Lesson 12-1 and 12-2

Pages 164 - 170

OBJECTIVES

- To build on work done on solids, liquids, and gases, and extend previous experiences of separating mixtures

LEARNING OUTCOMES

Students should be able to:

- classify some solids as soluble or insoluble.
- explain the meanings of the terms solvent, solute, and saturated solution.
- explain the difference between a dilute and a concentrated solution.
- explain the difference between a solution and a suspension.
- describe how mixtures can be separated by filtration, evaporation, sublimation, distillation, and chromatography.

START (10 min)

It would be useful to revise the particle model and use it to quickly go over the three states, the changes between the states (melting, evaporating, etc), and elements, atoms, compounds, molecules, and mixtures. Read pages 164 and 165 from the Student book.

Some of the terms in worksheet 12-1 can be defined after reading this section, others will be done as you go through the material.

MAIN (25 min)

The following separation techniques are covered in the text: filtration, evaporation, crystallization, distillation, chromatography, sublimation.

The link http://www.bbc.co.uk/education/guides/zgvc4wx/revision provides information about some separation techniques. The activity is a video, revising elements, compounds, and mixtures, and showing the following separation techniques:

- filtration
- evaporation
- distillation
- fractional distillation
- chromatography

You can read about each technique in the book and on the site in either order. The easiest experiments your students could do would be filtration, crystallization, and chromatography.

If only simple lab equipment is available, you might be able to demonstrate separating salt from sand (filtration and evaporation).

Distillation requires relevant equipment, and if you want to do fractional distillation, please do NOT use a flame but an electric heating device as alcohol is flammable.

Especially for chromatography, many diagrams and/or questions are highly idealized versions of what a real result looks like.

PLENARY (10 min)

It might be useful to revisit the concept of physical and chemical changes. All these techniques only separate components from a mixture. They are physical processes and do not separate substances which have undergone a chemical change.

The techniques given are only some of those available. For example, a mixture of iron and sulphur could be separated by using a magnet, and gas chromatography can separate gases.

Students could use the second and third exercises on worksheet 12-1 to show they understood the techniques.

HOMEWORK

Read pages 164 and 165 and do the Test yourself questions on page 165.

or

Workbook page 73, Question no. 5

Lesson 12-3

Pages 171 - 172

OBJECTIVES

- To introduce the relationships between temperature and the solubility of solids and gases

LEARNING OUTCOMES

Students should be able to:

- describe the relationships between temperature and the solubility of solids.

START (5 min)

Today's experiments investigate the following research question:

How does temperature affect the time it takes for a set amount of solute to dissolve in a constant volume of solvent?

Briefly discuss with students what they expect the answer to be. Make sure you do not accept just blind guesses—they have to explain their reasons for their expectations.

You can choose one of the two experiments below or do the bunties experiment in class and ask students to do the virtual lab at home.

MAIN (30 min)

Hands on experiment - simple

This experiment requires clear plastic cups, water (cold, room temperature, hot) and bunties (every colour except brown). *Please make sure students do not eat the bunties. Eating in the lab and/or eating materials meant for science experiments is potentially unsafe.*

Depending on your students, you could allow them to pour the water or you can give them the filled cups. You could put the different temperatures in thermos flasks (add ice cubes to the cold water). The 'hot' water should not exceed 50°C—some may be spilled and you do not want anyone to get scalded.

You may ask your students to take pictures of the bunties after they have been in the water for one minute, or you may take pictures yourself when you try this experiment. They would help when you are discussing the results.

VIRTUAL LAB

http://www.learningliftoff.com/high-school-science-learning-activity-solubility-experiment/#.WcyXtul03rd

This interactive site allows your students to model the activity of dissolving salt in a given amount of water at selected temperatures. The site will also plot the data for the students, but you could have two students paired up to do this: one to drop the salt in the water and the other to clock the time. This way, they could draw their own graph with numbers. (The graph on the site has no numbers.)

(Again, this uses Flash, so Chrome will not work. Internet Explorer works well.)

PLENARY

Compare students' expectations from the beginning of the lessons with their findings during the (virtual) lab. Did they match? If not, why not?

In general, ask students to name one thing they learned in today's lesson.

HOMEWORK

Workbook page 73-74, Question no. 5 and 6.

1. It is important to have an accurate understanding of the scientific terms used in this unit. Use chapter 12 in your Student book to help you put the right term with each definition. Once this is complete, you will be able to use this list for reference.

chromatography	distillation	filtration	saturated solution	solute	sublimation
concentrated solution	evaporation	insoluble	sediment	solution	suspension
dilute solution	filtrate	residue	soluble	solvent	unsaturated solution

term	**definition**
	a substance which will dissolve
	a substance which will not dissolve
	a mixture of a liquid and a solid
	a mixture of an insoluble solid and a liquid where small particles float around in the liquid
	insoluble particles which have settled at the bottom of a suspension
	the liquid in which a solute is dissolved
	the solid which is dissolved in a solvent
	when the maximum amount of solute is dissolved in the solvent
	when less than the maximum amount of solute is dissolved in the solvent
	a solution containing a large amount of solute relative to the amount of solvent
	a solution containing a small amount of solute relative to the amount of solvent
	the separation of an insoluble solid from the liquid by pouring the mixture through filter paper
	the liquid which passes through the filter paper
	the solid which does not go through the filter paper
	changing a liquid into a gas to separate it from a mixture
	changing a solid into a gas to separate it from a mixture
	separating the solvent from a solution or mixture of liquids which have different boiling points
	a method for separating dissolved substances from one another

2. a. Select the correct option for each picture. Cross out the ones which are not correct.

<table>
<tr>
<td colspan="2">dilute solution or
concentrated solution
 
A</td>
<td colspan="2"> 
dilute solution or
concentrated solution</td>
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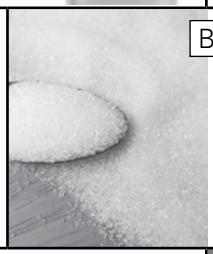
A solute or solvent or solution</td>
<td> 
B solute or solvent or solution</td>
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C solute or solvent or solution</td>
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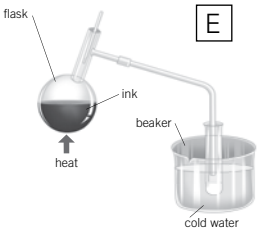
<td colspan="2"> 

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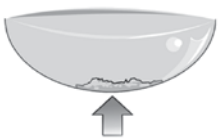
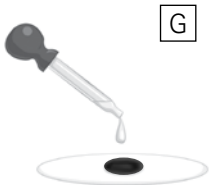
<td> 
F chromatography or distillation or evaporation or filtration</td>
<td colspan="2"> 
G chromatography or distillation or evaporation or filtration</td>
</tr>
</table>

1. If you drop a buntie into water, some of the colour on the outside of the buntie will dissolve. Does the temperature affect this?

   If you wanted to find this out, what are your variables?

   a. independent variable (= the one you decide to change)

   _____

   b. dependent variable (= the one you measure)

   _____

   c. controlled variable (= the ones you need to keep the same)

   _____

   _____

   i. Prepare three pieces of paper with 'cold', 'room temperature' and 'hot' written on them and put them side by side on the table/desk.

   ii. Put three clear plastic cups next to each other on the sheets of papers. Use a ruler and a waterproof marker to mark a line on the cups, 3 cm from the bottom. (Your teacher may tell you to change this, depending on the cups you use.)

   iii. Put three bunties of the same colour (not brown) on your table/bench.

   iv. One lab partner should hold the cup, the other can pour the water.

   v. Pour cold water into the cup on the paper marked 'cold', up to the mark.

   vi. Pour room temperature water into the cup on the paper marked 'room temperature' , up to the mark.

   vii. Pour hot water into the cup on the paper marked 'hot', up to the mark.

   viii. Drop one buntie in each cup. Try to do them at the same time and start the stopwatch.

   ix. After one minute, observe how much of the colour is still on the bunties and how much of the chocolate is visible.

Describe and/or draw what you saw

cold water	room temperature water	hot water

   d. Does the temperature affect the speed with which the colour of the buntie dissolves? YES / NO

e. How do you know this?

_____

f. Using the particle model, what happens when any solute dissolves in a solvent?

_____

_____

g. Why could temperature affect the speed of this process?

_____

_____

Answers

Chapter 1 Science skills

Taking measurements Page7

1. Scientists use measuring instruments whenever they can as their senses cannot always give them accurate answers.
2. a. litre, millilitre, cubic centimetre
   b. kilometre, metre, centimetre
   c. tonne, kilograms, gram
   d. hour, minute, second.
   e. degrees Celsius, Fahrenheit
3. a. electronic balance b. tape measure
   c. weighing scale d. thermometer
   e. stopwatch
4. Answers depend on students. Some examples include weighing scale, stop clock, measuring spoon, thermometer, etc.

Making difficult measurements Page 8

1. 4 grams
2. Put some water in a measuring cylinder and measure the volume. Push the cork down so that it is just under the surface of water. Measure the volume again. The difference between the two readings is the volume of the cork.
3. 1/250 s or 0.004 s

Handling data Pages 9 & 10

1. Scientific information
2. a. 18°C
   b. Day 3 at 11.00 pm
   c. The higher the night-time temperature, the more amount of cloud.
3. It can be used to read off values which have not been measured.
4. a. 151 cms b. 160 cms c. 7

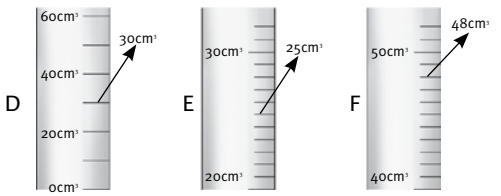
(Page 10)

5. a. 60°C b. 2 mins c. 20°C
6. a. Summer b. 16% c. 10 students

Exercise Pages 14 - 15

1. Multiple choice questions
   i. b ii. a iii. b
   iv. a v. c
2. True or False
   i. False ii. False iii. False
   iv. True v. True

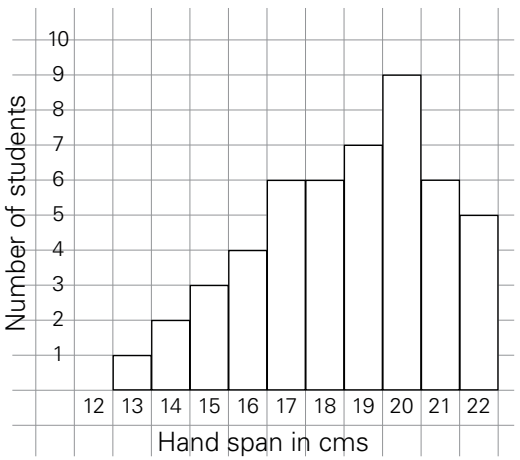
3.



4.

Measurement	Instrument used	Unit	Symbol
	ruler or tape measure		m
mass		gram or kilogram	
volume			cm^3
	thermometer	degrees celsius or centigrade	
		second	

5. i.



   ii. 12 cms
   iii. 20 cms iv. 49

Chapter 2 Life and living things

Life processes Page 18

1. An animal needs to move quickly in order to search for food and to escape from its enemies.
2. Animals eat food in order to produce energy and to grow.
3. Living things use the energy produced by respiration to grow, to move, and to enable the body to work properly.
4. Plants excrete carbon dioxide.

5. A car is not a living thing because it is not made up of cells, it does not grow and it cannot reproduce. A car does not move on its own, it has to be driven by a human being.

Animal cells vs Plant cells Page 20

1. The nucleus contains the information which controls everything that happens in the cell.
2. The cytoplasm is all the living matter of the cell except the nucleus. b) It is a jelly-like substance which is fluid in nature.
3. The vacuole is a space that is filled with a fluid. In plant cells the fluid is cell sap. In animal cells it usually contains waste matter.

Special cells for special jobs Page 21

1. Nerve cells, red blood cells, muscle cells.
2. Epithelial cells are thin and flat. They cover the surface like skin protecting against infection and from losing too much water.
3. Red blood cells have a large surface area to pick up lots of oxygen.
4. Pollen grains have a spiky surface to help them stick to the bodies of insects; others have tiny wings to enable them to be carried by the wind. This way they are carried from one plant to another and thereby help in plant pollination.

Cells, tissues, and organs Page 22

1. a. A group of similar cells doing the same job is called a tissue.
   b. Muscle tissue, nerve tissue, blood tissue.
2. a. The stomach is an organ.
   b. Muscle tissue, nerve tissue, and blood tissue.
3. Organs work together to form an organ system, e.g. the digestive system.

Eyes Page 25

1. Changes the shape of the lens.
2. Upside down (inverted) and smaller than the object.
3. In the dark the iris increases the size of the pupil allowing more light into the eye. When the light is switched on the opposite happens.

Ears Page 26

1. To determine where a sound is coming from.
2. Collect vibrations in the air and send them down the ear canal.
3. Vibrations in the eardrum are transferred and amplified by the hammer, anvil, and stirrup to set up vibrations in the liquid in the cochlea. These vibrations are detected by nerve endings in the walls of the cochlea. Signals are sent to the brain to be interpreted as sound.
4. Semi circular canals are at right angles to each other. Movement of fluid inside the canals is detected by nerve cells in the walls which send messages to the brain. The brain 'tells' the muscles to keep you upright.

Skin Page 27

1. Stops germs and harmful chemicals entering the body. Protects against sunlight and prevents water loss.
2. Three. Outer, inner, and fatty layers.
3. There are touch sensitive nerve cells at the root of every hair on the body.
4. There are fewer heat sensitive nerve cells on your back so it takes more heat to give the sensation of warmth.
5. White skinned people do not have the colouring that protects against sunlight.

Tongue and nose Page 28

1. In ridges on the surface of the tongue.
2. To stimulate as many different taste buds as possible.
3. Flavours of food are detected by the nerve cells in the nose.
4. Sight – eyes. Hearing – ears. Touch – skin. Taste – tongue. Smell – nose.

Exercise Pages 29 - 31

1. Multiple choice questions
   i. d ii. d iii. b
   iv. c v. b
2. True or False
   i. True ii. False iii. False
   iv. True v. True
3. i. reproduce ii. move
   iii. grow iv. respiration
   v. respond vi. excretion
   vii. feed
4. a. It is an animal cell because it has a no cell wall, vacuole or chloroplasts.
   b. The nucleus controls the whole working of the cell.
5. i. a. It carries messages from one part of the body to another.
      b. It has long thin fibres which enable it to carry messages.
   ii. cell, tissue, organ, organ system, organism.

Page 31

6. i. A - iris B – cornea
   C – pupil D – lens
   E – retina
   ii. A ring of muscle running around the edge.
   iii. E – retina
   iv. Interprets them as the picture that you see.

Ideas for investigations

These two investigations aim to enable students to experience for themselves the benefits of stereoscopic vision. In investigation 1, students should report the pencil appearing to move. This is because the image received from each eye is slightly different.
In investigation 2, students should find it easier to align the pencils with both eyes open.

Chapter 3 Energy resources

Energy resources Page 33

1. Most of the world's energy comes from burning fuels.
2. a. The chemical reaction which takes place when a fuel reacts with oxygen to give out thermal energy (heat) is called combustion.
   b. The small amount of energy needed to light a fuel is called ignition.
3. coal, natural gas, kerosene oil, wood, charcoal
4. Oil products are used in vehicles, for heating homes, and in power stations.

