Mrs Lawrence's

7/8X Science

PARTICLES

Assignment Booklet

Name: _____

HOW TO USE THIS BOOKLET:

- Complete the matching questions within the Assignment Booklet
- Submit the Assignment Booklet to Mrs Lawrence for Marking

DUE: 15th May 2020

If you are having trouble answering these activites, you can:

- ✓ *Call Mrs Lawrence at school on 6785 1184*
- ✓ *Email Mrs Lawrence at Ariana.lawrence@det.nsw.edu.au*
- ✓ *FB Messenger Mrs Lawrence as Ariana Lawrence*
- ✓ *Arrange for a tutorial session with Mrs Lawrence at the school library*

Middle School Science Stage 4 Course

Modelling Matter Set 1

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Contents

When you see this icon throughout the booklet it means that you will need to complete an activity.

Outcomes

By completing this unit, students are working towards achieving the following outcomes.

SC4-16CW: describes the observed properties and behaviour of matter, using scientific models and theories about the motion and arrangement of particles.

You have the opportunity to learn to:

- describe the behaviour of matter in terms of particles that are continuously moving and interacting
- relate an increase or decrease in the amount of heat energy possessed by particles to changes in particle movement
- use a simple particle model to predict the effect of adding or removing heat on different states of matter
- relate changes in the physical properties of matter to heat energy and particle movement that occur during observations or evaporation, condensation, boiling, melting and freezing
- explain density in terms of a simple particle model
- compare physical and chemical changes in terms of the arrangement of particles and reversibility of the process.

Glossary

Read through this list of terms and their meanings which are introduced throughout this unit.

Term	Meaning
change of state	The process by which matter changes from one form to another.
chemical change	A change resulting in the production of a new chemical substance.
compress	To press together and force into less space.
condensation	The change of state from a vapour to a liquid.
contraction	Becoming smaller or decreasing in size or volume.
density	The relationship between the mass of a substance and how much space it takes up (volume).
displacement	To be moved or put out from its usual place.
evaporation	The change of state from a liquid to a vapour.
expansion	Becoming larger or increasing in size or volume.
fluidity	The ability of matter to flow.
freezing	The change of state from a liquid to a solid.
irreversible change	A change that cannot easily be overturned.
mass	The amount of matter in a substance.
melting	The change of state from a solid to a liquid.
physical change	A change in which no new substance results, but the existing substance changes its state, size or shape.
reversible change	A change that can be overturned.
states of matter	Solid, liquid or gas forms of matter.
volume	The space that something occupies.

What is Matter?

Matter is the amount of stuff in an object. It is everything around you.

We define matter as something that has mass and takes up space.

What does this mean?

- Mass is how much matter is in an object. Heavy things have more matter in them than lighter ones, so they have more mass.
- The size of something is how much space it takes up. Big things take up more space than small things.

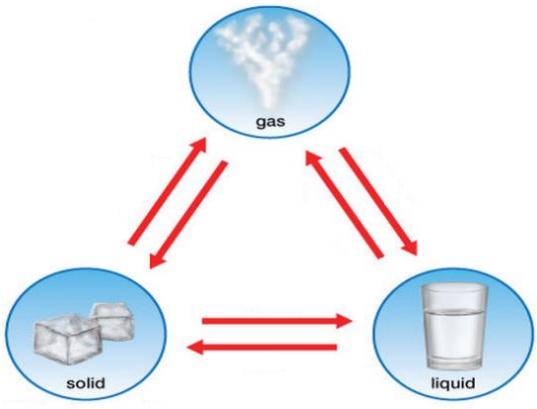
This gold bar is quite small but has a mass of 1 kilogram – so it doesn't take up much space but contains a lot of matter.

States of Matter

When you learnt about *Elements and Compounds* you discovered that there are three states of matter – **solid, liquid and gas.**

You learnt that orange juice is a liquid, hot air in a balloon is a gas and a t-shirt is a solid.

All of these things are **matter**.



- Water is a substance that can exist in all three states (or phases) on Earth.
- Some changes such as melting and freezing can be reversed but others cannot. You cannot un-burn the toast!
- The way we live depends on our use of materials and the use of specific materials depends on their particular properties.

Activity 1

Classify the common substances below into the correct column of the table.

tap water	rubber	milk	air
oxygen	olive oil	butter	ice

Solids	Liquids	Gases

Changing Matter

We change matter in different ways and for different purposes.

Some changes are easily reversed, such as freezing water into ice.

Reversible changes are also called **changes of state or phase**. Examples include evaporation, boiling, melting, freezing and condensing.

Other changes, such as the burning of wood in a fire, cannot be reversed. We call changes that cannot be overturned, **irreversible**.

Activity 2

1. For each of the statements below, circle whether the change is reversible (R) or irreversible (I).

(a) When you put tap water into a tray in the freezer and it forms ice blocks. I / R

(b) When you light LPG in a gas barbeque and it produces a hot flame I / R

(c) When an iceberg starts to turn into water on a hot day. I / R

(d) When you put bread dough into the oven and it turns into bread. I / R

(e) Frying an egg in a frypan. I / R

Properties of Matter

Properties of matter are used to describe how materials look and behave under different conditions.

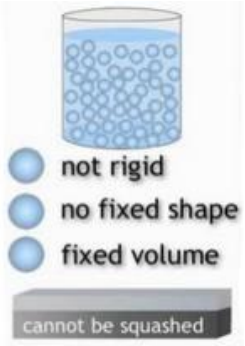
- **Physical properties** include melting and boiling points, ability to flow, whether matter or substances can be compressed (squashed), or conduct heat and electricity.

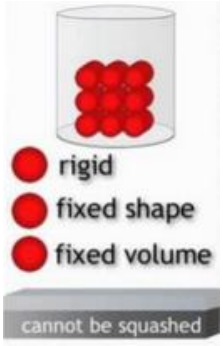
Physical Property	Solids	Liquids	Gases
Shape	Has a fixed shape	Takes up the shape of the container	Takes up the shape of the container
Volume	Fixed volume	Fixed volume	Changes volume to fill container
Fluidity	Does not flow easily	Flows easily	Flows easily
Compressibility	Not easy to compress	Not easy to compress	Easy to compress

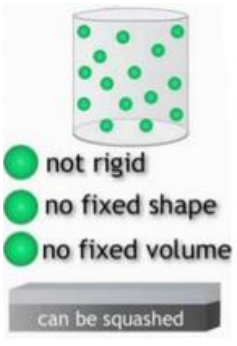
- **Chemical properties** include the tendency to combine with oxygen, acids and other chemicals, or react when exposed to heat, light or electricity.
  For example iron combines with oxygen to form rust.

Activity 3

Write the correct state of matter (solid, liquid or gas) for the pictures below.







Measuring Matter

Accurate measurements help us classify and investigate matter.

Technology has changed the way we can measure matter.

There are now electronics that use probes or detectors to take accurate measurements for us.

Matter takes up space

Scientists call the space that something occupies, its **volume**.

Volume is expressed in the metric units of millilitres (mL), litres (L) and kilolitres (kL), or cubic centimetres (cm^3) or cubic metres (m^3).

One litre occupies a space of 1000mL and one kilolitre occupies a space of 1000L.

One teaspoon holds 5mL. It is important to be precise when measuring medicine.

Measuring jugs are useful in the kitchen, but because they are wide, they may not be very accurate.

Standard spoon measures are reasonably accurate if filled correctly.

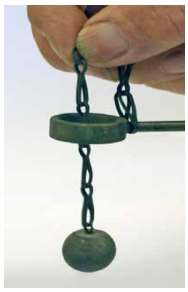
A measuring cylinder is ideal for measuring volume of liquids. The narrow tube and small scale marks improve accuracy.

