8A WORKBOOK ANSWERS

8Aa Food and advertising

1 Students' own answers, making reference to the need for food for energy and/or growth, repairing the body, health. Some students may list specific nutrients that the body requires from food (e.g. proteins, lipids/fats, carbohydrates, starch, vitamins, minerals) and fibre.
2 **a** ladybirds
b Sun
3 **a** large intestine, oesophagus, pancreas, small intestine, stomach
b blood/circulatory system
4 **a** Students' own responses (students carry out their own assessment of their answers to this in part **b**, the instructions for which are in question **8** in 8Ac Balanced diets).
b Students should be explaining how their meal plan is healthy or ways in which they now think it could be made healthier (using their knowledge from 8Aa, 8Ab and 8Ac). Ideas that should be covered include: that the meal plan is balanced overall and contains nutrients of each type, that there is a variety of foods, that starch-containing foods form the greatest proportion of the foods in the meal plan, that very fatty and sugary foods only form a small part, that there is some fibre-containing food, that there is not too much food.

8Aa Nutrients

1 What you eat.
2 **a** Students' own responses.
b 9.2 g
c 4.0 g
d 6.4 g
e minerals, vitamins (or named examples of these)
f for growth, for repair, for energy
g glucose/sucrose (there are many others but these are the expected answers)
h To stop intestines getting blocked/to stop constipation/to keep food moving through the gut.
3 From top: fat; Biuret solution; turns (orange to) blue-black.

8Ab Uses of nutrients

1 **a** eating/drinking
b any sensible suggestion (e.g. running, walking, sleeping, working)
2 for energy
3 **a** For energy; as an energy store; to help stop heat escaping from your body (a heat insulator).
b Name of any fatty food (e.g. cooking oil, avocado, cheese).
4 **a** kJ
b breakfast cereals (ensure that students understand that they need to compare the per 100 g columns in order to make fair comparisons)
c 100 g
d 370 + 360 + 330 = 1060 kJ
5 A
6 strong bones – calcium – milk; for fuel – carbohydrate – potatoes; healthy eyes – vitamin A – carrots; growth and repair – protein – meat and eggs

8Ab Nutrients and energy

1 **a** running fast
b **i** 2 × 470 = 940 kJ
ii 3 × 660 = 1980 kJ
iii (2 × 180) + (0.5 × 180) = 450 kJ
c 2 portions
d 470 + (2 × 250) + (180 ÷ 2) = 1060 kJ

2 **a** Ravi
b He has to move around more, which requires more energy than sitting at a desk.

3 The teenager needs more energy. Reasons could include: bigger so need more energy to move around; bigger muscles need more energy; growing faster.

8Ac Balanced diets

1 Students' own responses. Ideas may include:

protein is needed for growth and repair

carbohydrate is needed for energy

sucrose is a type of carbohydrate

water is an important part of the blood

scurvy is caused by a lack of vitamin C.

2 balanced, variety, foods, nutrients, nutrient, malnutrition

3 **a** Clockwise from bottom left: fruits and vegetables; dairy or foods containing lots of protein; fatty and sugary foods; dairy or foods containing lots of protein.
b One or more of these points:
He needs to eat a much greater range of foods.
His diet is missing fruits/vegetables and dairy products.
He may not be getting enough vitamins/minerals/fats.

4 A balanced diet has a good balance of all the nutrients provided by a variety of foods / does not contain too much or too little of any nutrient. So, someone with a balanced diet does not each too much food with a high-energy content.

5 kwashiorkor – too little protein – large belly; night blindness – too little vitamin A – poor vision in low light; rickets – too little vitamin D – poorly formed bones; anaemia – too little iron – tired and short of breath

6 **a** high blood pressure, heart disease (Note that being overweight is not caused by obesity.)
b **i** Arteries/blood vessels/capillaries become blocked by fat/cholesterol.
ii They die.

7 The recommended amount of protein to eat in a day is 50 g (for an adult).

8 See answer to 8Aa Food and advertising, question **4b**, above.

8Ac Making new foods (STEM)

1 **a** Students should identify ways in which the pizza base could be made healthier (e.g. reduce the sugar, reduce the fat, increase the fibre). There is no information about minerals or vitamins on the label but some students might suggest that more of these should be added.
b Encourage students to use the SCAM bullet points in the text in the Student Book. Ideas could include:
Less sugar: replace the sugar with artificial sweetener; reduce the levels of sugar/glucose.
Less fat: replace the oil with a gum; reduce the levels of oil.
More fibre: replace the bleached white flour with wholemeal/wholegrain flour; combine fibre from another source into the recipe.
c Students' own answers. Advertising boxes should include reasons why the product is now healthier (e.g. more fibre to help keep your intestines working properly).

8Ad Digestion

1 A group of organs working together.

2 **a** Breaks large/insoluble food molecules down into smaller ones.
b Many food molecules are too big for the body to use.

3 Any three from: pancreas, small intestine, stomach, salivary gland.

4 Labels:
to explain that muscles contract above the food
for 'oesophagus' or 'gullet'.
Students may also include notes about muscles beneath the food being relaxed, and that the food is on its way to the stomach. Some students may know that this process is called peristalsis, but this is not required knowledge.

5 From top:
A – liver – makes a substance to help digest fats
B – stomach – food is mixed with acid and digestive juices
C – large intestine – water is removed from undigested food
D – small intestine – food is digested and small molecules are absorbed
E – rectum – stores faeces

6 **a** defaecation or egestion
b defaecation or egestion
c ingestion
d absorption
e excretion

7 **i** Benefit – they can digest some foods that the body cannot.
ii Disadvantage – they cause flatulence; some of them are harmful.

8 They help to break down large/insoluble molecules into small/soluble molecules.

9 **a** They are catalysts because they speed up reactions, without being altered themselves; they are produced by organisms and so are 'biological'.
b Students' own responses. Note that improvements may include changes to spelling and grammar, as well as more factual points.

10 Scissors cut through paper and can make a large piece of paper into many smaller pieces of paper. Enzymes act in a similar way, turning large molecules into many smaller ones.

8Ae Surface area (WS)

1 28 × 15 = 420 m^2 (Ensure that units are included. Working need not be shown.)

2 **a** Smallest face is 2 × 0.5 = 1 m^2 (Ensure that units are included. Working need not be shown.)
b (2 × (2 × 0.5)) + (2 × (2 × 4)) + (2 × (0.5 × 4))
= (2 × 1) + (2 × 8) + (2 × 2)
= 2 + 16 + 4
= 22 m^2 (Ensure that units are included. Working need not be shown.)
c surface area = 22 m^2
volume = 2 × 0.5 × 4 = 4 m^3
$\frac{22}{4} = 10.5$
d **i** It increases
ii It increases

3 B

4 The smaller the food pieces are, the greater surface area they have and there is a larger area over which enzymes can break down the food. This means that smaller pieces of food will be digested faster; teeth help in this process by grinding up food into smaller pieces.

5 Surface area : volume ratio of the single cube is 0.75 (or 0.75 : 1)
Surface area : volume ratio of each of the eight smaller cubes is 1.5 (or 1.5 : 1)
The surface area : volume ratio doubles when the cube is cut up.

8Ae Absorption

1 **a** small intestine
b blood/plasma
c Sugars (glucose), because the enzymes break down the starch into sugars which are then small enough to diffuse through the Visking tubing.

2 **a** C
b A

3 Its surface area is increased by its length, folds, villi and microvilli.
The walls of the villi are only one cell thick, making it easier for molecules to diffuse.

8Ae Packaging and the law

1 **a** carbohydrate (sugars), protein, fat, salt
b starch
c 6.8 g
d Growth and repair.
e It is a warning that the food is quite high in fat. Eating too much fat can cause health problems such as cardiovascular disease/obesity/heart disease/heart attacks.

2 **i** Any vitamin or mineral
ii A correct description of a use in the body (e.g. calcium, is used for strong bones).

3 Flow chart showing:
starch being digested
by enzymes
into glucose,
which is soluble and
so can easily diffuse
through the wall of the small intestine and into the blood plasma;
cells take it out of the blood plasma.

4 **a**, **b** Students' own responses, showing an understanding of the concept of a balanced diet (eating food from a wide variety of sources to ensure the body gets enough, but not too much, of the nutrients that it needs to stay healthy).

8B WORKBOOK ANSWERS

8Ba Useful plants

1 Any one from: animal, fungus, protoctist, prokaryote ('animal' is the expected answer).

2 **a** **i** Any suitable such as fruit, vegetables.
ii Any suitable such as cotton for jeans.
iii Any suitable such as wood for houses.
iv Any suitable such as aspirin from willow bark, digitalis from foxgloves.
b Students' own answers.
c Any suitable such as: wood for furniture, wood for musical instruments, biodiesel from seeds, rubber from rubber trees.

3 They transfer pollen from one flower to another.

4 Pollination is followed by fertilisation of the female gamete in the flower, which leads to the formation of seed.

5 Any one from: edible fruits, wind, fruits that stick to animals, explosions.

8Ba Classification and biodiversity

1 **a** Animal cells have no cell wall and animals cannot make their own food.
b protoctists, prokaryotes, fungi

2 **a** *Bellis* or *Leucanthemum*
b Accept either perennis, vulgare or sylvestris, or full binomial names *Bellis perennis*, *Leucanthemum vulgare*, *Bellis sylvestris*.
c *Bellis perennis* and Bellis *sylvestris*, because they belong to the same genus which means they have a lot of features in common.

3 **a** They both have leaves, they both have roots, they both have xylem tissue (some students may include similarities from figure A on page 22 of the Student Book, e.g. their cells have cell walls).
b Conifers have cones, flowering plants have flowers; conifers have needle-shaped leaves, flowering plants have large, flat leaves.

4 **a** They are multicellular and their cells have cell walls.
b Any one suitable such as: their cell walls are made of different substances or fungi cannot make their own food but plants can.

5 **a** invertebrates: snail, fly; vertebrates: fish, snake
b Fish and snakes have a backbone, snails and flies do not.
mammals – have hair, young fed on milk; amphibians – jelly-coated eggs, moist skin; birds – hard-shelled eggs, feathers; reptiles – leathery-shelled eggs, dry scaly skin

6 Insect because it has six legs and body in three sections.

7 **a** Many different species (in a habitat/area).
b Any suitable such as: preserves ecosystems (since organisms depend on one another); preserves a source of undiscovered substances for human use; allows a habitat to recover faster if disaster strikes.

8Ba Accuracy and estimates (WS)

1 accurate – a measurement that is close to the real value; estimate – a measurement that is approximate; sample – a part taken from the whole for measurement; quadrat – a square frame used to sample habitats

2 50 ÷ 5 = 10, 10 □ 24 = 240 sweets

3 Any suitable such as: it would take too long to sample the whole area.

4 **a** Quadrat is placed in the habitat and all the organisms of interest inside the quadrat are counted/measured.
b To avoid bias in the samples / to avoid a scientist influencing the results, e.g. from placing the quadrat in easily accessible places.