Fossil fuels Page 35

1. A fossil fuel is formed from the remains of living things. Coal, oil, and natural gas are fossil fuels.
2. There were no human beings living on the Earth at that time.
3. a. Peat is the decomposed remains of forests that covered the Earth about 300 million years ago.
   b. Over millions of years, layers of mud, and gravel built up above the peat. These layers eventually turned to rock.
   Pressure and temperature increased causing the peat to slowly turn into coal.
4. a. Crude oil is thick and black.
   b. Crude oil is a fossil fuel because it was made from the dead bodies of microscopic plants and animals that once lived in the sea.
5. Porous means something having sponge-like holes through which liquid or gas can seep.
6. Gas deposits collect above the oil because they are less dense.

Burning fossil fuels Page 37

1. When fossil fuels are burnt they produce harmful substances that cause air pollution and, in turn harm the environment.
2. carbon dioxide, sulphur dioxide, nitrogen dioxide
3. When acid rain falls over forest areas, the acids release poisonous aluminium from the soil into the water.
   This aluminium is taken in by the tree roots and so kills the trees.
4. The layer of air which surrounds the Earth acts as an insulating layer. Carbon dioxide gas in the atmosphere absorbs the heat from the Sun and keeps it in thereby maintaining a suitable temperature for life on Earth.
5. a. Like a greenhouse, carbon dioxide is very good at keeping heat within the Earth's atmosphere. This is why it is called a greenhouse gas.
   b. methane
6. a. An increase in the amount of carbon dioxide in the air is increasing the greenhouse effect, which is causing the temperature of the Earth to rise. This is global warming.
   b. Global warming will cause the ice caps at the Poles to melt which in turn will cause the sea level to rise, thus causing a change in weather patterns: more flooding will occur in the low-lying parts of the world.

How long will fossil fuels last? Page 39

1. natural gas
2. There are three things that can be done:
   a. Make the best possible use of the energy we get from fossil fuels now.
   b. Find alternative fuels to coal, oil, and gas.
   c. Find new sources of energy where fuels do not have to be burned.
3. a. Conservation means making the best use of energy supplies and reducing waste as much as possible.
   b. More energy is used for heating in cooler parts of the world so it is important not to waste fuel in the home, in vehicles or in industry.
4. The floor of the loft and the cavity in the walls can be filled with material such as glass fibre or mineral wool.
   The fibres of the insulating material trap lots of air between them. Air is a poor conductor of heat and so less energy escapes.

5. a. through the roof, through the windows, through walls and through draughts
   b. by insulating roof and walls of a house, double glazing, draught excluders, covering cylinder with thick jacket

Renewable energy resources Page 41

1. A renewable energy source is a natural energy source which can supply energy for millions of years without becoming exhausted.
2. The energy produced by wind is difficult to store, and electricity is only produced when the turbines are rotating.
3. a. A wind farm has a large number of wind turbines in one place.
   b. A good place to establish a wind farm would be a windy location on land or out at sea.
4. a. Hydroelectric power is electricity produced from flowing water.
   b. A hydroelectric power station should be built below a good source of water.
5. Building a hydroelectric power station results in a great change in the surrounding environment. This change may cause flooding of farmland as well as relocation of people to new areas.

More renewable energy resources Page 41

1. a. Panels which use energy from Sun for generating electricity or heating.
   b. They should be located on the roofs of houses in order to make maximum use of the Sun's energy.
2. a. A solar cell produces a small amount of electricity when light shines on it.
   b. They produce electricity for satellites.
   c. A large number of solar cells are needed to produce useful energy.

Page 43

3. a. A tidal barrage is a long barrier built across the mouth of an estuary to control the water flow. A tidal power station is built on the tidal barrage. Water flows from the river through the turbines of the barrage. Electricity is produced and the water is trapped. Water is released to flow back through the turbines, producing more electricity.
   b. Since tidal barrages change the flow of the river, sea birds and other animals might not be able to live in the estuary.
4. Floating generators could be used to generate electricity as they would move up and down with the waves.
   The movement would drive the generators and produce electricity.
5. The sea is constantly moving and there is a lot of energy in the waves which can be used in several ways.
   There are days when the wind does not blow at all, which means the turbines will not be able to generate electricity on those days.

Energy from living things Page 45

1. Green plants get their energy from the Sun.
2. a. carbon dioxide
   b. Because they will be able to supply energy for millions of years.
3. a. Fermentation is the process by which sugar is changed into alcohol by using yeast.
   b. The alcohol produced by the fermentation of sugar in Brazil is mixed with petrol and used in cars and lorries as fuel.
4. a. Rotting biomass produces methane (natural gas) which is collected and used as a fuel. This gas is called biogas.
   b. Since most of the population in developing countries lives in villages and keeps cattle, biogas can easily be generated by using plant and animal waste and can be used as a fuel for heating and cooking.
   It is a cheap renewable energy source.
5. a. food
   b. i. Green plants make their own food by using the energy from the Sun. The process is called photosynthesis.
      ii. Animals get their food energy by eating plants or other living things.
   c. This energy is used by their body for carrying out different activities.
6. a. Some of the heat is absorbed by the container, the test tube, and some is lost to the surroundings.
   b. Diagram showing some indication that heat loses have been reduced e.g. heat shield around the burner and text tube, and a wider container for the water so as much heat as possible enters the water and not the air around it.

Exercise Pages 46 - 49

1. Multiple choice questions

   i. c ii. d iii. d
   iv. d v. a

2. True or False
   i. True ii. True iii. False
   iv. True v. True
3. i. Cardboard, paper, petrol, and tree branch can be used as fuel.
   c. When a fuel is *ignited* the energy is used to *break* the bonds holding the *atoms* in the fuel together. Once free, the atoms can *react* with oxygen to form new *molecules*. Energy is *released* when new bonds are made.
4. i. Coal was formed from the remains of plants which grew in huge forests about 300 million years ago. Bacteria changed the decaying plants into peat. Gradually the land sank and water covered it. As time passed layers of mud and gravel were deposited over the decaying plants. As more and more rocks were laid down by the sea above, the pressure on the peat layers as well as the temperature increased. Eventually, over millions of years the decaying plants formed coal.
   ii. Coal is called a fossil fuel because it is made from the remains of plants that lived millions of years ago.
   iii. Scientists are trying to find alternative energy sources now because we will run out of fossil fuels soon.
   iv. geography, geothermal, geology, geometry thermometer, thermoplastic, thermal, thermostat
5. i. sulphur dioxide, nitrogen dioxide.
   ii. These gases dissolve in rainwater and form acids which fall as acid rain. Acid rain harms plants, trees, and stone work.
   iii. An increased production of greenhouse gases will lead to global warming, which will eventually cause:
   ice caps to melt
   sea levels to rise
   weather patterns to change
   more flooding in the low-lying parts of the world
   larger deserts
   more droughts
   poor growth of crops
   spread of disease-carrying insects that live in warm areas
6. i. a. The Sun
   b. photosynthesis
   ii. The stepwise process involved in the production of ethanol from sugar cane.
   iii. A energy from sunlight taken in by sugar cane
   B pieces of sugar cane crushed
   C plant juice filtered and heated
   D plant juice fermented with yeast for several days
   E extract distilled to give 95% alcohol

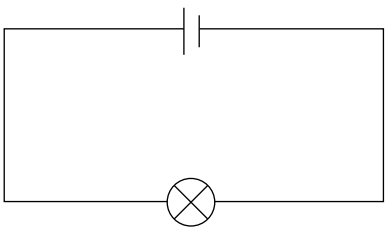
Ideas for investigations

Both of these investigations give students the opportunity to see for themselves the advantages of insulation in preventing the unnecessary loss of thermal energy.
Investigation 1 looks at pipe lagging and investigation 2 provides a simple scientific model of double glazing. Students should obtain significant results after 5–10 minutes. Heat loss will be greater in the non-insulated test tubes in both investigations.

Chapter 4 Electrical circuits

Conductors and insulators Page 52

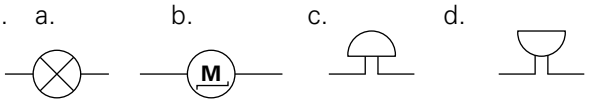
1. a. An electrical conductor allows electricity to pass through it.
   b. An electrical insulator does not allow electricity to pass through it.
2. conductors: metals, graphite, carbon
   insulators: glass, rubber, wood
3. They are made of plastic because plastic is an insulator and does not allow electricity to pass through it.
4. a.



   b. a switch

More electrical components Page 54

1. a. b. c. d.



2. a. Electrical energy is turned into sound energy.
   b. Electrical energy is turned into heat and light energy.
   c. Electrical energy is changed to mechanical/ movement energy.
   d. Chemical energy is turned into electrical energy.
3. Electrical components must be kept clean so that they do not corrode, they are reliable and last longer.

4. The gap between the contacts acts as an insulator.
5. A reed switch is operated by a magnet. When a magnet is held close to the switch, the contacts close and the switch is on. The switch is off when the magnet is removed.

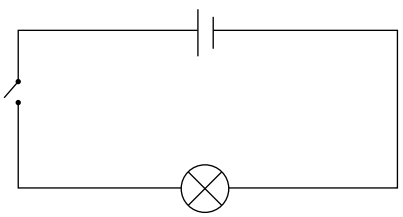
Current Page55

1. Electric current is measured in amperes (amps).
2. An ammeter is used to measure current flow accurately.
3. The symbol 'A' means amperes (amps).
4. The positive connector of the ammeter should be connected to the positive terminal of the battery and the negative terminal of the ammeter should be connected to the negative terminal of the battery.
5. The same amount of current i.e. 4 A flows out of the bulb.

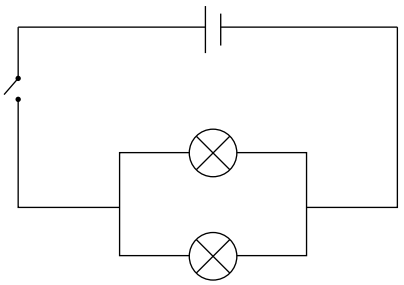
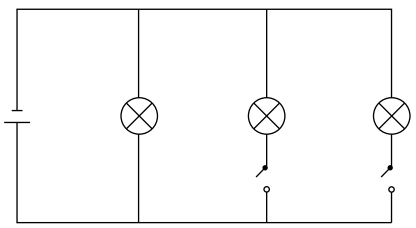
Voltage Page 57

1. Voltage is the 'push' needed to make a current flow in a circuit.
2. The unit of voltage is the volt (V).
3. The bulbs glows brighter.
4. A voltmeter is always connected in parallel with a component in a circuit, never in series. Also, always connect +ve on the voltmeter to +ve on a battery or power supply, and –ve on voltmeter to –ve on battery or power supply.

Series circuits Page 58

1. All the components are joined together in a line i.e. in series.
2. If one of the bulb blows, the circuit is broken. The other bulbs will not glow.
3. Adding more cells in a series circuit will push more current in the circuit and the bulbs will glow more brightly.
4. Adding more bulbs in a series circuit will make it more difficult for the current to flow. All bulbs in the circuit will glow dimly.
5. 

Parallel circuits Page 60

1. In a series circuit, all the components are joined together in a line. In parallel circuits, the components are arranged in such a manner that provides more than one pathway for electricity to flow.
2. If one bulb blows, the other bulbs keep glowing. This happens because the circuit still remains complete through the undamaged bulb or bulbs.
3. a. 
   b. Both bulbs glow with equal brightness as the same amount of current flows through them.
4. 

Parallel circuits in the home Page 62

1. Electrical devices can be connected to the parallel circuit in homes at any point.
2. a. A ring main is an extended form of a parallel circuit. The circuit is arranged in the form of a 'ring' around a house.
   b. Devices can be placed anywhere between the two wires of the ring.
3. lamp, radio, washing machine, toaster
4. a. Though a ring main is an extension of a parallel circuit allowing devices to be plugged in at any point of the ring, the ring also has an extra wire called the earth wire.
   b. The earth wire is present for the sake of safety.

Resistance Page 63

1. too much current flowing through the bulb
2. The thin filament of the bulb gets hot, burns and melts when a large current flows through it.
3. a. copper, glass
   b. Copper has the lowest resistance.
4. The resistance of a wire decreases as its thickness increases.

Exercise Pages 64 - 67

1. Multiple choice questions
   i. c ii. c iii. b
   iv. a v. a
2. True or False
   i. False ii. True iii. False
   iv. False v. True
3. i. Conductor is a material that allows electricity to pass through it.
   ii. iron wire, aluminium foil
   iii. The connections might be loose or the battery might be low. He could tighten the connections or change the battery.
4. a. 0.4 A b. 0.4 A c. 0.4 A
5. A2= 0.3A A3= 0.3A
   A4= 0.3A A5= 0.6A
6. i. electric fire: electricity to heat
   table lamp: electricity to light
   hairdryer: electricity to heat and mechanical energy
   television: electricity to light and sound energy
   toaster: electricity to heat energy
   ii. a. electric fire
   b. table lamp
   iii. A toaster needs thicker wires to carry a larger current with less resistance—hence safer.
   iv. a. 13A b. 5A c. 3A
   v. A fuse is made of a wire which has a high resistance. When too much current flows through it, the wire melts and breaks the circuit. When this happens the supply of electricity is cut off and the rest of the circuit, including any device attached to it, remains safe.
7. i. bedroom 1 ii. bathroom
   iii. a. It is called a ring main.
   b. The circuit is made in the form of a ring, and devices can be placed anywhere in the ring between the two wires.
8. i. a. towards A b. towards B
   ii. A thicker wire has lower resistance due to which the bulb will glow more brightly.

Ideas for investigations

Investigation 1 looks at the relationship between the length of a wire and its resistance. Using a simple circuit consisting of a battery, ammeter, connecting wires, and crocodile clips and resistance wire e.g. nichrome, students should obtain good results by taking ammeter readings using 10 cm, 20 cm, 30 cm and 40 cm of resistance wire in the circuit.
Using the formula for Ohms law
$\frac{\text{voltage}}{\text{current}}$ (voltage of the battery or power supply) (taken from the ammeter)
students should be able to obtain resistance values to complete the table and draw a graph of their results. The results should clearly show the longer the wire, the greater the resistance.

SAFETY NOTE: The resistance wire may get hot during this experiment depending on the voltage used. Investigation 2 requires students to set up a test circuit containing a bulb (or bulbs), connecting wires and the battery to be tested. The circuit will be left set up and the time for the bulb to go out recorded. Clearly this will take some considerable time, possibly a day. However using more bulbs to increase the load on the batteries will speed things up.

Chapter 5 Plants and photosynthesis

Photosynthesis Page 70

1. Plants are part of our food chain.
2. Energy for photosynthesis comes from the Sun.
3. Leaves are well adapted for the function they perform. Their broad, flat, thin shape provides a large surface area, ideal for absorption of carbon dioxide and sunlight.

The starch test Page 71

1. The iodine turned from brown to blue-black at the end of the test. It does so only in the presence of starch. Therefore, the test shows that the leaf had been photosynthesizing.
2. a. brown b. blue-black

Testing the equation Page 72

1. carbon dioxide
2. Starch will be present only in the uncovered part.
3. It bursts into flame.

