Contents

Words to Watch

account, account for State reasons for, report on, give an account of, narrate a series of events or transactions.

analyse Interpret data to reach conclusions.

annotate Add brief notes to a diagram or graph.

apply Use an idea, equation, principle, theory or law in a new situation.

assess Make a judgement of value, quality, outcomes, results or size.

calculate Find a numerical answer showing the relevant stages in the working (unless instructed not to do so).

clarify Make clear or plain.

classify Arrange into classes, groups or categories.

comment Give a judgement based on a given statement or result of a calculation.

compare Give an account of similarities and differences between two (or more) items, referring to both (all) of them throughout.

construct Represent or develop in graphical form.

contrast Show how things are different or opposite.

deduce Reach a conclusion from the information given.

define Give the precise meaning of a word, phrase or physical quantity.

demonstrate Show by example.

derive Manipulate a mathematical relationship(s) to give a new equation or relationship.

describe Give a detailed account.

design Produce a plan, simulation or model.

determine Find the only possible answer.

discuss Give an account including, where possible, a range of arguments for and against the relative importance of various factors, or comparisons of alternative hypotheses.

distinguish Give differences between two or more different items.

draw Represent by means of pencil lines.

estimate Find an approximate value for an unknown quantity.

evaluate Assess the implications and limitations.

examine Inquire into.

explain Give a detailed account of causes, reasons or mechanisms.

extract Choose relevant and/or appropriate details.

extrapolate Infer from what is known.

identify Find an answer from a given number of possibilities.

justify Support an argument or conclusion.

label Add labels to a diagram.

list Give a sequence of names or other brief answers with no explanation.

measure Find a value for a quantity.

outline Give a brief account or summary.

predict Give an expected result.

propose Put forward a point of view, idea, argument or suggestion for consideration or action.

recall Present remembered ideas, facts or experiences.

show Give the steps in a calculation or derivation.

sketch Represent by means of a graph showing a line and labelled but unscaled axes but with important features (for example, intercept) clearly indicated.

solve Obtain an answer using algebraic and/or numerical methods.

state Give a specific name, value or other brief answer without explanation or calculation.

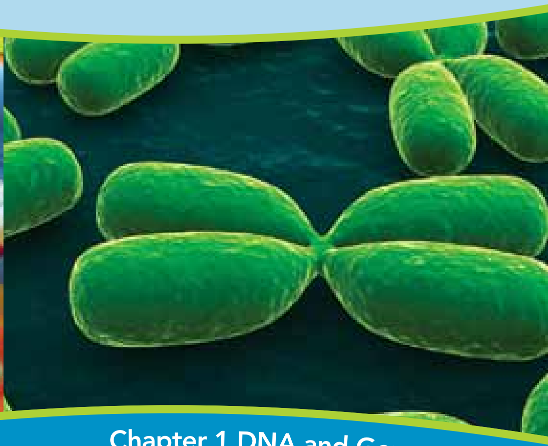
suggest Propose a hypothesis or other possible answer.

summarise Express concisely the relevant details.

synthesise Put together various elements to make a whole.

1 DNA and Genes

This chapter examines how hereditary information is passed from one generation to the next. It explains the structure of DNA and its role in controlling the characteristics of organisms. You will solve problems and predict the probability of offspring inheriting a certain trait. You will also investigate how technology has advanced scientific understanding of genetics and is used to assist people in their daily lives or provide new career opportunities.

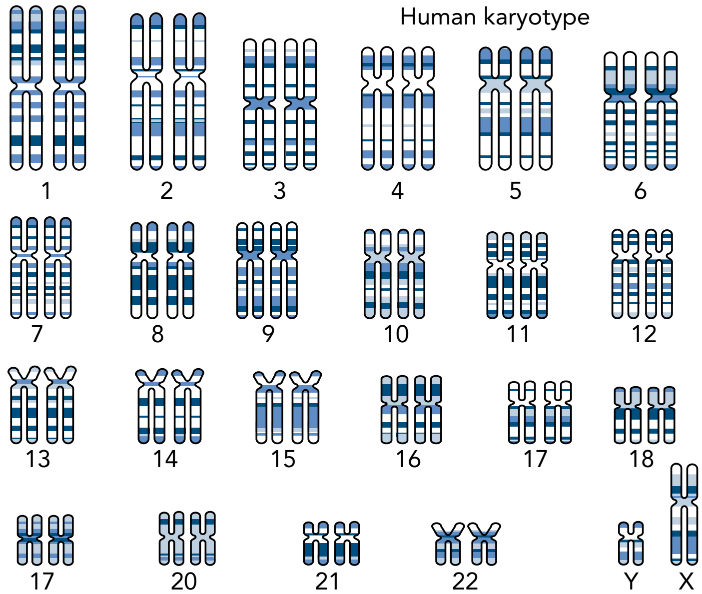


How much do you remember or already know?

1. What are cells?
2. How can you distinguish plant cells from animal cells?
3. Name the basic parts of all cells.
4. What is the function of the nucleus?
5. Describe the cell membrane.
6. What is cytoplasm?
7. Name some specialised animal cells.
8. What is a tissue?
9. Name three organs of the human body and state their function.
10. What is mitosis?
11. Why is mitosis important?
12. What is the difference between asexual and sexual reproduction?
13. Name some organisms that reproduce by asexual reproduction.
14. Name some organisms that reproduce by sexual reproduction.
15. What is the difference between inherited characteristics and acquired characteristics?
16. Name some of your own inherited characteristics.
17. Name some of your acquired characteristics.
18. What are organic molecules?
19. What is a macromolecule?
20. Name the four main types of macromolecules of organic compounds.
21. What is the basic unit of carbohydrates?
22. What is the basic unit of proteins?
23. What is the basic unit of lipids?
24. What is the basic unit of nucleic acids?
25. How many different amino acids are commonly found in proteins?
26. Name the two types of nucleic acid.
27. Why does the body need proteins?
28. Why does the body need carbohydrates?
29. What is the function of nucleic acids?
30. Define fertilisation.

1.1.6 Karyotypes

Human karyotype



A **karyotype** is an arrangement of all the chromosomes from the nucleus arranged in order from the largest to the smallest with the sex chromosomes last. A karyotype shows the number, size and shape of each chromosome. The centromere is the part that links sister chromatids and is seen during cell division. The centromere divides a chromosome into two arms and the position of the centromere helps to identify different chromosomes. Karyotypes are used in cell biology and genetics to provide information about gender, relationships between different species, cellular functions and chromosomal abnormalities which can cause genetic diseases.