Activity 4

1. Why is a measuring cylinder more accurate for measuring the volume of liquids compared with a measuring jug?

Expansion and Contraction

Heating and cooling can cause substances to expand (get bigger) or contract (get smaller). We call this **thermal expansion or contraction.**



Here is a picture of a metal ball and ring. Notice that the ball has been made so that it can easily slip through the ring.

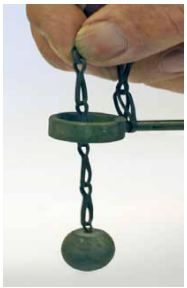
The ball is now being heated using a spirit burner. What will happen when we put the ball through the ring after heating?

As you can see, the ball no longer fits through the ring after being heated. The heat from the burner has made the ball **expand**.

Activity 5

Infer means to give a possible explanation.

1. After a few minutes, the ball is able to be passed through the ring again. What can you **infer** about the effect of cooling on the metal ball?



Experiment 1

Aim: To observe the expansion and contraction of a gas.

Equipment

- empty plastic bottle lid removed (about 500mL)
- water with some ice cubes
- hot water
- balloon
- two large bowls or buckets

Method

1. Place the balloon over the top of the water bottle.
2. Fill one bowl (bucket) with water and ice and the other with hot water
3. Put the bottle into the hot water and hold it as low as possible in the hot water taking care not to burn yourself.
4. Observe the changes in the size and shape of the balloon.
5. Then put the bottle into the iced water and observe the changes in the shape and size of the balloon.
6. Draw and label a diagram to show your observations

Observations – draw your observations in the box

Hot water	Cold water

What happened?

When you put the bottle with the balloon into the first jar, the hot water heated up the air in the bottle and made it expand. The expanding gas blew up the balloon.

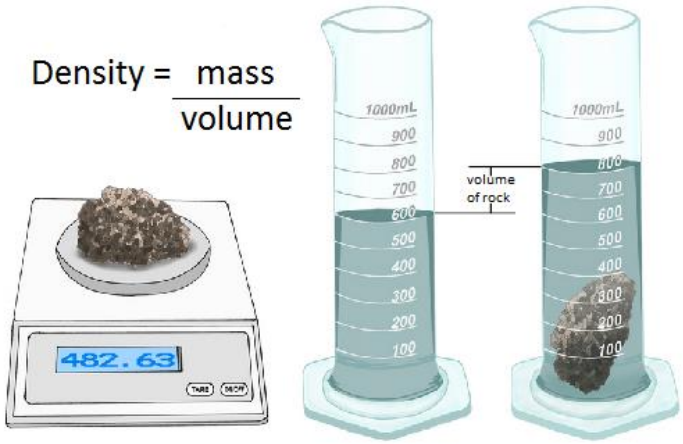
When you put the bottle in the cold water, the air cooled down and contracted back into the bottle causing the balloon to shrink.

Density

The density of a substance is the relationship between the mass of the substance and how much space it takes up (volume).

Density is a property of matter.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$



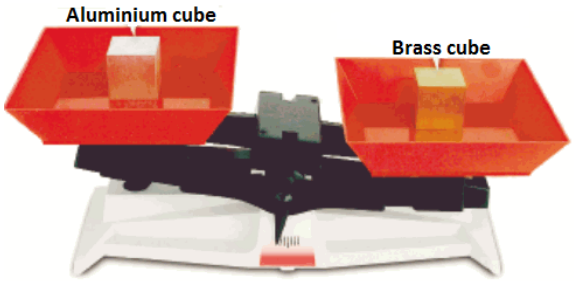
We use density to help compare different materials.

We can calculate density by,

- measuring the mass of an object
- measuring the volume of the object
- dividing the calculated mass by the volume.

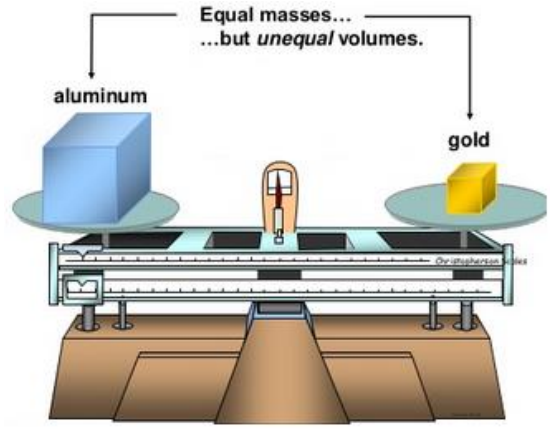
A substance will have a greater density than another substance if it has a,

- greater mass for the same volume



The aluminium and brass cubes are the same size, but the brass cube has a larger mass. It has a greater density as there is more matter packed into the same volume.

- smaller volume for the same mass.



The aluminium and gold cubes have the same mass, but the gold is much smaller. It has a greater density as there is more matter packed into a smaller space.

Experiment 2

Aim: To observe the difference in density of different solids and liquids.

Equipment

- Small jar or bottle
- Oil
- Cork or foam ball
- Coin
- Water
- Grape
- Honey

Method

1. Pour honey into the bottle and fill the bottom third of the bottle.
2. Fill the next third of the bottle with oil.
3. Fill the final third of the bottle with water.
4. Drop the coin, grape and cork/foam ball into the bottle.
5. Watch which layer the items settle into.

Observations - Draw a picture of your bottle once you have dropped in your items. Don't forget to label the objects and each layer of liquid.

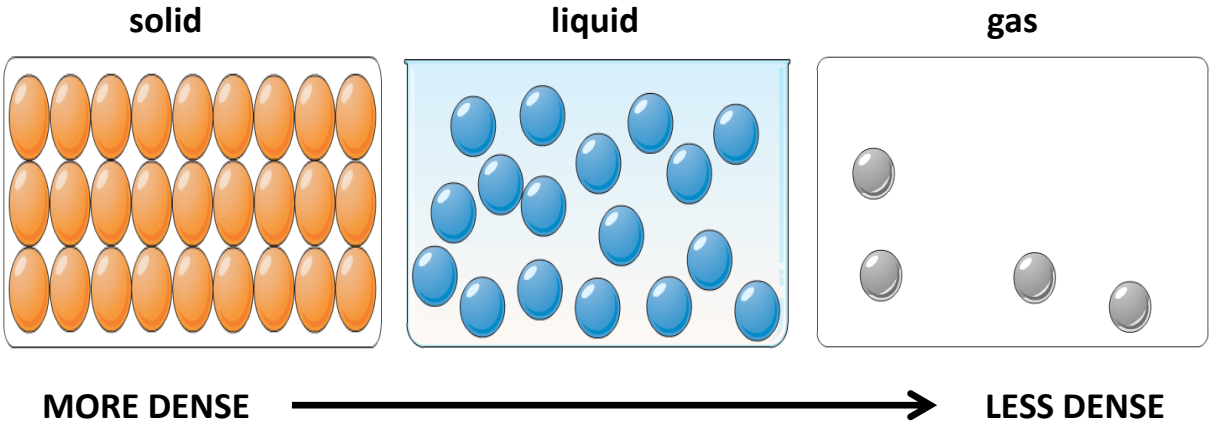
Conclusion

1. Which liquid is the most dense? _____
2. Which solid is the least dense? _____
3. Why does the coin sink to the bottom? _____

_____

Density and Particles

Differences between the type of particles and their arrangement affect the density of a substance.



We can add information about density and particle arrangement to our states of matter properties table from page 8.