What happens to the glucose? Page 74

1. A thin cell membrane makes it easy for water and minerals to pass through. It also helps the cells to absorb oxygen easily from air in the spaces between the soil particles.
2. a. Osmosis is the movement of water from a region of high water concentration to a region of low water concentration.
   b. There is more water outside the root hair cells than inside so water enters the cells by osmosis.

c. Water moves from cell to cell by osmosis because of the different water concentrations inside them.
Eventually water enters the xylem to be carried round the plant.

3. a. from air in spaces between the soil
b. Oxygen is important for respiration in the root cells.

Plants need minerals Page 75

1. Plants need minerals for normal, healthy growth.
2. Some minerals come from rocks, dissolved in rainwater. Others come from the faeces and urine of animals, and the dead bodies of plants and animals as they decay. Farmers add artificial fertilizers to the soil which contain all the minerals that crop plants need.
3. In cultivated soils, removal of minerals takes place by uptake of minerals by plants and by leaching. So fertilizers have to be added to improve the fertility of the soil.
4. Mineral salts get into the roots of plants in solution. Some dissolve in the water in the soil and then enter the root hair cells in water. Most minerals, however, are moved into the plant root cells using energy.

Exercise Pages 76 - 79

1. Multiple choice questions
i. b ii. d iii. b
iv. a v. c
2. True or False
i. False ii. False iii. True
iv. False v. False
3. i. A: water B: carbon dioxide
ii. D: oxygen E: glucose
iii. sunlight
iv. carbon dioxide + water + energy from the Sun → glucose and oxygen
v. By testing it for starch.
4. Put a leaf in boiling water for two minutes to soften it.
Put out the Bunsen flame.
Heat the leaf in alcohol to take away the green colour.
Soften the leaf in water.
Add iodine to the leaf.
5. i. It uses the stored glucose for growth, respiration, and for storage when the leaves fall off.
ii. Cellulose is used for making cell walls.
iii. a. nitrogen b. from the soil
iv. Because they contain stored sugar.
6. i. from the soil
ii. By osmosis from the soil into the root hair cells. Osmosis is the movement of water from a high concentration to a low concentration.
iii. They have thousands of tiny root hairs which have very thin walls which can absorb water easily.
iv. Water travels in tubes called xylem.
v. Plants use water for photosynthesis and to keep their cells fully stretched.

Ideas for investigations

Investigation 1 enables students to investigate chlorophyll to find out if it is a pure substance. Using chromatography (see also Chapter 12) students will find out that chlorophyll is made up of several different coloured pigments. Of these, green, yellow and orange should be visible.

SAFETY NOTE: Put on safety goggles. No naked flames. Work in a ventilated space.
Investigation 2 enables students to investigate osmosis. Students should take special care to ensure there is a tight seal between the Visking tubing and the capillary tube, and also ensure the knot in the Visking tubing is tight. Once the apparatus is set up, the level of sugar solution will rise quite quickly indicating an increase in the volume of the contents of the tubing. Water molecules pass through the wall of the Visking tubing by diffusion because they are small. Sugar molecules are too large to pass in the opposite direction.

Chapter 6 Particles

Evidence for the particle model Page 84

1. The 'skin' of the balloon has millions of tiny holes in it. The air molecules are small enough to pass through these holes and so the balloon deflates slowly.
2. When a pin is stuck in an inflated balloon, it deflates quickly because a larger hole has been made through which the gas particles escape.
3. The spreading of one substance through another.
4. Diffusion does not happen in solids because the particles are held together by strong forces of attraction. Although the particles vibrate, they are unable to break free.
5. The three physical states of matter are solid, liquid, and gas.

6. a) A solid has a well-defined shape.
   b) A gas does not have a well-defined shape.
   c) A liquid has a specific volume.
   d) A solid has a definite volume.
7. Natural gas has a specific smell which spreads through the air.
8. Water exists in all three states: solid (ice), liquid (water), steam (gas).
9. a. Strong forces of attraction hold the atoms or molecules close together in a solid that is why they do not flow.
   b. Due to the large distances between gas particles, gases can be compressed easily.

Expansion and contraction Page 85

1. When a metal bar is heated, its molecules gain energy and begin to move faster. They bump into each other more often and with greater force. This makes them move further apart and the space between them increases, thus causing the bar to expand.
2. Heating gives atoms and molecules more energy. This causes them to move faster and bump into each other more often and with greater force. As a result, they move further apart. Since the particles are much further apart in gases as compared to solids, expansion is more in gases than in solids.

Pressure in gases Page 86

1. Gases are squashy and can easily be compressed. If a sealed container can resist the expansion when a gas is heated, gas pressure will be produced inside it.
2. Millions of air molecules inside the balloon move rapidly in all directions, bouncing off each other and the walls of the balloon. Each time a molecule hits the wall of the balloon, it gives the wall a tiny push. Millions of tiny pushes add up to one big push, leading to increasing air pressure that inflates the balloon.
3. Air pressure is highest inside the balloon. That is why it remains inflated: otherwise it would become squashed.

Exercise Pages 87 - 89

1. Multiple choice questions
   i. d ii. c iii. c
   iv. b v. d
2. True or False
   i. False ii. False iii. False
   iv. False v. True
3. i. gas ii. solid iii. solid
   iv. liquid v. gas vi. liquid
   vii. gas
4. In a gas, particles are **far apart** and move very **quickly**. They frequently change **position**, moving in **straight** lines and **bouncing** off each other and the walls of the **container** they may be in. Gases have no **shape** and they can be easily **compressed** because the particles are not packed closely together.
   Gases usually have a low **density** because there are few particles in a small **volume**.
5. i. Heating gives atoms and molecules more energy, which makes the particles move at a much faster rate. They bump into each other more often and with greater force, thereby pushing each other further apart and causing an increase in size or volume of the material.
   ii. Aluminum expands three times as much as concrete so it will damage a concrete structure.
   iii. i. It will bend with the steel strip inwards as brass expands more than steel when heated.
   ii. It will straighten out then bend the other way.

Ideas for investigations

Investigation 1 enables students to investigate diffusion in liquids. A dish of large diameter will make measurements easier. After only a few minutes, students should be able to obtain the data to enable them to use the given formula to calculate the speed of diffusion.

As an extension to this investigation, students could repeat the experiment using water at different temperatures. This should enable them to confirm that diffusion is quicker at higher temperatures.

Investigation 2 looks at the effect of temperature on melting of ice and the evaporation of water. A thermometer in a beaker of ice will read 0°C irrespective of the amount of heat applied to the beaker. The temperature will only rise once all of the ice has turned to water. Similarly students will discover that water boils at 100°C no matter how much heat is applied.

SAFETY NOTE: Put on safety goggles. Take care with hot apparatus.

Chapter 7 Forces and their effects

Why do things float? Page 92

1. a. It seems to lose weight.
   b. When submerged in water, the water pushes against the object giving an impression that the object has lost weight. In other words, the upward push or upthrust is equal to the weight of the water that had been displaced by the object.
2. This means that one cubic centimetre of water weighs one gram.
3. A floating boat displaces a large volume of water. This water provides enough thrust on the hull to balance the weight of the boat pushing downwards.
4. Because of the high salt content in the Dead Sea, the density of the water is very high. The body of the swimmer will float because it is less dense than the sea water.

Stretchy materials Page 93

1. a. The ability of the body to return to its original length after being stretched.
   b. Elastic limit is the maximum amount of force beyond which the material which is being stretched will not come back to its original length.
2. a. Rubber is a very elastic material. It can stretch several times its original length so it is useful for making rubber bands.
   b. Since bicycle tyres need to bear a lot of pressure of the air inside them, the elasticity of the rubber helps them to bear the pressure without bursting.
3. Springs are good force measurers because when forces are applied, they stretch and spring back into shape evenly afterwards.
4. Answers similar to the following.
   Hang a metre-ruler and a strong spring from a nail. Mark the position of the end of the spring on the ruler. Hang the given standard masses to the end of the spring and note the extension in the spring on the ruler.
   Now hang the unknown object on the spring and mark the extension of the spring on the ruler. Use the obtained information to plot a graph and calculate the weight of the unknown object.
5. a. i. 5 cm ii. 0.5cm iii. 7.5 cm
   b. 15 cm

Calculating weight Page 95

1. a. 50 x 9.8 = 490 N
   b. 50 x 9.85 = 492.5 N
   c. 50 x 1.6 = 80 N
   d. 50 x 3.7 = 185 N
2. Mass remains constant as it is the quantity of matter in a body and is measured in kilograms. Weight is the pull of gravity which is acting on the body. So weight changes with the distance of the body from the centre of the Earth whereas mass will remain constant no matter where the body is.

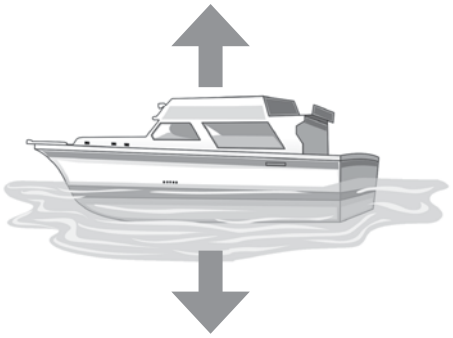
Slowing things down Page 96

1. The force that is produced when two surfaces rub against each other.
2. a. Possible answers are wood, rubber, sand, concrete
   b. Possible answers are water, oil, ice
3. a. Friction can be a nuisance when the tyres rub against the road slowing the bicycle down.
   b. Friction can be very helpful when we apply the brakes of the bicycle.
4. The molecules of the gases in air bump into moving objects causing a force which is called air resistance.
5. Air resistance can be overcome by using shapes which let the air slip past more easily. This is called streamlining.

Exercise Pages 98 – 101

1. Multiple choice questions
   i. b ii. c iii. b
   iv. b v. c
2. True or False
   i. True ii. False iii. True
   iv. True v. True
3. i. lawn mower, digging, weight-lifting
   ii. pulling the arrow, dragging a sledge, rowing
   iii. Magnetic force such as a bar magnet attracting iron filings. Frictional force, for example, a bicycle wheel rubbing against the road when brakes are applied.
   iv. Gravitational force
4. i. The density of an object is mass per unit volume.
   ii. 1g/cm^3
   iii. a. oil b. gold and lead
   c. hydrogen d. wood
   iv. Water has an up thrust which is the force that opposes the weight of wood. That is why wood floats on water.

5. i. a.



b. The gravitational force pushes downwards on the boat, whereas upthrust, or the upward push of the water, pushes against the boat from below to keep it afloat.

ii. The boat displaces water according to its weight. The upthrust of the water is equal to the weight of the boat.

iii. When the boat is fully loaded, it floats lower in the water because its weight is more than the upthrust.

6. i. thin tyres of the cycle, proper oiling of parts

ii. By reducing friction, the cyclist would be able to move faster. More friction would require the cyclist to apply more force and energy to ride the cycle.

7. i. a. The car's streamlined shape allows air to slip past easily.

b. The big, wide rear wheels have more contact with the road creating greater friction.

Ideas for investigations

This experiment enables student to investigate that how elastic an elastic band is and also to find its elastic limit. By hanging weights from an elastic band suspended from a stand, students should measure the extension and record their findings in a table.

Loads of 1N, 2N, 3N, 4N and 5N are suggested although more may be needed depending on the thickness of the elastic band. To find the elastic limit of the elastic band, students will need to see if the elastic band returns to its original length after each weight is used.

Enough data should be obtained for students to draw a graph and see if the results support Hook's law.

Chapter 8 Food and digestion

Food and digestion Page104

1. Food
2. The body needs fuel for energy, for growth, and to keep it working properly.
3. Our body needs different types of food in the right quantities. If one type of food is missing, a person can become ill. On the other hand, large quantities of a particular type of food can make a person unfit. Therefore, a balanced diet is required to maintain a healthy body.
4. A balanced diet is one which provides the right balance between:
   - foods that provide energy
   - foods that help in body growth and repair
   - foods that help control chemical reactions inside the body
   - foods that contain dietary fibre (roughage)
5. Water is an essential part of a balanced diet because all the chemical reactions in the body take place in solution.
6. An illness that is caused when a vitamin is missing from our diet is called a deficiency disease. For example, a deficiency of vitamin C causes scurvy, a disease that makes the gums swell and bleed, and slows down the healing of wounds.
7. a. Add some Biuret solution to the milk in a test tube and shake it carefully. If the Biuret solution changes colour from light blue to purple, it means that protein is present.

   b. Shake a small amount of cheese with some ethanol in a test tube. Filter the solution into a clean test tube and then add some clean water to the filtrate. A white, cloudy emulsion will appear to prove the presence of fat.

   c. Add Benedict's solution to some crushed biscuits in a test tube. Put the test tube in a beaker of water and heat gently. If glucose is present, the Benedict's solution will change colour from blue, to green to brick-red.

   d. Add a few drops of iodine on to a fresh potato slice. If starch is present, the colour of iodine will change from brown to blue-black.
8. Wear safety glasses and handle hot equipment and harmful chemicals with care.

Digestion Page 105

1. Food consists of large molecules which cannot be dissolved. These must be broken down or digested into smaller soluble molecules, so that they can be easily absorbed into the blood.

2. Enzymes help to break down the large food molecules, thereby bringing about digestion of food.
3. A long tube called the alimentary canal that runs from mouth to anus, plus a few other organs such as the liver and pancreas that produce digestive enzymes.
4. About 10 metres
5. About 24 hours.

Digestion Page 107

1. The muscles in the walls of the alimentary canal contract and relax rhythmically in order to push food along, this action is called peristalsis.
2. To break down food into smaller pieces and to be mixed with saliva.
3. Saliva is slippery, it mixes with food to make it easier to swallow.
4. It is an enzyme that digests starch.
5. A short tube connecting the mouth with the stomach.
6. The stomach is a muscular sac with valves at each end to control the flow of food into and out of the stomach.
7. Gastric juice contains protease enzymes which digest protein, and hydrochloric acid which kills bacteria.

Digestion Page 109

1. The first part of the small intestine
2. In the gall bladder.
3. Emulsifies fats and neutralizes stomach acid.
4. In the pancreas.
5. In the walls of the small intestine.
6. & 7. Amylase digests starch to maltose
   Protease digests protein to amino acids
   Lipase digests fats to fatty acids and glycerol
   Carbohydrase digests remaining carbohydrates to glucose.
8. Glucose, amino acids, fatty acids and glycerol.
9. The appendix is a small organ lying at the junction of the small and large intestines. In many herbivores such as rabbits the appendix is large to assist in the digestion of cellulose in plant cell walls.

Enzymes Page 110

1. A biological catalyst speeds up a chemical reaction, but is not broken down or changed by it. It lowers the amount of energy required for a chemical reaction to take place.
2. Starch, protein, and fat.
3. Glucose, amino acid, fatty acid.
4. A starch molecule is made up of several glucose molecules joined together like a string of beads.
5. Starch breaks down into glucose molecules.
6. Protease—acts on proteins and breaks them into amino acids.
   Carbohydrase—acts on starch and breaks it into simple sugars like glucose
   Lipase—acts on fats and breaks them into fatty acids and glycerol.

What affects enzymes? Page 113

1. a. Amylase is an enzyme found in saliva in the mouth.
   b. Amylase helps to break down starch into glucose.
2. To make a fair test and therefore obtain accurate results.
3. A sample was taken each minute. By counting the number of minutes from the first spot to the point when the starch was digested, the speed of the digestion can be found.
4. Enzymes work best at 37°C. At temperatures above this, enzyme activity is affected.
5. No starch had been digested. Not enough time.
6. pH7 neutral conditions in the mouth.
7. The stomach is pH4, very acidic. Amylase only works in neutral conditions.

