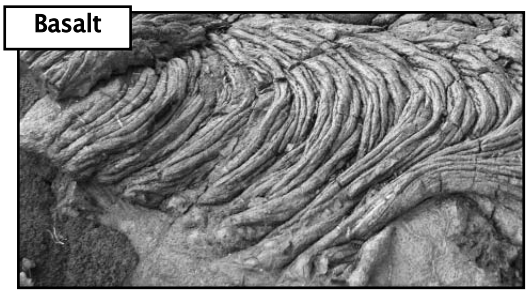
As the magma or lava cools down, the molten minerals solidify and form solid crystals. This forms igneous rocks.

Magma cools slowly, deep underground. This allows the mineral crystals to grow larger and be clearly visible in the rock. Lava cools quickly at the surface, and the crystals are too small to see.

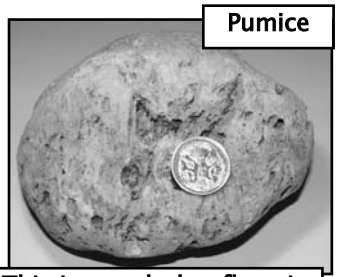
The colours vary, too. Igneous rocks with large amounts of quartz are pale in colour. If there is less quartz and more silicate minerals, the colour is usually darker.

Some Common Igneous Rocks

Granite forms from slow-cooling magma. You can see the separate mineral crystals, including a lot of quartz.



This is basalt from a recent lava flow. You can still see the flow patterns from when it was liquid. Basalt is dark-coloured with microscopic crystals.



This is a rock that floats! Pumice is like the "froth" on lava from volcanic gases forming bubbles.

keep it simple science

The Rocks of the Lithosphere

Rocks can be mixtures of many different minerals combined in any proportions. This means that thousands of different kinds of rock are possible. However, all rocks can be classified into just 3 groups, according to how the rock was formed.

Sedimentary Rocks

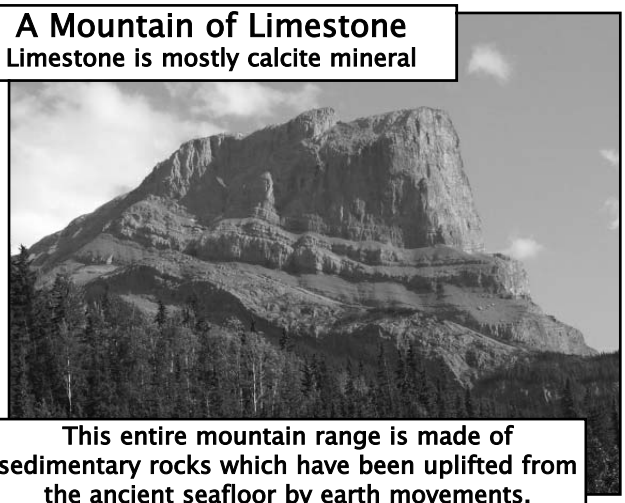
Sediments

Rocks are worn down and carried away by water, wind and ice. Erosion of rocks produces gravel and sand and silt, or mud.

Eventually, these eroded fragments settle to the bottom of a lake or ocean. These are called sediments.

As more and more sediments accumulate on top, the layers are compressed by huge forces. Any water is squeezed out. The grains become cemented together and the whole mass becomes a hard rock. (Although it's usually not as hard as igneous rock)

A Mountain of Limestone
Limestone is mostly calcite mineral

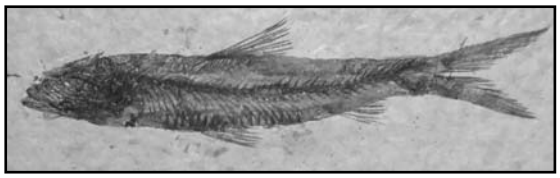


This entire mountain range is made of sedimentary rocks which have been uplifted from the ancient seafloor by earth movements. You can clearly see the sedimentary layers.

During erosion, the pebbles, mud, sand, etc. are often sorted out and separated from each other. Sediments are often made of particles all the same size.

Fossils

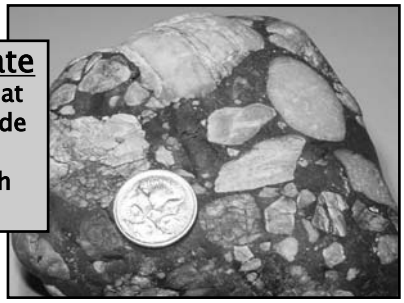
Some sedimentary rocks contain the remains and traces of ancient living things that were buried in the sediments.