Physical Property	Solids	Liquids	Gases
Shape	Has a fixed shape	Takes up the shape of the container	Takes up the shape of the container
Volume	Fixed volume	Fixed volume	Changes volume to fill container
Fluidity	Does not flow easily	Flows easily	Flows easily
Compressibility	Not easy to compress	Not easy to compress	Easy to compress
Density	Very dense	Dense	Not dense
Packing and arrangement between particles	Closely packed in an orderly arrangement	Closely packed in a disorderly arrangement	Far apart in a random arrangement

Activity 7

Scan this QR code with your smartphone. [You will need a QR reader app]

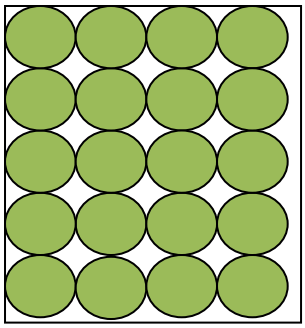
Or visit the website below: (note – you must type in the address exactly the way it is written).

http://www.bbc.co.uk/bitesize/ks3/science/chemical_material_behaviour/particle_model/activity/

Watch the video about **The Particle Model.**

1. What was your score in the online particle model quiz? Score: _____ / 6

2. Assuming all the green particles and the boxes are the same, which of the following boxes is the most dense?



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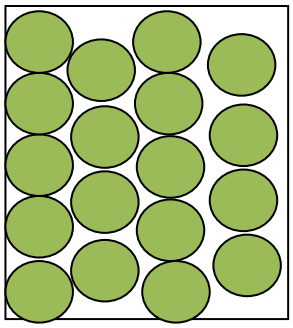

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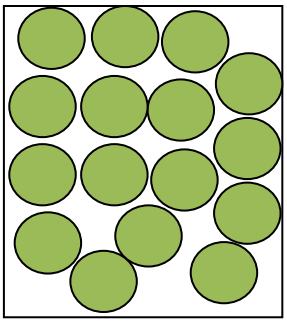
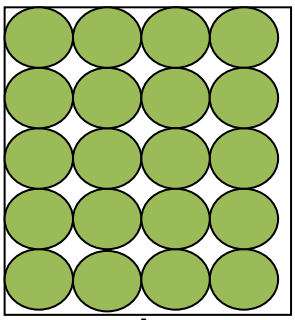


C

3. Assuming the purple particles have the most mass, which of the following is the most dense?



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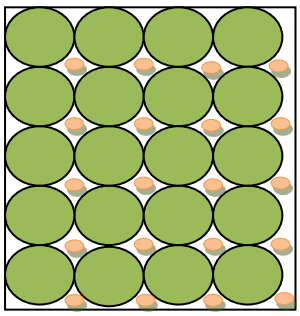

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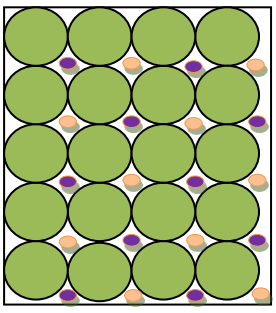

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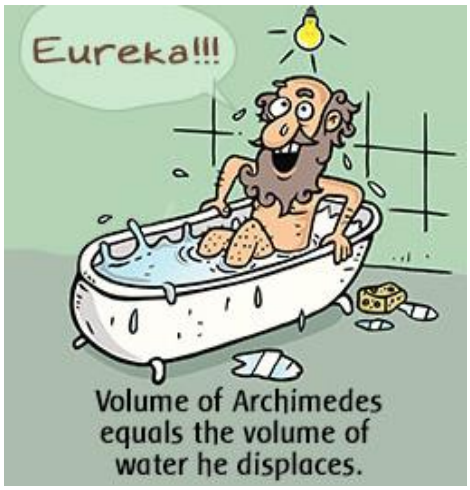
Water Displacement



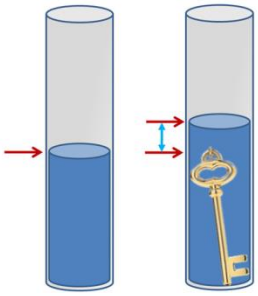
Archimedes was a Greek scientist who was asked by King Hiero's to find out whether a crown maker had stolen some gold when he was making a crown.

During his investigation, Archimedes realised that when an object is placed under water, it displaces a volume of water equal to its own volume. This means that the water level rises the same volume as the volume of the object.

The volume can then be used to calculate the density of the object.

Example

Initial water volume = 60cm^3



Final water volume = 80cm^3

Water displacement = final water volume – initial water volume

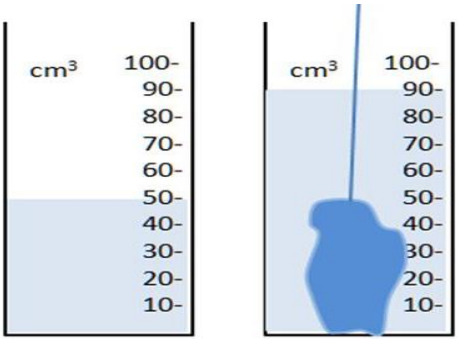
= 80-60

= 20cm^3

Therefore, the key has a volume of 20cm^3.

Activity 8

What is the volume of the rock in the cylinder on the right?



Middle School Science Stage 4 Course

Modelling Matter Set 2

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- compare physical and chemical changes in terms of the arrangement of particles and reversibility of the process.

Glossary

Read through this list of terms and their meanings which are introduced throughout this unit.

Term	Meaning
calibrated	To accurately mark the scale of a measuring instrument so that readings can be made.
degrees Celsius	The measurement of temperature (^{o}C).
density	Mass per unit of volume of a substance.
heat	Heat is the amount of energy something has.
Joules	The measurement of heat energy (J).
line graph	Shows the relationship between two things that both vary continuously (eg temperature and time).
temperature	Tells you how hot or cold something is.
thermometer	A piece of equipment for measuring temperature.

Hot and Cold

When scientists need to describe how hot or cold something is, they measure and report the temperature or use precise language.

We all know that a 36^{o}C day is hotter than a 24^{o}C day but we may disagree as to whether fiery is hotter than blazing.

Activity 1

Think about the words you use to describe whether something is hot or cold.

Sort the following words into an order from coldest to hottest.

frosty	**scorching**	**chilly**	**sweltering**
blazing	**fiery**	**icy**	**freezing**

Coldest

Hottest

Heat

Heat and temperature are not the same thing!

Heat is a form of energy that can be used to do work.

Heat travels in waves like other forms of energy, and is measured in Joules (J).

Heat energy has the ability to do work:

- Heat is released when fuel burns, electricity flows, friction is applied, and when our muscles contract.
- Heat is captured by engines to do work when fuels such as petrol, diesel, gas or coal are burnt.
- Heat from the sun warms the Earth creating winds that can drive turbines to generate electricity.

It is difficult to determine the amount of heat energy in a substance. The amount of heat energy depends on the mass of the object, the type of material and its temperature.

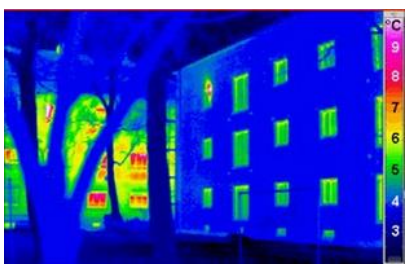
Activity 2

1. What is heat? _____

   _____

2. Give an example of how heat energy can do work. _____

   _____



Temperature

Temperature tells you how hot or cold something is.

Temperature is related to heat but is not the same. It is a physical property of matter. Temperature does not depend on the size or type of object.

We measure temperature on the Celsius scale and record it in ^{o}C. The average human body temperature is about 37^{o}C.

Thermometers

Thermometers are often used to **measure temperature**.

Some thermometers have a liquid that rises or falls depending on how hot or cold something is. The liquid is often mercury or alcohol.

The thermometer has a scale which shows an accurate temperature reading.

Digital thermometers rely on a probe being held in place until it can sense the temperature and give an accurate reading.

You can use a thermometer to tell the temperature outside or inside your house, inside your oven, even the temperature of your body if you're sick.

Activity 3

1. List 2 examples of when it is important to accurately measure temperature. One example has been provided for you.

   A fridge must be kept at specific temperature for food safety reasons.