Exercise Pages 114 - 117

1. Multiple choice questions
   i. a ii. d iii. c
   iv. d v. d
2. True or False
   i. True ii. False iii. True
   iv. False v. True
3. i. fat: energy and insulation
   protein: body building
   starch: energy
   sugar: energy
   ii. a. cheese b. meat
   c. bread d. sweet biscuits
   iii. Water is essential because all the chemical reactions in the body take place in solution.
4. i. glucose ii. amino acid
   iii. fatty acid and glycerol
   iv. amylase v. lipase
   vi. protease
5. a. i. E ii. H iii. D
   iv. B v. A vi. F
   vii. J
6. i. Villi increase the surface area of the lining of

the small intestine for the absorption of food into the bloodstream.

ii. a. Soluble substances can easily diffuse through the walls of the villi.
b. More digested food will be absorbed.
c. Small molecules of digested food pass through the thin capillary walls and enter the blood plasma easily.

Ideas for investigations

Investigation 1 uses a model of the small intestine to enable students to see that only small (digested) molecules such as glucose will pass through the wall of the small intestine and into the blood. Dialysis ('Visking') tubing is used to represent the small intestine. It behaves like a microscopic sieve allowing only tiny molecules such as water and glucose, through. Students should take special care to ensure the knots at each end of the 'Visking parcel' are tight. Testing the surrounding water for the presence of glucose will confirm that glucose passes through this model intestine.

Investigation 2 requires students to apply their knowledge of food tests and the effect of temperature on enzyme activity. Samples should be taken at 1 minute intervals and tested for the presence of starch (iodine) and sugar (Benedict's solution), until no more starch is found. Testing the saliva/starch mixture at room temperature should show that the starch is digested quite quickly. However the sample mixture containing boiled saliva should only show the presence of starch. From this students will see for themselves that enzymes are destroyed at high temperatures.

SAFETY NOTE: Put on safety goggles. Take care when handling hot apparatus. Take care when boiling the saliva in a test tube.

Chapter 9 Elements, compounds, and mixtures

What is an element? Page 119

1. An element is a substance containing only one kind of atom. Carbon contains only carbon atoms.
2. About 90
3. Solids: iron, silver, zinc
   Liquid: mercury
   Gas: bromine
4. a. silver b. copper c. mercury

Metals and non-metals Page 121

1. Dividing them into metals and non-metals.
2. a. Can be easily bent.
   b. Copper
3. a. Makes a ringing sound when hit.
   b. Iron
4. Refer to diagram of apparatus on Page 121.
5. Carbon

Uses of elements Page 123

1. Glows brightly when electricity passes through it.
2. Liquid helium is very cold which makes it ideal for cooling the magnet in medical scanner
3. Good conductor of electricity and can be drawn into wires.
4. Computers (electronic brains) are made up of silicon chips.

What is an atom? Page 124

1. An atom is the smallest part of an element that can exist and take part in a chemical reaction.
2. proton: a +ve charged particle
   neutron: a neutral particle with no charge
   electron: -ve charged particle
3. Nucleus.
4. Hydrogen has no neutrons. Hydrogen has only one electron shell. Other differences—numbers of electrons/neutron/protons.
5. Electron whizz around the nucleus in tiny orbits, so quickly that they turn into a blurry cloud.

Compounds and mixtures Page 125

1. Iron (Fe) and sulphur (S)
2. a. A mixture of copper and sulphur would be formed.
   b. A compound (copper sulphide) would be formed.
3. The chemicals are not chemically combined so can be separated by physical means.
4. Physical change—no new substance is made and a change, if any, is easy to reverse.
   Chemical change—a completely new substance is made and the change is difficult to reverse.

A mixture called air Page 127

1. a. Nitrogen, oxygen, and carbon dioxide.
   b. Nitrogen 79 cm^3, oxygen 20 cm^3, and carbon dioxide 0.04 cm^3.
   c. i. Nitrogen and oxygen
      ii. Carbon dioxide
2. a. Oxygen
   b. Carbon dioxide and nitrogen.

3. a. Carbon dioxide is denser than air and settles over a fire, putting it out.
   b. Liquid nitrogen is so cold it freezes food immediately.
   c. With argon surrounding it, a wire filament in a bulb can get very hot without burning.
4. a. Oxygen is used in hospitals for breathing.
   b. Oxygen is used for producing a very hot flame for welding.
5. The gases in the air can be separated by fractional distillation.

Exercise Pages 129 – 131

1. Multiple choice questions
   i. c ii. c iii. d
   iv. c v. b
2. True or False
   i. True ii. False iii. True
   iv. False v. True
3. Which of these is an element, compound, or mixture?
   i. Mixture ii. Compound
   iii. Compound iv. Element
   v. Element vi. Compound
   vii. Mixture viii. compound
   ix. Element
4. i. does not tarnish
   ii. can be drawn into wires
   iii. can be melted
   iv. can be hammered into thin sheets
5. i. A – proton B – neutron
   C – electron D – nucleus
   ii. a. electron b. proton
   c. neutron
   iii. Because atoms have same numbers of protons and electrons.
6. i. chemical change ii. physical change
   iii. physical iv. chemical change
   v. chemical change vi. physical change

Ideas for investigations Page 131

In investigation 1 students will investigate the conductivity of electricity by a selection of elements. Electrical conductivity is a property of metallic elements. Using the apparatus referred to, students will soon find out that, in general, metallic elements will conduct electricity and non-metallic elements will not.

When testing the carbon, students should find that it will conduct electricity, confirming that it is the only non-metallic element that has the same properties as metallic elements.

Investigation 2 requires students to find out what uses metals are put to in the home. The following is a list of metals and their uses which students may suggest (though there will probably be others). Alongside each is written whether it is an element or a compound.

Copper wire – element
Aluminium saucepan – element
Steel cutlery – compound
Brass door knobs – compound
Silver jewellery - element
Gold jewellery - element
Mercury thermometer - element

Chapter 10 The solar system

The planets of our solar system Page 133

1. A galaxy is a huge mass of stars.
2. Universe is so big that it contains 100 billion galaxies and scientists had to invent a new unit to measure it.
3. Eight
4. Luminous objects reflect light. Non-luminous objects do not.
5. All the planets and other bodies revolving around the Sun are held in orbit by the force of gravity.

Planet facts Page 135

1. a. 4500 million km b. –23°C
   c. 10 hrs
2. a. Mercury b. Neptune
3. a. Mars
   b. For Mars to rotate once takes 24 hrs 30 min. Its surface is rocky. It has nitrogen gas.
4. Venus has a much higher temperature than expected because its atmosphere contains carbon dioxide which has a greenhouse effect.

Days, months, and years Page 137

1. Night-time falls when our part of the Earth faces away from the Sun, where there is no light.
2. When the side of the Moon lit by the Sun faces the Earth, we see a full Moon. When the Moon is on the side of the Earth nearest the Sun it is called a new Moon.
3. a. The time taken for the Earth to complete one rotation on its axis.
   b. 27.3 days. The time taken for the Moon to orbit the Earth once.
   c. 365.25 days. The time taken for the Earth to orbit the Sun once.

4. Since the Earth takes 365.25 days to orbit the Sun, we cannot have a quarter of a day at the end of each calendar year. So the quarters are added together to produce an extra day every four years. Years that have an extra day are called leap years.

The seasons Page 138

1. 23 degrees
2. a. The part of the Earth which is tilted towards the Sun receives more light and is warmer, therefore, it experiences summer.
   b. The part of the Earth which is tilted away from the Sun receives less light and is colder, therefore, will be having the winter season.
3. a. The northern half of the Earth is tilted towards the Sun in June.
   b. The southern half of the Earth is tilted towards the Sun in December.
4. In December the northern half of the Earth, where UK is located, is tilted away from the Sun while the southern part, where Australia is located, is tilted towards the Sun. So it is warmer in Australia than in the UK.
5. Answers depend on students.

The Moon and eclipses Page 140

1. a. The craters were caused mainly by meteorites as they collided with the Moon.
   b. The Moon's seas are areas of basalt rock.
2. The Moon rotates once as it completes one orbit of the Earth. This means that the same side of the Moon is always facing the Earth.
3. a. An eclipse takes place when one planet or Moon blocks off light from another.
   b. i. During a solar eclipse, the Moon passes between the Earth and the Sun. As a result, light from the Sun is hidden and the Moon appears to us as a black disc surrounded by a halo of bright light.
      ii. During a lunar eclipse, the Earth is positioned between the Moon and the Sun. The Moon dims as the shadow of the Earth moves across the face of the moon.
   c. The Moon's orbit is slightly tilted (not in the same plane).

Information from space Page 141

1. a. We look at the stars from the Earth which is slowly revolving. So, like the Moon, the stars appear to move across the night sky.
   b. The Pole Star stays in the same position because it is in line with the Earth's axis.
2. The modern telescope uses large mirrors instead of lenses to focus light on to detectors. High quality images are then generated by computers.
3. Radio telescopes detect radio waves sent out by objects in space. These telescopes have large reflectors which focus the radio waves on to detectors.
4. The Hubble space telescope is not affected by dust and other pollution in the air.
5. Computers help to generate high quality images from the telescope detectors.

Information from space Page 144

1. a. Magellan flew to Venus.
   b. From May 1989 to August 1990.
   c. It found out that most of the planet was covered with volcanoes and lava.
2. Galileo and Cassini.
3. a. Yuri Gagarin. b. Russian.
4. The space ship was launched in 2001, which was part of the title of the movie.
5. a. The strong evidence that Mars had water.
   b. From April to October 2001.

Exercise Pages 145 -147

1. Multiple choice questions
   i. d ii. b iii. a
   iv. b v. a
2. True or False
   i. True ii. False iii. False
   iv. False v. False
3. The **Universe** contains everything that exists. Planet Earth is just a tiny part of a galaxy called the **Milky Way**. Our galaxy is only one of many star systems scattered throughout the Universe. Each galaxy contains millions of **stars** together with clouds of dust and gases. Galaxies are very far apart.
   Scientists gave estimated that the Universe contains 100 billion galaxies. It is so big that it is measured in light **years**. This measurement is the distance light travels in one year moving at 300,000 km per **second**.
4. i. a. Stars have light of their own, so they shine all the time.
      b. Planets reflect the light of the Sun so they can only be seen at night.
   ii. A star will appear to move across the night sky over a period of time.
   iii. a. The Earth is slowly revolving so the stars appear to move across the night sky.

b. The Pole Star does not appear to move because it is in line with Earth's axis.

5. i. It does not reflect light.
   ii. Sun
   iii. a. B and C b. A
   iv. 24 hours
6. i. An eclipse takes place when one planet or moon blocks off light from another.
   ii. Light from the Sun is blocked so the moon appears to us as a black disc surrounded by a halo of bright light.
   iii. If the orbits of the Earth and the Moon were in the same plane there would be a lunar eclipse every month. However, the Moon's orbit is slightly tilted so it does not occur very often.

Ideas for investigations

These investigations enable students to develop their knowledge and understanding of night and day, sunlight intensity over the Earth and the seasons of the year.

Investigation 1 is very simple, best carried out in a darkened room. On a piece of vertical card the beam of light from the torch will be circular. When the card is lowered to 45° the shape changes to oval and the brightness of the light dims a little.

After carrying out investigation 2 students will hopefully appreciate why it is hotter in the equatorial regions than at the N and S Poles.

Investigation 3 enables students to model the relative positions of the Earth and the Sun during a year. The seasons in the N and S hemisphere should be easy to see. Students may wish to refer to the diagram of the seasons in the Student Book for extra guidance.

Chapter 11 The environment

The environment Page 149

1. a, b, and c. Answers depends on students. For example the student could be in a school environment with chairs, desks, cupboards etc.
2. a. Living things together with the abiotic (non-living) parts of their environment.
   b. A wood, river, seashore etc.

Where things live Page 150

1. Where animals and plants live.
2. The development of special features to enable a plant or animal to survive in its habitat.
3. Fruits/seeds in the shrub layer.

Habitats and adaptations Page 151

1. a. By filtering microscopic animals and plants from sea water.
   b. For cracking open the shells of crabs/mussels etc.
2. Sea currents and waves that might wash seaweeds away. Being submerged for long periods can deprive them of light for photosynthesis.
3. a. i. Stops them sinking into the sand.
      ii. Stores food as fat (not water!).
4. Leaves reduced to spines so there is a smaller surface area for evaporation of water. Water stored in fleshy stems. Waxy covering of leaves and stems to retain water.
5. a. Sleep during the day. Active at night.
   b. During the hot day animals will quickly dehydrate (lose water) and die. At night it is cooler so more comfortable to find food.
6. a. So that their leaves float closer to the surface to get light for photosynthesis.
   b. Streamlined bodies. Fins to help them swim through the water.

Food chains Page 153

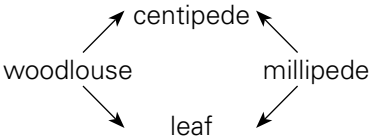
1. a. Any living thing that makes its own food. Green plants are producers.
   b. Animals obtain their food by eating plants or other animals.
2. Most humans are omnivores as they eat both plants and animals.
3. Green plants use the Sun's energy to make their food during photosynthesis. Herbivores obtain this energy when they eat plants. When herbivores are eaten by other animals, this energy is transferred from them to the flesh-eating carnivores.
4. a. pond weed → tadpole → water beetle
   b. three.

Food webs Page 154

1. a. i. E.g. rose → bee
      ii. grain → dormouse → owl
      iii. lettuce → slug → thrush → sparrow hawk
   b. slug, rabbit, chaffinch, dormouse, greenfly
   c. Sparrow hawk has the most varied diet as it eats different birds and rabbits.
   d. i. The sparrow hawk eats rabbits which eat the farmer's lettuce.
      ii. Slugs spoil a gardener's lettuce plantation. Thrushes eat slugs thereby keeping a control on their population. By eating the thrush, the sparrow hawk allows more slugs to feed on the lettuce.

2. a. It will reduce the number of blue tits and in turn the number of sparrow hawks will be affected.
   b. Encourage more blue tits e.g. provide safe nesting sites.

Investigating food webs Page 155

1. a. leaf b. woodlouse or millipede
   c. centipede d. woodlouse
   e) centipede
2. dead leaf → woodlouse → centipede.
   In dish 1 the leaf was partly eaten and the woodlouse was alive. In dish 4 the woodlouse was partly eaten and the centipede was alive.
3. 

4. a. To prevent the animals escaping and also to prevent other animals getting into the dishes.
   b. To let air in and out.
   c. The animals live in the dark (leaf litter) where it is cool and dark.

Change part of a food web and… Page 156

1. Rabbits destroy all sorts of young plants by eating the young shoots. They also eat grass which could be used for grazing sheep and cattle.
2. a. Buzzards that fed mainly on rabbits became fewer in number.
   b. Plant-eating animals like deer increased in numbers because there was more to eat.
   c. Since the number of rabbits reduced, meat-eating animals had to look for other things to eat. For this reason smaller animals like mice were preyed upon and their populations began to decrease.
3. In Poland, otters were killed to protect fish stocks. In fact fish stocks fell. This is because otters often feed on diseased fish which are easy to catch. By killing the otters, the number of diseased fish increased leading to a fall in the fish stock.
   The DDT which was sprayed on to apple trees actually killed the small animals that lived in the barks of these trees and fed on the red spider mites. With the absence of a predator, the number of red spider mites increased.
   DDT that is sprayed on to fields to kill insects dissolves in rain water and is carried to rivers where the fish retain it in their bodies. Fish-eating birds such as herons and grebes accumulate DDT in their bodies after eating these fish.