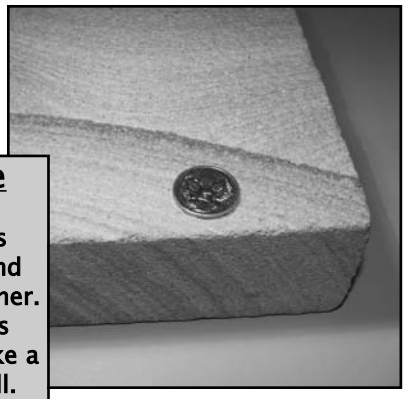
This fish lived 150 million years ago. Its body was trapped in silt which later became shale rock.

Common Sedimentary Rocks

Shale
This rock forms from layers of silt or mud. Colours vary, but it is fine-grained. You can see the sedimentary layers in this sample.



Conglomerate
You can see that this rock is made from gravel cemented with a dark mud.



Sandstone
Forms from sand particles compressed and cemented together. This piece has been cut to make a decorative wall.

keep it simple science

The Rocks of the Lithosphere

Rocks can be mixtures of many different minerals combined in any proportions. This means that thousands of different kinds of rock are possible. However, all rocks can be classified into just 3 groups, according to how the rock was formed.

Metamorphic Rocks

These are rocks that are formed when a previous igneous or sedimentary rock is changed by extreme heat and/or pressure within the lithosphere.

Heat & Pressure Causes Changes

The extreme heat near a chamber of molten magma can cause changes to surrounding sedimentary rocks.

For example, the sand particles in sedimentary sandstone can partly melt so they all fuse together to form a mass of glassy quartzite rock.

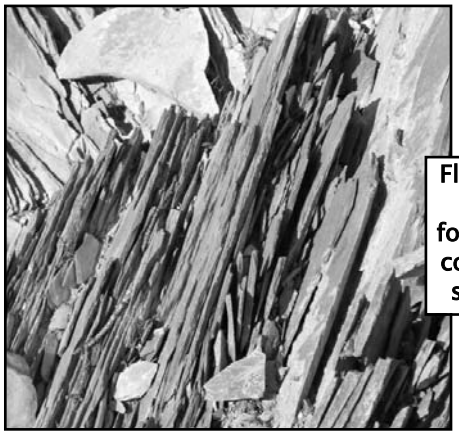
Quartzite

Perhaps the best known metamorphic rock is marble. It is formed from limestone, a sedimentary rock containing a lot of calcite mineral.

Under great heat and pressure, the calcite is re-crystallised and the rock becomes much harder. Beautiful colours and patterns may develop due to small amounts of other minerals in it.

People have been using marble for statues and decorative structures for thousands of years.

Just like the limestone from which it came, marble will "fizz" if a few drops of acid are placed on it.



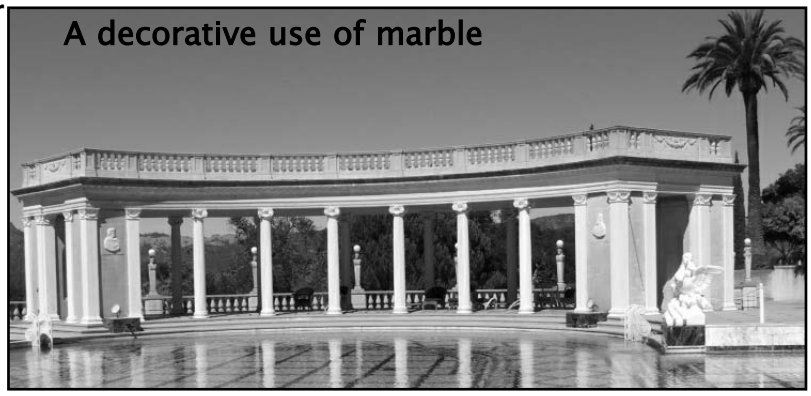
Flat slabs of Slate formed from compressed shale rock

The massive movements of the lithosphere that slowly push the continents around and lift up entire mountain ranges generate enormous, relentless forces.

These forces can squeeze rock so much that its structure changes. Slate is a hard metamorphic rock formed from shale that has been pressurised.

