SAMPLE CHAPTER

SPRINGBOARD KS3 SCIENCE

KNOWLEDGE BOOK

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WORKING SCIENTIFICALLY

BIOLOGY

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CHEMISTRY

PHYSICS

WS

Health and safety

Not all experiments are safe. At school we do not carry out experiments that are very dangerous, but there are still things that could go wrong and could cause us pain or injury. It is therefore important to know about hazards, risks and precautions.

	Question	Answer
1	What is a hazard?	A source of harm
2	What is a risk?	The likelihood that a hazard will cause harm
3	What is a safety precaution?	Something you do to minimise risk
4	What is the hazard associated with using a Bunsen burner?	Burning
5	What safety precautions should be taken when using a Bunsen burner?	Light it using the safety flame Turn it to the safety flame when not in use Wear goggles
6	What is the hazard associated with using acids?	They are corrosive
7	What does corrosive mean?	Can damage your skin
8	What safety precautions should be taken when using acids?	Wear goggles Use dilute acid Clean up spills immediately

Working scientifically

A student is warming up a beaker of sulfuric acid using a Bunsen burner and adding copper oxide to it. Before they conduct their experiment, their teacher identifies the hazards and the precautions that they need to take in order to work safely.

▼ Precautions that should be taken for some different hazards

Hazard	Potential harm	Safety precaution
Copper oxide	Irritates skin	• Pour carefully • Wash off immediately if any goes on your skin
Sulfuric acid	Corrosive	• Wear goggles • Use dilute acid • Clean up spills immediately
Bunsen burner	Can cause burns	• Light it using the safety flame • Turn it to the safety flame when not in use • Wear goggles

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Analysis and evaluation

Tables

We have already seen that scientists often present data in tables. However, there is still more to do to these data before we can increase our knowledge of the world. Sometimes we need to process the data mathematically in order to calculate means and ranges. We can also try to start explaining the data and relating them to our predictions.

- To calculate a **mean**, you take all the values you have, add them up and divide by the total number of values.
- To identify the **range**, you look at the lowest and highest values.
- To see if your prediction was correct, you can look at the table and try to identify a **trend**, to see if it matches your prediction.
- To identify any **anomalies**, you look for values that do not fit the trend and are likely to be mistakes.
- A **conclusion** is then a statement about whether your prediction was correct or, more generally, about what your experiment shows you.

Working scientifically

A student is adding masses to a spring to see how the extension of the spring changes. They establish a line of inquiry: *How does the mass added to a spring affect the spring's extension?*

They make a prediction: *As the mass added to the spring increases, the extension of the spring will increase.*

They conduct their experiment and draw a table like the one on the next page. They take three readings and use those readings to calculate a mean. The labels on the table show you how this is done. They also show how to calculate the range, and identify the anomaly and trend (see also page 15).

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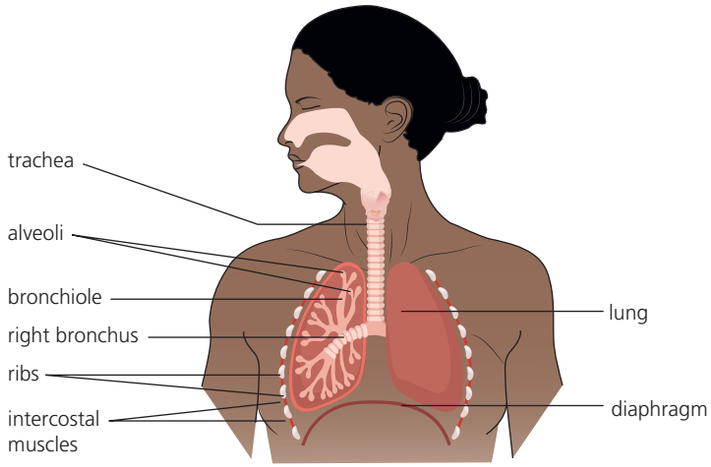
B4 Gas exchange systems