Predators and prey Page 158

1. If one animal eats another, their populations affect each other. The number of predators affects the size of the population of its prey.
2. a. The number of snowshoe hares is reduced.
   b. It takes time for the effects of population changes to happen.
   c. There would be an overpopulation of snowshoe hares. They would start competing for food and ultimately they would start dying.
3. The Arctic lynx keeps the population of snowshoe hares under control. Sick and old animals are removed leading to a healthy hare population. The population of lynx is regulated by the number of hares available for food.

Exercise Pages 159 - 163

1. Multiple choice questions
   i. b ii. b iii. d
   iv. a v. a
2. True or False
   i. False ii. False iii. True
   iv. True v. True
3. i. Green plants can make their food during the day time. When the Sun sets, the process of photosynthesis stops and the plant makes use of the stored food.
   ii. In summer, trees make food by photosynthesis and store it in their stems. In winter the trees lose their leaves and can survive by using the food stored inside their stems.
   iii. <u>Examples of competition:</u>
   Two stags fighting for control over a herd of deer.
   Trees in a forest growing upwards to get light.
   A seagull chasing off other birds from food in a garden.
   <u>Examples of predation:</u>
   Farm cats killing mice, stopping them eating cereal crops.
   Lions hunting a zebra for food
   A spider catching a fly in its web.
   iv. zebra, fly
4. i. damp grass near a pond - frog
   ii. farmland growing crops - owl
   iii. damp ground with lots of soft-leaved plants - snail
   iv. a rose garden - bee
   v. fast running water - fish
   vi. an apple orchard - green fly
5. i. a. An eagle has sharp claws and beak.

b. The leaves of a cactus are reduced to spines, and the stem is covered with a waxy coating to reduce water loss.
c. Its mouth is shaped like a long tube.
d. It has sharp, pointed canine teeth and strong jaws.

ii. a. Not urinating and staying in their holes during the day helps gerbils to avoid water loss from their body.
b. Feeding at night helps gerbils to avoid being seen by their predators.

6. There are four links.
The arrows indicate flow of energy along the food chain.
Energy comes from the Sun.
Energy enters the food chain from sunlight by photosynthesis.

7. i. elodea → snail → water beetle
milfoil → tadpole → water beetle

ii. a. duckweed/elodea/milfoil/microscopic algae
b. snail
c. stickleback/water beetle/leech/ dragonfly nymph etc.

iii. The number of animals that feed on the snails e.g. water beetles, will be reduced in number.

iv. Bacteria and fungi decompose the dead remains of the organisms living in this pond. These are used by producers thereby recycling important elements.

Ideas for investigations

The first part of this investigation aims to develop student's understanding of the interaction between living things and with their environment. The second part test their understanding of predator—prey relationships.

The complete activity is very much dependent upon what sort of habitat students choose to study. The suggested small pond or pile of dead leaves should provide plenty of opportunity for the study of food chains and webs. Accurate identification of plants and animals may be difficult so it is probably best for students to use simple names such as grass, leaf, tree, bush tree, fish, snail, worm, fly, bird etc..

Chapter 12 Solutions

Solutions Page 165

1. a. The liquid in which a solute dissolves.
b. The solid which dissolves in a solvent.
c. A solution is formed when two substances mix completely with each other.
d. A suspension is formed when small particles of an insoluble substance float in a solvent.
2. a. sugar b. water
3. Sugar, salt. We call them soluble.
4. Sand, oil. We call them insoluble.
5. Fizzy drinks contain carbon dioxide dissolved in flavoured water. When the bottle is opened the carbon dioxide rushes out of solution causing the drink to foam.
6. When no more solid will dissolve in a liquid the solution is saturated. Before that, the solution is unsaturated.

Separating solids from liquids Page166

1. a. The removal of suspended solid particles from a mixture by pouring the mixture through filter paper.
b. The liquid part of the mixture which passes through the filter paper.
c. The solid particles that are left on the filter paper.
2. Filtration is not a good method for removing dissolved solids because all the solution would pass through the filter.
3. a. Filter the sea water to remove the suspended insoluble matter from it. Heat the filtered sea water in a china dish. Dry salt crystals will be left behind.
b. The water will evaporate.
4. Add water to the mixture and stir it. Sugar will dissolve in the water and chalk will be suspended in the liquid. Filter the mixture. Chalk will be left as residue on the filter paper. Sugar can be recovered from the filtrate by heating it to dryness.

Liquids from solutions Page169

1. The steam will be colourless because it is only the water that is evaporating and not the ink particles.
2. a. distilled water.
b. It is used in car batteries, steam irons and laboratories.
3. a. boiling b. condensing
4. As the solution is heated and the temperature rises to 56°C, the liquid with the lowest boiling point (A) evaporates first. It condenses and can be collected in a beaker. When the temperature begins to rise, it means that liquid A has evaporated completely. Continue heating and

when the temperature reaches 72°C, liquid B begins to evaporate. This can be condensed and collected in a second beaker.
The liquid that is left behind in the flask is water. It can be tested by heating the solution further to 100°C as pure water boils at that temperature.

Separating coloured substances Page 172

1. Water moving across the absorbent paper.
2. The movement of the colours depends on their solubility. The most soluble colour moves the furthest.
3. Absorbent paper is rolled up and stood in a solvent. The solvent rises up the paper carrying the substances with it. Each substance travels a different distance.
4. The base line is drawn so that all the chemicals start from the same point and distance travelled by each substance can be measured
5. Some coloured dye (not chemical) could be added so that the distance the amino acids travelled could be seen easily.

Separating solids from a mixture Page 171

1. When a solid turns directly into a gas without passing through the liquid state.
2. Heat the mixture in a heatproof dish covered with a plugged inverted funnel. Iodine will sublime then condense on the cool walls of the funnel.

Solubility Page 172

1. a. A saturated solution is one which cannot dissolve any more solute at that particular temperature.
   b. Take 100 cm^3 of water in a beaker, add a teaspoonful of sugar and stir it well. Keep adding sugar and stirring until no more sugar can dissolve in it. Sugar will start settling at the bottom of the beaker. This is a saturated sugar solution at room temperature.
2. a. 180 g b. 250 g
3. 85°C
4. Salt. Solubility of each solute is different at a particular temperature.
5. As the temperature rises the solubility of a salt also increases.

Exercise Pages 173 -175

1. Multiple choice questions
   i. b ii. c iii. b
   iv. b v. c
2. True or False
   i. True ii. False iii. False
   iv. True v. False
3. i. The filtrate is brown.
   ii. To remove or hold back the ground coffee beans.
   iii. i. the dissolved coffee
   ii. the undissolved particles of coffee beans
   iv. a. the insoluble particles will be seen floating or settled at the base of the coffee
   b. suspension
   c. When some of the insoluble particles settle at the bottom of a liquid, they form sediment.
4. i. fractional distillation
   ii. filtration and evaporation
   iii. fractional distillation
   iv. filtration
   v. evaporation
   vi. paper chromatography
5. i. Place a drop of ink at the centre of a piece of filter paper. Carefully squeeze drops of water on to the ink. Leave a little time between the drops to let the ink spread out. As the water moves across the filter paper it will carry the colours with it.
   ii. Refer to the diagram on page 168 of Student Book.

Ideas for investigations

Investigation 1 aims to enable students to extend their knowledge of chromatography. The use of washable pens is because their inks dissolve easily in water. Water can therefore be used as the solvent in this investigation rather than other more hazardous chemicals. Surprisingly many coloured inks are not pure substances and students will see an array of different coloured results which they can present in the table.
In investigation 2 students are presented with the challenge of obtaining pure salt from rock salt. By carefully carrying out the processes of grinding to a powder, dissolving in warm water, filtering and evaporating to dryness, student should achieve good results. Reference to the appropriate pages of the Student book will provide any necessary guidance.

SAFETY NOTE: Put on safety goggles. Take care handling hot apparatus.

Answers (Workbook)

Chapter 1 Science skills

Page 2

1. i. False ii. True iii. False
   iv. True v. False
2. i. a ii. c iii. b
   iv. c v. a

Page 3

3. i. pipette ii. scales
   iii. round bottomed flask
   iv. test tube v. filter funnel
   vi. beaker vii. thermometer
   viii. evaporating basin ix. flat bottomed flask
   x. ruler
4.

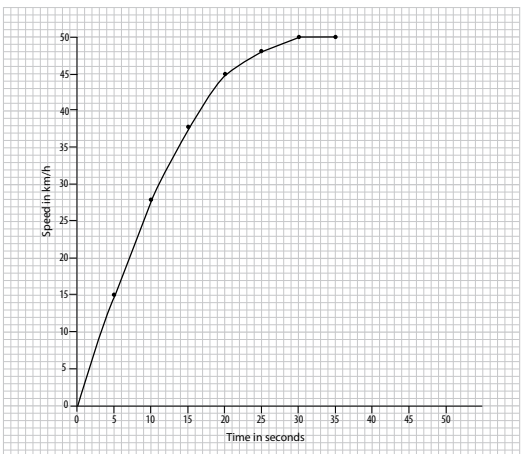
Measurement	Units	Unit symbol
length		m
	kilograms	
volume	metres cubed	
	seconds	
temperature		

Page 4

5. i. 40 ml ii. 64 ml
   iii. 122 ml iv. 70 ml
6. i. 20° C ii. 50° C
   iii. 75° C iv. 25° C
7. i. 5 min 7s ii. 36 min 26s
   iii. 8s iv. 20 min 56s

Page 5

8. 4.8g 72.6g 199.1g 0.5g
9. i.



   ii. 25 km/s (± 1 km/s)
   iii. 12 s (± 1 s)
   iv. Cyclist has reached his/her maximum speed

Chapter 2 Life and living things

Page 6

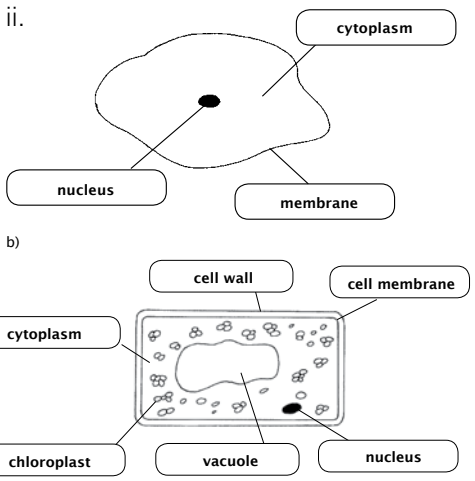
1. i. False ii. True iii. False
   iv. True v. True
2. i. c ii. b iii. a
   iv. a v. c

Page 7

3. Respiration - getting energy out of food
   Growing - getting bigger
   Reproduction - making more of the same kind
   Movement - going from one place to another
   Excretion - getting rid of waste
   Response - reacting to something
   Feeding - taking in nutrients

Page 8

4. i and ii.



   iii. a. Plant cells have a cell wall.
   b. Plant cells have chloroplasts.
   c. Plant cells have a vacuole.

Page 9

5. red blood cells - smooth and circular shape to squeeze easily past other cells.
   nerve cell - long extension to carry messages over long distances
   pollen grain - spiky surface to help them stick to the insects.
   epithelial cell - thin and flat to form a protective layer against infection.

Page 10

6. Lungs to exchange oxygen and carbon dioxide with the surrounding air.
   Kidneys to remove waste from the body and to regulate the amount of water in the blood.
   Stomach and intestines digest and absorb food into the body.
   Heart is a muscular pump which send blood around the body.
   Nerve is made up of nerve cells which carry messages around the body.

Page 11

7. i. A - eyepiece lens B - objective lens
   C - stage D - mirror
   E - focus knob
   ii. To magnify the image.
   Putting the microscope slide on.
   Reflects light through the object and then through the lenses.
   Adjusts the objective lens to focus the image.
   iii. It magnifies the image 10 times so it appears 10 times larger
   iv. 10 × 10 = 100 times

Page 12

8. i. 1. Light from an object
   2. Light passes through the cornea, pupil, and lens.
   3. Light strikes the retina and stimulates nerve cells.
   4. Picture (image) on the retina is small and upside down.
   5. Nerve cells send signals to the brain along the optic nerve.
   ii. Two from:
   Upside down
   Smaller than the object
   Laterally inverted
   iii. Light rays are focussed by the cornea and lens
   iv. The lens

Page 13

9. i. a. fingertip
   b. elbow
   ii. It is not the same all over the body.
   iii. They are not the same distance apart all over the body
   iv. Repeat the test on more people.

Chapter 3 Energy resources

Page 14

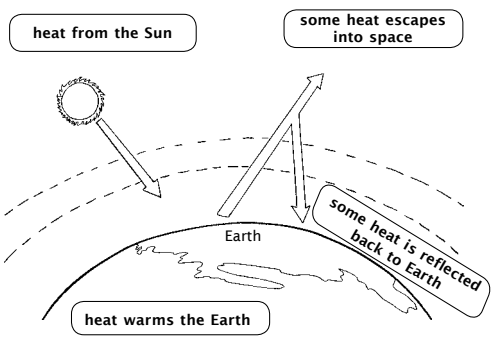
1. i. True ii. False iii. False
   iv. False v. True
2. i. b ii. d iii. b
   iv. a v. a

Page 15

3. When animal and plant waste **decays**, a gas called **methane** is given off. This gas can be collected and used as **fuel**. Some villages in developing countries have **biogas** generators. Animal waste is put into a tank with a lid. As **microbes** digest the waste, gas is given off. This can be used for **cooking** and heating homes in cold countries.
4. i. Any two from coal, oil, natural gas, wood, peat.
   ii. a. oxygen
   b. oxygen + carbon → carbon dioxide
   iii. When ignited, energy is used to break the bonds in the fuel molecules. Fuel atoms combine with oxygen to form new molecules. Making of new bonds releases energy.

Page 16

5. i.



   ii. Global warming
   iii. Carbon dioxide is a good insulator/good at keeping heat in. Just like the glass in a greenhouse.
   iv. Ice caps melt, sea levels rise so low-lying countries flood.

Page 17

6. Solar panels absorb heat from the Sun to heat water so saving fuel.
   Double glazing has a layer of air trapped between the glass. Air is a good insulator so reducing heat loss.

Shutters trap a layer of air between themselves and the window. Air is a good insulator so reducing heat loss.
Conservatory facing south will get most available heat from the Sun. Heat is retained (like a greenhouse) during the night thus saving fuel to heat the house.
Cavity wall insulation traps air which is a good insulator and prevents heat loss by conduction/ radiation.
Loft insulation traps air which is a good insulator and prevents heat loss by convection.

Page 18

7. i. Electricity is produced from the rising and falling of the tides.
   ii. estuaries/mouths of rivers.
   iii. At high tide water passes through a turbine and into the river. At low tide water moves in the other direction also turning the turbine producing electricity.
   iv. a. Constant supply of electricity
   b. Once built it provides cheap electricity
   v. a. Expensive to build
   b. Considerable environmental impact.