Humans have 46 chromosomes (23 pairs).
There are 22 pairs of **autosomes** (chromosomes which do not determine a person's sex) and the **sex chromosomes** are called the **X** and **Y chromosomes**. Females are XX and males are XY. Genetic diseases caused by chromosome abnormalities include Down syndrome (trisomy 21) in which the person has three copies of chromosome 21, Turner syndrome (XO) in which the person appears female and has only one X chromosome, Jacob syndrome (XYY) is male with an extra Y chromosome and Klinefelter syndrome (XXY) is male with an extra X chromosome.

1.1.6.1 What is a karyotype? ....

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1.1.6.2 What is shown in a karyotype? ....

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1.1.6.3 How can karyotypes be used? ....

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....

1.1.6.4 How many chromosomes do humans have? ....

1.1.6.5 What is the difference between autosomes and sex chromosomes? ....

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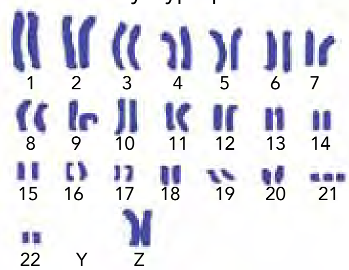
1.1.6.6 The diagram shows the karyotype of person A. What is the gender of this person and what genetic disease do they have?

....

....

Karyotype person A



1.6.3 Transgenic organisms

A **transgenic organism** is an individual organism that has had a gene inserted into its genome from another organism of the same or different species. The bacteria that has the gene for human insulin and the bacteria that has the gene for human growth hormone are transgenic organisms.

Bt plants

'Bt' stands for *Bacillus thuringiensis*. It is a bacteria. It is an important bacteria as it produces a protein that is an insecticide. *Bacillus thuringiensis* became important to humans when scientists discovered that this bacteria causes a disease in flour moth caterpillars. This protein it produces also affects butterflies, flies, mosquitoes, beetles, wasps, bees, ants, sawflies and roundworms. The protein is the basis of many pesticides.

Genetic engineers isolated the gene that produces the pesticide protein and have inserted it into many crop plants. This means that the Bt plant now makes the chemical that kills the pest, e.g. caterpillar that tries to feed on the plant. Examples of transgenic Bt crops include Bt crops of cotton, corn, potato, maize and rice.

Transgenic organisms

1.6.3.1 Define a transgenic organism. ....

....

1.6.3.2 Name two transgenic organisms. ....

....

1.6.3.3 What does the 'Bt' mean if it is next to a type of plant, e.g. 'Bt cotton'? ....

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1.6.3.4 Why have scientists developed Bt crops? ....

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1.6.3.5 **Genetically modified food** (GM food) comes from crop plants that have been genetically altered – from transgenic plants. There has been great debate about the health risk of eating GM food. In 2008 a review published by the Royal Society of Medicine, UK, reported that research projects over 25 years showed that eating GM food was no more risky than eating food grown by conventional plant breeding technologies.

Suggest why many people still have concerns about eating GM foods.

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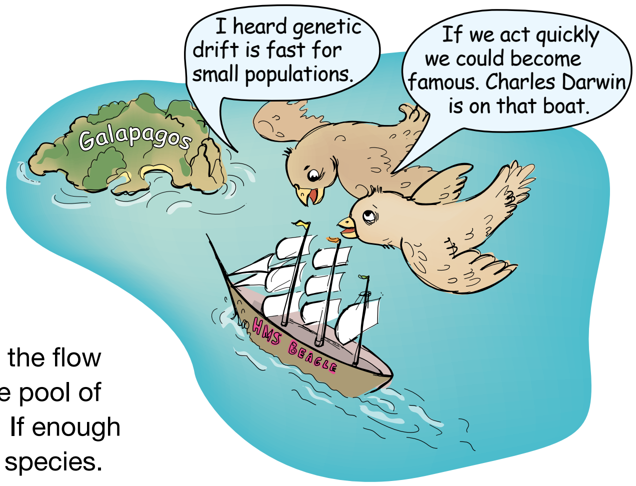
2.4 Factors for survival

2.4.1 Genetic characteristics and survival



The **gene pool** is all the genes in a population at one time. There are alleles for each gene, e.g. the gene for eye colour could have the allele for blue eyes and the allele for brown eyes. Natural selection favours the alleles for the favourable traits and over time the frequency of these alleles increases in the population. This is called **directional selection**.

Changes in gene pools lead to evolution. Large populations have more stable gene pools than small populations. If groups are separated the barrier prevents the flow of genes throughout the population. This means the gene pool of one group can change independently of the other group. If enough differences occur then the two groups become separate species.

Since a population has a definite size there can be changes in the frequency of some alleles due to random chance – just as you toss a coin for heads or tails and the result in 100 tosses is not always 50 heads and 50 tails. This is called **genetic drift**.

2.4.1.1 What is meant by the gene pool? ....

....

2.4.1.2 How does natural selection affect the gene pool? ....

....

2.4.1.3 Define genetic drift. ....

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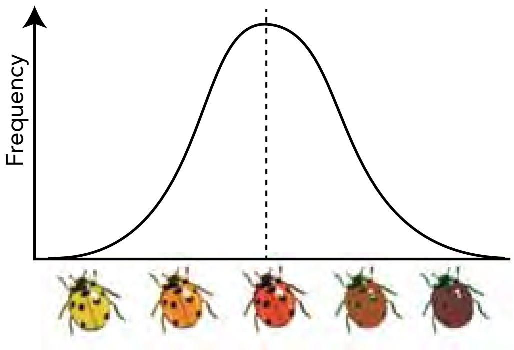
2.4.1.4 The graph shows a population with five different colours for the ladybird beetles.



(a) Suggest an advantage of the bright colour of ladybird beetles.

....