5 **a** Total area of field = 20 □ 15 = 300 m^2, total area sampled = 10 □ 0.5 □ 0.5 = 2.5 m^2
estimate of number of daises on field = 300 □ 2.5 □ 6 = 720
b Advantage: likely to give more accurate estimate; disadvantage: takes more time.

8Bb Types of reproduction

1 gamete, gamete, zygote, inherit, parent, parent

2 **a** B
b **i** They are in the same genus but not the same species, so they are closely related but different species.

ii Plumcot plants are hybrids and so are sterile/do not produce gametes.
iii No, because they have the same information in their cells as in the one parent plant.

3 **a** flowers/pollen grains and egg cells/gametes
b runners

8Bc Pollination

1 **a** Clockwise from top right: anther, stamen, filament, ovule, carpel, pistil, style, stigma.
b To produce pollen grains (containing male gametes)
c ovule/ovary (containing ovule)
d stamen

2 **a** Pollen is transferred from an anther to a stigma.
b To bring a male gamete from another plant to the female gamete for fertilisation.

3 **a** petals: wind-pollinated – none (or very small); insect-pollinated – large brightly coloured
anther position: wind-pollinated – dangling outside flower; insect-pollinated – within flower
stigma structure: wind-pollinated – feathery; insect-pollinated – sticky
pollen grains: wind-pollinated – light, small, smooth; insect-pollinated – large, rough
scent: wind-pollinated – none; insect-pollinated – present
b Students' own answers

4 Pollen is transferred from the anthers of one plant to the stigma of another (of the same species).

5 It is the male tree that produces male gametes allowing cross-pollination of all the female flowering trees.

6 Because cross-pollination means the offspring have a mixture of characteristics from two different plants.

8Bd Air quality (STEM)

1 $\frac{268}{2000} = 0.134$ grains/cm^3

2 Student's own hypothesis from investigation, such as: The concentration of pollen in the air will be higher where there are more flowering plants with flowers open.

3 Factors that should be controlled (ignoring the factor investigated) include:
variation due to position – collect all measurements in one place
time of day – collect all measurements over same time period of day
time of year – collect all measurements at same time of year
weather – take measurements under same weather conditions (e.g. temperature, wind speed, air humidity).

4 Completed table with slide ranked from 1 to 5, where 1 is most pollen and 5 is least.

5 Suitable conclusion related to slide ranked 1 in table.

6 Measure off 1 mm square and count pollen grains in that, then multiply up by total area of collecting tape on slide.

8Bd Fertilisation and dispersal

1 **a** 1 – A pollen grain sticks to the stigma.
2 – A tube grows from the grain down through the style to the ovule.
3 – The male gamete moves down the pollen tube to the ovule.
4 – The male gamete joins the female gamete in the ovule.
5 – The nuclei of the gametes fuse to form a zygote.
b C

2 An embryo.

3 **a** From top: seed coat, embryo shoot, embryo root, food store.
b Shoot and root.
c Seed coat protects the embryo and food store; food store provides food for growth of embryo when seed germinates.
d ovary

4 **a** anomalous: 2nd drop at 8 cm (2.58)
b Any suitable reason to explain why the time is longer than others, such as not timing accurately when it hit the ground.
c 10 cm – 2.62; 8 cm (not including anomalous value) – 2.29; 6 cm – 1.81; 4 cm – 1.45; 2 cm – 1.13; 0 cm – 0.70
d As the length of wings gets shorter, the spinner falls faster.
e Students' own answers.
f Seeds that disperse using spinners need to have long wings so they can disperse far enough to avoid competition of the germinating seed with the parent plant.

5 Any two from: by being egested after fruits eaten by animal; attached to animal fur; explosion; floating on water.

6 **a** seed coat
b To stop the seeds being digested in the digestive system of the animal that eats them.

8Be Germination and growth

1 Students' own answers, though statements **a** and **d** are correct; **b** and **c** are incorrect (mitochondria carry out respiration in the embryo cells; dormant seeds are alive even though they are not growing).

2 **a** carbon dioxide + water (some students may also have included (+ energy))
b To release energy for growth.

3 **a** carbon dioxide, oxygen
b It traps energy from light and transfers it to glucose for storage.

4 **a** carbon dioxide, light, mineral salts
b for photosynthesis and healthy growth

8Be Animals using plants

1 So that scientists know exactly what organism is being talked about: there is less chance of confusion.

2 **a** They share key features of plants, e.g. have cell walls made of cellulose; they can make their own food by photosynthesis.
b Any one from: needle-like leaves, cones that contain seeds.

3 pollination – linked to flower; fertilisation – between flower and seed; seed dispersal – between seed and seedling; germination – after seed dispersal but before seedling

4 **a** In photosynthesis, carbon dioxide and water react to produce glucose and oxygen.
b They need glucose for food. They break down the glucose in respiration to release energy for growth and other processes, and as a raw material to make all the other molecules they need.

5 **a** Any two suitable such as: for shelter; for camouflage; as tools; for display.
b Different animals need different plants for different reasons. More types of plants mean more types of animals can survive.

8C WORKBOOK ANSWERS

8Ca Water sports and breathing

1 **a, b** Students' own concept maps – suitable words include: breathing tube/trachea, bronchi/bronchioles, diaphragm, energy, oxygen, carbon dioxide, ventilation, glucose, water, blood, cardiovascular system, heart.

2 **a** They both increase.
b More oxygen is needed by cells, therefore more air needs to be taken into the lungs so that more oxygen can be taken into the blood; the oxygen needs to be supplied to the cell more quickly by the blood so the blood must be pumped faster.

8Ca Aerobic respiration

1 **a** Beaker X because the peas are respiring (and this process releases energy, some of which is transferred by heating); accept answers that refer to releasing 'heat energy'.
b Beaker X because the peas are respiring (and this process produces carbon dioxide).

2 oxygen, glucose, carbon dioxide, water, energy, ATP, energy

3 **a** oxygen + glucose → carbon dioxide + water (+ energy)
b Good model: one from: you can see the reactants and products clearly, it is simple to understand; poor model, one from: it does not tell you anything about the energy released, it does not show you that a whole series of reactions is occurring.

8Cb Gas exchange system

1 ventilation – air movement into and out of the lungs; respiration – breakdown of glucose in cells to release energy; breathing – movements of the diaphragm and ribcage; exhalation – breathing out

2 **a** diaphragm
b Left diagram, arrowhead down/into lungs; right diagram, arrowhead up/out of lungs.
c Breathing in: muscles between ribs contract to pull ribs up and out, and muscles in diaphragm contract to pull it down/flatten it, decreasing pressure inside lungs so that air flows in from higher pressure to lower pressure.
d Prevents trachea collapsing or bursting as air as passes through it.

3 There are cells that produce mucus to trap dirt etc., and there are ciliated epithelial cells, which have cilia to sweep the dirty mucus away.

8Cb Gas exchange in the lungs

1 diffusion, random, carbon dioxide, alveoli, oxygen, blood

2 It increases the surface area for gas exchange so diffusion happens more quickly.

3 **a** X – carbon dioxide; Y – oxygen
b There is a lot of blood to exchange gases with, so diffusion happens more quickly.
c Both are very thin so diffusion happens more quickly.

4 The cilia do not work and so mucus builds up. This increases the distance through which gases have to move to pass between blood and air in the lungs and/or this reduces the amount of surface area for gas exchange, because some of it is blocked.

8Cb Means and ranges (WS)

1 B

2 **a** Hitesh: 30 cm^3 before exercise, 110 cm^3 after exercise; Josie: 50 cm^3 before exercise, 150 cm^3 after exercise.
b The results before exercise, because they have a narrower range.
c Hitesh before exercise 435 cm^3, Josie before exercise 327.5 cm^3 (a better answer would round this up to 330 cm^3 since all the figures in the table are given to only two significant figures); Hitesh after exercise 1037.5 cm^3 (a better answer would round this up to 1040 cm^3), Josie after exercise 860 cm^3.
d The mean value is likely to be closer to the real value because using a mean helps to take account of random errors in the measurements.
e Exercise increases tidal volume in males and females.
f Students' own answers

8Cb Exercise and pulse rate (WS)

1 **a** Measure pulse rate using a pulse meter (such as on a fitness app) at each 5-minute interval; running could be done on a treadmill at a constant speed, or over a track distance in a specific time.

2 **b** (62 + 63 + 62) □ 3 = 62.3 beats/min

c Students' own graphs:

- Axes should be labelled to say what they show
- Write the units after each axis label
- The graph should have a title
- Numbers on the scales should be written in
- Divisions on the scales should be evenly spaced
- The graph should fill as much of the paper as possible
- Use small neat crosses to plot points
- Plot points accurately
- Draw in (sharp) pencil.

d Start between 10 and 15 min; end between 30 and 35 min.

e Muscles need to carry out respiration faster during exercise. The heart beats faster to supply blood containing oxygen and glucose faster to muscles and carry away carbon dioxide from respiration in muscles.

8Cc Getting oxygen

1 **a** red blood cells (not white)
b bright red (not dark red)
c product (not reactant)
d capillaries (not veins)

2 **a**, **b** Students' own sentences with mistake corrected.

3 1 – Blood is carried from the lungs in blood vessels to the heart.
2 – The heart pumps the blood through arteries to other parts of the body.
3 – Blood flows through the tissues in capillaries.
4 – Capillaries connect to form veins, which carry blood back to the heart.
5 – The heart pumps the blood to the lungs. (Numbers should therefore read: 1, 5, 4, 2, 3.)

4 Carbon dioxide is a waste product of aerobic respiration. More respiration is needed when you run upstairs because muscle cells need to release more energy for contraction to move the body upstairs.

5 During exercise, more energy is needed therefore more aerobic respiration needs to occur, which needs more oxygen. The swimmer breathes faster to get more oxygen into the blood.

8Cc Lack of oxygen

1 **a** B
b B

2 **a** Possible answers include:

- tar coats the alveoli making diffusion of oxygen into the blood slower
- smoke irritates the lungs and can cause the alveoli to break down, reducing surface area
- carbon monoxide stops red blood cells carrying oxygen
- smoke and heat cause the cilia to stop working and mucus builds up which can cover some of the surfaces used for gas exchange.

b Students' own answers, including one from the list in part **a**.

3 **a** More fatty substance builds up in the arteries of smokers than in non-smokers.
b Narrowed arteries reduces blood flow, so less oxygen can get to cells. If they do not get enough oxygen the cells will die.

4 reduces, slower, less, faster

8Cc Epidemiology (STEM)

1 The largest volume of air that can be breathed in after all possible air is breathed out.

2 **a** Students' own spreadsheets.
b vital capacity – cm^3; age – years; height – m
c Students' own completed spreadsheets, plus scatter graphs of vital capacity against each of the other variables.
A description of a positive correlation that their spread sheet shows.