Page 19

8.

woodland	- renewable
wind	- renewable
food	- renewable
uranium	- non-renewable
gas	- non-renewable
hydroelectric	- renewable
oil	- non-renewable
solar	- renewable
coal	- non-renewable

Page 20

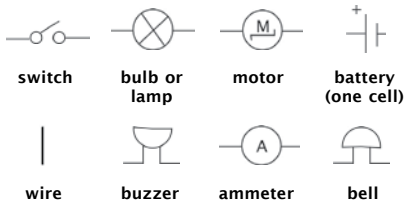
9. i. to make it a fair test ii. walnut
   iii. sunlight iv. chemical
   v. a. sleeping/sitting b. running
   vi. a. put a screen around the apparatus.
   b. to prevent heat loss to the surroundings (by radiation)

Chapter 4 Electrical circuits

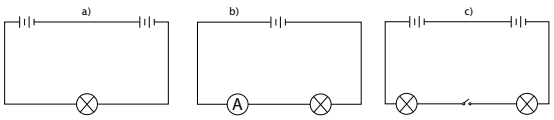
Page 22

1. i. True ii. False iii. False
   iv. False v. False
2. i. b ii. c iii. c
   iv. d v. b

Page 23

3. 

Page 24

4. 

5. i. 0.4 A
   ii. a. The brightness decreases.
   b. The total current is divided equally between the two bulbs.
   c. It becomes difficult for the current to flow in the circuit.
   d. The cell is pushing the current through two bulbs.

Page 25

6. i. a. B2
   b. The switch to B1 is open so no current can flow to B1
   ii. They will be dimmer than when B2 was lit on its own.
   iii. Parallel circuit
   iv. in the home

Page 26

7. i. a. The reading on the ammeter also increases.
   b. The wire wool becomes hotter and glows red.
   ii. The wire wool should not be touched.
   iii. It tries to stop the current from flowing through it.
   iv. in an electric bulb or in fuses

Page 27

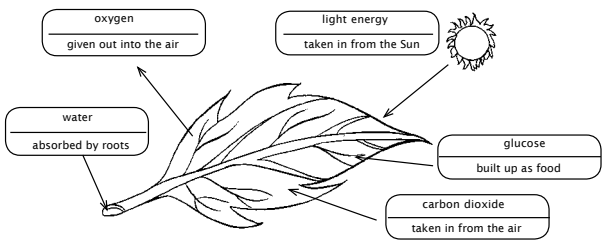
8. i. a. 13 A b. 3 A
   ii. If the current flow becomes too large, the 13 A fuse will not break the circuit, and the food processor may burn out.
   iii. a. 13A b. 920/230 = 4 A
   c. 5A

Chapter 5 Plants and Photosynthesis

1. i. False ii. False iii. True
   iv. True v. True
2. i. a ii. c iii. b
   iv. a v. c

Page 29

3. Glucose is a type of **sugar**. It is the 'food' made by plants during photosynthesis'. A plant can do lots of things with the glucose it makes.
   Some of it will be used straight away to produce energy during **respiration**.
   Some glucose is changed into **cellulose** to make new cell walls. It gives a strong coat to plant cells.
   Some glucose will be changed into **starch** or oil and stored in the roots, **stem**, seeds, and fruits.
   Some is joined up with **minerals** from the soil. Nitrogen, for example, is joined with glucose to make **protein** which is needed for growth.
4. i.



   ii. carbon dioxide + water → glucose + oxygen

Page 30

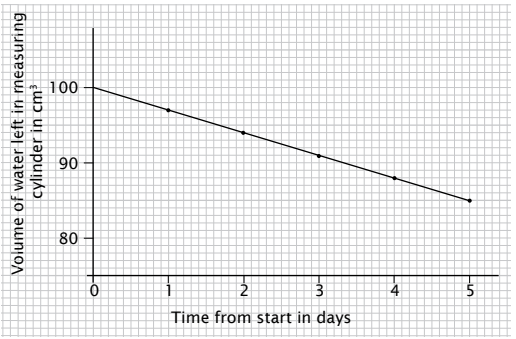
5. i. a. to soften/kill it
      b. alcohol will catch fire
      c. removes chlorophyll
      d. iodine
      e. blue-black
   ii. a. sunlight
      b. The part that was covered did not receive sunlight therefore it could not photosynthesize and make starch.
      c. So the leaf gets enough water. Only one variable is changed.

Page 31

6. i. So there is enough light for photosynthesis
   ii. Bubbles of gas are produced during photosynthesis and are lighter (less dense) than water.
   iii. a. oxygen
      b. Test the gas with a glowing splint, it will burst into flame.
   iv. a. The rate of the bubbles rising in the tube will slow down.
      b. Less light means less photosynthesis therefore less oxygen produced.

Page 32

7. i.



   ii. So the only water lost is through the leaves.
   iii. The volume of water in the cylinder falls.
   iv. Water is absorbed by the plant through the roots and carried to the leaves where it is lost to the air (by transpiration).
   v. Root hairs increase the surface area for absorption. Their thin walls help to absorb water quickly.

Page 33

8. i. a. Its leaves will be yellow. Good root growth.
      b. Its leaves will be yellow. Poor root growth.
   ii. A plant starved of nitrogen has yellow leaves, a short stem and a poor root system.
      A plant starved of magnesium also has yellow leaves but the stem is longer and has better root growth.
   iii. Through the roots. Some in solution in soil water. Some transported directly as mineral ions.
   iv. Nitrogen joins with glucose to make protein which leads to successful and rapid growth of leaves etc.. The better the growth the more food is produced.

Chapter 6 Particles

Page 34

1. i. True ii. True iii. True
   iv. False v. False
2. i. a ii. c iii. a
   iv. b v. a

Page 35

3. i. a. bricks, timber, tiles
      b. They are solid so have a fixed shape and volume.
   ii. a. Paint and polish

b. They are liquid so have no fixed shape. They take the shape of their container. A lid is useful to prevent spillage.

iii. a. Propane, butane, and compressed air.
b. Gases take up all available space and escape easily so need to be kept in sealed containers.

Page 36

4. i. solid
ii. The particles are held close together (but not tightly) in rows and they are arranged a definite pattern.
iii. The particles have enough energy to move about (vibrate) but not break away.

Page 37

5. i. melting ii. boiling iii. cooling
iv. freezing v. melting and boiling

Page 38

6. i. The particles of water fill the spaces between the alcohol particles and this makes the volume smaller than expected.
ii. There are tiny holes in the skin of the balloon through which the air particles escape.
iii. The molecules of the gas collide with the moving air molecules and spread through the room by diffusion.
iv. The air pressure inside the tyre increases as more air particles will be pumped into it. It will get harder as more particles bounce off the inside of the tyre.

Page 39

7. i. a. There will be an even light brown colour in both jars.
b. No, the result should be the same. The gases would mix evenly by diffusion irrespective of their position.
ii. Since particles are always in motion, some of the manure particles collide with the air particles and the smell of the manure will spread by diffusion.
iii. The smell of food cooking in the kitchen spreads throughout the house.

8. i. The top would expand, loosen and come off easily.
ii. The particles of the metal screw top will gain heat energy and will start moving faster, thus bumping into each other and pushing each other away and causing expansion.
iii. Plastics do not not expand and contract as much as metals so plastic tops will usually be easier to remove.

Chapter 7 Forces and their effects

Page 40

1. i. True ii. True iii. False
iv. False v. True
2. i. a ii. c iii. b
iv. b v. c

Page 41

3. i.

Pull cables	Brake pads	Pulls brake pads onto the wheel	Brake cables
Turns the main gear around	The wheels	Turns the wheels round	A chain

ii. a. brakes, gripping pedals, gripping handlebars, tyres on the road
b. oiling the chain and other moving parts, keeping tyres inflated to reduce contact with the road

iii. a. increases
b. surfaces rub together more as speed increases

Page 42

4. i. A life jacket is filled with air so it is less dense than water. Upthrust of the water is greater than the weight of the body and lifejacket.
ii. A ship displaces much more water than a block of steel. The upthrust of water on the ship is greater than that of the steel block due to the difference in the amount of water displaced.
iii. As the load increases, the weight of the ship becomes greater so reducing the upthrust of the water.
iv. When in water, upthrust acts upon the whale's body making it feel relatively light. On land, its weight pulls down on it making it difficult for the whale to move.
v. Upthrust of the sea water acts on our feet, therefore, reducing the force being applied on the pebbles and causing less pain.

5. i. copper block
   ii. cork, wood, magnesium, china, aluminium, copper
   iii. wood 6 / 8 = 0.75 g/cm^3
   cork 2.4 / 8 = 0.3 g / cm^3
   copper 70 / 8 = 8.75 g/cm^3
   magnesium 14 / 8 = 1. 75 g/cm^3
   aluminium 22 / 8 = 2.75 g/ cm^3
   china 19 / 8 = 2.38 g/cm^3
   iv. a. wood and cork
   b. They have a density less than that of water.

Page 43

6. i. 4 kg ii. 10 N iii. 10 N
   iv. 1 kg
7. i. 10N ii. 2 kg iii. 6 times
   iv. a. Nothing He/she is weightless.
   b. No gravitational pull in outer space.

Page 44

8. **ladder**
   i. large ii. otherwise the ladder would slip
   hand gripping handle
   i. large ii. otherwise the person's hand would slip and not grip the handle
   sliding door
   i. small ii. otherwise it would need a lot of force to open and close the door
   ship
   i. small ii. otherwise it would be difficult for the ship to move
   subway track
   i. large ii. so the wheels grip the track
   skier
   i. small ii. otherwise the skier would not be able to ski downhill

Chapter 8 Food and digestion

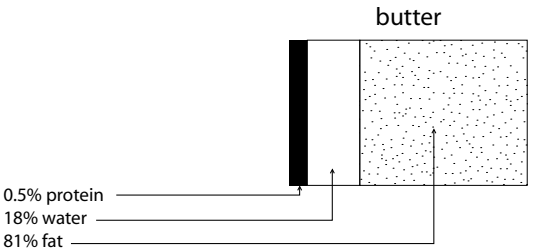
Page 46

1. i. False ii. True iii. False
   iv. True v. True
2. i. b ii. a iii. a
   iv. b v. b

Page 47

3. 'The end products of digestion are glucose amino acids, fatty acid and glycerol. The molecules are absorbed through the wall of the small intestine into the bloodstream, where they are carried in solution in the plasma. The wall of the small intestine is folded and covered in tiny projections called villi which have very thin walls.'

4. i. a. bread, potato, biscuit
   b. milk, Cheddar cheese, biscuit
   c. Cheddar cheese, bread, meat, fish, milk, egg
   d. lettuce, egg, orange , milk potato
   ii. Fruit and green vegetables have no fat and very little carbohydrate.
   iii. Milk contains less fat than cheese. It also has some carbohydrate which cheese does not. Cheese contains more protein.
   iv.

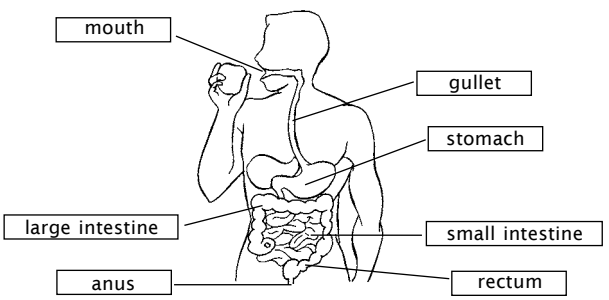


Page 48

5. i. a. 14.1 g
   b. It helps to retain water keeping the faeces soft. It also gives the intestine muscles something to push on, to keep the food moving through the system.
   ii. a. It contains few minerals and vitamins.
   b. Minerals important for making body parts e.g. calcium for bones and teeth. Vitamins for chemical reactions in the body.

Page 49

6. i.



   ii. a. Food is chewed and mixed with saliva, and then swallowed.
   b. Food is churned and mixed with gastric juice.
   c. The process of digestion is completed and digested food is absorbed through the walls into the blood stream.
   d. Water is absorbed from the waste leaving semi-solid faeces.

Page 50

7. i. a. Starch and protein molecules are complex molecules which exist as chains.
   b. Protein molecules break down to form amino acids. Starch molecules break down to form glucose molecules.
   ii. From the type of food substances that they act upon.
   iii. a. Carbohydrase (in saliva) can only act in a neutral medium. The medium in the stomach is acidic due to the presence of hydrochloric acid.
   b. Neutralization is carried out because the enzymes in the small intestine cannot work in an acidic medium.

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8. i. 40°C
   ii. The normal temperature of the human body is between 37 to 40°C which is the best temperature for enzymes to act in.
   iii. At low temperatures it takes longer for the egg white to be digested.
   iv. It would take too long for protein to be digested and be passed out with the faeces.
   v. Repeat the experiment to get more readings then average. Use narrower temperature bands e.g. 5°C

Page 52

9. i. a. Take a small amount of the solution in a test tube and add a few drops of iodine solution. If the colour changes from brown to blue-black, it shows that starch is present.
   b. Take a small amount of the solution in a test tube and add some Benedict's solution. Shake the test tube carefully. Heat the test tube gently in a beaker of water. If glucose is present, the Benedict's solution will change colour from blue to green to brick-red.
   ii. a. Glucose
   b. The glucose molecules are smaller than the holes in the membrane.
   iii. Starch molecules are larger than the holes in the membrane.
   iv. The small intestine.
   v. The blood

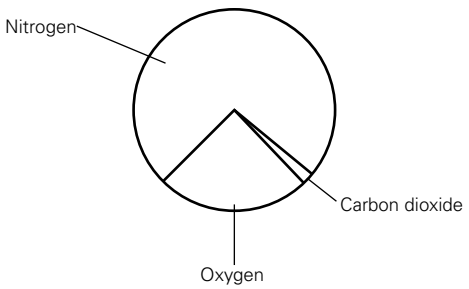
Chapter 9 Elements, compounds, and mixtures

Page 54

1. i. False ii. True iii. True
   iv. True v. False
2. i. a ii. b iii. a
   iv. c v. c

Page 55

3. i. a. nitrogen b. hydrogen
   c. argon d. oxygen
   e. carbon dioxide
   ii.



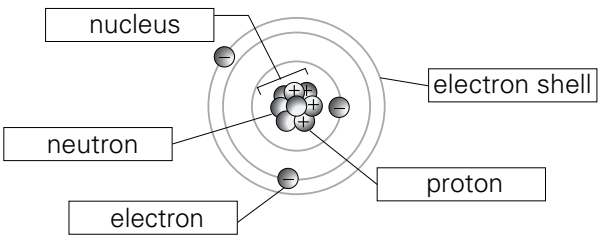
   iii. Air is liquefied by cooling. Each gas has a different boiling point. The liquefied air is warmed. As each gas vapourizes it is collected.

4.