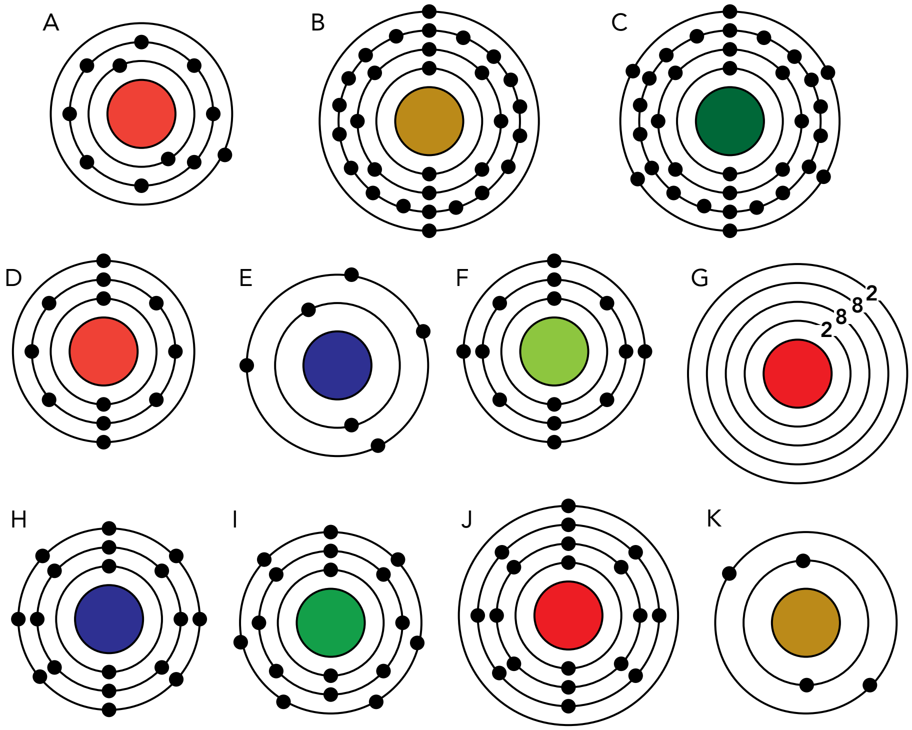
(b) From the graph, what is the most common form of ladybird beetle?

....

(c) How could you determine that all these beetles were the same species?

....

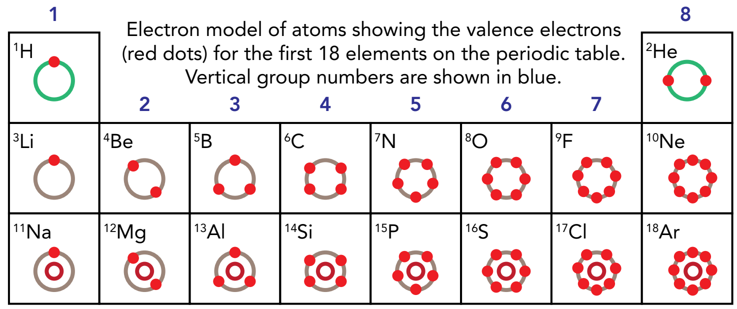
3.2.2.3 The diagrams show the arrangement of electrons in their shells for some atoms. Use the information in the diagrams to complete the table of information for each atom below.



Atom	Name of element atom represents	Atomic symbol of element	Electronic configuration	Valency of element	Number of chemical bonds atom makes with other atoms
A					
B					
C					
D					
E					
F					
G					
H					
I					
J					
K					

3.2.3 Electron patterns in horizontal rows

The table shows the valence electrons of the first 18 electrons in the periodic table.



3.2.3.1 What pattern do you notice in the number of valence electrons in the atoms as you go across a period?

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3.2.3.2 What is the relationship between the number of valence electrons and the periodic table group number?

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3.2.3.3 Use the information above and your own knowledge to complete the table.

Group number of element	1	2	3	4	5	6	7	8
Number of electrons in outside shell of atoms								
Chemical valency or combining power								

3.2.3.4

(a) Write the electronic configuration of each element next to its name.

Elements in period 2	Electronic configuration of these elements	Elements in period 3	Electronic configuration of these elements
Lithium		Sodium	
Beryllium		Magnesium	
Boron		Aluminium	
Carbon		Silicon	
Nitrogen		Phosphorus	
Oxygen		Sulfur	
Fluorine		Chlorine	
Neon		Argon	

(b) What two patterns do you notice in these two sets of electronic configurations?

....

....

(c) With the exception of the **transition** elements (the metals in the middle section of the periodic table), these patterns repeat for the elements in period 4 and period 5 and period 6. Suggest a reason for this.

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4.1.2.1 Using the information, give four arguments in favour of generating electricity from nuclear fuel.

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4.1.2.2 Using the information, give four arguments against producing electricity from nuclear fuel.

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4.1.2.3 Discuss the points you have made and then decide, in the light of these statements what should be used to produce our electricity: fossil fuels, nuclear technology or perhaps some other source. Explain why you made this decision.

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4.1.2.4 The efficiency of a fuel is a measure of how much energy is given out when either 1 gram of solid or liquid fuel or 1 cm^3 of a gaseous fuel is burnt. Efficiency is measured in joules of energy per gram, or joules of energy per cubic centimetre. The diagram shows some information about the energy released when some fuels are burnt.

According to this data:

(a) Which solid fuel is most efficient?

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(b) Which liquid fuel is most efficient?

....

(c) Which solid fuel is least efficient?

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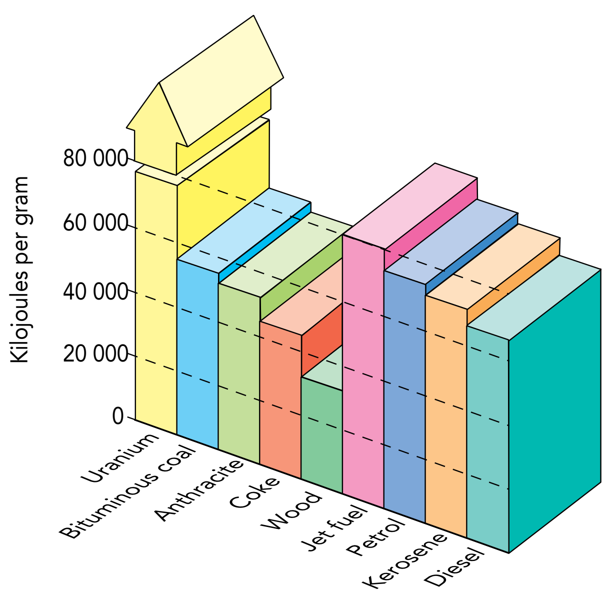
(d) Which liquid fuel is least efficient?