It splits into thin slabs that make it useful for roof and floor tiles.

A decorative use of marble



keep it simple science

Worksheet 9
Rocks & Minerals

Student Name.....

Fill in the blank spaces.

Minerals

Most rocks are mixtures of various a)....., each with its own b)..... shape, colour and hardness.

The most common mineral on Earth is c)..... which is hard and d).....-like.

Another common mineral is calcite, which is easily identified by placing a drop of e)..... on a rock sample. If calcite is present, it will f).....

95% of rocks contain one or more of the many types of g)..... minerals. These are based on quartz, but have various metals embedded in the h)..... structure. This changes the colour, crystal shape and i).....

Igneous Rocks

Igneous rocks form from j)..... minerals and are associated with k)..... activity.

Molten rock deep in the Earth is called l)..... If it cools deep underground, it will cool m)..... and mineral crystals have time to grow. A common rock of this type is n)..... in which you can easily see different o).....

If the molten rock erupts at the surface it is called p)..... This cools q)....., so the crystals are very r)..... A common rock of this type is s).....

Sedimentary Rocks

Rocks and soil are worn down and carried away by water, wind, etc. This is called t)..... Eventually the sand, clay or silt is deposited on a lake or sea floor as u)..... More and more layers accumulate, v)..... the layers below, until the sediments become rock. Often, some mineral in the sediments acts like w)..... and helps hold the rock together.

Sometimes the body or traces of living things are trapped in the sediments and are preserved as x).....

Two common sedimentary rocks are shale, made from y)..... sediments, and z)..... from sand.

Metamorphic Rocks

These are made when an existing rock is changed by aa)..... and/or .....

The heat from nearby ab)..... activity can change sandstone into ac).....

The huge ad)..... that occur when mountain ranges are being formed can squeeze shale into a new structure called ae).....

Rocks containing a lot of calcite, such as af)..... can be re-crystallised by heat and pressure to become ag)..... This beautiful rock has been used for statues for thousands of years.

keep it simple science

Weathering of Rocks

**Most rocks are pretty hard, but they're not indestructable.
Rocks are gradually "broken down" into smaller pieces,
and chemically changed into new substances.
This breaking-down of rock is called weathering.
There are 2 quite different weathering processes that occur.**

Physical Weathering

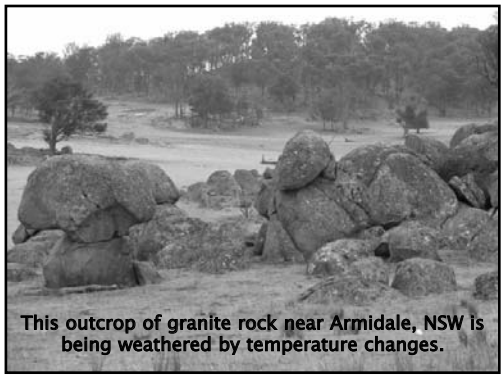
This means the physical breaking of rock into smaller particles, without changing it chemically.

The classic example is when quartz crystals are broken into small fragments to form sand grains. It's still quartz, but the grains are smaller.

What causes physical weathering?

One of the main causes is temperature change. On a hot day the outside of a rock becomes hot and expands slightly. At night it gets cold and contracts.

This cycle of expanding and contracting cracks the surface and small fragments fall off. On a cold night in the mountains, you can often hear the clatter of small rock fragments tumbling down the cliffs and gorges.



This outcrop of granite rock near Armidale, NSW is being weathered by temperature changes.

If it gets cold enough to freeze water this process speeds up. Water seeps into cracks in the rock. When it freezes, it expands and cracks the rock further until pieces break off.

Another major process of physical weathering is the tumbling of stones in a fast-flowing river, or by the waves near the coast. Sand and rocks are tossed and tumbled together so they are first rounded, and then worn down into smaller and smaller pieces.

Chemical Weathering

This is when the minerals in a rock are chemically changed by reaction with oxygen and natural acid chemicals in the environment.

The crystal structure of the mineral changes to a new, softer substance, and the rock softens and falls apart.

Quartz does not change chemically, (it only breaks physically into sand grains) but many of the silcate minerals change into what we might call "clay".

Rocks containing the mineral calcite are especially easy to weather. As you know, calcite reacts chemically with acids. If water with some dissolved acid seeps through calcite rocks, the rock slowly dissolves away. This is how limestone caves develop.