How thermometers work

We learnt in Modelling Matter 1 that heating and cooling can cause substances to expand (get bigger) or contract (get smaller).

Matter takes up **more space when it is heated** and **less space when it is cooled**.

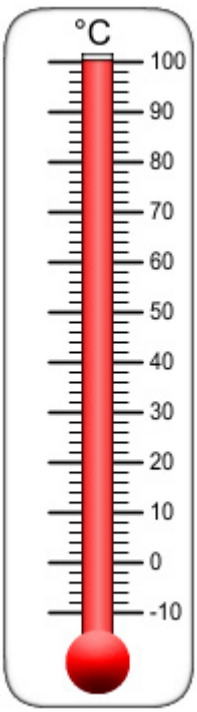
A common thermometer uses mercury or alcohol in a glass tube.

An **increase** in temperature causes the liquid to **expand** (get bigger) and **rise** in the tube.

A **decrease** in temperature causes the liquid to **contract** (get smaller) and **lower** in the tube.

Thermometers are **calibrated** by marking the tube at known temperatures. For a Celsius thermometer we could mark it at:

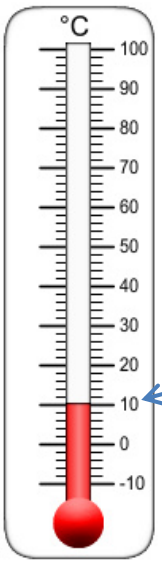
- 0 degrees for the temperature of freezing water
- 100 degrees for the temperature of boiling water
- 10 degree marks by dividing the distance between 0 degrees and 100 degrees.
- 1 degree marks by dividing the distance between each 10 degrees.



Reading temperature

We can use the calibrated marks on a thermometer to accurately record the temperature of a substance.

To read the temperature we look at the nearest line to the level of the liquid.

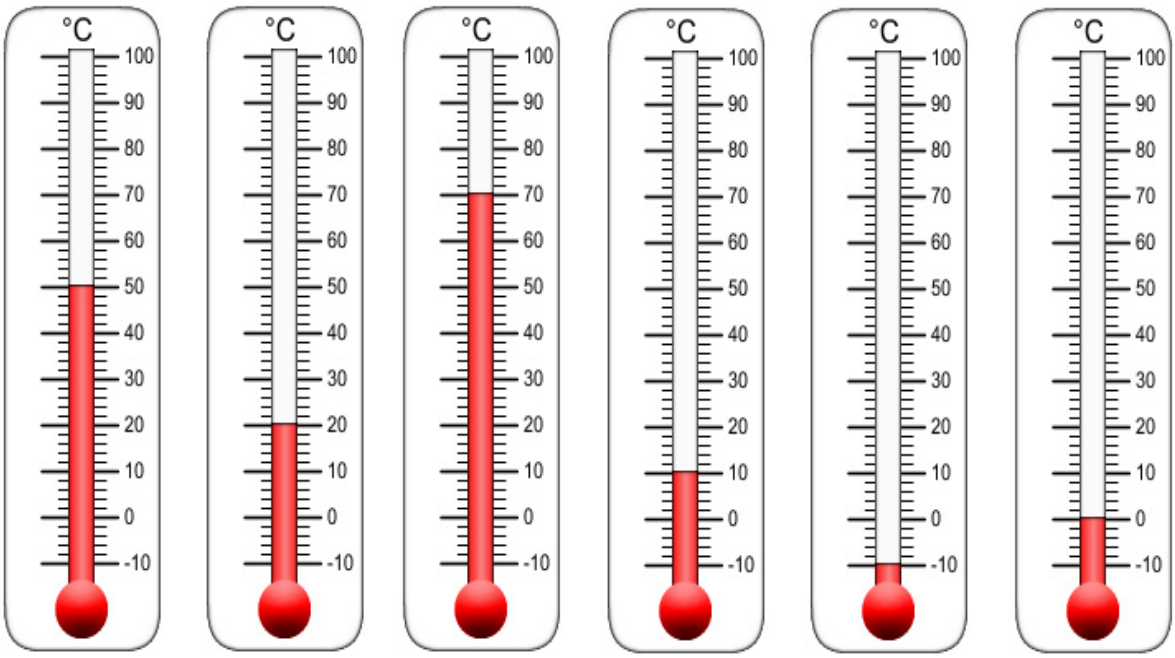


The line is to the 10^{o}C mark on the thermometer.

The temperature is 10^{o}C.

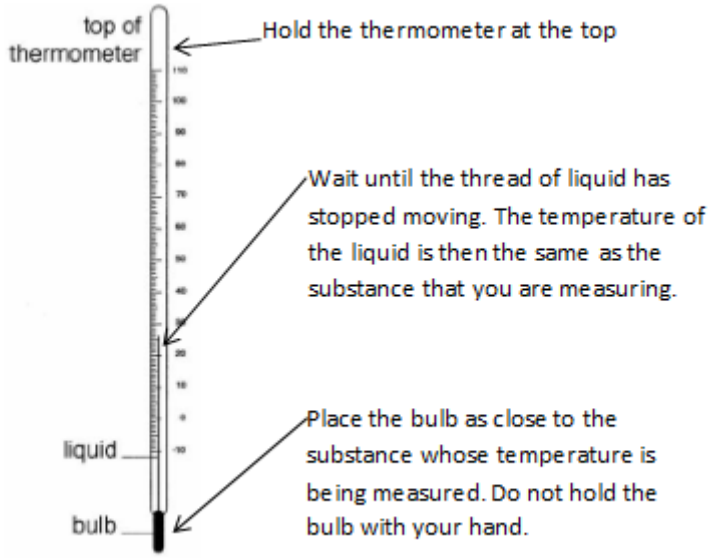
Activity 4

1. Write the temperature shown on each of the thermometers below. Don't forget to always include your units.



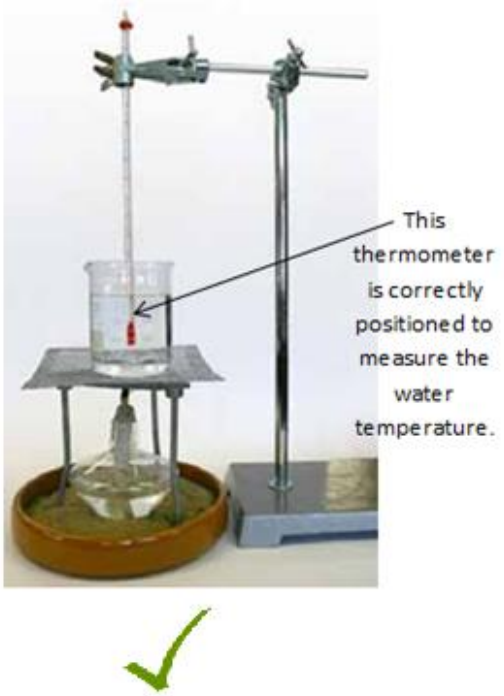
_____ _____ _____ _____ _____ _____

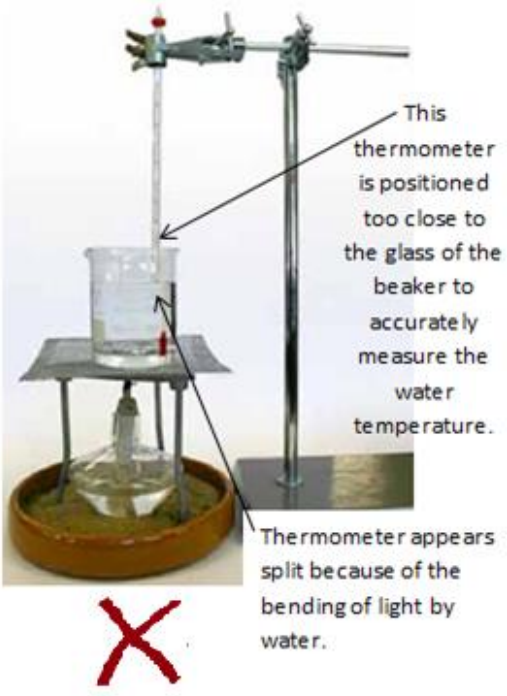
Using a thermometer



- Thermometers are designed to work in a specific temperature range. The range can be determined from its scale. You should never expose a thermometer to a temperature beyond this range.