3 **a** Straight line on graph that is close to as many points as possible.
b There is a positive correlation between height and vital capacity. / As height increases, vital capacity also increases.
c Any suitable comments, such as: The scatter graph in the Workbook shows many more data points so the correlation is more obvious.

8Cd Comparing gas exchange

1 **a** hydrogen carbonate
b There will be little change in tube A because fresh air is drawn in through that tube. Tube B will become cloudy as exhaled air containing higher levels of carbon dioxide bubbles through it.

2 Some of the energy released by respiration causes heating of the body, which warms air in the lungs.

3 **a** Gases diffuse into and out of the leaf.
b C
c During the day, photosynthesis takes carbon dioxide from the air around the plant, reducing the acidity, which is indicated by the pink colour of hydrogen carbonate.

8Ce Anaerobic respiration

1 **a** both
b only aerobic
c only anaerobic
d only aerobic
e both
f both

2 **a** Stores energy released in respiration for use later by the cell.
b Aerobic respiration produces much more ATP than anaerobic (from each molecule of glucose).

3 **a** The swimmer needs more energy for fast swimming than can be supplied by aerobic respiration / because oxygen cannot get to muscle cells fast enough for all energy to be supplied by aerobic respiration.
b Anaerobic respiration makes muscles become tired quite quickly. / Anaerobic respiration uses up glucose faster than aerobic respiration and so runs out of glucose in the muscles quickly.

4 Any suitable such as:
lactic acid being turned into glucose in the liver requires additional energy from aerobic respiration which requires additional oxygen
replenishing oxygen stores in blood and muscles
additional aerobic respiration required to operate rib muscles and diaphragm at a faster rate (faster breathing rate)
additional aerobic respiration required to operate heart muscles at a faster rate (faster pulse rate).

8Ce Fitness training

1 Students' own completed maps.

2 **a** This increases the amount of oxygen circulating in the blood so that muscles can contract strongly from the start of the race.
b They run the race anaerobically. / All the energy for muscle contraction during the race is supplied from anaerobic respiration.
c Training increases the size of the heart muscle so it can pump out more blood in each contraction. So the athlete's heart can pump the same amount of blood in fewer contractions.

3 A vein has been cut because the blood is dark, so is lacking oxygen. Oxygen left the blood from capillaries as they passed through tissues before they joined up to form the vein.

4 Attached to the ribs, in the diaphragm.

8D WORKBOOK ANSWERS

8Da The Black Death

1 Movement, Respiration/Reproduction (either order), Sensitivity, Growth, Excretion, Nutrition

2 animals – feed on living organisms; plants – make own food; fungi – live on dead organisms; protoctists – mostly single-celled with nucleus in cell; prokaryotes – single-celled, no nucleus in cell

3 **a** **i** controls what moves into and out of cell
ii where respiration happens
b Any one from: cell wall supports the cell; chloroplasts where photosynthesis happens; vacuole stores cell sap.

4 **a** Tiny organisms/an organism that you need a microscope to see.
b Any sensible answer such as: baking, brewing.
c Any sensible answer such as: cause disease, cause decay of food.

8Da Unicellular or multicellular

1 **a** prokaryotes
b nucleus, mitochondria
c The cell walls are made of different substances so are not the same.

2 **a** They do not carry out any of the life processes on their own.
b 1 – protoctist cell; 2 – prokaryote cell; 3 – virus

3 From top: protein coat, fat envelope, strand of genes, protein molecule.

4 **a** Answers similar to: cell; the cell to make new viruses; break out of the cell.
b Any suitable viral infection such as: flu/influenza, HIV/AIDS, measles, chicken pox.
c They damage cells when they break out.

5 **a** Replication means copying from an original one; reproduction involves copying of DNA and cell division.
b Obligate means they have to be parasites at some stage to complete their cycle. Parasite means they live in or on another organism.

6 moving, overall, more, fewer

7 **a** **i** B
ii B
b Volume increases faster than surface area as dimensions increase.
c Cube A fully coloured in; cube B coloured in around the edges, centre still clear.
d The colour has not diffused into the centre of cube B in 30 minutes.

8 **a** circulatory system
b Substances can diffuse into and out of a unicellular organism fast enough for life processes to continue. Humans have too large a volume for substances to reach all cells by diffusion to or from the environment.

8Da Tackling diseases (STEM)

1 **a** Vaccines prevent infections; antibiotics kill bacteria after they have infected you.
b Soaps wash microorganisms off skin; disinfectants kill bacteria on skin.

2 Measles is caused by a virus and antibiotics do not affect viruses.

3 The vaccine stops the people getting the disease. The more people who are vaccinated, the less likely it is that the infected person comes into contact with an unvaccinated person to pass the disease on to.

4 **a** Students' own answers from experiment.
b Students' own explanations of conclusion drawn from results in experiment.
c Any suitable variables, such as amount of cinnamon/oil mixture used each time; time taken during washing; amount of soap used with cold and warm water; whether hands rubbed or not while washing.

8Db Microscopic fungi

1 **a** glucose + oxygen → carbon dioxide + water (+ energy)
b glucose → ethanol + carbon dioxide (+ little energy)
c Aerobic produces the most ATP, as more energy is released from the breakdown of glucose by aerobic than anaerobic respiration.
2 Any suitable such as: ringworm, athlete's foot fungus. Disease related to answer: ringworm causes red rings on skin; athlete's foot fungus causes athlete's foot (itchy skin).
3 Daughter cells are genetically identical to the parent cell.
4 **a** B
b C
c glucose

8Dc Bacteria

1 **a** circular chromosome
b cell membrane
c cell wall (accept slimy capsule)
d circular chromosome(s) and plasmids
e flagellum
2 **a** Completed diagram should show:
animal cells only – no structures; plant/animal overlap – nucleus, mitochondria; plant cells only – chloroplast, (permanent) vacuole; plant/animal/bacteria overlap – cell surface membrane, cytoplasm; plant/bacteria overlap – cell wall; bacteria only – nucleoid, plasmid, slimy capsule, circular chromosome.
b Key should separate the groups clearly by distinctions given in Venn diagram, for example:

1 has a nucleus go to 2	
has no nucleus	bacterial cell
2 has large vacuole	plant cell
no large vacuole	animal cell

3 **a** lactic acid
b anaerobic respiration
c Muscle cells in human/mammal.
4 **a** Graph should look similar to graph E on page 59, topic 8Db in the Student Book.
b Fridge line should show much slower increase from original number.
c Students' own answers
5 **a** Vaccination against whooping cough bacterium.
b Taking antibiotics should kill bacteria in the person.
c It causes disease/harm in humans.

8Dc Pie charts (STEM)

1 C
2 **a** lower respiratory infections
b Sixth
c **i** 17% (breathing system infections) + 13% (diarrhoea) + 10% (HIV/AIDS) + 9% (malaria) + 8% (tuberculosis) + 7% (infections before birth) + 7% (infections during/after birth) = 71%
ii 8% (breathing system infections)
iii Any answer similar to: infections cause nearly three-quarters of deaths in low-income countries but less than one-tenth of deaths in high-income countries.
iv Any suitable answer which relates proportions of causes to income, e.g. lack of health care/medicines available in low-income countries to treat infectious diseases.

8Dd Protoctists

1 **a** They are unicellular and have a nucleus.
b *Euglena* as it has chloroplasts and can photosynthesise.
c Yes, *Euglena* moves using its flagellum; *Paramecium* moves by waving cilia.
2 **a** Yes, because it causes disease/damages blood and liver cells.
b Yes, it is a parasite because it lives inside humans, and it is obligate because it needs to live in humans to complete its life cycle.

8Dd Algae

1 **a** carbon dioxide + water → glucose + oxygen
(light energy and chlorophyll may be indicated above and below the arrow)
b It captures energy from light for carrying out photosynthesis.
2 **a** Pyramid of three rectangles, of the same depth centred on each other, and drawn to scale: producers at bottom of width 703 units (e.g. 7.03 cm), primary consumers in middle of width 132 units (1.32 cm), and secondary consumers at top with width of 11 units (0.11 cm).
b Energy is transferred from organisms to the environment at each trophic level of the food chain. This leaves less energy stored as biomass than in the level below.
c If the algae are killed, then no food is produced on the reef for animals to eat, so they will die from starvation or move away.
3 Tuna, because the organisms in each trophic level above algae will store mercury from what they eat. The salmon will absorb only the small amounts of mercury in the microscopic animals. The tuna will get much larger amounts from the large fish that ate the small fish that ate microscopic animals.

8De Decomposers and carbon

1 B
2 **a** photosynthesis (not respiration)
b correct
c fossil fuels contain a lot of carbon
d two processes add carbon dioxide: combustion and respiration
e correct
3 **a** Stops energy being transferred from the heap, which results in an increase in temperature. This helps to increase rate of growth by decomposers/rate of decomposition by/enzyme activity in decomposers.
b Adds nutrients/nitrates/mineral salts to the soil, which plants need for healthy growth.
4 enzyme(s)
5 We are burning more fossil fuels. We have cut down forests that remove carbon dioxide from the atmosphere.

8De Black Death hypotheses

1 **a**, **b** Answers will vary between students, but suitable suggestions include:

Topic	Important points
viruses	• do not carry out life processes for themselves • are obligate parasites (have to be inside a cell to complete cycle)
diffusion	• the overall movement of particles from a region of their higher concentration to a region of their lower concentration • diffusion cannot exchange materials fast enough for life processes in large cells • surface area to volume ratio decreases as size increases
microscopic fungi (e.g. yeast)	• can carry out aerobic respiration: glucose + oxygen → carbon dioxide + water (+energy) • can carry out fermentation/anaerobic respiration: glucose → carbon dioxide + ethanol (+ some energy)
fermentation	
growth curves	• population growth is fastest where graph line is steepest • population growth slows down when glucose is a limiting factor and cells compete for it
bacteria	• some bacteria can respire anaerobically: glucose → lactic acid (+ some energy) • are killed by antibiotics • contain circular chromosome in nucleoid region (no nucleus) and plasmids • surrounded by slimy capsule to help stop them drying out
protoctists	• unicellular but many different kinds • unicellular algae photosynthesise • some protoctists can move, using a flagellum, cilia or pseudopods
pyramid of biomass	• shows how biomass in a trophic level changes as you move up a food chain • usually shows pyramid shape because energy is transferred to the environment by each trophic level
decomposers	• includes bacteria, fungi and protoctists • break down dead organic material (plant/animal tissue and animal waste) using enzymes, releasing mineral salts, and carbon dioxide by respiration
carbon cycle	• photosynthesis by producers removes carbon dioxide from the air • respiration by all living organisms adds carbon dioxide to the air • combustion (burning) of plants and fossil fuels adds carbon dioxide to the air

2 Algae need light to survive (for photosynthesis).

8E WORKBOOK ANSWERS

8Ea Engines

1 **a** C
b B
c D
d B
2 Students' corrections to question **1**.
3 When the fuels are burnt, they release substances that cause pollution; some students may illustrate with specific substances (e.g. CO, CO_2, NOx, particulates) and the specific harm they cause to the environment (e.g. CO_2 being a greenhouse gas, which increases the greenhouse effect that is leading to climate change).
4 hydrogen + oxygen → water (vapour)
5 Pass the gas through limewater; carbon dioxide makes it go milky/cloudy/misty.
6 Fuel is burnt to release energy, which is transferred to the wheels to make them go around.