So, where do the acids come from?

Carbon dioxide (CO_2) gas from the air dissolves in water to form a (very weak) acid solution. Living things in the soil produce natural acids, and the rotting of dead vegetation releases natural acids.

In many cases, both physical and chemical weathering occur together. Rock becomes fragmented and softened, so that it disintegrates.

keep it simple science

Erosion

Once rocks have been weathered, another process becomes possible. Erosion is the <u>movement</u> of rock and soil from one place to another. The main things which cause erosion are flowing water or ice, and the wind.

Wind Erosion

In deserts and along beaches, the wind often moves loose dust and sand. Sand is often piled up to form "sand dunes".

These can slowly "migrate" as sand is blown up and over the top, and cascades down the other side.

Erosion by Ice

There are no glaciers in Australia, but in many colder climate areas, they are one of the most important agents of erosion.

A glacier is nature's bulldozer. The slow, relentless movement of billions of tonnes of ice gouges out the rock, weathering and eroding in one step.

This chunk of ice has broken off a glacier and has floated across a melt-water lake. Notice the load of broken rock it is carrying. This ice must have been at the base or side of the glacier and gouged the rock from the mountains visible in the background. When the ice melts, the rock will be deposited, then washed away again by flowing water.

Erosion by Water

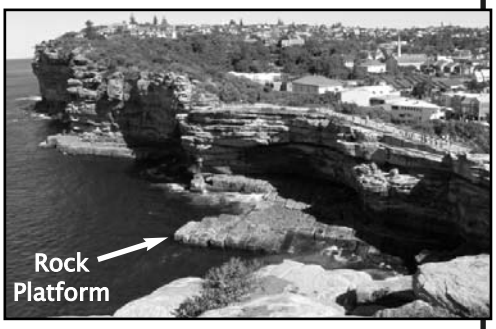
Moving water is a major cause of erosion.

As rivers flow, they carry tonnes of fine sand and "silt" down to the sea. Eventually these solid particles will settle to form sediments. They may form sand-bars, or beaches, or simply be buried to become new sedimentary rocks millions of years later.

In steep mountain creeks, the fast flowing water can transport pebbles and boulders. The tumbling stones help cut through the bed-rock and gouge out canyons and valleys.

The action of waves at the coast is a powerful agent of erosion.

Waves "undercut" the rock at sea level. Then the rock above collapses, leaving vertical cliffs.



At water level, a flat rock platform shows where the base of the cliff used to be, before erosion.

These sea cliffs are at "The Gap", Watsons Bay, Sydney.

keep it simple science

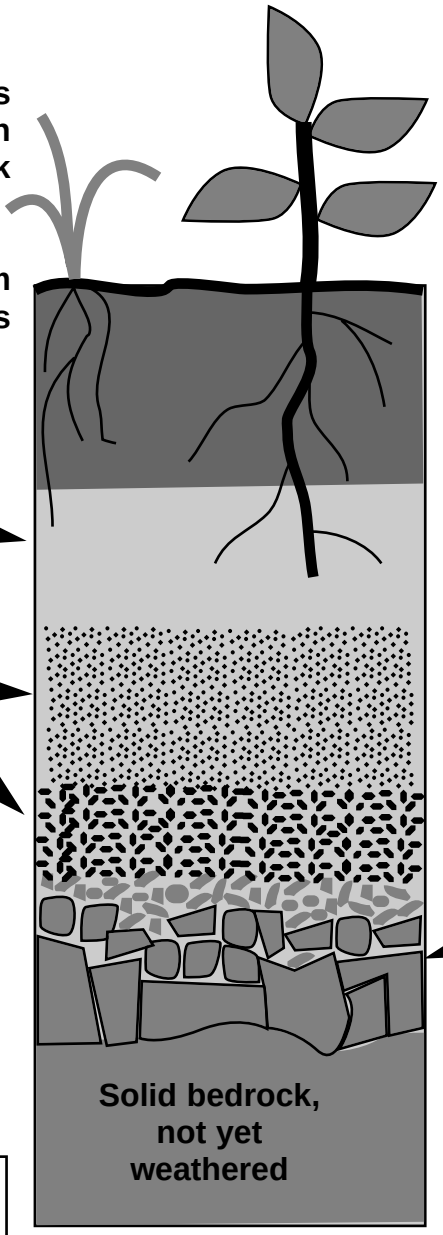
Soil Formation

**We rely heavily on soil for growing food crops and grass for grazing animals.
Good soil can take thousands of years to develop,
and is often less than a metre thick.
Soil formation depends on weathering and erosion.**

A Soil Profile

The diagram shows a cross section through a soil which has formed from the bedrock underneath.