- Thermometers need to be correctly placed to accurately measure temperature. A thermometer should **never touch the side or bottom** of the container.

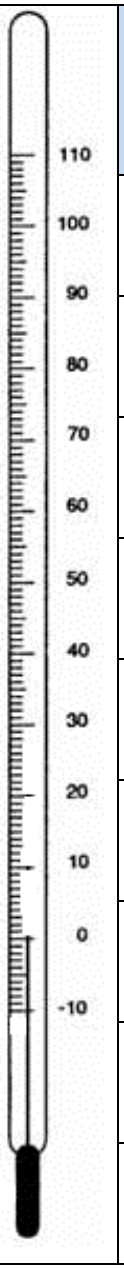




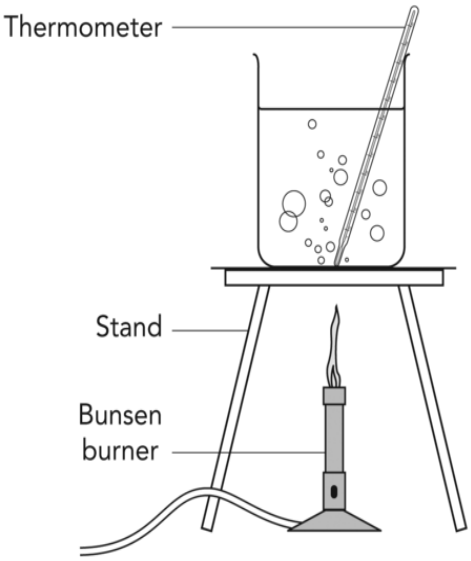
Activity 5

1. Look carefully at the scale on the thermometer below.

   Decide which things from the list it would be appropriate to use this thermometer for and tick the correct box (yes / no).

	**Measurement** **Can this thermometer be used?**	**Yes**	**No**
	1. Water boils at 100^{O}C.		
	2. Cooking fat boils at about 350^{O}C.		
	3. Water freezes at 0^{O}C.		
	4. Refrigerators operate at 4^{O}C.		
	5. A candle flame is about 1000^{O}C.		
	6. A freezer is at -18^{O}C.		
	7. Hot tap water maximum is 50^{O}C.		
	8. Oven temperature is 180^{O}C.		
	9. Body temperature (36.5^{O}C – 37.5^{O}C).		

2. What is wrong with the placement of the thermometer in this picture?



3. Use your knowledge of scientific equipment to draw a picture of a correctly placed thermometer in a beaker.

Measuring Temperature

Take out the thermometer that came in your kit for this topic.

We are going to use this thermometer to make some observations about temperature.

Activity 6

1. What is the highest temperature marking on the thermometer?

   _____

2. What is the lowest temperature marking on the thermometer?

   _____

3. What temperature is currently shown on the thermometer?

   _____

4. Rub your hands together so they warm up and then hold the bulb. What happened to the liquid in the thermometer? Did it go up or down?

   _____

5. Put some ice (about 3 ice cubes) in a cup and half fill the cup with water. Place the thermometer in the cup.

   (a) Did the liquid in the thermometer rise or fall? _____

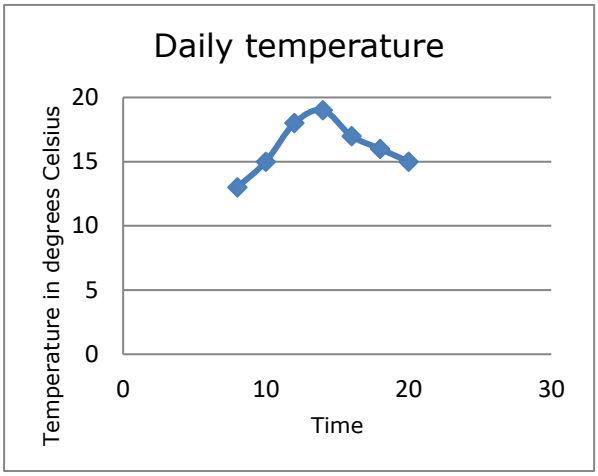
   (b) What was the lowest temperature it reached? _____

Temperature Graphs

Sometimes when we conduct an experiment we measure a change of temperature over time.

There are lots of ways we can present our data and one of these ways is a **line graph**.

Line graphs are used to show relationships between two things that both vary continuously.



In this graph the relationship is between time and temperature.

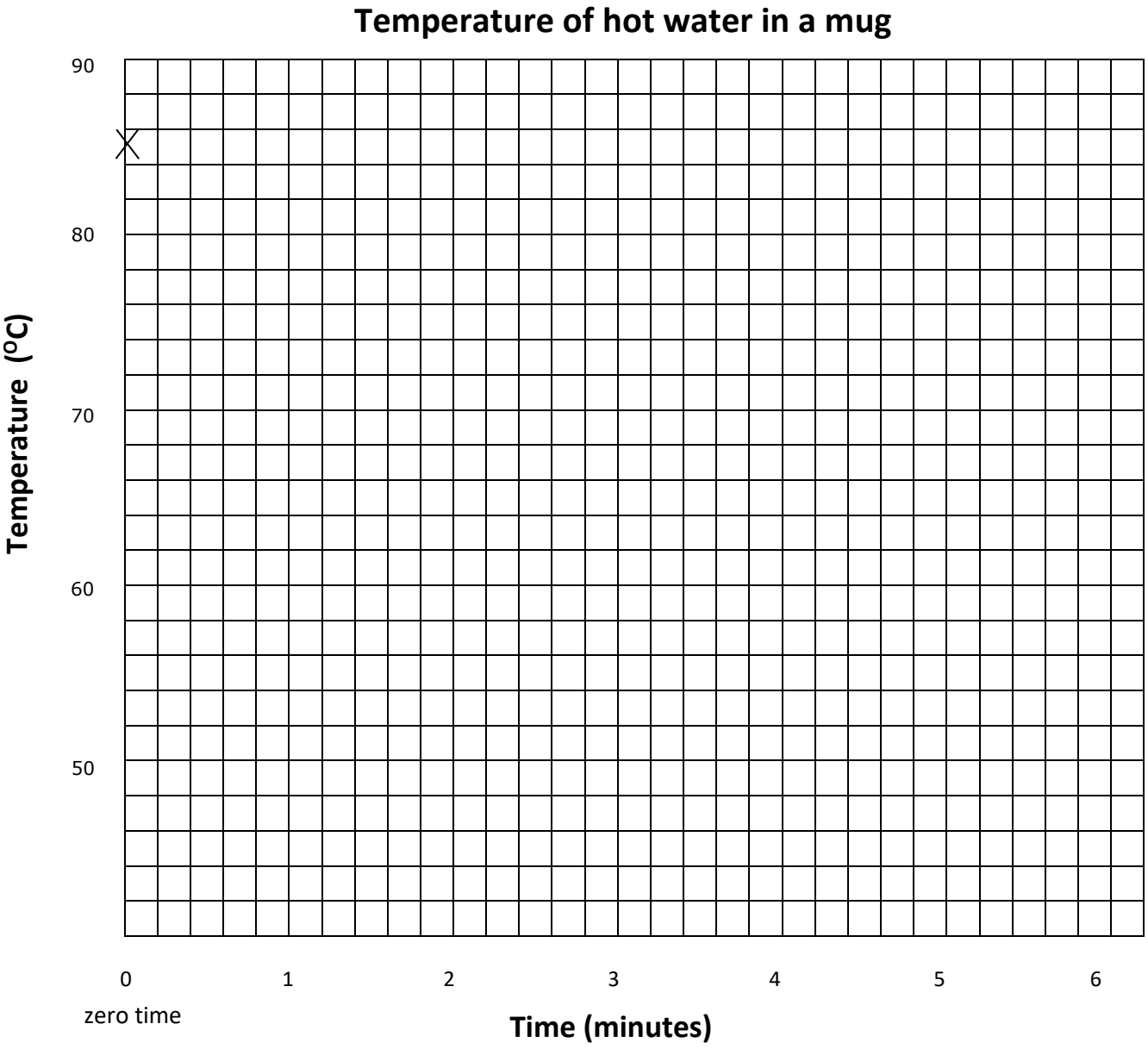
Activity 7

Here is some data that we are going to represent on a line graph.