8Ea Burning fuels

1 A fuel is a chemical substance from which stored energy can be transferred usefully through a combustion reaction.
2 Water (vapour)
3 **a** C
b C
4 fire (is flammable) / explosion / compressed gas
5 **a** A burning splint is put to the gas (in a tube); a squeaky pop or bark shows that the gas is hydrogen.
b The gas is passed through limewater; a change (from clear, colourless) to milky (or misty / cloudy) shows that the gas is carbon dioxide.
6 C, because water is formed, which is always formed when a hydrocarbon burns in air.
7 **a** Water of crystallisation
b It goes blue again (some students may know that it also gets hot).

8Eb Oxidation

1 oxygen
2

(The exact arrangement of atoms in the right-hand molecule is not essential, as long as one carbon and two oxygens are joined together.)
3 **a** magnesium + oxygen → magnesium oxide
b iron + oxygen → iron oxide
c copper + oxygen → copper oxide
4 That mass is never gained or lost in a chemical reaction.
5 From top: 40 g; 16 g; 64 g.
6 phlogiston, burns, heavier, oxygen, increases
7 By heating or by light

8Eb More about oxidation

1 **a** **ii** and **v** are true
b Students' own work.
c Examples could include:
i iron + oxygen → iron oxide
iii During an oxidation reaction, metal atoms do not change.
iv The products in an oxidation reaction have the same mass as the reactants.
vi 56 g of zinc reacts with 16 g of oxygen to make 72 g of zinc oxide

2 **a** The greater the mass of X, the greater the mass of the product.
b It reacts with oxygen; which makes it gain mass.
c 48 g (40 g of X reacts with 16 g of oxygen so 120 g of X reacts with 48 g of oxygen)

3 **a** 2
b 1
c 2
d 2

8Ec Fire safety

1 A reaction that releases energy as heat to the environment.

2 **a** Labels 'heat' and 'oxygen' added.
b If one side of the triangle is removed, the fire goes out.

3 **a** B
b B

4 **a** explosive
b flammable
c oxidising

5 **a** Water sinks through hot oil, then boils to steam with a large increase in volume, which pushes the oil out of the pan spreading the fire.
b Students' own confidence responses.

8Ec Fair testing (WS)

1 **a** **i** Independent variable: volume of fuel burnt.
ii Dependent variable: time taken for all fuel to burn.
b Different fuels might release heat at different rates, affecting the time taken for all the fuel to burn.
c E.g. size and type of container might affect the rate of combustion; the person measuring the time might affect the time; judging when the fuel has stopped burning might affect the time.

2 **a** incorrect
b correct
c correct
d incorrect

3 control, independent, dependent, fair, fair, valid

4 In the table, students need to show the independent variable in the first column. The two dependent variables should be in the second and third columns. Units should be given in brackets in the column headings. The readings need to be in a logical order (alphabetical by fuel or in order of time or maximum temperature). So an answer could be:

Fuel	Time the fuel burned (minutes)	Maximum temperature reached (°C)
A	7	63
C	6	71
B	4.5	55
D	3	26

5 Three variables and methods of control, for example, any three from:

Control variable	How it is controlled
Mass of metal	Use balance properly zeroed.
Form of metal	Ensure each metal is of same form (e.g. turnings, powder, granules).
Metal treated in the same way	E.g. preheated the same amount, heated to the same temperature (before adding to oxygen).
Apparatus	Keep same apparatus, cleaned between tests.
Timing start and end points	Stop timing at same point for each e.g. no more smoke, no more glow.
Volume of oxygen	Same container/gas jar for each experiment.

8Ed Air pollution

1 Carbon dioxide, carbon monoxide. Do not accept soot/carbon, which is not a compound.
2 **a** carbon monoxide
b carbon dioxide
c oxygen (molecule, gas)
d sulfur dioxide
3 **a**

Students are likely to suggest one of nitrogen monoxide or nitrogen dioxide. As above, the structure does not need to show any bonds, just the correct numbers of properly labelled atom centres, so N – O or O – N – O. Other answers may be worthy of credit, particularly if they show the correct bonding.
b Because the high engine temperature (and pressure) allow the combustion of nitrogen inside the engine to make nitrogen oxides.
c Any one from: use of filters, catalytic converters, cleaner fuels, more efficient/hybrid engines, lighter vehicles.
4 D
5 **a** B
b C
6 calcium nitrate + water
7 A
8 **a** emissions; 17; fell; 2007; 3.3; million; 0.5; tonnes; 85
b One reasonable suggestion e.g. use of neutralising sprays in power stations, use of lower sulfur fuels, catalytic converters

8Ee Global warming

1 The Sun

2 **a** Some energy emitted from the warm Earth is absorbed by carbon dioxide (and other greenhouse gases) and can be transferred back to the Earth's surface. Without carbon dioxide this emitted energy will be lost into space.
b An improvement such as in content, use of language, clarity, structure.

3 **a** That the amount of CO_2 in the atmosphere is increasing.
b The rate of increase is accelerating/not slowing down; will lead to climate change. (Some students may answer the first part of part **b** in their response to part **a**.)

4 Two sensible examples based on your local area, e.g. floods, drought, more frequent extreme weather events.

5 Because making cement involves the thermal decomposition of limestone which generates carbon dioxide. Carbon dioxide is a greenhouse gas, and will increase the level of global warming.

8E Carbon footprints (STEM)

1 A 'carbon footprint' is a measure of the masses of greenhouse gases (especially carbon dioxide) put into the atmosphere by people or organisations.

2 Car sharing means that there are fewer cars on the road; so less carbon dioxide is produced; this reduces the carbon footprint of the company.

3 **a** Eating locally produced foods reduces transport distances (fuel used) and so carbon footprint.
b Students' own responses.
c Ideally, pick one of their foods from the table with a high food miles value and suggest a way to reduce the effect, such as: eat less of that food, shop locally, buy locally grown produce, grow your own food.

4 List of four key bullet points – this could be required before any poster work is commenced to allow formative input.

8Ee Reducing pollution

1 **a** e.g. saves fuel, saves money
b e.g. reduces noise, reduces pollution

2 carbon – A; calcium carbonate – D; magnesium – B; methane – C

3 **a** C
b B

4 sulfur dioxide

5 Any one from: carbon monoxide gases react with more oxygen to form carbon dioxide / nitrogen oxides are broken down to oxygen and nitrogen.

8F WORKBOOK ANSWERS

8Fa Fireworks

1 An element contains only one type of atom whereas a compound is two or more different atoms that are chemically bonded.
2 D
3 D (C is also a correct answer, but is probably not the *best* explanation.)
4 Any two from: colour change, spontaneous change in temperature/gets hotter/gets colder, fizzing/effervescence, precipitate forms, change in pH.
5 Correct answer is '*is not*' in both sentences. Both are physical changes. Ideas may include: liquid water looks different from ice, but no new substance has formed; although the ice gets warmer it is only approaching room temperature (not generating its own heat or cooling down); a gas forms when the water boils but it is water vapour – no new substance has formed; the water only gets hotter (as it boils) because it is being actively heated.
6 carbon + oxygen → carbon monoxide/carbon dioxide
sulfur + oxygen → sulfur oxide/sulfur dioxide
aluminium + oxygen → aluminium oxide

8Fa Dalton's atomic model

1 atom, element, two, joined, reactions, substances
2 **a,b** Several possibilities, but a suggestion is given here (order of properties in the table is not important):

Properties of metals	Properties of non-metals
Shiny/lustrous (when polished)	Some shiny, some not
All good conductors of heat and electricity	Mostly not good conductors (some exceptions)
All ductile/can be drawn into wires	Not ductile/tend to be brittle
All malleable/can be bent into different shapes	Generally not malleable/tend to be brittle
Generally high melting/boiling points	Generally low(er) melting/boiling points
Generally hard	Generally not hard
SOME are magnetic	NONE are magnetic

3 **a** Mg
b S
c C
d Ga
4 **a** (6.4 + 1.6 g =) 8 g
b Students' own responses.

8Fb Chemical properties

1 **a** Any two from: hard/shiny/good conductor/ductile/malleable.
b Any two from: reacts readily with acids/reacts (slowly) with water/burns in air OR oxygen/flammable.
2 5 g
3 Table completed as follows:

Name	water	methane	ammonia	methanol
Number of atoms	3	5	4	6
Chemical formula	H_2O	CH_4	NH_3	CH_3OH or CH_4O

4 **a** Diagram showing one carbon atom and two bonded oxygen atoms combining to form a molecule of CO_2, i.e. one carbon bonded to two oxygen atoms.
b Students' own answers.

8Fc Mendeleev's table

1 periodic, Mendeleev, elements, mass, properties, discovered
2 **a** react with metals to form a solid compound/to form a salt
b react with water to form hydrogen and hydroxide/react with oxygen to form metal oxide
c unreactive/inert
3 B
4 **a** Any one from: fizzes/bubbles/catches fire/red flame/melts/gets hot/moves on surface of water.
b sodium (Na), potassium (K), rubidium (Rb), caesium (Cs)
c Also in group 1 or also an alkali metal (also accept 'also has only one electron in its outer shell').
5 sodium + water → sodium hydroxide + hydrogen
zinc + chlorine → zinc chloride
6 **a** D
b C
c B
d C
e A
f A
7 Students' own answers.

8Fc Anomalous results (WS)

1 **a** Mass on horizontal axis, volume of gas on vertical axis. Points plotted accurately to one small square.
b Point at 0.2 g and 138 cm^3 circled.
c Straight line through points, omitting point at 0.2 g, 138 cm^3.
d Several possible answers, e.g. some gas lost during experiment/wrong mass of lithium used/mass measured incorrectly.
e Students' own answers.

8Fd Physical trends

1 **a** BC
b DE
c liquid
d Diagram showing particles in a regular arrangement, fixed positions (solid).
e A
f heat energy is being used disrupt/break attractions between molecules (NOT bonds)

8Fd Looking for trends

1 **a** 98 °C (freezing point = melting point)
b solid
2 **a** solid
b liquid
3 **a** increases
b bromine
4 **a** lithium, Li
b magnesium, Mg
c fluorine, F
d krypton, Kr
5 **a** Any one from: silicon, germanium, tin, lead, flerovium.
b Any one from: sodium, magnesium, aluminium, silicon, phosphorus, chlorine, argon.

8Fd Inspiring teachers (STEM)

1 118, oganesson, Og
2 Several possible answers, e.g. demonstrated experiments, used lots of images/props, talked excitedly about the subject, encouraged questions, answered questions with enthusiasm, discussed topics off the syllabus, etc.
3 Students' own answers.
4 Students' own answers.