Working from the bottom upwards, the profile reveals the stages in soil formation.



Fine-grained sand and clay "subsoil"

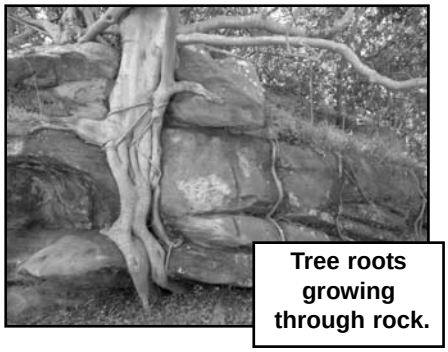
Rock broken into smaller pieces. Quartz forms sand grains. Chemical weathering turns silicates into clay.

"Topsoil" is usually darker than subsoil because it contains "humus". This is rotted plant material which changes the texture of the soil, helps hold moisture and fertilizes plant roots.

The topsoil is the essential, fertile layer.

The plants and rotting humus produce acids which seep down through the subsoil. This causes the chemical weathering.

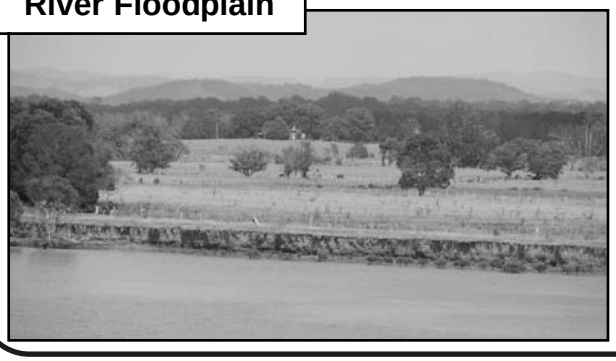
Cracked and broken rock... weathering beginning. Tree roots often grow into cracks and break the rock.



Tree roots growing through rock.

Deposition Soils

River Floodplain



Many soils are formed by erosion and deposition, rather than weathering of the bedrock. The soil in this photo has been deposited as alluvial sediments during floods.

Floodplains are flat and ideal for farming and each flood deposits another silt layer, so the soil stays fertile.

keep it simple science

Landscapes Formed by Erosion & Deposition

Many landscapes, both ordinary and spectacular, are the result of the weathering and erosion of rock, or the deposition of sediments.

Wind Erosion

This rock formation in Western Australia is called "Wave Rock". It has been eroded into this shape by wind-blown sand.

Erosion by Rain

The soft volcanic ash of this part of Turkey washes away in rain, except where it is "capped" by harder, darker rock. Erosion has produced these strange "fairy chimneys". Local people hollow them out to use as homes.

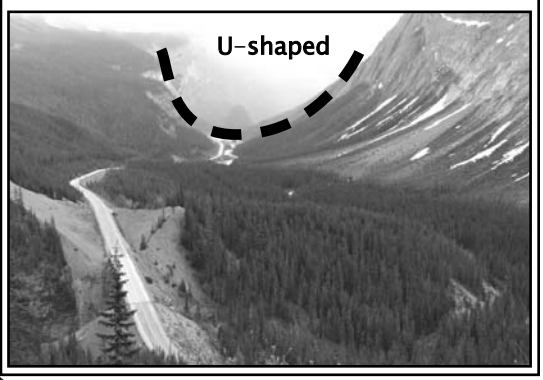
River Erosion & Deposition

Once they're down out of the mountains, rivers <u>meander</u> sideways and erode a wider and wider valley. Seasonal flooding deposits sediments to form a flat floodplain.

Flood waters cut new channels creating islands, and river meanders get cut-off to form billabongs , or "ox-bow lakes".

Ice Erosion

A glacier once filled this valley and gouged out all the rock. The U-shape is typical of erosion by ice. (Mountain valleys eroded by water are V-shaped)



Coastal Deposition

This <u>sand spit</u> and <u>beaches</u> have formed from sand deposited by tides rushing in and out of this coastal bay.

keep it simple science

Worksheet 10
Weathering & Erosion

Student Name.....