B4.1 Ventilation

	Question	Answer
1	What is the respiratory system?	A system that allows air to pass in and out of the body
2	In the respiratory system, what is ventilation?	The movement of gases into and out of the lungs
3	What happens to the intercostal muscles and rib cage when we breathe in?	Intercostal muscles contract and rib cage expands
4	What happens to the diaphragm when we breathe in?	Diaphragm contracts and flattens
5	What happens to lung pressure when we breathe in?	Lung pressure decreases
6	What happens to the intercostal muscles and rib cage when we breathe out?	Intercostal muscles relax and rib cage drops inwards
7	What happens to the diaphragm when we breathe out?	Diaphragm relaxes and moves up
8	What happens to lung pressure when we breathe out?	Lung pressure increases
9	What is the function of the goblet cells in the trachea?	To release mucus into the trachea
10	What is the function of mucus in the trachea?	To trap dust and bacteria
11	What is the function of the ciliated epithelial cells in the trachea?	To sweep mucus up and out of the trachea

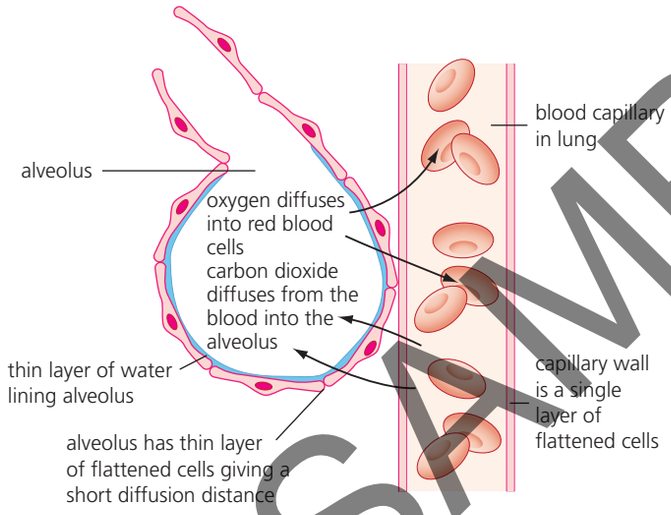
▼ Parts of the human respiratory system



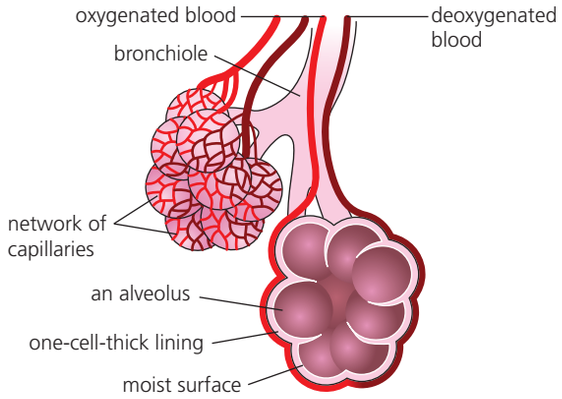
B4.2 Gas exchange

	Question	Answer
1	Where does gas exchange take place in the lungs?	Alveoli
2	Which gas diffuses from the alveoli into the bloodstream?	Oxygen
3	Which gas diffuses from the bloodstream into the alveoli?	Carbon dioxide
4	Name the four ways in which alveoli are adapted for gas exchange.	Good blood supply, membrane is one cell thick, large surface area, moist surface

Diffusion of gases from the alveoli to the blood



The key adaptations of alveoli



C1 The particle model

C1.1 Simple particle model

	Question	Answer
1	What are the three states of matter?	Solid, liquid and gas
2	What are all things around us made of?	Particles
3	Describe the arrangement of particles in solids.	Regular arrangement; touching
4	Describe the arrangement of particles in liquids.	Random arrangement; touching
5	Describe the arrangement of particles in gases.	Random arrangement; not touching
6	How do the particles in gases move?	Randomly in every direction until bumping into each other or their container
7	How do the particles in liquids move?	Moving over each other randomly
8	How do the particles in solids move?	Vibrate around a fixed point