Time (minutes)	Temperature in ^{O}C	Here are some temperature readings taken after boiling water was poured into a mug and a thermometer inserted. Readings of temperature were made every minute as the water started to cool. Time **zero** is the reading after the thermometer was first placed in the boiling water and reached maximum temperature.
0	85	
1	82	
2	80	
3	78	
4	77	
5	76	
6	75	

1. Use the data in the table to plot the points on the graph below and join the dots to create a line graph. The first point has been plotted for you.

Time (min)	0	1	2	3	4	5	6
Temp (^oC)	85	82	80	78	77	76	75



2. What temperature was the water at 1.5 minutes? _____

3. What might the temperature of the water have been at 7 minutes?

_____

Predicting what future points might be on a graph is called extrapolation.

Experiment 1

You may have seen people add salt to a pot of water when cooking pasta. Some people say this is to increase the temperature when the water boils, other people say that it is to make the water boil faster, whilst others say that the salt adds flavour to the pasta or makes it not stick.

We are going to conduct our own mythbusters experiment to see if adding salt to water does actually increase the boiling temperature or make the water boil faster.

Aim: To determine what effect salt has on the boiling point of water and how quickly water boils.

Equipment

Thermometer	Spoon
Small saucepan	Watch / clock
Stove	Water
Measuring jug	Salt

Method

1. Add 200 mL of cold tap water to the saucepan using the measuring jug.
2. Add 5 teaspoons of salt and stir to dissolve.
3. Measure the temperature of the mixture.
4. Place the saucepan on the stove and set to a medium temperature.
5. Start timing.
6. Stir the mixture with a spoon every minute and check and record the temperature using the thermometer.
7. Continue to measure and record the temperature until the water has been boiling for 3 minutes.
8. Turn off stove and allow mixture to cool slightly.
9. Empty the mixture into the sink and rinse the saucepan with water.
10. Repeat steps 1 - 9 but **DO NOT** add the salt.

Results:

1. Record your experiment results in the tables below.

With salt	
Time (minutes)	**Temperature (^oC)**
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	

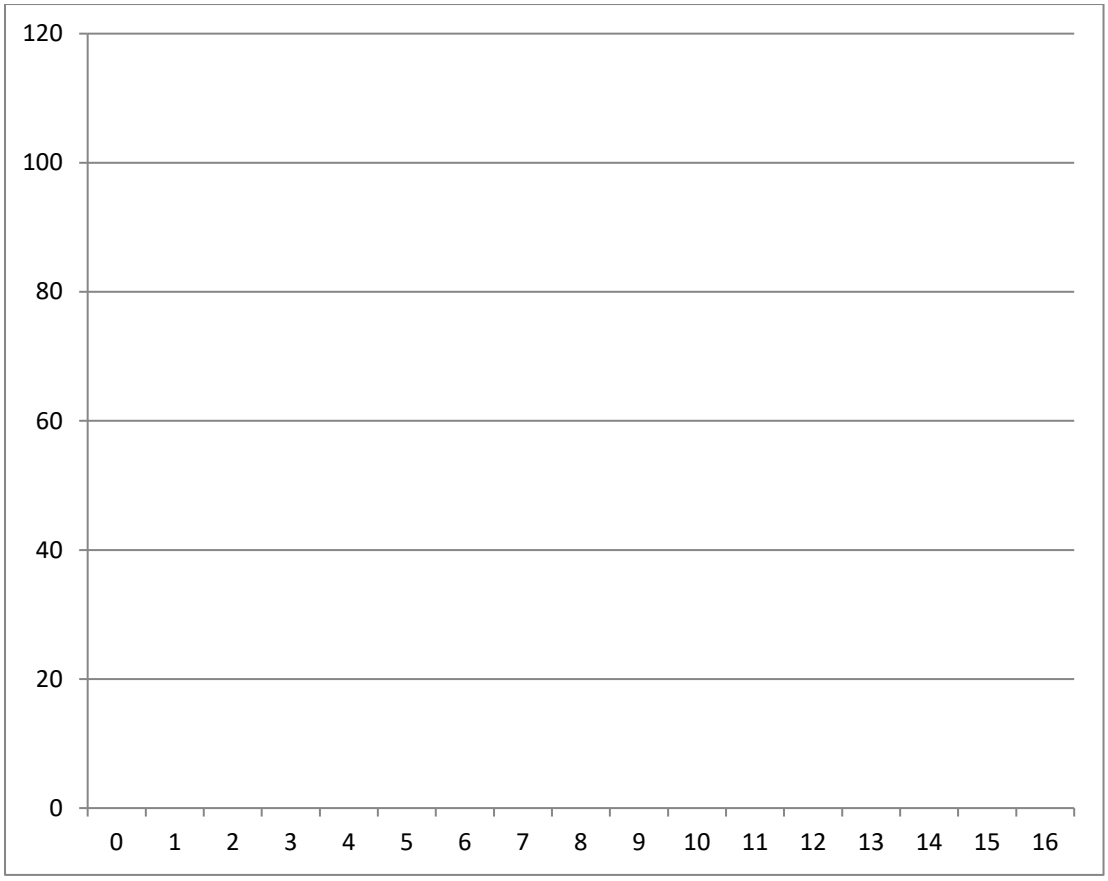
Without salt	
Time (minutes)	**Temperature (^oC)**
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	