Answer these Questions

1.
Explain the difference between physical weathering and chemical weathering by completing these sentences.

Physical weathering breaks rock into a)....., but does not change it into b).....

Chemical weathering changes rocks and minerals into c)..... .....

2.
a) Describe 2 things which cause physical weathering of rock.

.....

.....

b) Name a substance which can react to cause chemical weathering.

.....

3.
Explain the difference between weathering and erosion by completing these sentences.

Weathering a)..... rock into smaller pieces, or changes it into b).....

Erosion c)..... the weathered rock to a d).....

4.
List 3 things which cause erosion.

.....

.....

.....

5.
Complete the sentences to describe the ways that soil can form.

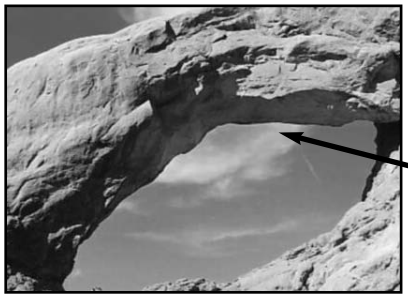
Soil can form from the underlying bedrock by a)..... of the rock. The rock is b)..... broken into smaller particles, and also c)..... changed into substances such as clay.

Good d)"....." always contains a lot of e)"....." which is rotted plant material

Some soils are formed by f)..... of eroded silt. On a river g).....plain, every flood deposits h).....

6. Give one example of a landscape created by:

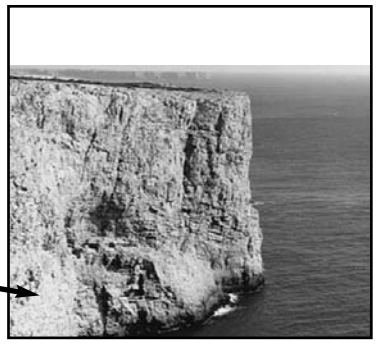
a) wave erosion at a coastline .....
b) deposition of sediments on a coastline.....
c) river erosion and seasonal flooding .....



7. What do you think has created the landscapes in these photos?

a).....

b).....



keep it simple science

Topic Test
The Earth

Student Name..... Score = /26

Answer all questions in the spaces provided.

1. (10 marks)

True of False?	T or F
a) The innermost layer of the Earth is liquid.	.....
b) Oxygen is required for things to burn.	.....
c) CO_2 is needed for cellular respiration.	.....
d) Ozone is a form of oxygen.	.....
e) Clouds in the sky are made of gas. (water vapour)	.....
f) Silicate minerals are similar to calcite.	.....
g) Slow-cooling igneous rocks have the smallest crystals.	.....
h) Fossils are found in igneous rocks.	.....
i) Temperature change can cause physical weathering.	.....
j) Sand dunes are created by wind erosion.	.....

2. (6 marks)
Briefly explain the difference between:

a) magma and lava.

b) evaporation and condensation.

c) weathering and erosion.

3. (10 marks)
Match each description to an item from the list. To answer, write the letter (A,B,C, etc) of the list item beside the description.

Description	matches with	List Item
a) Combination of crust plus upper mantle rocks.		.....
b) Second most abundant gas in the atmosphere.		.....
c) Needed for photosynthesis.		.....
d) Type of atoms in ozone.		.....
e) Its value decreases with altitude.		.....
f) Evaporation from plants.		.....
g) Most common mineral.		.....
h) Molten rock, deep down.		.....
i) Metamorphic rock, from limestone.		.....
j) Causes a lot of chemical weathering.		.....

List Items Not all will be used. Some may be used more than once.

A. Transpiration	G. Carbon dioxide
B. lava	H. Calcite
C. Quartz	I. Lithosphere
D. Oxygen	J. glacier
E. acid	K. air pressure
F. magma	L. marble

Answer Section

Worksheet 1

a) Crust b) Mantle
c) Outer Core d) Inner Core
e) Seismology: study of earthquake waves
f) Outer core
g) iron & nickel metals
h) It is made up of the crust rocks with some mantle rock attached.