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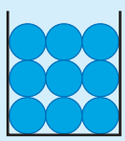
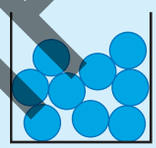
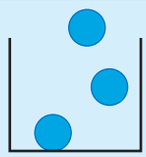
C1.2 Properties of different states of matter

	Question	Answer
1	Give two properties of gases.	Can flow; can be compressed
2	Give two properties of liquids.	Can flow; cannot be compressed
3	Give two properties of solids.	Cannot flow; cannot be compressed
4	Why can solids not flow?	There are strong forces of attraction between the particles
5	Why can liquids and gases flow?	There are weak forces of attraction between the particles
6	Why can gases be compressed?	There is space between the particles
7	Why can solids and liquids not be compressed?	The particles are already touching

▼ Summary of the simple particle model and the properties of solids, liquids and gases

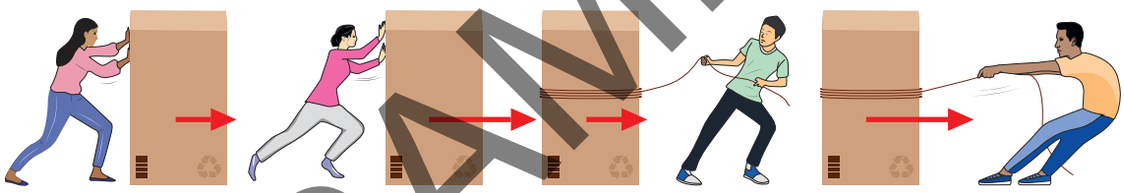
State	Solid	Liquid	Gas
Particle diagram			
Key features of diagram	Particles are all touching Regular arrangement Draw at least nine Normally at the bottom of the box Particles do not overlap	Particles are all touching Random arrangement Draw at least nine Normally at the bottom of the box Particles do not overlap	Particles are not touching Random arrangement Draw at least three Anywhere in the box Particles do not overlap
Arrangement of particles	Regular arrangement Touching	Random arrangement Touching	Random arrangement Not touching
Movement of particles	Vibrate around a fixed point (on the spot)	Slide over each other, remaining touching	Randomly in all directions
Bonding of particles	Strong forces of attraction between the particles	Medium-strength forces of attraction between the particles	Weak forces of attraction between the particles
Properties of particles	Cannot flow Cannot be compressed	Can flow Cannot be compressed	Can flow Can be compressed

P3 Forces

P3.1 Basic forces and diagrams

	Question	Answer
1	What is a force?	A push or a pull
2	What unit do we use to measure the size of a force?	Newton, N
3	What instrument can be used to measure the size of a force?	A newtonmeter
4	How can we show forces on a diagram?	As arrows
5	In a force diagram, what does the direction of an arrow show?	The direction of the force
6	In a force diagram, what does the length of an arrow show?	The longer the arrow, the bigger the force

▼ Showing the size and direction of forces using arrows



small push | large push | small pull | large pull

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P3.2 Naming and categorising forces

	Question	Answer
1	What do we call it when two objects act on each other with a force?	An interaction
2	How many forces are produced during one interaction between objects?	Two
3	What are contact forces?	Forces that only happen when objects touch
4	What are non-contact forces?	Forces that can happen even when the objects are not touching
5	What is the name of the force when a person pushes or pulls an object?	Applied force
6	What is the name of the force produced when solid surfaces rub against each other?	Friction
7	What is the name of the force produced by engines?	Thrust
8	What is the name of the force produced when an object moves through the air?	Air resistance
9	What is the name of the force produced when an object moves through water?	Water resistance
10	What is the name of the force that stops objects sinking in water?	Upthrust
11	What is the name of the force that pulls objects towards Earth?	Weight
12	What is the name of the force that stops objects falling through solid surfaces?	Normal contact force
13	What is the name of the force that stops airplanes falling down towards Earth?	Lift
14	Name two non-contact forces.	Weight, magnetism
15	Name the eight contact forces.	Friction, thrust, air resistance, water resistance, lift, normal contact, applied force, upthrust