....

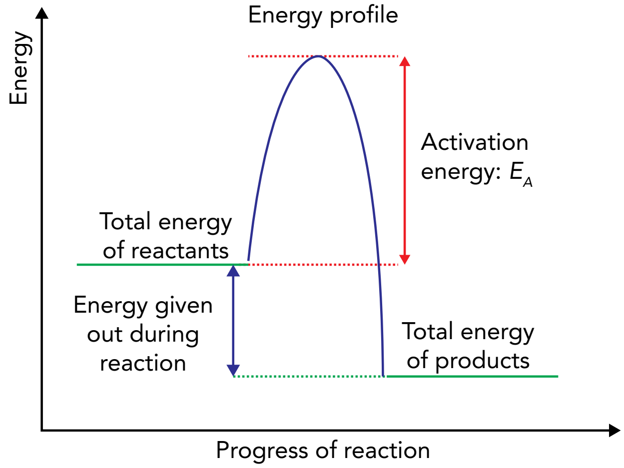


5.3.1.6 Read the information below about the effect of catalysts on chemical reactions, then answer the questions that follow.

A catalyst is a substance which speeds up a reaction, but is chemically unchanged at the end of the reaction. When the reaction has finished, exactly the same mass of catalyst can be recovered.

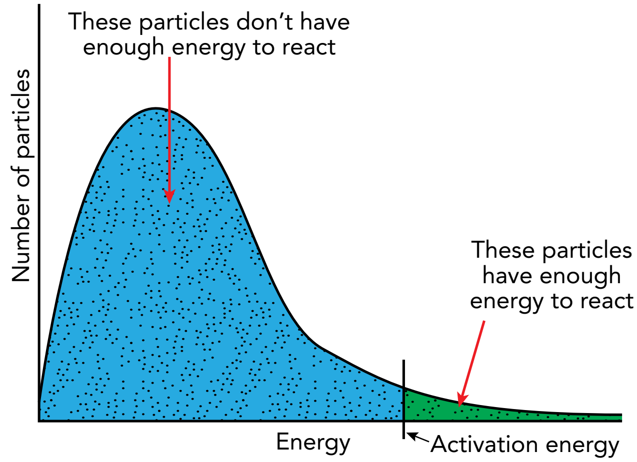
It is pretty obvious that two atoms or molecules can only react together if they collide, and even then they only *may* react. It isn't enough for the two particles to collide – they have to collide with enough energy for chemical bonds to break and re-form.

The minimum energy required for a particular reaction to commence is called its **activation energy**. We can show this on an **energy profile** for the reaction. The energy profile for a simple exothermic reaction is shown on the right.



If the particles collide with less energy than the activation energy, no reaction occurs, they simply bounce apart. Only those collisions which have energies equal to or greater than the activation energy will result in a reaction. Activation energy is involved in breaking some of the original bonds so that the particles can react with each other.

In any reaction mixture, the particles present will have a wide range of energies. This idea can be shown on a graph like the one on the right.



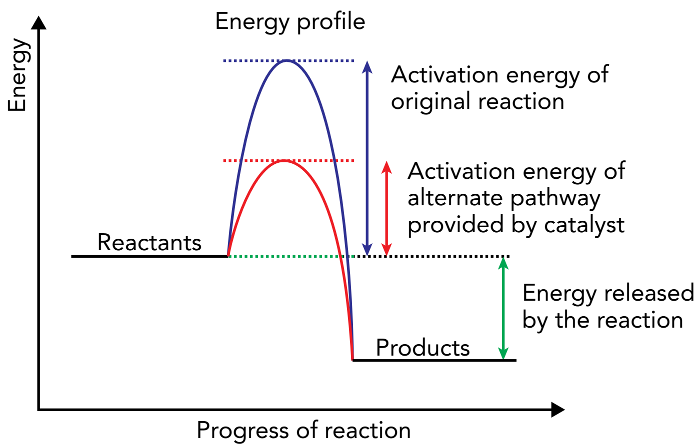
For a reaction to happen, particles must collide with energies equal to or greater than the activation energy for the reaction.

Notice that the large majority of the particles don't have enough energy to react when they collide (see graph).

To increase the rate of a reaction we need to increase the number of collisions that have enough energy to cause reaction to occur.

To increase the rate of reaction we have to either:

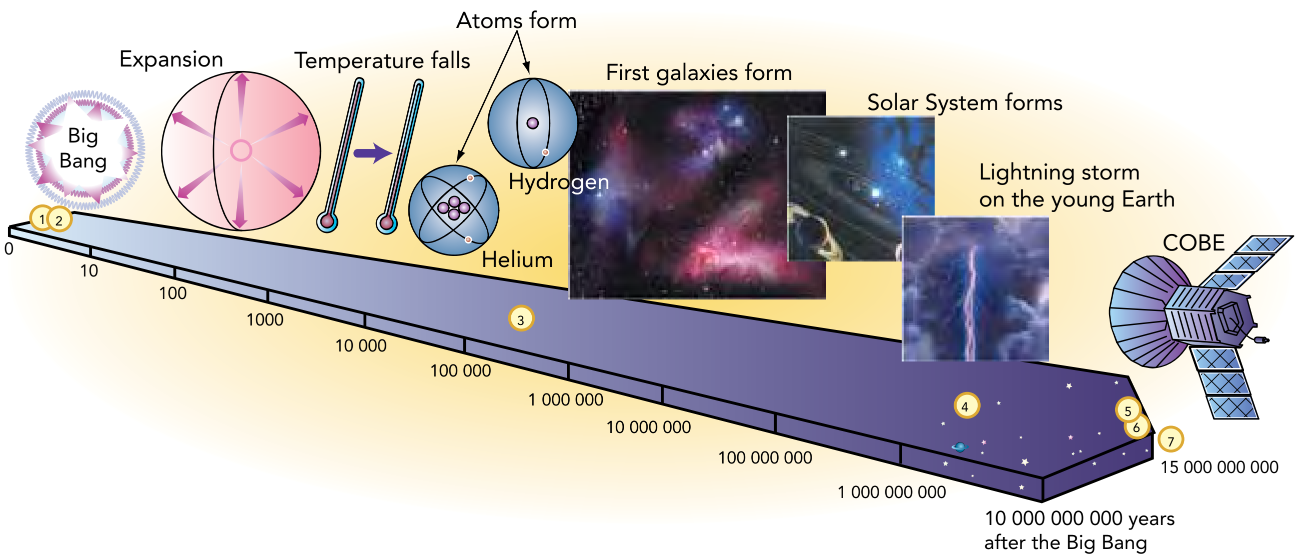
- Provide more particles with energy greater than the activation energy (this is what happens when a reaction mixture is heated) *or*
- Provide an alternate reaction pathway that has a lower activation energy. This is what catalysts do. The energy profile on the right shows this concept.