8Fe Chemical trends

1 **a** more
b **i** rubidium hydroxide AND hydrogen (gas)
ii violent fizzing, fire/flame, explosion
c They form hydroxides with water, which are alkaline.
2 **a** silvery metal – alkaline solution; gas – acidic solution
b **i** on the left/group 1 (or 2)
because metals are found on the left of the periodic table/because group 1 (and some group 2) metals react with water/because it formed an alkali.
ii on the right/group 5/6/7 (NOT group 0)
because (some) elements on the right/in those groups are gases at room temperature/because it formed an acidic solution.
3 **a** B
b acid + base → salt and water (either order)
4 **a** sodium chloride
potassium nitrate
copper sulfate
b zinc oxide + hydrochloric acid → zinc chloride + water
5 **a** A
b D
6 **a** It would burn brightly.
b Fluorine would be more reactive than chlorine as reactivity increases up the group of halogens.

8Fe Firework ban

1 Many possible answers, e.g.: Ba, barium; C, carbon; Fe, iron; K, potassium; Li, lithium; Mg, magnesium; N, nitrogen; Na, sodium; O, oxygen; S, sulfur.
2 **a** Particles change from being close together/touching to far apart (and moving much faster).
b −7 °C (same as melting point)
c gas
d Boiling points increase as you go down the group.
e A
f F_2
g B

8G WORKBOOK ANSWERS

8Ga Building up

1 A, D, E, H, I
2 **a** strong and stiff
b Several answers possible – e.g.: stronger than iron, less brittle, cheaper.
3 **a** A mixture of metal and non-metal.
b Two reasonable suggestions, for example: stronger, lighter, more resistant to corrosion.
4 Box 1: students should note that there is a chemical reaction (as there are bubbles) and spot that one product is a gas. Some may know or guess what the gas is.
Box 2: see the answer to question **7** in 8Gd Metal salts.

8Ga Metal properties

1 good conductor of heat – frying pan – copper
good electrical conductor – mobile phone cable – gold
malleable and ductile – garden fencing wire – steel
shiny – jewellery – silver
strong – beams to hold up roofs – iron
2 A physical property can be observed or measured without changing the material. A chemical property may only be observed by changing the chemical identity of a substance.
3 **a** sodium oxide
b magnesium fluoride
c silver chloride
4 A substance that changes the speed of a reaction without being permanently changed itself.
5 Any one from: they are often expensive; the same catalyst can be used again and again.
6 Any one from: they are used in catalytic converters to remove harmful gases from car exhaust; they are used in some chemical industries to speed up reactions. (Other examples may also be correct and some students may name specific applications of catalysts in industrial chemistry, for example in production of ammonia.)

8Gb Corrosion

1 The corrosion of iron/when iron reacts with oxygen and water.
2 **a** $36 - 28.8 = 7.2\ cm^3$
b $(7.2/36) \times 100 = 20\%$
3 Titanium corrodes naturally in air, forming a surface layer of metal oxide. The oxide coating sticks to the surface, does not affect the strength of the metal and protects it from further corrosion.
4 $Mn + O_2 \rightarrow MnO_2$ ratio is 1:2
$2Cu + O_2 \rightarrow 2CuO$ ratio is 1:1
(Note that students are not expected to be able to balance equations at this stage.)
5 2:3
6 **a** Nail X rusts more quickly because it is in contact with air/oxygen and water.
b Any two from: paint; plastic coating; oil coating; powder coating.

8Gc Metals and water

1 **a** potassium + water → potassium hydroxide + hydrogen
b calcium + water → calcium hydroxide + hydrogen
2 D, B, C, A
3 Confidence grid – student opinion. **c** is correct; **a**, **b** and **d** are not correct.
4 **a** copper
b potassium
c silver or mercury

8Gd Quality evidence (WS)

1 **a** B
b A
2 If results are measured by one experimenter and are all very close together, then we say they are repeatable. If other people can get similar close values, we say the data is reproducible.
3 **a** beaker
b jug
c bucket
4 **a** X; because with only one result, there is no way of knowing if it is repeatable or not.
b Z; because this has the readings closest together.
c 35 (final result in Y).
d e.g. misreading scale, timing too short/long
e C
5 **a, b** Students' own responses. Ensure that students are clear on the meanings of these words.

8Gd Metals and acids

1 **a** Any of: potassium, sodium, lithium.
b Any of: platinum, gold, silver, mercury, copper.
2 **a** **i** true, **ii** true, **iii** false, **iv** false, **v** false.
b Students' own answers.
3 **a** The solution is being filtered.
b To remove excess calcium (otherwise the dry solid will not be pure calcium chloride).
c The solution is being heated (gently).
d To remove/evaporate water and leave behind the solid dry salt.
e calcium chloride
4 acid + metal → salt + hydrogen
5 **a** H_2
b $BaSO_4$
c hydrogen chloride
d sodium; hydrogen
6 **a** Na – hydrochloric acid (HCl); NaCl
Mg – sulfuric acid (H_2SO_4); magnesium sulfate
K – 2:1:4
K – potassium nitrate; KNO_3
b Place the gas in a boiling tube and light it; a squeaky pop indicates the presence of hydrogen.
7 Students should now be able to state that it is a chemical reaction, the gas is actually hydrogen (which we can test for with a lighted splint) and the reaction produces a salt. Students may have included the word and/or symbol equation (magnesium + sulfuric acid → magnesium sulfate + hydrogen / $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$).

8Ge Pure metals and alloys

1 **a** The composition of a pure substance is the same throughout. A mixture does not have a constant composition. (Some students may answer in terms of a pure substance being made of only one 'type of thing' / substance or that pure elements contain only one type of atom. Give credit for these attempts.)
b An alloy is not a pure metal but is a mixture of metals. Must use the word 'metal'.

2 **a** Any of the properties accompanied with a reason/justification (e.g. bronze is harder and so less likely to change shape if things hit it; bronze is stronger and so less likely to change shape if things fall on it; bronze does not corrode so easily so is more likely to stay shiny for longer; bronze is more shiny and so looks more attractive).
b Improved ductility.
c Stainless steel does not rust but steel can rust.
d 8%
e They are all stronger.

3 **a** Labels should make it clear that:
the upper diagram is the pure metal (there are no other atoms in the diagram) / the lower diagram is the alloy
a force allows layers of atoms to slide over one another in the pure metal
the additional atoms in the alloy block up the layers/distort the regular structure and so stop the layers from sliding.
b Students' own answers.

4 **a** B
b B
c A
d C

5 Students' own answers.

8Ge New alloys (STEM)

1 metallurgist

2 **a** 25% X; 75% Y
b Any one from: not ductile/too brittle, low melting temperature, too expensive.

3 **a** Students' own choices; one from: strength, ductility, malleability or heat conductivity.
b Students' own decision – new invention or adapt an existing device.
c Features likely to include something that: applies a force (gradually increasing), draws the object/material into a wire (gradually increasing in length), changes the shape of an object/material (through hammering/pressing with increasing force), increases heat applied to an object/material.

8Ge Metals in art

1 **a** A – copper; B – gold; C – iron
b stainless steel

2 **a** 1:2
b 1:1:1
c 1:1:4
d 2:1:4

3 **a** catalyst
b Zinc chloride and copper.

4 From top: iron oxide, water, copper oxide, barium chlorate + hydrogen, iron hydroxide, nitric acid.

8H WORKBOOK ANSWERS

8Ha Disaster!

1 **a** Two sensible suggestions, such as:
Ash destroys crops (by blocking out the Sun or covering them).
Sulfuric acid destroys crops (due to acid rain or by causing a haze that blocks sunlight).
Lava destroys crops/livestock/homes/utilities.
Rock slides destroy crops/livestock/homes/utilities.
b lava
2 C
3 **a** It increases the temperature/keeps the Earth warm.
b Burning fossil fuels/burning forests.
4 **a** Carbon dioxide
b Ash/rock fragments

8Ha Rocks and their uses

1 Rocks, compounds, grains, shapes, texture.
2 **a** Water can soak into it.
b Labelled diagram showing rounded grains with spaces in between.
c Sandstone is the expected answer but others are also correct (e.g. limestone).
3 Any two from: blocks for building; in cement or concrete; to neutralise acidic soils.
4 **a** 4
b They have interlocking (grains)/crystals.
5 **a** Any two from: easy to carve; resistant to wearing away; attractive appearance.
b Strong; resistant to wearing away.

8Hb Igneous rocks

1 From top to bottom: crust, mantle, outer core, inner core.
2 Magma is molten rock within the ground; lava is molten rock that has reached the surface of the Earth.
3 **a** B
b A
4 **a** Expected answers include gabbro, basalt, granite.
b Intrusive rocks cool slowly.
5 **a** D (bottom right)
b It is igneous – shown by interlocking crystals; and extrusive because the crystals are small.

8Hb Metamorphic rocks

1 High temperatures and large pressures.
2 At position 2: this is existing rock that is heated by the molten rock next to it.
3 **a** Gneiss
b Because it has bands in it.
4 Underlined/highlighted: gneiss, quartzite and amphibolite.
5 Students' own answers.

8Hb Predicting eruptions (STEM)

1 There is more magma inside it.
2 **a** There are no right or wrong answers but possible responses include:
carbon dioxide/a gas comes out of it, things pour down its sides.
b It is predictable, it is not hot, the foam is white (and not red).
3 **a** Points made may include:
The seismometer works by detecting movements in the ground.
When you shake the box, this is like the Earth shaking in an earthquake. The cup full of stones tends to stay still.
The pen records how the box (the Earth) moves relative to the cup of stones.
As you pull the paper strip through, it shows how the Earth's movements change with time.
b Students' own answers

8Hc Weathering and erosion

1 biological weathering – occurs when plants grow in the cracks in rocks and their roots make the cracks wider so the rock breaks; chemical weathering – occurs when acid rain falls on rocks and reacts with it; physical weathering – occurs when changes in temperature cause rocks or water within the rocks to expand and contract
2 **a** Freeze–thaw action is a form of physical weathering.
b Sandstone and limestone.
3 **a** calcium carbonate → calcium (nitrate) + water + (carbon) dioxide
b calcium sulfate + water +carbon dioxide
c Reactants: any one of: calcium carbonate, nitric acid, sulfuric acid.
d Products: any one of: calcium nitrate, calcium sulfate, water, carbon dioxide.
4 Correct responses are:
Freeze–thaw action happens in wet places where the temperature often goes below 0 °C.
Carbonates, such as limestone, react with acid and are used to neutralise acidic soils.
5 How fast the river is flowing.
6 They get more rounded.
7 **a** A river of ice.
b The glacier carries large rocks that can scrape pieces of rock from the land they move over.
8 **a** water collects in rock crack.
b water freezes and expands forcing crack to widen.
c ice thaws, contracts and water gets deeper into cracks again.
d contraction causes further cracks until rock splits.