Metals	Non-metals
difficult to melt	melt easily
high melting point	poor conductors of heat
make a noise when hit	dull appearance
shiny when polished	many are gases
hard solids	brittle or powdery

Page 56

5. i. a. (a) b. (b) c. (c)
   ii. An element contains only one kind of atom.
   iii. A mixture can be easily separated. A compound cannot be separated.
6. i.



ii. An electron has a negative (-ve) charge. A proton has a positive (+ve) charge.
iii. Neutrons have no charge.
iv. Electrons

Page 57

7.

aluminium	cooking foil
americium	smoke alarms
copper	electric wires
chromium	shiny car parts
mercury	thermometers
silicon	computer chips
xenon	car headlights

8.

sand	building
baking powder	cooking
lime	mortar
ammonia	cleaning
carbon dioxide	fizzy drinks
methane	fuel

Chapter 10 The solar system

Page 58

1. i. False ii. False iii. True
   iv. False v. False
2. i. c ii. d iii. c
   iv. c v. c

Page 59

3. A solar eclipse happens when the **Moon** passes between the **Sun** and the **Earth**. Light from the **Sun** is hidden and the **Moon** appears to us as a black disc surrounded by a halo of bright light.
   A lunar eclipse happens when the **Earth** passes between the **Sun** and the **Moon**. The shadow of the **Earth** covers the face of the **Moon**.
4. **V**enus, **E**arth, **M**ars, **J**upiter, **S**aturn, **U**ranus, **N**eptune

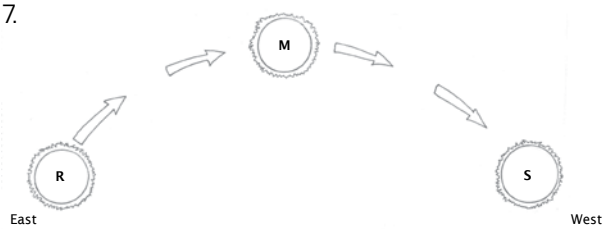
Page 60

5. i. a. Mercury b. Neptune
   ii. a. Jupiter b. Mercury
   iii. a. Mercury b. Neptune
   iv. Neptune
   v. The further the planet is from the Sun, the longer it takes to orbit it.
   vi. Because Neptune is very far away from the Sun.

Page 61

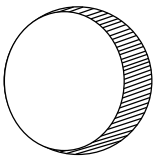
6. i. A, B and C ii. D and E
   iii. C iv. A
   v. E

7.



Page 62

8. i. The Moon does not give out its own light. It reflects light from the Sun.
   ii.



   iii. 1 iv. 5 v. 28 (27.3)
   vi. The Moon rotates once in the same time as it takes to complete one orbit of the Earth.

Chapter 11 The environment

Page 64

1. i. True ii. False iii. False
   iv. False v. False
2. i. b ii. d iii. c
   iv. d v. c
3. i. Environment is a scientific word for surroundings. It consists of all the living and non-living things that occur naturally in that area.
   ii. The living things in an environment.
   iii. The non-living things in an environment.
   iv. Any four from: fox, bird, squirrel, deer, tree, grass, flowering plants.
   v. Any four from: wind, rain, temperature, landscape, soil type.

Page 66

4.

eagle	accurate vision to see prey from a long way off
whale	thick layer of fat beneath the skin to keep it warm
cheetah	long legs and stretched body to catch prey on grassland
bat	'sees' by sending out sound waves (sonar) to hunt insects at night
camel	stores food to help it live for a long time without eating or drinking
polar bear	thick fur to keep it warm

Page 67

5. i. Answer depends on the student but should include a reference to such things as;
good (forward) vision
speed
agility
strong jaws
ii. Answers depend on the student but should include a reference to such things as;
good all round vision
speed (for escape)
agility (for escape)
camouflage

Page 68

iii.

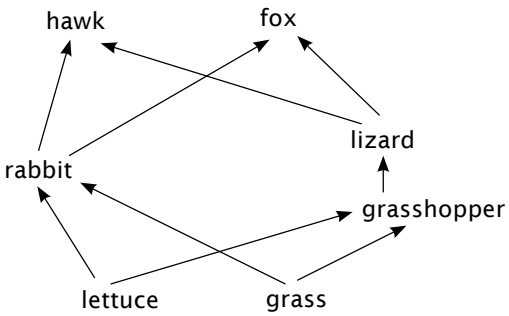
butterfly	bird
deer	lion
rabbit	fox
mouse	owl
fish	seal

Page 69

6. i. herbivore: slug
carnivore: thrush or cat
consumer: slug thrush or cat
ii. lettuce
iii. a green plant
iv. The flow of energy along the food chain.

Page 70

7. i.



ii. a. The number of lizards will reduce because with the grasshoppers dead, the lizards will not have any food. They will die of starvation.
b. Grass and lettuce plants will grow and reproduce more as the number of one of their consumers has been reduced.
c. With the grasshoppers dead, the rabbits would be able to get plenty of grass and lettuce to eat. Their number would increase, which means foxes would have more rabbits to prey on. Thereby the population of foxes will also increase.

8. i. For 60 years
ii. They have been living together quite happily in many areas of woodland.
iii. The red squirrels are unable to digest acorns.
iv. The squirrels are competing for food.
v. More coniferous woodland, especially pine trees, should be grown so that red squirrels can have their preferred diet.

Chapter 12 Solutions

Page 72

1. i. False ii. False iii. True
iv. False v. True
2. i. a ii. a iii. c
iv. c v. b

Page 73

3. When sugar dissolves completely in water a **solution** is formed. The solid sugar is called the **solute** and the water is called the **solvent**. Because it dissolves, sugar is described as **soluble**. Sand will not dissolve in water, it is described as **insoluble**.
4. i. evaporating ii. filtering
iii. sieving iv. filtering/sieving
v. sieving vi. filtering
5. Weigh a sample of lawn sand. Put it in a beaker, add water to it and stir. The fertilizer will dissolve in the water, and sand will settle at the bottom as sediment. When filtered, sand will be left on the filter paper and the solution will pass through. Heat the solution to dryness in a china dish. Dry the sand by heating it in a china dish. Weigh both the sand and the fertilizer thus obtained. If the manufacturer's claim is genuine, their weights should be equal.

Page 74

6. i. 2 ii. D
iii. a. B
b. Its components have separated into 2 spots which are similar to the homework pen.
iv. The ink dissolves in the solvent. The solvent rises up the paper carrying the ink with it. Individual pigments/colours do not move as fast as each other so get left behind as blobs. Each pigment /colour travels a different distance.
v. chromatography

Page 75

7. i. a. sodium chloride
   b. potassium nitrate
   ii. sodium chloride
   iii. approximately 40 g
   iv. 24°C

Page 76

8. i. Change state from solid to a gaseous.
   ii. To cool/condense the iodine vapour
   iii. a. Iodine crystals
   b. Iodine vapour condenses on the cold surface to form iodine crystals.
   iv. Ammonium chloride

Answers (Worksheets)

Chapter 1

Worksheet 1–1

1. Science is about obtaining knowledge by observation and experimentation and using that information to describe natural things.

2.

biology	the study of life and living things
chemistry	the study of matter and its properties
physics	the study of matter and energy and their interactions

3.

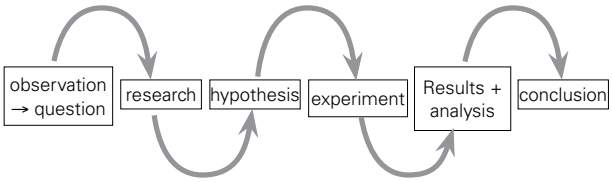
Chapter 1	Science skills	all three
Chapter 2	Life and living things	biology
Chapter 3	Acids and alkalis	chemistry
Chapter 4	Energy resources	physics
Chapter 5	Simple chemical reactions	chemistry
Chapter 6	Electrical circuits	physics
Chapter 7	The environment	biology
Chapter 8	Particles	chemistry
Chapter 9	Forces and their effects	physics
Chapter 10	Variation and classification	biology
Chapter 11	Solutions	chemistry
Chapter 12	The solar system	physics

4.

paleontology	the study of prehistoric life
oceanography	the study of the oceans
forensics	the science used to solve crimes
astronomy	the scientific study of space
ecology	the study of organisms and their environment
ethology	the study of animal behaviour
zoology	the study of animals
biochemistry	the study of chemical process in living things
genetics	the study of hereditary traits
botany	the study of plants
meteorology	the study of the atmosphere, including weather forecasting
pharmacology	the study of the effects of medicines

Worksheet 1-2

1.



a. An observation leads to a question. You need to research what information is already available that is relevant to your question. You need to form a hypothesis (based on your research).

b. You need to observe carefully, write down what you see, and measure to obtain your data.

c.

What are you measuring?	**Which instrument do you use?**	**What units could you use?**
length	ruler, tape measure	km, m, cm
volume	measuring cylinder	l, ml, cm^3
mass	scales, balance	g, kg
temperature	thermometer	degrees Celsius (°C), degrees Kelvin (K), degrees Fahrenheit (°F)
time	stop clock, stopwatch	s, min

d. Answers will depend on the dimensions of the pencil and paperclip. Please ensure units are included – most likely cm.

e. 29 ml

f. 0.30 gms

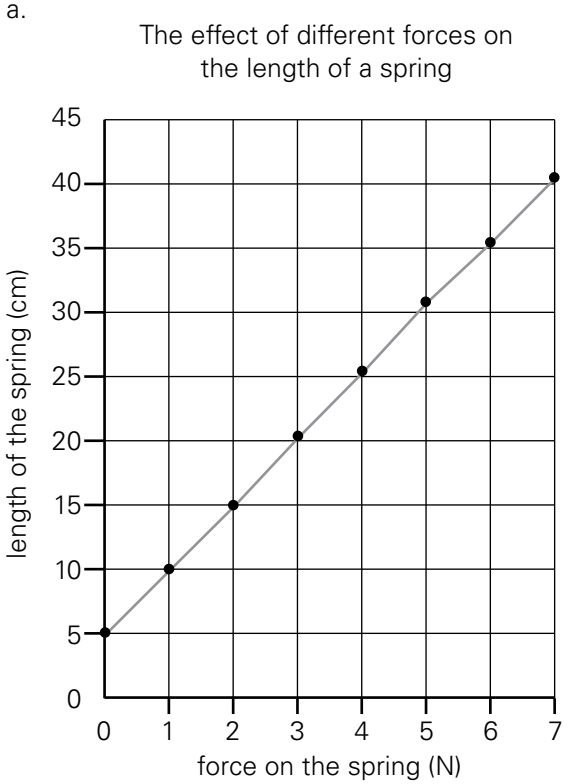
g. 1 m 12 sec

Worksheet 1-3

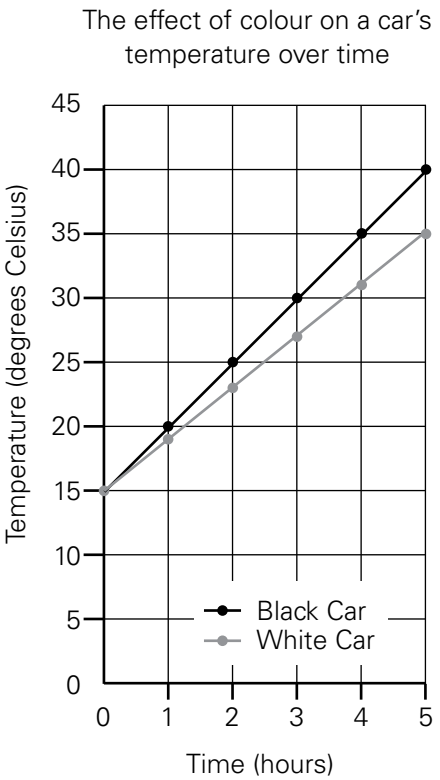
Answers depend on students

Worksheet 1-4

1. a.



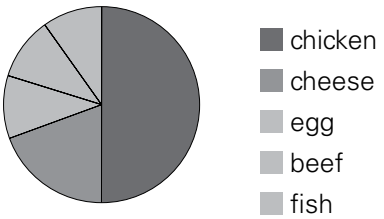
b.



2. a.

sandwich	tally	total number
chicken	///	5
cheese	//	2
egg	//	1
beef	//	1
fish	/	1

b. Sandwiches sold



Worksheet 1-5

a. What is the effect of applying different forces on the length of a spring?

b. I expect that the spring becomes longer when a force/weight is put on the spring. I would expect that the extension of the spring will be more when the force/weight is bigger.

c. My conclusion confirms my hypothesis, which is that the spring extends more if more weight is applied.

d. If I did this experiment again, I would apply a heavier weight because I expect that at some point the spring will not extend any more.

e. Research question : Do black cars warm up faster than white cars when left in the sun?

f. Hypothesis : Since black absorbs light and white reflects light, I would expect the black car to warm up faster.

g. Conclusion : The results confirm the hypothesis and show that the black car warms up faster than the white car.

h. Reflection : I could include more different colours and/or I could check if these results would also be found if the cars were in the shade.

Chapter 2

WORKSHEET 2-1

1.

	characteristic of life
M	movement
R	release energy
S	sensitivity
G	growth
R	reproduction
E	excretion
N	nutrition

2. MRS GREN
3. a. movement, release of energy , reproduction (young giraffe), growth (young giraffe)
   b. movement (growing towards light), nutrition/feeding
   c. excretion of carbon dioxide, release of energy
   d. growth (from seed to plant), reproduction
   e. reproduction (pollination), nutrition (bee on nectar), movement or feeding , sensitivity (bee recognizes flower with nectar)

WORKSHEET 2-2

a. eyepiece lens
b. coarse focusing knob
c. objective lens
d. stage
e. mirror
f. turret
g. fine focusing knob
h. stage clips
i. diaphram
j. eyepiece lens, objective lens

WORKSHEET 2-3

1. a. Answers depend on students
   b. Answers depend on students
   c. green
2. a. nucleus
   b. cytoplasm
   c. cell membrane
   d. cell wall
   e. chloroplasts
   f. vacuole
3.

name of the structure
nucleus
cytoplasm
cell membrane
cell wall
chloroplast
vacuole

WORKSHEET 2-4

1.

picture	name of cell	function	structural adaptations
	pollen grain	reproductive cells	spikes so that the pollen sticks to the insect which carries it to the next flower
	red blood cell	carry oxygen around the body	round with a dent in the middle so that it has a large surface area which makes it faster to absorb or give off oxygen
	nerve cell	carry messages from one part of the body to another	long thin fibres so messages can be passed most quickly
	epithelial cell	cover surfaces	packed close together without any spaces between the cells so that everything entering or leaving the body is controlled by having to go through the cells

2.

name of the structure	description	example plant	example animal
cell	basic unit of life	root cell	skin cell
tissue	group of similar cells doing the same job	vascular tissue	epithelial tissue
organ	several tissues working together	leaf	stomach or lung
organ system	several organs working together to carry out large jobs	branch	digestive system
organism	something that is able to live on its own	palm tree	chicken

Chapter 3

WORKSHEET 3-2

a. 1000: 280 ppm
b. 1900: 290 ppm
c. difference: 10 ppm
d. 1900: 290
e. 2000: 370 ppm
f. difference: 80 ppm
g. The patterns are very similar.
h. Answer depends on students.

WORKSHEET 3-3

a. measuring : temperature
b. changing : type of food
c. staying the same : amount of food, distance between food and the water, starting temperature of the water
d.

independent variable	type of food
dependent variable	temperature
controlled variables	amount of food, distance between food and the water, starting temperature of the water

e. warmth/heat
f. nothing /no heat/very little heat
g. calorimeter

h. insulate the test tube/put a lid/cork on test tube
use a large beaker to put the food in and to hold the test tube

i. Weigh the food before and after and only use the amount actually burnt to calculate the energy.