6.1.2 The Universe since the Big Bang

1. Nothing existed before the Big Bang. In an instant of time an enormous amount of energy was created.
2 Just after the Big Bang, the Universe was very small and consisted of only energy. It began to expand outwards in every direction. Heat energy spread throughout space.
3. As the Universe expanded, it cooled and continued to cool as expansion continued.
4. When the Universe had cooled from an initial 10 billion degrees to about 3000 degrees Celsius, hydrogen atoms and some helium atoms started to form.
5. Hydrogen and helium filled the Universe (still expanding and cooling) with a fog of matter. The gas atoms in denser parts of the fog were pulled together into separate small clouds of matter with huge empty spaces in between.
6. Gravity pulled the atoms closer, 'lumps' of matter started to form within the fog (also known as gas clouds).
7. The lumps of matter became even more dense as gravity forced atoms close together. The compressive forces caused the temperature within the lumps to rise to the point that hydrogen fusion started. The first stars were born.
8. Groups of stars (as in millions of them) in each gas cloud were attracted to each other by gravitational forces and grouped together to form galaxies.
9. Galaxies stay as integral groups while expansion of the Universe continues. The galaxies themselves, stay the same size.
10. Most scientists currently agree that our Sun formed about 4.6 billion years ago, although some recent evidence dates the Sun at 12 billion years. Around it was a dust cloud of numerous elements, possibly produced by older stars and blasted into space when they blew up. These elements came together to form the planets.

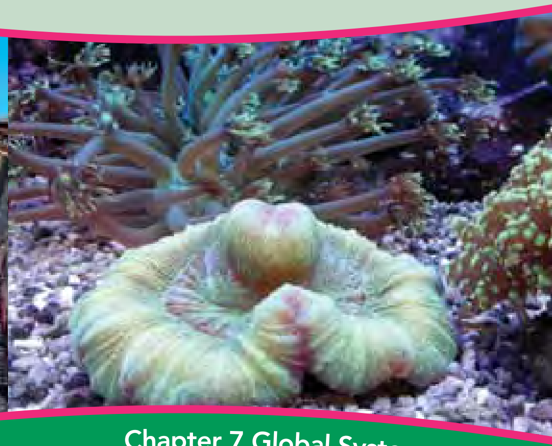
The evolution of the Universe



7 Global Systems

In this chapter you will study several of the major natural cycles that occur with chemicals on Earth and the effects humans have had on these cycles. Of increasing importance is the greenhouse effect and its contribution to global warming, along with the predicted consequences for life on Earth if global warming progresses as many scientists predict.

While past generations have developed and implemented the technologies that are contributing significantly to these effects the current generation realises that major problems lie ahead. It is probably your generation and future generations that will develop and implement technologies to counteract these effects and ensure that the Earth can continue to support life.



7.1.2.2 For each of the following human activities, briefly describe two possible effects of that activity on the water cycle.

(a) Deforestation.

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(b) The growth of cities.

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(c) Agriculture.

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(d) Growth of industry.

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This used be a forest!


Irrigating crops affects the water cycle too.


Cities affect the water cycle.


Rising salt caused by human interference with the water cycle.

Ways people could reduce their carbon footprint

Make climate-conscious political decisions. Change to carbon-reducing strategies must come from the government. Business and industry will not spend money to reduce their carbon footprint unless legislation enforces the changes. The only way governments will legislate this way is for the voters to demand it.

Eat less red meat and more white meat. Most of our red meat comes from cattle and sheep. These animals produce large amounts of methane when digesting their food. Methane is a significant contributor to the greenhouse effect. Other types of animals, such as chickens, pigs or kangaroos, produce far less emissions.

Purchase 'green power'. The non-polluting future of energy lies in renewable sources. 'Green power' is electricity that comes from these technologies. It costs more, but the money is used to develop more green energy resources, and as more people use these resources they will become cheaper.

Save energy at home. Turn off lights when you are not using them. Turn the TV off at the wall, not the remote. Put on an extra jumper instead of the heater. Shower for 3 minutes not 10 – saves water too. Cook in the microwave instead of the oven. Walk to the corner shop, don't drive. Use public transport more often. Insulate the house. By being sensible about your household energy use you can make a large reduction in your carbon footprint.

Buy energy- and water-efficient appliances. When buying new appliances look at their energy and/or water usage. The more energy efficient they are, the more they'll save you in the long run, and the lower their CO_2 impact will be.

Get more exercise or catch public transport. Cars are slower as our roads choke up, and also use large amounts of petrol. Going from A to B by walking or using public transport is much more greenhouse friendly and often considerably cheaper than driving a car.

Recycle. Recycling saves raw resources and it is more energy efficient to recycle old than to produce new. Fix appliances and tools rather than replacing them.

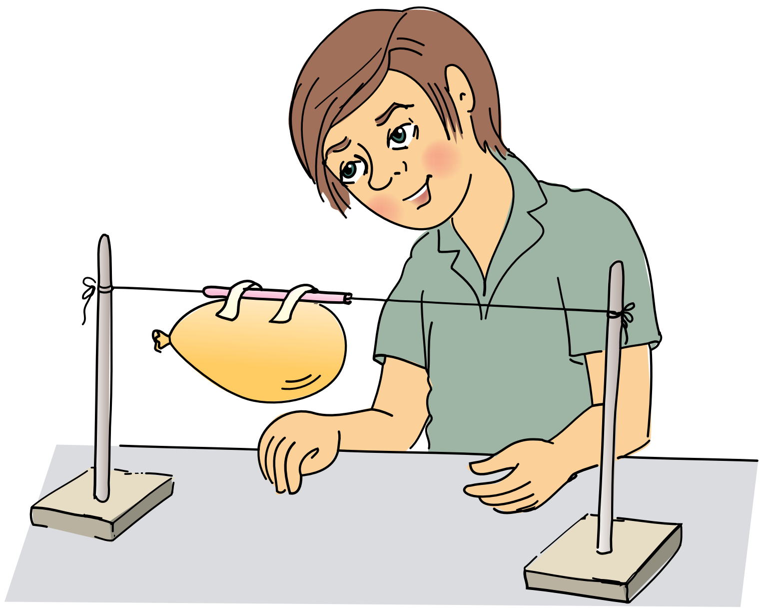
Telecommute and teleconference. Adults could try to work from home if they can, even one day a week and save transport energy. Teleconference instead of travelling to meetings.