8Hd Sedimentary rocks

1 **a** **i** Sedimentation – eroded sediments end up in the water and begin to settle
ii Compaction – over time more layers form and press down on the lower layers.
iii More layers are added (and compaction forces water out).
iv Cementation – the layers are glued together and sedimentary rock is formed.
2 **a** It has to be heated or compressed.
b Correct words in order: mudstone, slate, quartzite.
3 Minerals dissolved in the water that was between the grains.

8Hd Theories in geology (WS)

1 Prediction
2 C
3 A, C
4 Answers should resemble the figure in the workbook, but have 'gather more observations' instead of the 'experiment' and 'data' boxes.

8Hd The scientific method (WS)

1 Earth scientists cannot easily do experiments, they have to rely mainly on observations.

2 **a** Type of rock.
b Mass of water absorbed.
c That different types of rock absorb different amounts of water depending on their permeability.
d Sandstone or limestone.
e These rocks have gaps between the grains that will trap water.

3 **a** The volume of hot water added to the jelly.
b Any two from: the type of jelly; the distance travelled; the angle of the slope; the surface of the ramp.
c 12 cm^3 of hot water.
d The more hot water is added, the runnier the jelly, so the further it travels.

8He Materials in the Earth

1 A, C
b Students' own answers.

2 **a** ore
b mining or quarrying
c minerals
d native

3 Disturbs habitats, causes pollution.

4 It costs money, so would reduce profits.

5 Any two from: it reduces pollution; it reduces landfill use; it allows metal supplies to last longer; it needs less energy than extracting the metal from ore.

8He Living in danger

1 **a** From top, clockwise labels in boxes: sedimentary rock, igneous rock, metamorphic rock.
A line should be drawn from metamorphic rock to increasing temperature and pressure.
A line should be drawn from sedimentary rock to weathering, erosion, deposition and cementation.
b Examples of types of rock could include: sedimentary – limestone, sandstone; metamorphic – marble; igneous – basalt, granite.
c Students' own answers.

2 It forms gabbro if it cools down slowly (e.g. underground) and forms basalt if it cools down quickly (e.g. on the surface). Basalt is also formed in thin intrusions such as dykes and sills, but students have not covered this yet.

3 **a** Any two from: chemical weathering – minerals in rocks react with chemicals in rain/water; biological weathering – plants grow in rocks, breaking them apart; freeze–thaw action – water gets into rock cracks then freezes, expands and breaks the rock; onion-skin weathering – rocks expand and contract with temperature changes and cracks form.
b Any two from: wind, water, ice.

4 calcium carbonate + sulfuric acid → calcium sulfate + water + carbon dioxide

8I WORKBOOK ANSWERS

8Ia Exploring extremes

1 **a** solid
b gas
c liquid

2 Note that students are not expected to be able to answer this question in detail until they have finished studying the unit.
a **i** The pressure of water on the outside. The pressure is caused by the force of water particles hitting the outside.
ii The pressure increases as you get deeper, because the further down you go, the more weight of liquid there is above.
b Answers could include breathing underwater, keeping warm enough, providing light.
Note that students are not expected to be able to answer this question in detail until they have finished studying the unit.

3 **a** As you get higher in the atmosphere the pressure gets less, because there is less weight of air above pressing down. This means that the density is also less, and so there is less oxygen in each breath.
b Answers could include protection from cold, being able to walk on ice/snow, taking all their food and equipment with them.

4 Students' own answers.

8Ia The particle model

1 **a** B
b C

2 **a** D
b B

3 **a** They flow.
b Gases are easy to compress, liquids are not.
Gases expand to fill their containers, liquids have a fixed volume.

4 **a** Brownian motion – tiny specks in air or water jiggling around; diffusion – liquids or gases mixing without anything moving them; expanding and contracting – materials changing size when heated or cooled
b **i** Diffusion – the particles are moving around all the time.
ii Brownian motion – the specks are hit by the moving air/water particles.
iii Expanding – the particles move faster and so need more room in which to move.

5 **a** The movement gets less.
b It gets smaller/the volume gets smaller.

6 liquid, move around, heated, vibrate volume, mass, bigger, smaller

7 The volume of the liquid inside the thermometer depends on the temperature. As it expands and contracts the volume of liquid in the tube changes and the relevant temperature is read off the scale.

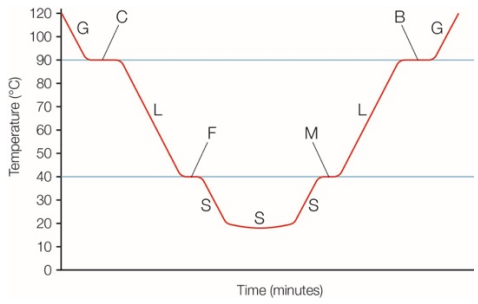
8 **a** The metal would expand in hotter weather, so the bridge might buckle.
b The metal would contract in colder weather, so the bridge might break/be pulled apart.

8Ia Calculations with density (WS)

1 mass, volume
2 decreases, expands, increases, larger, less
3 2 × 5 × 1.5 = 15 cm^3
4 Fill a displacement can with water and place a measuring cylinder under the spout. Carefully drop the piece of clay in. The volume of water pushed into the beaker is the same as the volume of the modelling clay. Alternatively, put some water in a measuring cylinder and read the level. Drop the object in. Its volume is the same as the change in water level.
5 **a** cm^3, m^3 (accept ml for one answer)
b g, kg
c g/cm^3, kg/m^3
6 **a** convert the mass to g, by multiplying by 1000
b density = 1800 g / 90 cm^3 = 20 g/cm^3
7 **a** mass = density × volume
b volume = mass/density
8 **a,b** **i** 0.25 g/cm^3
ii 25 m^3
iii 20 g/cm^3
iv 3 m^3
v 160 g
vi 3 cm^3
vii 400 kg
9 **a** mass = density × volume
b mass = 2.7 g/cm^3 × 50 cm^3 = 135 g
c volume = 810 g / 2.7 g/ cm^3 = 300 cm^3

8Ib Changing state

1 No new substances are formed/the atoms in the molecules are not rearranged.
2 **a** Any two from: melting, boiling, evaporating, condensing, freezing, subliming, dissolving.
b Any two chemical changes (e.g. combustion, neutralisation, rusting, baking a cake, heating limestone).
3 **a** Graph labelled as shown. Note that only one label is required for G, L and S, which can be in any of the places shown.



b Students' own answers
4 **a** 40 °C (students may have drawn a line as shown above to read off the temperature).
b 90 °C (students may have drawn a line as shown above).
c 40 °C
d The freezing point is the same temperature as the melting point.
5 **a** Evaporation can happen from a liquid at any temperature.
b It changes directly from a solid to a gas.
6 The volume of the solid increases gradually as it is heated, then increases suddenly when the substance melts. The volume of the liquid then increases gradually again.
7 **a** Particles vibrate further (for a solid) or move around faster (liquids and gases) so the substance takes up more space.
b The volume of the liquid iron gradually gets less as it cools down, then it decreases suddenly when the liquid turns into a solid.
8 **a** It increases because the volume decreases.
b It decreases.
c It makes ice float, so it forms on the top of ponds, which helps fish and other organisms to survive.

8Ic Pressure in fluids

1 A liquid or gas
2 Particles hitting the walls of a container/ particles hitting something in the fluid.
3 Fluids inside our body have a similar pressure.
4 **a** A
b B
5 **a** C
b A
6 When the bag was sealed at sea level, there were a certain number of air particles in it, giving the same pressure inside the bag as outside it. When the bag is taken up a high mountain, the pressure outside the bag is less. This means there are more particles hitting the inside of the bag than the outside, so the bag bulges outwards.
7 Pressure is caused by particles in the fluid hitting us. The particles in a liquid are much closer together than the particles in a gas, so there are many more of them hitting each square centimetre of our skin. Pressure also depends on the weight of the fluid above us. Water is much denser than air, so the change of pressure with depth/height is greater.

8Id Floating and sinking

1 Upwards arrow drawn same size as the downwards one. Upwards arrow labelled upthrust; downwards arrow labelled weight.
2 **a** Weight and upthrust.
b They are the same size.
3 **a** A – 0.8; B – 0.05; C – 0.4; D – 2.0; water – 1.0
b Students' own answers.
c Any sensible explanation, such as: floating blocks have densities less than water, and the lower the density the higher they float. The block on the bottom has a density greater than water.
d Yes, all objects in a fluid have upthrust. The upthrust on D is not enough to make it float.
4 **a** Iron will float in mercury because it is less dense than mercury.
b Polystyrene is less dense than water, so it floats in water. It is more dense than air, so it will not float in air.

8Ie Drag

1 The resistance force caused when an object is moving through a liquid or a gas.
2 **a** **i** It heats the object.
ii By giving the object a smooth surface.
b **i** Increased speed increases the drag, because more fluid particles have to be pushed out of the way each second.
ii Any one from: give the object a streamlined shape; keep the front area as small as possible.
3 Arrow on second car approximately half the size of the blue arrow, and pointing to the left.
Arrow on third car the same size as the blue arrow and pointing to the left.
4 **a**, **b** Any two from: increase power/make engine bigger (increasing the amount of force produced by the engine increases the forwards force of the car), decrease drag/make car more streamlined (decreasing the drag force means more of the engine forces are used to move the car forwards – increases the forwards force of the car). Note that decreasing the weight of the car will also increase the top speed, but this is due to decreasing friction within wheel bearings etc., so it is increasing the effective force available from the engine. Students are not expected to know this.
5 Students' own answers.

8Ie Operating aeroplanes (STEM)

1 **a** Airline pilots can fly all over the world, so they need to be able to understand maps for all parts of the world.
b kg/m^3
c So that machines built in one country can be safely worked on/repaired by electricians in other countries. Accept any similar explanations.

2 The density is approximately 0.34 kg/m^3 at 12 km height, compared to 1.2 kg/m^3 at sea level. The density at 12 km is about 1/4 of the density at sea level.

3 **a** The lift is less, as lift increases with increasing speed (or similar explanation).
b The lift is less. At a greater height the air density is less. As lift is proportional to air density, the lift also decreases.

4 On a hot day the density of the air decreases, and so the lift for a given speed decreases. This means that to get the same amount of lift as on a cold day, the aeroplane needs to go faster.

8Ie Humans at the extremes

1 Students' own answers.

2 **a** The pressure of water on the outside. The pressure is caused by the force of water particles hitting the outside.
b The pressure increases as you get deeper, because the further down you go, the more weight of liquid there is above.

3 As you get higher in the atmosphere the pressure gets less, because there is less weight of air above pressing down. This means that the density is also less, and so there is less oxygen in each breath.

4 **a** Give it a smooth surface (to reduce friction), a streamlined shape and a small frontal area.
b The overall volume remains the same but the mass of the submarine increases, so the density increases as density = mass/volume.