2. Use the templates on page 21 to create a line graph for the two sets of data.

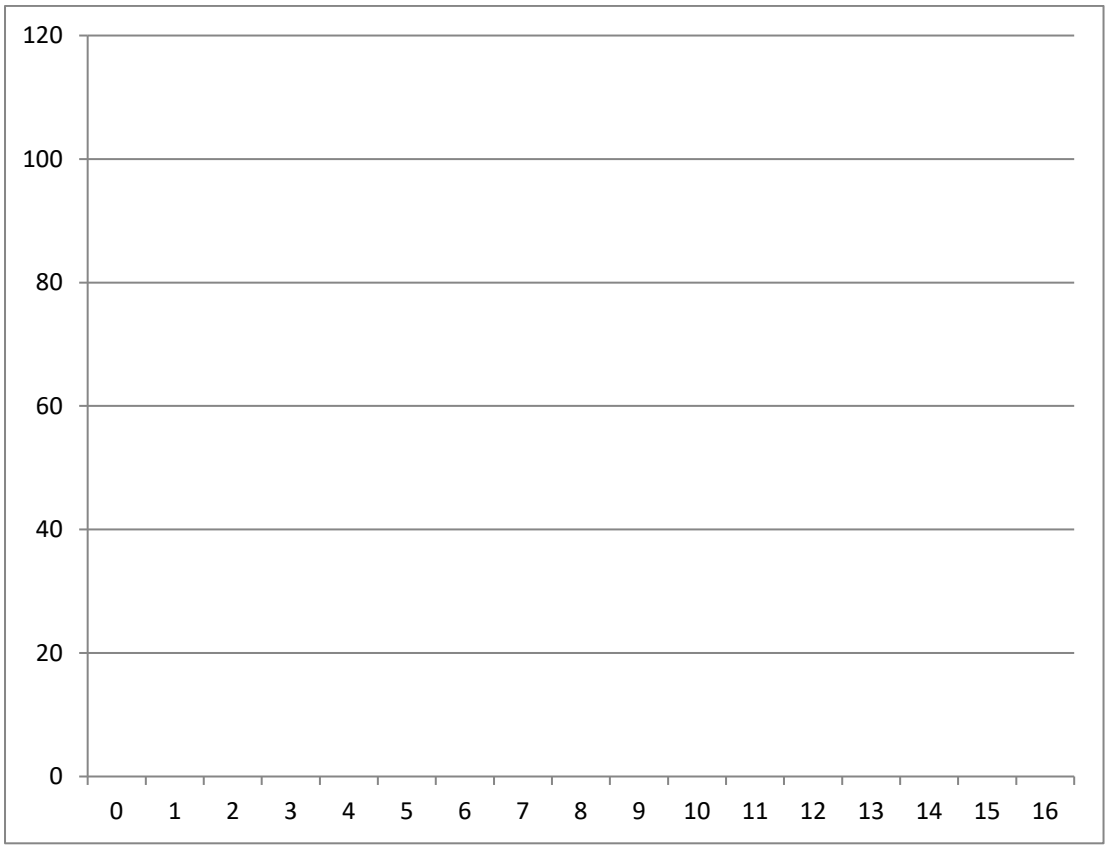
   Make sure you:

   - Include a graph title.
   - Label your axes.
   - Use a ruler.

Title:


120
100
80
60
40
20
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Title:


120
100
80
60
40
20
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Conclusion

1. What temperature did the water boil at when the salt was not added?

   _____

2. What temperature did the water boil at when the salt was added?

   _____

3. Did adding salt to the water change the temperature at which the water boiled? **Yes / No**

4. Adding salt causes the boiling point of water to **rise / fall / stay the same.** (choose one)

5. Did adding salt to the water make the water boil faster? **Yes / No**

6. Adding salt to the water made the water boil **faster / slower / in the same time.** (choose one)

7. Did you prove any of the theories about adding salt to water when cooking pasta? Give a reason for your answer.

   _____

   _____

Temperature and Density

Remember that **density is a property of matter**.

> The density of a substance is the relationship between the mass of the substance and how much space it takes up (volume).

An Italian physicist Galileo Galilei discovered that the **density** of most liquids **decreases as temperature increases**.

You may have seen a thermometer (called a Galilean thermometer) which works because of this principle.

The small bulbs rise or fall depending upon the temperature. This means that the thermometer can be used to tell the temperature of the room.

A Galilean thermometer

A close up of a Galilean thermometer

We will learn more about **why** the temperature affects density in our next lesson.

Activity 8

To see how the temperature of a liquid affects density, **scan this QR code with your smartphone.** [You will need a QR reader app]

Or visit website:

http://www.middleschoolchemistry.com/multimedia/chapter3/lesson6

After watching the video, answer the questions below.

1. What did you observe when the hot water (yellow liquid) was placed over the cold water (blue liquid)?

2. What did you observe when the cold water (blue liquid) was placed over the hot water (yellow liquid)?

3. What do your observations tell you about the density of hot and cold water? (Hint: a less dense liquid will float on a more dense liquid).

Middle School Science Stage 4 Course

Modelling Matter Set 3

Acknowledgments

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Contents

When you see this icon throughout the booklet it means that you will need to complete an activity.

Outcomes

By completing this unit, students are working towards achieving the following outcomes.

SC4-16CW: describes the observed properties and behaviour of matter, using scientific models and theories about the motion and arrangement of particles.

You have the opportunity to learn to:

- describe the behaviour of matter in terms of particles that are continuously moving and interacting
- relate an increase or decrease in the amount of heat energy possessed by particles to changes in particle movement
- use a simple particle model to predict the effect of adding or removing heat on different states of matter
- relate changes in the physical properties of matter to heat energy and particles movement that occurs during observations or evaporation, condensation, boiling, melting and freezing
- explain density in terms of a simple particle model
- compare physical and chemical changes in terms of the arrangement of particles and reversibility of the process.

Glossary

Read through this list of terms and their meanings which are introduced throughout this unit.

Term	Meaning
cause and effect	A relationship between actions where one event causes another to occur.
change of state	The process by which matter changes from one form to another.
compress	To press together and force into less space.
contract	Become smaller or decreasing in size or volume.
expand	Become larger or increasing in size or volume.
fluidity	The ability of matter to flow.
prediction	To guess in advance before something happens.
pressure	Force on a surface by matter in contact with the surface.
states of matter	Solid, liquid or gas forms of matter.
volume	The space that something occupies.

The Particle Model of Matter

All matter is made up of particles that are too small to be seen. These particles are always moving and have empty spaces between them. The structure of the particles depends on the state the matter is in – **solid, liquid or gas**.

- The particles in a **solid** are packed together tightly and vibrate (move) slightly. They are strongly attracted to each other and keep the solid held in its shape.

- The particles in a **liquid** are attracted to each other, but move more freely than the particles in a solid. The particles are able to move past one another. This is why a liquid is able to flow.

- The particles in a **gas** are not attracted to each other much at all. They vibrate and are able to move freely past each other. A gas does not have a definite shape or volume; the particles will spread out evenly to fill any container.

Activity 1

Complete the following sentences.

1. The particles in a _____ can spread to fill any container.

2. The particles in a _____ are held tightly together.

3. The particles in a _____ are able to move freely past each other and allow the material to flow.

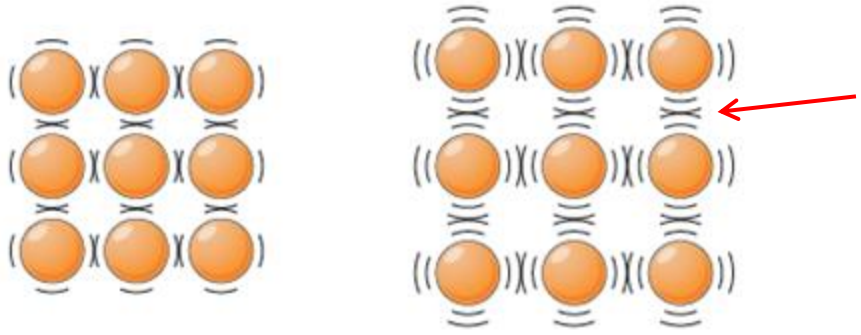
Expansion and Contraction

We have previously learnt that when matter is heated it **expands** (gets bigger) and when it is cooled it **contracts** (gets smaller).

Did you know that this happens because of particles in the matter?

When substances expand or contract, their particles stay the same size. It is the space between the particles that changes.

The particles in a solid, liquid and gas all vibrate and move more when they are heated, and that causes them to take up more space.



COLD **HOT**

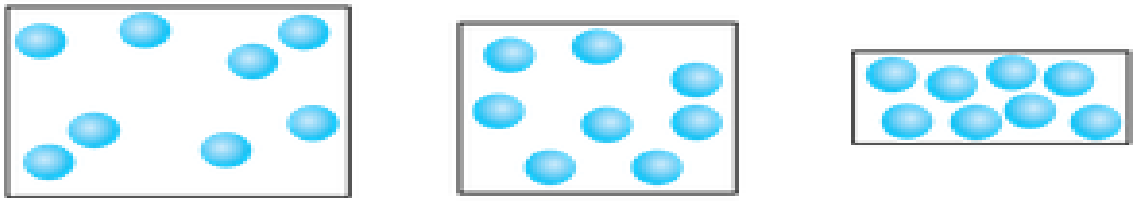
The particles stay the same – only the **space** between the particles changes.