Buy local produce. Buying local produce or goods manufactured in Australia rather than overseas saves the energy in transporting non-local materials from wherever they are produced.

8.4 Modelling energy transfers

8.4.1 A rocket-propelled balloon

8.4.1.1 Imagine a blown up balloon hanging on a fishing line threaded through a drinking straw. The ends of the fishing line are tied to two rigid supports as shown in the diagram.



(a) Predict what will happen when the balloon is let go.

(b) What energy change does this experiment model?

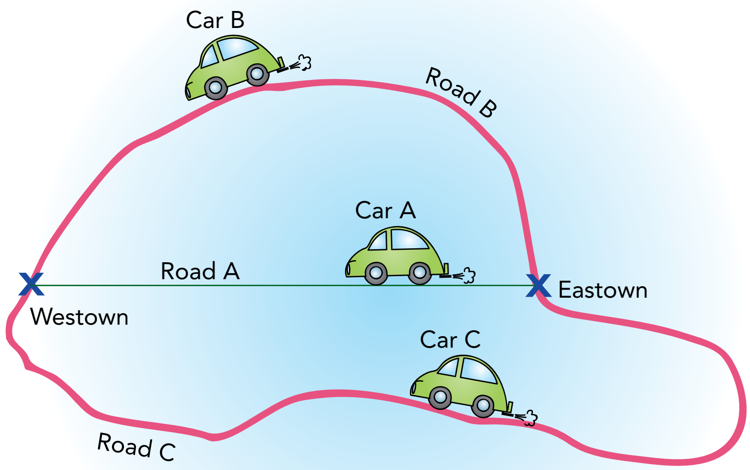
(c) Explain why fishing line is better to use in this experiment than a length of string.

(d) How could the balloon be made to go faster? Explain your answer.

9.2.2.3 Three cars travel from Eastown to Westown by three different roads, A, B and C, as shown in the diagram.

Road A is 80 km long, road B is 100 km long and road C is 150 km long.

Car A takes 2 hours to complete its journey, car B takes 4 hours and car C takes 3 hours.



Complete the table of information about these three journeys.

Car	Total distance travelled by car (km)	Time taken for this journey (hours)	Average speed of car (km h^{-1})	Displacement of car when it is at Westown (km)	Average velocity of car (km h^{-1})
A	80	2			
B					
C					

9.2.2.4 Complete the table below. Each car has travelled in a straight line.

Car	Total distance travelled by car (m)	Direction car travelled (bearing)	Time taken for this journey (s)	Average speed of car (m s^{-1})	Displacement of car at end of journey (m)	Average velocity of car (m s^{-1})
A			5			45 m s^{-1} bearing 180
B				12	60 m bearing 230	
C	256					16 m s^{-1} north
D	50	Bearing 056	20			
E	375	South		7.5		

10.3 Newton's second law of motion

10.3.1 Newton's second law of motion

- When an object is accelerated, the acceleration depends on the mass of the object and the size of the force applied to it. The larger the mass, the less the acceleration, the greater the force, the larger the acceleration.
- Newton's second law is often stated this way:

  The acceleration produced when a net force is applied to an object is directly proportional to the magnitude of the applied force, and inversely proportional to the mass of the object.
- Mathematically, this can be represented by: $F = ma$

  Where F = applied force in newtons (N)

  m = mass of object in kilograms (kg)

  a = acceleration in metres per second per second (m s^{-2})
- Both force and acceleration, like displacement and velocity, are **vector** quantities. We must give them a direction when we refer to them.

10.3.1.1 What force would be needed to give a 2.5 kg mass an acceleration of 4 m s^{-2} to the east?

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10.3.1.2 Calculate the acceleration of a 3 kg toy car if a force of 15 N north was applied to it.

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10.3.1.3 What mass would be given an acceleration of magnitude 1.5 m s^{-2} when a 12 N force was applied to it?

....

....

Chapter 1 DNA and Genes

How much do you remember or already know?

1. Cells are the basic unit of life. All living things consist of cells.
2. Plant cells have a cell wall and may have chloroplasts while animal cells do not have a cell wall and never have chloroplasts.
3. All cells have a cell membrane, cytoplasm and genetic information in the form of DNA.
4. The nucleus controls cell activities and how the cell develops.
5. The cell membrane is a thin layer that surrounds the cell and which controls the substances that can move into and out of the cell.
6. The cytoplasm is the entire contents of the cell except for the nucleus and is surrounded by the cell membrane.
7. Specialised animal cells include red blood cells, white blood cells, nerve cells, muscle cells, gametes (sperm and ova).
8. A tissue is a group of specialised cells that work as a group and do the same job, e.g. muscle cells form muscle tissue.
9. Human organs include: 1. Heart – to pump blood around the body. 2. Stomach – to digest food. 3. Brain – to control and coordinate different parts and activities of the body.
10. Mitosis is the division of the nucleus in cell division.
11. Mitosis is important as it produces new, identical cells for growth, repair and maintenance of body parts.
12. Asexual reproduction only involves one parent to produce genetically identical offspring while sexual reproduction involves two parents and produces offspring that have a unique combination of characteristics from the two parents.
13. Asexual reproduction is used by many unicellular organisms, e.g. bacteria, algae, yeast and many plants, e.g. when grass sends out a new 'runner' that takes root or new growth sprouts from a rhizome.
14. All plants and animals can reproduce by sexual reproduction, e.g. flowering plants such as eucalypts, banksias, grevilleas and animals such as humans, kangaroos, cockatoos.
15. Inherited characteristics are features that were passed to you from your parents in your genes while acquired characteristics you learn or gain during your lifetime. You cannot genetically pass acquired characteristics to your children.
16. Your inherited characteristics include the colour of your eyes, the shape of your face, the natural straightness of your hair.
17. Your acquired characteristics include activities you have learnt, e.g. swimming, how to skateboard, the language you speak and ways you have changed your appearance, e.g. coloured or straightened your hair, scars from injuries.
18. Organic molecules are chemical compounds containing carbon.
19. A macromolecule is a very large molecule made up of many small subunits.
20. Four main groups are – carbohydrates, lipids, proteins and nucleic acids.
21. Glucose is the basic unit of carbohydrates.
22. Amino acids are the basic unit of proteins.
23. Fatty acids and glycerol are the basic units of lipids.
24. Nucleotides are the basic unit of nucleic acids.
25. There are 20 amino acids commonly found in proteins.
26. DNA (deoxyribose nucleic acid) and RNA (ribose nucleic acid).
27. Proteins are needed to build body structures for growth, repair and maintenance.
28. Carbohydrates are needed to provide energy. Glucose is used to make complex carbohydrates to store energy, e.g. starch in plants or structures, e.g. cellulose cell wall, in plants.
29. Nucleic acids transmit inherited information and control cellular activity.
30. Fertilisation is the union of two gametes (sex cells).