8J WORKBOOK ANSWERS

8Ja Seeing things

1 light source – something that produces light; transparent – a material that light can travel through without scattering; shadow – a place where light cannot get to because something is blocking the light; opaque – a material that does not let light through

2 B

3 **a** We can see the lights on the buildings directly, when light coming from them enters our eyes. We can see the rest of the buildings and the water, because light reflects from their surfaces and some of it enters our eyes.
b Some light in the laser beams is scattered by dust in the air, and some of this scattered light enters our eyes.
c, **d** Students' own answers.

8Ja Light on the move

1 absorb – to take in; transmit – to pass through a substance; reflect – to bounce off a surface; scatter – to send things off in different directions

2 Light travels much faster than sound.

3 Any two from: light travels faster than sound; sound waves are longitudinal and light waves are transverse; light can travel through a vacuum but sound needs matter; sound is vibrations of particles but light is not.

4 Light ray from TV directly to boy's eye, light ray from lamp to book and then to girl's eye. Light rays should include arrows to show direction of travel.

5 **a** Z
b Y
c Z is letting most of the light pass through it, but the direction of the light is changed. Y is reflecting or absorbing all the light that hits it: no light can pass through.

6 Sound can pass through the materials that the door/wall is made of, but light cannot.

7 **a** Light cannot pass through the box. Light travels in straight lines, so it cannot reach the part of the wall beyond the box.
b Straight line drawn from bulb past the top of the box to meet the wall. Wall shaded below this point.
c Straight line drawn as above; wall shaded below the point where the ray of light meets it.
d Students' own answers.

8Jb Drawings and conventions (WS)

1 The box produces a narrow beam or beams of light that can be marked on paper. This makes it easier to follow and measure the paths of light rays.

2 So that all scientists can understand the diagrams.

3 **a** angle of incidence – the angle between the incident ray and the normal; angle of reflection – the angle between the reflected ray and the normal; incident ray – a ray of light travelling towards a mirror; normal – a line drawn at right angles to the mirror; plane mirror – a flat mirror; ray diagram – a diagram showing rays of light as straight lines with arrows showing which way the light is going; reflected ray – a ray of light travelling away from the mirror after being reflected

b **i** Reflected ray drawn such that the angles of incidence and reflection are equal. Ray should include an arrow.

ii Diagram labelled correctly (as per diagram D on page 153 of the Student Book).

4 **a** A possible answer is:

Apparatus: ray box and slit, mirror, paper, pencil, ruler.

Instructions:

Put a ray box and mirror on a piece of paper and draw a line along the back of the mirror.
Aim a ray of light at the mirror and mark the path of the light using small crosses.
Join the crosses using a ruler.
Draw a line at right angles to the mirror line where the light hits the mirror and measure the angles between the light rays and the normal.
Repeat by shining the light at the mirror at different angles.

b Students' own answers.

c Students' own answers.

5 If the ray is narrower, it is easier to mark the middle and more precise measurements can be obtained. Students could mention that a brighter beam is easier to see, which may also help accuracy when looking at the beam a long way from the source.

8Jb Reflection

1 20°

2 **a** false
b true
c false
d true
e true
f true

3 Polishing makes the surface smoother, so light is more likely to be reflected evenly/less likely to be scattered.

4 **a** Completed ray diagram should look like diagram D on page 155 of the Student Book. Students should use a ruler for drawing straight lines, and put arrows on their rays to show direction of movement.

b Image labelled correctly.

5 **a** B
b C

6 **a** The law of reflection is obeyed for each part of the surface, but because the surface is rough/has lots of different angles, the reflected rays go off in different directions.

b Students' own answers.

8Jc Refraction

1 Diagram labelled correctly.

2 transparent, slowly, towards, away from

3 First diagram (X) shows refracted ray bent towards normal. Ray should include arrow.
Second diagram (Y) shows refracted ray bent away from the normal. Ray should include arrow.

4 Rays of light reflected by the object bend away from the normal as they leave the water. The rays of light appear to be coming from a place above the bottom of the water, so the water looks shallower than it really is.

5 Thicker/fatter in the middle than at the edges.

6 **a** Makes the beam come together/makes rays of light converge.

b The thicker the lens, the closer the focal point is to the lens.

8Jd Cameras and eyes

1 **a** **i** F
ii C
iii E
iv B
v G
vi D
vii A
b **i** the lens and cornea
ii the pupil
iii the retina
iv the lens and muscles
c Students' own answers.
2 **a** It gets bigger.
b It allows more light into the eye.
3 In a camera, the electronic signals are recorded on a memory card. In the eye, impulses are sent continuously to the brain.
4 red, green, blue

8Jd Looking after our eyes (STEM)

1 Answers could include:
When they are using a chart, they need to ask the patient to read out the letters.
They need to talk to the patient about any problems they are having.
They need to explain to the patient what is wrong and what treatments are available.
If they need to send the patient to an ophthalmologist, they need to explain to the ophthalmologist what the patient's problems are.
2 **a** Left-hand diagram: short sight, light focused in front of retina.
Centre diagram: normal vision, light focused on retina.
Right-hand diagram: long sight, light focused behind retina.
b Paragraphs should include:
Short sight means light is focused in front of the retina; it can be due to the eyeball being too long; people can see close objects clearly but not distant ones.
Long sight means light is focused behind the retina; it can be due to the eyeball being too short; people can see distant objects clearly but not close ones.
3 They are short sighted. They cannot see distant objects clearly, so they can only read the largest letters on the chart.

8Je Colour

1 water, white, spectrum, frequency, refracted, dispersion
2 **a** Violet light is bent/refracted the most, and it has the highest frequency of the colours. So higher frequencies must be refracted more than lower frequencies of light.
b Students' own answers.
3 **a** blue
b all the other colours (red, orange, yellow, green, indigo, violet)
4 It transmits the blue light and absorbs all the other colours.
5 The red ball absorbs all the colours except red (or the red ball only reflects red light). If there is only blue light shining on it, it will not reflect anything.

8Je Invisibility cloaks

1 **a** refraction
b When light goes from one transparent medium to another.
2 **a**, **b** Students' own answers.
3 Some light in the laser beams is scattered by dust in the air, and some of this scattered light enters our eyes.
4 As light enters the glass it bends towards the normal, then bends away from the normal again when it leaves.
5 White light is a mixture of different frequencies of light. Each frequency is refracted by a different amount as it passes through the prism, so the light is dispersed and we can detect the different colours.
6 cornea, iris, pupil, lens, retina, muscles, optic nerve

8K WORKBOOK ANSWERS

8Ka Living in extremes

1 **a** Any four from: light/radiation; heat/thermal; sound/waves; electricity; magnetism; forces/movement.
b Any four from: thermal; gravitational potential; elastic potential/strain; chemical; nuclear/atomic.

2 Evaporation can happen at any temperature. Boiling is when a liquid is evaporating as fast as it can, and the temperature of the liquid will stay the same while this is happening even if energy is still being supplied. Students working at a higher level might also point out that evaporation happens at the surface of a liquid, whereas in boiling, the gas forms within the liquid.

3 **a** conduction
b convection
c convection, radiation
d conduction, radiation
e radiation

4 **a** Energy makes the particles vibrate more, and the vibrations are passed on through the solid.
b Energy makes the particles move around more and take up more space. This makes part of the fluid less dense than the rest and it rises, setting up a convection current.

5 It transfers more energy in a given time/per second.

8Ka Temperature changes

1 Internal energy is the energy stored in the movement of particles of a substance; temperature describes how hot or cold an object is.

2 Its mass, the material it is made from, its temperature.

3 **a** The kettle
b The water in the kettle; both containers have the same material at the same temperature, but there is a greater mass of water in the kettle.
c More energy needs to be transferred to it because there is a greater mass of water to be heated.

4 **a** C
b B

5 **a** It will melt, and the liquid water will warm up to 21 °C, because energy will be transferred to it from the room until they are both the same temperature.
b Students' own answers.

8Kb Transferring energy

1 absorb – to take in; emit – to give out; infrared radiation – a way of transferring energy by heating that does not need a material; medium – any substance through which something travels; reflect – to bounce off a surface instead of passing through it or being absorbed; thermal conductor – a material that allows internal (thermal) energy to be transferred through it easily; thermal insulator – a material that does not allow internal (thermal) energy to be transferred through it easily

2 Any three from: no medium required; can go through transparent substances; can be focused; can be reflected.

3 **a** **i** true
ii false
iii false
iv true
v true
vi true

b Students' own answers.

4 Metals are good thermal conductors, so they transfer energy from the cooker/stove to the contents of the pan quickly. Plastic and wood are insulators, so energy from the hot pan is not transferred to your hand.

8Kb Convection

1 A liquid or a gas.

2 **a** D written in, above, or next to the stove.
b Energy from the stove will make the particles here move faster and take up more space, so this bit of air will be less dense.
c Arrow pointing upwards from the D.
d Arrows and labels similar to diagram D on page 169 of the Student Book.

3 **a** It is more dense.
b Downwards arrows next to the lolly.

8Kc Controlling transfers

1 **a** The particles are far apart.
b If it is not trapped, the air can transfer energy by convection.

2 It reduces the amount of energy needed to keep the house warm.

3 **a** Arrow on top pipe going to the right; arrow on bottom pipe to the left.
b Hot water will rise in the pipes, so hot water flows out of the top of the panel.
c Black is the best colour to absorb infrared radiation. The top of the box is glass to allow infrared radiation to pass through. The glass stops air warmed by the hot pipes from escaping, and the insulation on the rest of the box also helps to keep the pipes hot. Accept similar answers.

4 **a** The black one, because dark colours absorb infrared radiation better than light colours.
b The black one, because dark colours are the best emitters of infrared radiation.

5 particles, energy, fastest, evaporates, less, cooler, absorb

8Kc Accuracy and precision (WS)

1 precise, accurate, systematic, random, valid

2 **a** advantage
b disadvantage
c disadvantage
d advantage

3 **a** C, B, A, D
b They are precise because they are grouped closely together. They are not accurate because they are not near the centre of the target.

4 Sunita should use Y because the waxes could have melting points that differ by tens of degrees, and she does not need very accurate temperatures.
Davinda should use X, because there will probably only be small changes in temperature so she will need to measure them accurately.

5 **a** They are precise, as they are all within 0.2 minutes of each other.
b The true value is likely to be close to the mean obtained by the rest of the class, so this implies that the measurements in part **a** are not accurate.

6 Sally will need to use the most accurate measuring instrument, because the change in length of the brass rod will be very small. Ben does not need such an accurate instrument as the water will move much further up the tube than the brass will expand.

7 Students' own answers.

8Kd Power and efficiency

1 **a** 10 000 W
b 10 kW

2 **a** 3 kJ or 3000 J
b It does not need to heat as much water as quickly.

3 **a** C
b B

4 **a** 400 J
b 1600 J/2000 J × 100% = 80%
c Kettles have lids/are enclosed so less energy is transferred from the water by evaporation and convection while the water is heating up.