Worksheet 2

a) atmosphere b) weather
c) oxygen d) UV radiation
e) hydrosphere f) lakes & rivers
g) ice caps h) crust
i) mantle j) tectonic
k) biosphere

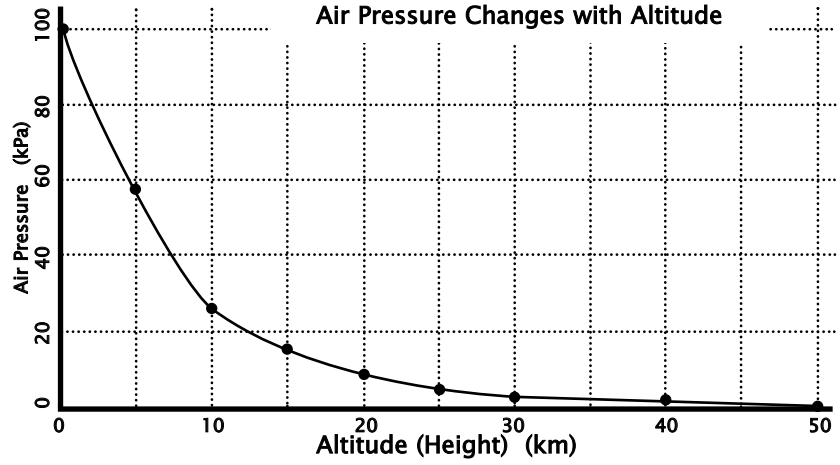
Worksheet 3

1. A 2. F 3. G 4. E 5. E
6. E 7. C 8. C 9. H 10. B

Worksheet 4

a) nitrogen b) oxygen
c) respiration d) argon
e) carbon dioxide f) photosynthesis
g) oxygen h) heat
i) Greenhouse j) fossil
k) coal & petroleum
l) Global m) oxygen
n) ultra violet (UV) o) CFC's
p) pressure q) decreases
r) breathing s) pressure / space
t) space

Worksheet 5



Worksheet 5 (cont)

1. kilopascals (pressure unit used a lot in Science)
2. 3-4 km approx (reading from graph)
3. (from graph) 27-28 kPa (approx)

Worksheet 6

1.
Processes: (top) photosynthesis, (bottom) cellular respiration.
Substances: (left) oxygen + glucose, (right) carbon dioxide + water.
2. Carbon dioxide
3.
Clearing forests reduces the amount of plants carrying out photosynthesis. Since plants absorb CO_2, less plants means that CO_2 levels rise. This promotes the greenhouse effect.

Worksheet 7

1. P = evaporation
   Q = condensation
   R = precipitation
2. Energy is from the Sun.
3. Arrow should go from the ground (actually from plants) to the cloud.

Worksheet 8

a) oceans b) glaciers
c) underground d) Sun
e) evaporate f) liquid to gas
g) transpiration h) condenses
i) clouds j) rain
k) hail or snow l) precipitation
m) oceans n) rivers
o) atmosphere and hydrosphere
p) pressure
q) wind
r) climate
s) Pacific
t) El Nino

Worksheet 9

a) minerals b) crystal
c) quartz d) glass-
e) acid f) fizz / bubble
g) silicate h) crystal
i) hardness

j) molten
k) volcanic l) magma
m) slowly n) granite
o) mineral crystals
p) lava q) quickly
r) small s) basalt

t) erosion u) sediments
v) compressing w) cement
x) fossils y) silt / clay / mud
z) sandstone

aa) heat and/or pressure
ab) volcanic ac) quartzite
ad) pressures ae) slate
af) limestone ag) marble

Worksheet 10

1.
a) smaller pieces
b) a new substance
c) new chemical substances
2.
a) temperature change,
flowing water tumbling rocks
b) acid or oxygen
3.
a) breaks
b) new substances
c) moves or transports
d) new location, different place
4.
Moving water, wind, ice (glaciers)
5.
a) weathering b) physically
c) chemically d) topsoil
e) humus f) deposition
g) flood h) a new layer of silt
6.
a) sea cliffs b) beach, sand bar
c) floodplain
7.
Wind erosion
Wave erosion

Topic Test

1.
a) F b) T c) F d) T e) F
f) F g) F h) F i) T j) T

2.
a) Magma is molten rock deep underground, while lava is molten rock at the surface.
b) Evaporation is liquid → gas.
Condensation is gas → liquid.
c) Weathering breaks rock down, erosion moves it to a new location.

3.
a) I b) D c) G d) D e) K
f) A g) C h) F i) L j) E