1.1.1.1 Heredity is the transmission of characteristics from one generation to the next.

1.1.1.2 Genetics is the study of heredity and how variation of inherited characteristics occurs.

1.1.1.3 Deoxyribose nucleic acid.

1.1.1.4 DNA has the code that determines the structure of the proteins made by the cell and thus it controls the characteristics of the organism.

1.1.1.5 DNA is called the blueprint of life as it contains the code to control the characteristics of an organism. This is like the blueprint (technical drawing) that shows a builder the house design.

1.1.1.6 A change in DNA changes the code for protein production. This can lead to new variations of features – changes in the way an organism looks or functions.

1.1.1.7 A genome is the entire genetic code for an organism.

1.1.1.8 New technologies enabled scientists to map the code in DNA and store the information in massive databases. During the process further technological advancements made the processes quicker, cheaper and easier and faster computers with larger storage capacity made analysis and use of the code more efficient.

1.1.2.1 DNA is in the nucleus.

1.1.2.2 Chromosomes are threadlike structures in the nucleus of plant, animal and fungal cells. They are made of DNA and are visible during cell division.

1.1.2.3 Chromatids are the two parallel strands of a chromosome that become visible during cell division. One chromatid will go to each new daughter cell that forms when a cell divides into two.

1.4.2.1 A sex-linked gene is a gene which is on either the X chromosome or the Y chromosome.

1.4.2.2 TH Morgan.

1.4.2.3 (a) (i) Female homozygous for normal blood clotting = X^HX^H

(ii) Female heterozygous = X^HX^h

(iii) Male with haemophilia = X^hY

(iv) Male with normal blood clotting = X^HY

(b) Let – X^H = normal blood clotting
X^h = haemophilia
Y = no gene for haemophilia

Parent phenotype: mother normal blood clotting × father haemophiliac

Parent genotype: X^HX^H × X^hY

father \ mother	X^H	X^H
X^h	X^HX^h	X^HX^h
Y	X^HY	X^HY

Offspring genotype – 2 X^HX^h : 2 X^HY
Offspring phenotype – 2 female normal blood clotting : 2 male normal blood clotting
No offspring are haemophiliacs (note that the females are carriers and heterozygous for haemophilia)

1.4.2.4 Let – X^H = normal blood clotting
X^h = haemophilia
Y = no gene for haemophilia

Parents: Alexandra × Nicholas

Parent genotype: X^HX^h × X^HY

father \ mother	X^H	X^h
X^H	X^HX^H	X^HX^h
Y	X^HY	X^hY

Offspring genotype – 1 X^HX^H : 1 X^HX^h : 1 X^HY : 1 X^hY
Offspring phenotype – 2 female normal blood clotting (one is a carrier) : 1 male normal blood clotting : 1 male haemophilia

Therefore there is a 25% chance that a child will be a son with haemophilia.
(Note that of the sons, there is a 50% chance the boy will have haemophilia.)

1.4.2.5 Let – X^B = normal vision
X^b = red-green colourblind
Y = no gene for red-green vision

Parents phenotype: normal red-green vision × red-green colourblind

Parent genotype: X^BX^b × X^bY

father \ mother	X^B	X^b
X^b	X^BX^b	X^bX^b
Y	X^BY	X^bY

Both parents must have the recessive allele for a daughter to be red-green colourblind

Offspring genotype – 1 X^BX^b : 1 X^bX^b : 1 X^BY : 1 X^bY
Offspring phenotype – 1 female normal vision : 1 female colourblind : 1 male normal vision : 1 male colourblind

1.4.2.6 A Y-linked disorder can only affect males as they do not give their daughters a Y chromosome (females are XX and males are XY). Males produce sperm that carry either an X chromosome (which produces daughters) or a Y chromosome (which produces sons). Therefore if the child is a son, he must inherit the affected allele on the Y chromosome.

1.4.3.1 Codominance is the situation when both alleles are exhibited in the phenotype, e.g. AB blood group.

1.4.3.2 Multiple alleles are a situation where there are more than two possible alleles for a gene.

1.4.3.3

Blood group	A	B	AB	O
Allele combination	AA Ai	BB Bi	AB	ii

2.2.3.1 Divergent evolution is the development of different species from a common ancestor.

2.2.3.2 Adaptive radiation is the process where a number of new species develop from a common ancestor.

2.2.3.3 Scientists use fossil evidence, radiometric dating and DNA sequencing to work out when different groups diverged from common ancestors. This information is then used to construct evolutionary trees to show the relationships between different groups.

2.2.3.4 Changes in the pelvic limb that occurred around 360 million years ago enabled life to move from living in water to living on land. This saw adaptive radiation from fish to amphibian.

2.3.1.1 The main abiotic features that can act as selection pressures are temperature and rainfall. Other abiotic features include wind speed and direction, humidity, soil type, light intensity, ion and gas availability, pressure, altitude, pH.

2.3.1.2 A structural adaptation is the streamlined body of a shark for swimming through the water. A behavioural adaptation is a ringtail possum being a nocturnal feeder. A physiological adaptation is a rat-kangaroo producing very concentrated urine to conserve water when living in the desert.