P3.3 Stretching and squashing forces

	Question	Answer
1	How can we squash an object?	Push on opposite sides of the object
2	What do we call the change in size when an object is squashed?	Compression
3	How can we stretch an object?	Pull on opposite sides of the object
4	What do we call the change in size when an object is stretched?	Extension
5	What is the equation for calculating extension?	extension = new length – original length
6	What units do we use to measure extension?	Metres, m
7	What do we call a material that returns to its original size after it has been stretched or squashed?	Elastic material

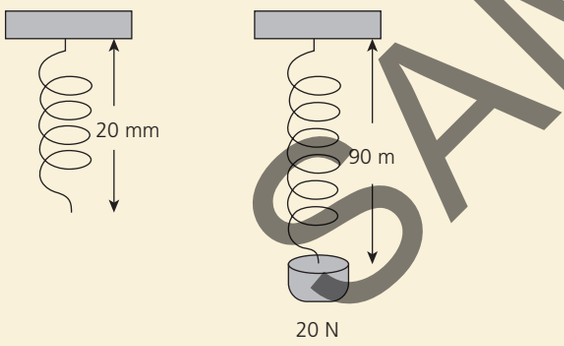
Worked example

Calculating extension

An unloaded spring has a length of 20 mm. When loaded with 20 N it measures 90 mm.

What is the extension of the spring in metres?

▼ Calculating the extension of a spring



Equation	extension = new length – original length
Values	extension = ? new length = 90 mm ÷ 1000 = 0.09 m old length = 20 mm ÷ 1000 = 0.02 m
Enter values	extension = 0.09 – 0.02
Result	extension = 0.07
Y(units)	extension = 0.07 m

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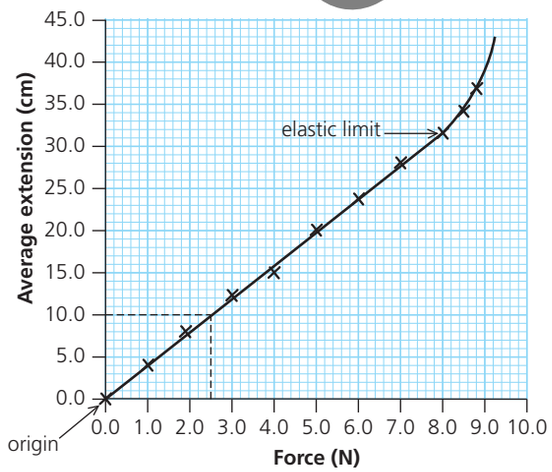
P3.4 Hooke's law and work done

	Question	Answer
1	What is the relationship between force and extension according to Hooke's law?	As the force doubles, the extension doubles
2	What do we call the point at which a spring no longer obeys Hooke's Law?	Elastic limit
3	What do we call the force required to extend or compress an elastic object by 1 m?	Spring constant
4	What unit do we use to measure spring constant?	Newtons per metre, N/m
5	If a spring is hard to compress or stretch, is the spring constant large or small?	Large
6	In words, what equation links force, spring constant and extension (also known as Hooke's law)?	force = spring constant × extension
7	In symbols, what equation links force, spring constant and extension?	$F = k \times e$
8	What do we call the force created by a stretched or squashed object as it tries to return to its original shape?	Elastic force
9	What is another phrase for energy transferred by a force?	Work done
10	What unit do we use to measure work done?	Joules, J
11	When work is done to stretch an elastic band, what energy transfer is this?	Energy transferred by a force
12	When work is done on an elastic band, which store of energy increases in the elastic band?	Elastic store

▼ A graph to show extension against force for a spring



Worked example

Calculating the force on a spring

A spring had a spring constant of 20 N/m. When a force was added it extended by 0.25 m. Calculate the force that was added.

Equation	force = spring constant × extension $F = k \times e$
Values	$F = ?$ $k = 20$ N/m $e = 0.25$ m
Enter values	$F = 20 \times 0.25$
Result	$F = 5$
Y(units)	$F = 5$ N

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