Chapter 4

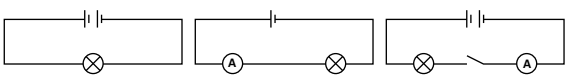
Worksheet 4-1

1. Answer depends on student's experiment.
2. Unsafe practices include:
   1. filling the kettle while still plugged in
   2. keeping a kettle and microwave near water
   3. putting a metal object into the toaster while it is plugged in
   4. many computers linked to a single socket
   5. wires on the floor (tripping)
   6. someone putting something into a socket
   7. coffee on the pc
   8. watering plant near the keyboard

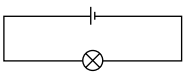
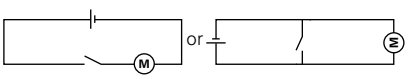
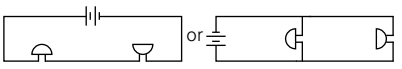
Worksheet 4-2

1.

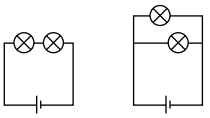
	Explain why the bulb(s) will not light.
1.	complete circuit, bulb will light up
2.	incomplete series circuit : switch is open
3.	parallel circuit; one circuit is complete so that bulb will light, the other will not because the switch in that circuit is open so the circuit is incomplete
4.	complete series circuit; both bulbs will light up.
5.	complete circuit, bulb will light up
6.	parallel circuit; one circuit is complete so that bulb will light, the other will not because the switch in that circuit is open so the circuit is incomplete

2. 

3.

A battery connected to a bulb.	
A battery connected to a motor and a switch.	
Two batteries connected to a buzzer and a bell.	

Worksheet 4-3

1. a. series circuit b. parallel circuit
2. a. yes b. no, less bright
   c. no d. yes
   e. yes f. yes
3. 

No, the bulbs in the series circuit will be less bright than those in the parallel circuit.

Worksheet 4-4

1.

	Ammeter	Voltmeter
What does it measure?	current (electrons running through)	voltage (the energy of the electrons)
Which units does it use?	ampere	volts
How is it placed in the circuit?	in series	parallel to a component
Does it matter where it is placed?	No, the current is the same everywhere in the circuit as long as all components are in series;– if they are in parallel, the current is divided over the parallel sections according to resistance.	Yes It must be in parallel and the sum of the voltage across all components is the same as the voltage provided by the battery. NB not all components have the same voltage!

2. a. ~~Series~~ / Parallel ~~Current~~ / Voltage
   b. Series / ~~Parallel~~ ~~Current~~ / Voltage
   c. Series / ~~Parallel~~ Current ~~/ Voltage~~
   d. ~~Series~~ / Parallel Current / ~~Voltage~~
3. a. the same (9A) everywhere in the circuit
   b. divided over the components (4V each)
   c. divided over the different loops (3A each)
   d. the same (12V) across each component

Worksheet 4-5

1. hotplate, electric heater, electric blanket, hair dryer, etc.

Worksheet 4-6

1. Lamps, electric heaters, air conditioners, fans, ovens, hair dryers, radio, TV, computer, iron etc.
2. Fuses which allow more electricity would be found in washing machine, microwave, iron, toaster, hair dryer and in circuits which have heaters or air conditioners. Circuits which will have lamps, computers, TV, radio will have fuses that allow less electricity.

Chapter 5

Worksheet 5-1

1. a. He did an experiment to test his idea.
   b. Does all the mass that the tree gains in five years only come from the minerals in the soil?
   c. Van Helmont concluded that the mass gained came only from the water.
   d. tree gained 164 pounds: 164 x 454 = 74,456 g = 74.456 kg
   e. soil lost 2 ounces : 2 x 28.35 g = 56.7 g
   f. Yes, because the mass of the tree increased much more than the mass of the soil decreased.
   g. No, because Van Helmont did not know that there were other places from which the tree could obtain mass (the air).
2. a. Dependent variable: which candles goes out first.
   b. Independent variable: the amount of air around the candle (or the size of the glass).
   c. Hypothesis: I expect candle C to continue to burn and candle B to go out sooner than candle A. A flame uses oxygen and once all oxygen is used up, it goes out.
   d. Results: Candle B went out first and candle A soon afterwards. Candle C continued to burn because the oxygen was not limited. Candle B was under the smaller glass so there was less air, so less oxygen than for candle A. This is the reason B went out before A.
   e. The function of candle C is to be the control. It has the same conditions as candles A and B, the only difference is the amount of oxygen available. It shows that this is the factor that extinguishes candles A and B.
3. carbondioxide + water → oxygen + biomass

Worksheet 5-2

a. the air in the airspaces and/or the waxy cuticle
b. bicarbonate provides carbon dioxide
c. Photosynthesis took place.
d. No, because photosynthesis needs light.
e. oxygen

Worksheet 5-3

1. because photosynthesis only takes in place in plants.
2. chlorophyll
3. The first test will show no starch anywhere in the leaf
4. The second test will show that the green part of the leaf now contains starch (indicating photosynthesis has occurred), while the non-green part has no starch because chlorophyll is missing in that part.
5. the mesophyll layer
6. the lower skin/epidermis
7. Because it needs to let as much light as possible through so that the light can reach the chloroplasts.
8.

stomata
chlorophyll
thin
large surface area
network of veins

9.

root hairs
large vacuole
living cells
network of veins

Worksheet 5-4

1.

use of glucose	main point
respiration	to release energy
storage (as starch, fats, oils)	to store energy
cellulose	needed to make new cell walls
joined with minerals	to make protein

2. Answers may include the following:
   - for oxygen
   - for clothes – cotton and linen
   - for bio-fuel
   - for building – wood
   - to keep warm – wood (fire)
   - to cook – wood
   - for shade
   - to stabilize land – plant roots can hold soil and reduce erosion and landslides
   - for decoration – gardens and flowers in vases
   - for medicines – e.g. morphine from poppies is still used to kill severe pain
   - for cosmetics – e.g. henna

Chapter 6

Worksheet 6-1

1. a.

Action	Observation	Concluding statement about solids
Try to press and squeeze the stone. What happens to its shape and volume?	Shape: *no change* Volume: *no change*	*Solids do not change their shape or volume when pressed. Solids cannot be compressed.*
Put the stone in different-shaped containers. Do the shape or the volume of the stone change?	Shape: *no change* Volume: *no change*	*Solids keep their shape and volume when put in different containers.*

b.

Action	Observation	Concluding statement about liquids
Measure 100 mL of water into different-shaped containers. Observe what happens to the volume and shape of the water when you place the water in different-shaped containers.	Shape: *changes to take the shape of the container* Volume: *no change*	*Liquids take the shape of their container but their volume does not change.*

c.

Action	Observation	Concluding statement about gases
Blow air in the balloon. Does its shape and volume change?	Shape: *changes to take the shape of the container* Volume: *changes to fill the container*	*Gases fill the volume of the container in which they are placed. They also take the shape of the container.*

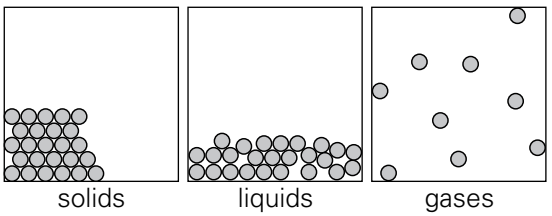
d.

Action	Observation	Concluding statement about the sponge
Squeeze the sponge. Does its shape and volume change?	Shape: *it changes its shape when pressed and then goes back* Volume: *it changes its volume when pressed and then goes back*	*A sponge can be compressed because it is a flexible solid with many air holes. The air can shape its shape and volume but the flexible sponge will go back to its shape when released.*

2. a. properties b. fixed
   c. squashed d. fixed
   e. flow f. density, volume
   g. squashed h. volume
   i. flow, fixed j. dense, lower
   k. easy l. fixed
   m. fill n. dense, rise

Worksheet 6-2

1. a. This depends on the results
   b. Most likely they were close to the tissue.
   c. The scent spreads through the air via diffusion

2. 

3.

Are there big spaces between the particles in a solid?	no
Are there big spaces between the particles in a liquid?	no
Are there big spaces between the particles in a gas?	yes
When you compress a substance, do the particles get smaller?	no
When you compress a substance, do the spaces between the particles get smaller?	yes

Worksheet 6-3

1. a. will spread out
   b. faster
   c. faster
   d. This depends on results.
   e. This depends on results.
   f. Diffusion in a gas is much faster than diffusion in a liquid.

Worksheet 6-4

1. a. The can collapsed.
   b. from outside the can
   c. air
   d. air pressure
   e. When it was in cold water, the water vapour (gas) condensed into liquid water, taking up a lot less space. So the pressure inside the can became much smaller than the outside pressure, causing the can to collapse.

Worksheet 6-5

a. The rails must have been straight once, but now they are bent out of shape.
b. They got hot and expanded, but could only do this by changing their shape.
c. The little spaces allow the rails to expand without getting bent.
d. When placed in hot water, the mercury will warm up and expand. This means that the level in the small tube will rise and we can read from the scale how hot the water is.

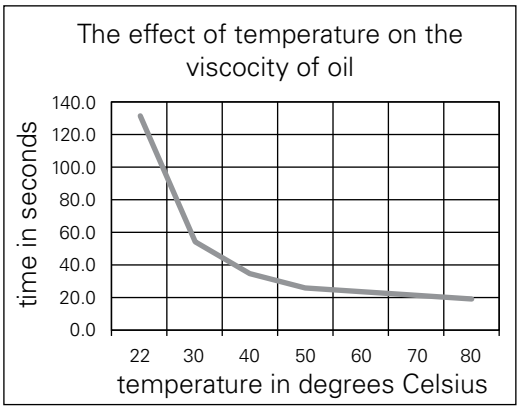
Worksheet 6-6

1. a. Research question: Does oil become more runny when it is warmer?
   b. Dependent variable: time (for the oil to run through the funnel); independent variable : temperature (of the oil)
   c. Most likely because the room was at 22 degrees C.

d.

131.3
54.7
34.7
25.3
22.0
19.7
18.7

e.



f. As the temperature increases, the time for the oil to run through the funnel decreases because it becomes more runny. In scientific terms: the viscosity of the oil decreases with increasing temperatures. As the oil gets warmer, the spaces between the particles increase and they can move past each other more easily, making the oil more runny.

Chapter 7

Worksheet 7-1

1. a. In first picture to the left, and in second picture downwards.
   b. A small push would move the eraser a short distance; a larger push would move it further.
   c. A force has a direction and a size (or magnitude).
2. a. Two teams are pulling on a rope. The team with the most force will pull the other team in their direction.
   b. The handkerchief will not move.
   c. Nothing, it still remains in the same place.
   d. No, it did not change speed, direction or shape.
3. a. The Moon's gravity is smaller than that on Earth.
   b. The Earth is bigger than the Moon.
   c. Yes, because Newton said that the force of gravity is bigger when the objects are bigger.
   d. Armstrong would have weighed more on Earth than on the Moon.
   e. Armstrong would have weighed nothing in space since there is no gravity. The scales would have shown zero.
4. a. Yes, the weight of the object is affected by the force of gravity.
   b. No, the mass of an object is independent of gravity.
   c. Weight is measured in Newtons (N)
   d. Mass is measured in kilograms (kg)
   e. We should discuss the mass because that tells us 'how much' there is.

Worksheet 7-2

1. a. ball sank
   b. boat floated.
2. a. big
   b. small
   c. sink
   d. small
   e. big
   f. float
3. volume of stone = 21.75 – 20.50 = 1.25 ml.
   density = 3.1 g/1.25 ml = 2.48 g/ml
   No because a sapphire has a density of 3.98 g/ml.

Worksheet 7-3

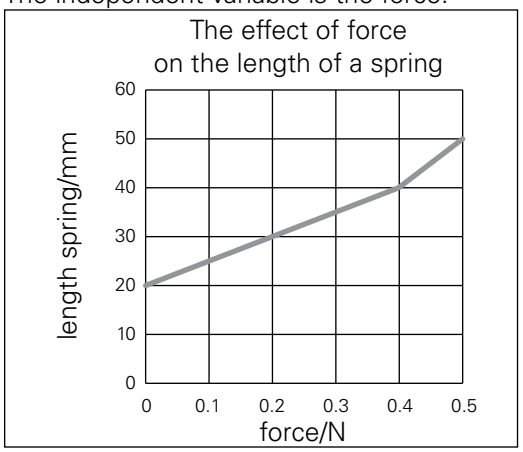
1. a. The plank bends.
   b. Assuming the person's mass is 75 kg, the force would be 750 N.
   c. At some point, the plank would break (and the people would get wet).
2. a. to be able to measure a range of forces accurately
   b. If you put too heavy a mass, the spring would be pulled out of shape and would not work anymore.
   c. If you put a very small weight, you would not be able to measure it accurately.

Worksheet 7-4

1. a.

mass in g	force in N	length in mm
0	0	20
10	0.1	25
20	0.2	30
30	0.3	35
40	0.4	40
50	0.5	50

b. The dependent variable is the length.
c. The independent variable is the force.



Worksheet 7-5

1. a. The tyres of the racing bikes are very narrow.
   b. The tyres of the cross country bike are much wider.
   c. Yes. A wider tyre means more friction. This will slow down the competitor but also reduce his chances of slipping and falling.
2. a. The friction increases.
   b. The speed of the car would reduce because the driver is no longer pushing the accelerator (so no more force to make the car move) and at the same time, the friction (of the brakes on the wheels) increases a lot.
   c. It is easy to do and students may feel their hands becoming a little warm.
   d. It is much more difficult and hands become very warm.
   e. It would be easier and less warm since the oil reduces the friction.
   f. Because oiling the brakes would reduce the friction and the brakes would not work anymore.
3. a. Thinking time and braking time or thinking distance and braking distance.
   b. 50 km = 50000 m
   1 h = 60 x 60 seconds = 3,600 s
   50 km/h = 50,000 m/3,600 s = 13.9 m/s
   c. 100 km/h is twice 50 km/h so it is 2 × 13.9 m/s = 27.8 m/s. In 2 s, the car will cover 2 x 27.8 m = 55.6 m.
   d. 50 km/h = 13.9 m/s. Thinking time is 1.5 sec so average thinking distance is 1.5 x 13.9 m = 20.85 m
   e. Answers for factors affecting braking distance would include: the brakes (type and maintenance), tyres (pressure and tread or profile), the car's mass, the road surface, etc

Chapter 8

Worksheet 8-1

1. i. a. carbohydrates
   b. fats
   c. proteins
   d. minerals
   e. vitamins
   f. roughage/fibre
   ii. roughage/fibre
   iii. water
   iv. because all chemical reactions in the body take place in solution

2.

nutrient *which kind*	**mainly used for**	**food rich in**	**test**
carbohydrates			
glucose	for energy (immediately)	fruit, juice, energy bars, salad dressing	Benedict's test
starch	for energy (after digestion)	rice, wheat (bread, pasta), corn, potatoes, beans	iodine test
fats	for energy	fish (salmon), butter, oil, nuts, avocado	ethanol test
protein	for building muscles for enzymes	beans, meat, cheese	Biuret test
minerals			
calcium	for strong bones	dairy products, green leafy vegetables	
iron	for red blood cells (which transport oxygen)	liver, beef, spinach	
vitamins			
vitamin C	for growth and repair	(citrus) fruit, green leafy vegetables	
vitamin D	to absorb calcium	salmon, butter made by skin under UV light	
roughage/fibre	to make gut work	whole wheat products, bran, lentils, broccoli	
water	(important but has no nutritional value)		