2.3.1.3 As Australia moved north from the South Pole the climate became warmer and drier. This led to the changes in the plants. Less water meant rainforests could no longer survive when living in those areas so that many parts of inland Australia are now grassland or desert.

2.3.1.4 There are many ways animals avoid predators: 1. They can be faster movers so they can run, swim or fly away, e.g. kangaroos are fast hoppers. 2. They can be slow movers and have spines or a tough outer coat that deter predators from biting, e.g. echidna. 3. They can have a nearby shelter the predator cannot invade, e.g. a burrow or a hollow in tree, e.g. possum. 4. They may have toxins that make them unsavoury so they are left alone, e.g. corroboree frog. 5. They may be so large that almost nothing can tackle them and bring them down, e.g. elephant. 6. They may live in a large herd or flock and bunch together for protection, e.g. cockatoos.

2.3.1.5 Examples of sexual selection to attract a mate include: 1. In some species there is a distinct difference between the male and female appearance, e.g. one is larger or more brightly coloured, e.g. female lyrebirds are attracted to the male lyrebird with the best display. 2. There may be male competition which means the strength and overall size or size of horns/teeth/claws are important, e.g. male kangaroos fight over females. 3. Some species release pheromones to attract mates, e.g. codling moth. 4. Some species have courtship rituals and behaviours to attract mates of the same species, e.g. brolgas.

2.3.2.1 Artificial selection occurs when humans select and breed for particular traits.

2.3.2.2 (a) The diagram shows that the original einkorn wheat was crossed with wild grass to produce macaroni wheat (also called hard wheat). Macaroni wheat was then crossed with goatgrass to get bread wheat (also called common wheat).

(b) Plant breeders want higher grain yields, higher grain quality, resistance to diseases, drought tolerance, heat tolerance and with the aid of scientists who now use genetic techniques they are creating new wheat varieties with required traits.

2.3.2.3 Broccoli – large green flowers and stems; cauliflower – large, white flower clusters; cabbage – large, leafy terminal bud; brussels sprouts – compact, large lateral bud; kale – large green leaves; kohlrabi – swollen stem.

2.3.3.1

Scientist	Is this work part of the currently accepted theory?	Contribution
Jean-Baptiste Lamarck	No	Proposed that evolution occurred due to the inheritance of acquired characteristics. During the life of an organism it acquired characteristics due to use and disuse of body parts. Their offspring inherited these acquired traits and over many generations the population changed and evolution occurred.
George Cuvier	No	Cuvier studied elephant fossils found in Paris and proposed that periodically the Earth had sudden changes when many life forms were wiped out and then new species were specially created.
Charles Darwin	Yes	Proposed that evolution occurred by natural selection and published his book *On the Origin of Species* after the joint presentation with Wallace. The book was a best-seller, made Darwin famous and evolution became linked with his name. He proposed: • More organisms are born than can survive. • Within a population there is variation. • Those with favourable features survive by natural selection and reproduce. • The offspring inherit the favourable features. • Over time the population changes so that the favourable features become more common.
Alfred Wallace	Yes	Proposed that evolution occurred by natural selection. When he contacted Darwin and explained his ideas, it led to Darwin and Wallace publishing papers in the same journal at the same time. Wallace also mapped the biogeographical zones of the world.

2.3.3.2 (a) Lamarck.

(b) The diagrams show giraffes of a similar size and height reaching for the tree branches and leaves. By stretching their necks they increased the length of their necks so that over generations the giraffe neck became longer and longer.

2.3.3.3 (a) Darwin and Wallace.

(b) Within the population there is variation, the giraffes with longer necks survived (favourable characteristic) by natural selection and reproduced offspring with long necks. Over generations the long neck became more common.

Chapter 4 Fuels, Metals, Pharmaceuticals

How much do you remember or already know?

1. Wood for fires.
2. Fuel formed from the remains of past life.
3. Coal, oil, natural gas.
4. They are readily available and comparatively inexpensive.
5. Their atmospheric polluting effects.
6. Fuels which cannot be replaced once they are used.
7. The fossil fuels: coal, oil and natural gas.
8. Solar energy, hydro energy, wind energy.
9. Because they will always be available.
10. They produce radioactive wastes.
11. A biofuel is a fuel produced from living materials (plant remains, decomposing vegetation).
12. Carbon dioxide and water.
13. Methane + oxygen → carbon dioxide + water
14. Aluminium, copper, magnesium, iron, nickel.
15. Au, Ag, Zn, Pb, Sn
16. Magnesium.
17. Gold.
18. They can be drawn into a thin wire.
19. They can be beaten into shapes.
20. They conduct electricity, they conduct heat, their clean surfaces are shiny and metallic in appearance.
21. A metal oxide.
22. ZnO
23. Na_2O
24. Fe_2O_3
25. Aluminium.
26. For example, water pipes, electrical wiring, coins.
27. Zinc + oxygen → zinc oxide
28. Sodium + oxygen → sodium oxide
29. Iron + oxygen → iron oxide
30. Breaking down of a compound that occurs when a substance is heated.

4.1.1.1

Renewable energy sources	Renewable energy sources	Non-renewable energy sources
Wood Fuel crops (e.g. sugar cane) Solar energy Wind energy	Tidal energy Hydro energy Geothermal energy Biogas	Coal Oil Natural gas Uranium fission

4.1.1.2 The hangman's noose suggests that fossil fuels (in this case petrol) will be the death of the environment as we know it if we keep using them. The colour black used on the petrol hose reinforces the deadly nature. The white colour of the wind turbines suggests a more healthy source of energy.

4.1.1.3
(a) Australia has no major geothermal areas (but there is some research into the possible use of hot sedimentary aquifers) and waves and tides as an energy source have not been significantly developed.
(b) The political and environmental pressures in Australia currently prevent the development of nuclear energy.
(c) The Sun will be there for another 5 billion years. Its use now is limited because of the cost of solar technology and its relative efficiency. However, Australia has the highest average solar radiation per square metre of any country in the world.
(d) Fusion reactions are not yet possible. The energy required to start them is enormous, and the temperatures reached mean we have no container in which to contain the reaction.
(e) We should take a responsible attitude towards environmental protection and reduce fossil fuel use. We should also develop alternative sources because fossil fuel reserves will not last forever.

4.1.1.4 Answers will vary, for example:

Fuel	Natural gas	Coal	Petroleum	Nuclear	Renewable
Percentage (%)	23	23	40	8	6