5 **a** 9 J/20 J × 100% = 45%
b Students' own Sankey diagrams with 20 J on the left-hand side of the arrow, '9 J light' as an arrow approximately one-third the size of the main arrow on the right, '11 J transferred by heating' as an arrow approximately two-thirds the size of the main arrow on the right; arrows should be labelled.

6 Motor B is the most efficient because it transfers the greatest percentage/proportion of energy as useful energy (accept similar explanations).
Calculations should show the following efficiencies: A – 75%; B – 80%; C – 50%.

8Kd Managing disasters (STEM)

1 Answers could include: providing lighting or heating or cooling in hospital and other temporary buildings; operating other medical equipment; operating computers and communications equipment.

2 **a** People could include:
Phi Phi – search and rescue teams; engineers to supervise digging people out of ruined buildings; doctors and nurses; people to make records of people saved and people still missing; people to give out tents, food and water.
Lapu – as above, but with the addition of engineers to repair bridges and/or roads.
Equipment could include:
search equipment such as infrared cameras; digging and engineering equipment such as bulldozers, diggers, shovels; shelters, such as tents or other temporary buildings; computers; medical equipment.
As Phi Phi is much warmer than Lapu, students may not include shelter etc. in their Phi Phi lists.
Supplies could include:
blankets, food, water, bandages, medicines, materials to rebuild houses and other buildings.
As above, blankets may not be included for Phi Phi.
b Students' own answers.

3 **a** Students' own answers; however, the most sensible suggestion for Lapu, Nepal, is likely to be by helicopter. For Phi Phi, Thailand, it could be ship/boat or helicopter.
b Lapu: the country is mountainous with poor roads, so transport by air will be much quicker.
Phi Phi: the location is an island, so transport to the nearest part of the mainland by road is a possibility, with the final transport being by boat. Using boats will be much cheaper than using helicopters, and will be able to transport more people/supplies.

4 **a**, **b** Students' own answers; however, shelter and heating supplies should appear on lists for Nepal when they may not for Thailand.

8Ke Paying for energy

1 **a** hours (h)
b kilowatt (kW) (accept watts (W))
c kilowatt-hour (or kWh)

2 **a** 5 kWh
b The numbers would be very big.

3 **a** 2 kW × 3 h = 6 kWh
b 0.1 kW × 4 h = 0.4 kWh
c 0.5 kW, 0.5 h
0.5 kW × 0.5 h = 0.25 kWh
d 1500 W = 1.5 kW, 12 min = 0.2 hours
1.5 kW × 0.2 h = 0.3 kWh

4 A more efficient appliance uses less energy to transfer the same amount of useful energy.

5 Difference in running costs is £5 per year; difference in price is £30
payback time for buying fridge B instead of fridge A is £30 ÷ £5 = 6 years
A fridge should last longer than 6 years, so it is worth Mrs Holman spending extra to buy fridge B.

8Ke Keeping warm

1 **a** Energy makes the particles vibrate more, and the vibrations are passed on through the solid.
b Energy makes the particles move around more and take up more space. This makes part of the fluid less dense than the rest and it rises, setting up a convection current.

2 It transfers more energy in a given time/per second.

3 Students' own answers.

4 **a** Energy refers to the energy stored in something and cannot be measured directly. Temperature is how hot or cold something is and can be measured with a thermometer.
b Energy can be stored or transferred; power is the energy transferred in a certain time.

5 **a** It is cheaper; it contributes less to climate change/global warming.
b Divide the useful energy transferred by the total energy supplied (× 100%).

8L WORKBOOK ANSWERS

8La Changing ideas

1 The Sun can only shine on half of the Earth at any one time. As Ecuador is on the opposite side to Malaysia, it is dark in Malaysia when the Sun is shining on Ecuador.
2 The shadow of a central stick moves around a dial as the Sun appears to move across the sky. The dial is marked to show the time of day where the shadow falls.
3 Mass is the amount of matter in something. Weight is the force of gravity pulling on the mass
4 star – a ball of hot gases in the centre of the Solar System; planet – large, spherical body that orbits the Sun; moon – a body that orbits around a planet; asteroid – small rocky body that orbits the Sun
5 In New Zealand:
there are more hours of daylight in summer than winter, because the South Pole is tilted towards the Sun
the tilt means the Sun is higher in the sky in summer than in winter
the Sun feels hotter in the summer, because the Sun's rays are more concentrated
stronger sunshine and longer days mean the weather is hotter in summer than in the winters.

Accept equivalent answers.

8La gathering the evidence

1 **a** **i** Ptolemy, Copernicus
ii Copernicus, modern
iii Ptolemy
iv modern
v Ptolemy, Copernicus
vi all three
b Students' own responses.
2 He had information observed using telescopes/better instruments.
3 Any three suitable answers, such as: telescopes in space; space probes landing on planets/moons; space probes flying past planets/moons; bringing back Moon rocks to study; astronauts visiting the Moon.
4 The modern model is best at explaining all the observations we have.
5 **a** They reflect light from the Sun.
b Phases of the Moon.

8La Working in space (STEM)

1 **a** Any two from: urine; sweat; moisture in exhaled air.
b If it was not recycled, water would have to be sent up to the space station. This would be very expensive and involve a lot of rocket flights.
2 **a** Wind (there is no air on the Moon) and water power of any kind (there is no liquid water on the Moon). Note that geothermal power may be possible, but geological investigations would have to be carried out to find suitable locations.
b All the fuels would have to be taken to the Moon, using rockets.
3 Students' own answers.
4 Students' own answers.

8Lb Seasons

1 Equator, North Pole, northern hemisphere, and southern hemisphere all linked to appropriate places on the diagram.

2 **a** Y
b Y
c X
d X
e Y
f Y
g X

3 **a** Daylight lasts longer in the summer than in the winter.
b It is warmer in the summer than in the winter.

4 When it is summer in a particular place, that place spends more time in the zone lit by the Sun.

5 **a** A
b D

6 Two beams of light added to the drawing of the Earth (similar to those in diagram E), one hitting the equator and one further north or south, showing the beam hitting the equator having the smaller area.

7 The longer the Sun is shining on a place, the more time it has to warm up, so longer days lead to warmer temperatures.

8lc Magnetic Earth

1 A magnet that can swing to point north.

2 Correct words are: repel, attract; field, magnetic, strongest; iron, small, north, south

3 Magnetic field drawn around the magnet of similar shape to that shown in figures C or E in the Student Book. Arrows on the lines point from N to S.

4 **a** Check lists could include: lines with arrows pointing away from N pole and towards S pole; lines closer together near the poles of the magnet; symmetrical field.
b Students' own answers.

5 **a** A states that the Earth has a bar magnet inside it. (A bar magnet is only a model to help us to think about the Earth's magnetism.)
b Compasses point to the north magnetic pole, not the North Pole.

8Ld Gravity in space

1 **a** **i** true
ii true
iii false
iv false
v false
vi true
b Students' own responses.

2 It has a larger mass because there is more matter in it.

3 **a** N (or newton), kg
b gravitational field strength

4 **a** weight = 2 kg × 10 N/kg = 20 N
b weight = 2 kg × 1.6 N/kg = 3.2 N

8Ld Gravity and orbits

1 **a** The force of gravity between the Sun and the Earth.
b The force of gravity between the Earth and the Moon.
2 **a** **i** Planet A is closer to the star than planet B.
ii Planet B has more mass than planet A.
b Arrows similar to those on diagram D on page 191 in the Student Book. Arrows should both be the same size, and pointing in opposite directions along a line between the star and planet B.
3 On top of Everest, you are further away from the centre of the Earth.
4 **a** It orbits the Earth; it was not made by humans (or similar answer).
b Any two from: photographing the Earth; transmitting TV programmes; observing weather; or any other sensible suggestions.
5 If the Sun's gravitational field did not extend that far, Neptune would fly off into space instead of staying in orbit around the Sun.

8Ld Making comparisons (WS)

1 Any sensible description, such as Neptune's diameter is four times as big as the diameter of the Earth.
2 **a**, **b** Students' own answers, which should include writing both numbers down with a colon (:) between them, dividing both numbers by the smaller one, rounding the answer.
c 3.7:23.2 = 1:6.27 = 1:6
3 **a** Buenos Aires – 1:1.5; Quito – 1:1.0; Rio de Janeiro – 1:1.3; Salvador – 1:1.1
b Quito, Salvador, Rio de Janeiro, Buenos Aires
c The difference in daylight between summer and winter is greater the further a place is from the equator. Students could look back at topic 8Lb if they need help working out this answer.
4 **a** **i** Write the two numbers as a fraction, then carry out the division to convert it to a decimal.
ii Work out the decimal, then multiply by 100.
b Students' own answers.
5 **a** diameter of Mercury ÷ diameter of Jupiter = 4880 km ÷ 142 838 km = 0.034. Tell students this would be described as the diameter of Mercury being 0.034 times the diameter of Jupiter.
b 0.034 × 100 = 3.4% Tell students this would be described as the diameter of Mercury being 3.4% of the diameter of Jupiter.
6 **a** *g* for Mercury ÷ *g* for Jupiter = 3.7 ÷ 23.2 = 0.159
b 0.159 × 100 = 15.9%
7 35 ÷ 100 = 0.35
8 **a** Day length for Buenos Aries ÷ day length for Quito = 10.7 ÷ 12.1 = 0.88
b 0.88 ×100 = 88%

8Le Beyond the solar system

1 moon, planet, star, galaxy, Universe
2 A huge ball of gas that gives off large amounts of energy.
3 Any two from: a star gives off light and a planet does not; a planet orbits around a star; a star is bigger than a planet (this last one is not always true, but students are not expected to know that).
4 It is much closer.
5 They are not bright enough compared with the Sun.
6 D
7 It is our galaxy – a collection of millions of stars. We cannot see its shape directly because we are inside it.
8 Students' own answers.
9 Astronomers today have much more powerful telescopes than they had 200 years ago, so they can see many more galaxies.

8Le Studying space

1 a Their position in the sky, the appearance of their surface, whether or not they have moons.
b Any two sensible suggestions, e.g. better telescopes to make more detailed observations; sending space probes to other planets to get more detailed images/make other measurements; returning rock samples from the Moon.

2 a Mass is the amount of matter in something. Weight is the force of gravity pulling on the mass.

3 An artificial satellite has been made by humans; a natural satellite already existed.

4 **a** Mass is the amount of matter in something. Weight is the force of gravity pulling on the mass.
b Students' own answers.
c Students' own answers.
d Students' own answers.
e Students' own answers.

5 **a** In New Zealand:
there are more hours of daylight in summer than winter, because the south pole is tilted towards the Sun
the tilt means the Sun is higher in the sky in summer than in winter
the Sun feels hotter in the summer, because the Sun's rays are more concentrated
stronger sunshine and longer days mean the weather is hotter in summer than in the winters.
Accept equivalent answers.
b Students' own answers.

6 **a** weight = mass × gravitational field strength
= 80 kg × 3.8 N/kg = 304 N
b 3.8/8.8 × 100% = 43.2%