The spaces get **bigger** as the **temperature increases**.

Activity 2

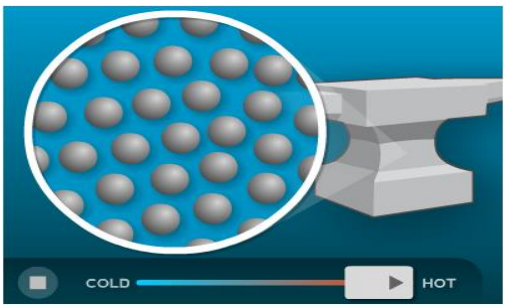
The pictures below show the particles in water.

The water is at three different temperatures – hot, cold and room temperature. Use your understanding of the spaces between the particles to label each picture (hot water, cold water, or room temperature water).



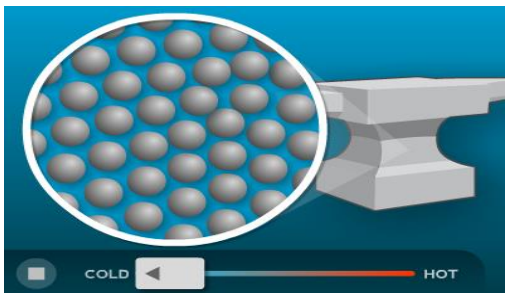
Heating and cooling in a solid

- The particles in a solid move apart when it is heated. The spaces between the particles **increases**.



When a solid is **heated**, the **particles move faster** and **slightly further apart**.

- The particles in a solid move closer together when it is cooled. The spaces between the particles **decreases**.

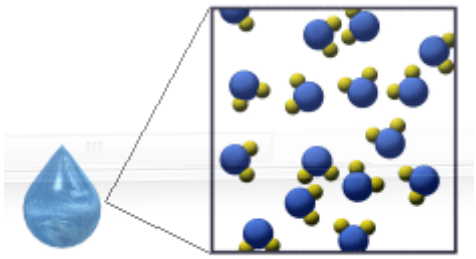


When a solid is **cooled** the **particles move slower** and move closer together.

Heating and cooling in a liquid

The particles in water behave in a similar way to those in a solid when heated or cooled.

- The particles in cold water are close together and move slowly.
- As the water is heated the particles move faster and further apart.
- The spaces between the particles get bigger as the temperature increases.



Activity 3

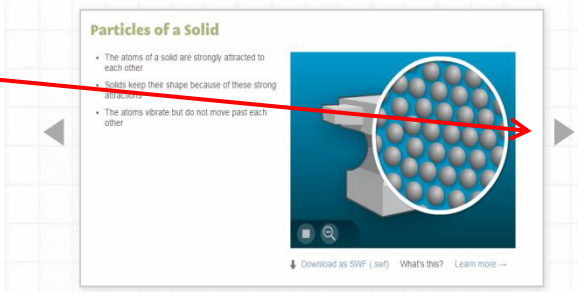
You are going to watch a video of a metal solid being heated to observe the impact of heat on a solid.

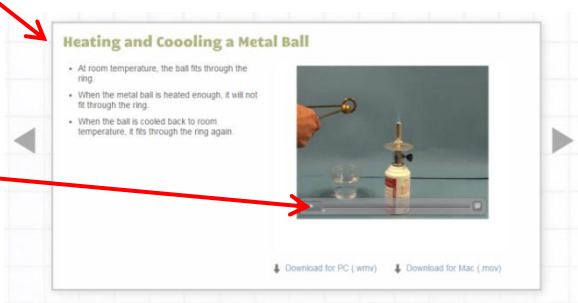
1. Make a **prediction** about what you think will happen to the solid? Will it expand or contract?

   _____

2. Visit the following website:
   http://www.middleschoolchemistry.com/multimedia/chapter1/lesson4

- Click on the right arrow, until you reach this screen.





- Then, watch the video of ball and ring by clicking on the play button.

3. What did you observe happen when the ball was heated? _____

   _____

4. Was your prediction correct? Yes / No

5. Why was the ball placed into a cup of water? _____

   _____

Experiment 1

Warm water has more energy than cold water which is why the particles move faster in warm water.

Aim: To observe the difference in particle movement in hot and cold water.

Equipment

2 glasses
Blue or green food colouring
Warm water
Cold water
Ice

Method

1. Half fill one glass with warm water.
2. Half fill the second glass with cold water and add a couple of pieces of ice to make sure the water is very cold.
3. Place the glasses beside each other on a table.
4. Add 3 drops of food dye to each glass (ideally at the same time).
5. Observe the movement of the coloured dye in the water in both glasses.

Results: What did you observe happen?

_____

_____

_____

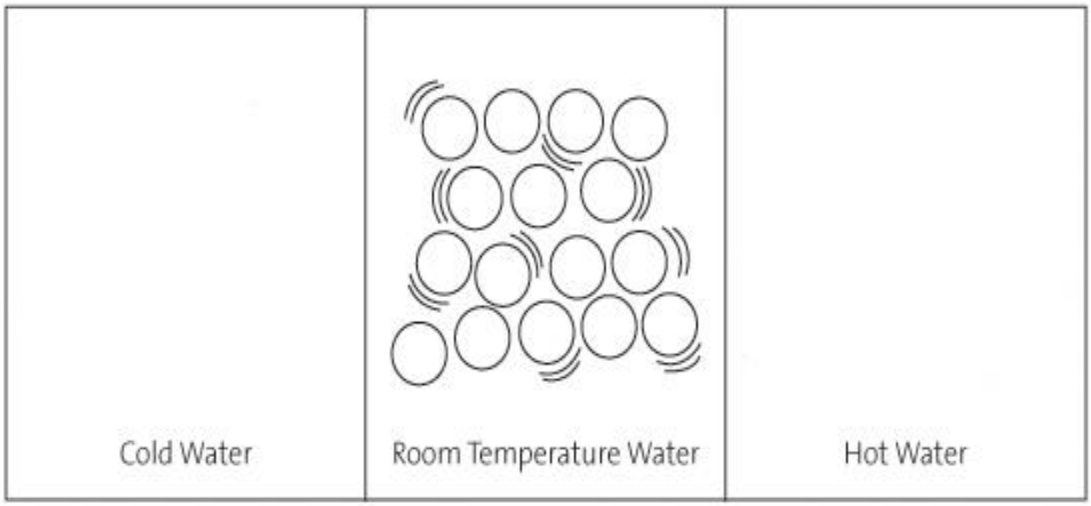
Hint: Did you notice that the dye spread out in the water more quickly in the hot water? If not, try the experiment again making your water colder with more ice and the warm water a little hotter.

Activity 4

Complete the diagram below by drawing what the particles would look like for cold water and hot water. Use the room temperature particles as a guide.

You can use circles ○ to represent the particles and curved lines) to show the movement of the particle (more lines = faster movement).

Don't forget to think about the spaces between the particles and how this changes as the temperature increases or decreases.



Heating and cooling in a gas

The particles of a gas have very little attraction for one another. This means that they barely interact with each other.

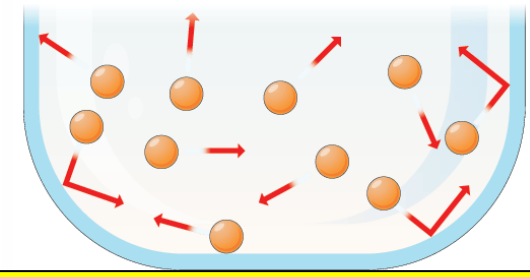
When the particles of a gas are heated, they move faster. When a balloon filled with gas is heated, the particles move faster and the distance between the particles increases. This causes the balloon to get bigger.

When the particles of a gas are cooled, they move closer together and move more slowly. This causes the gas to contract.

Under pressure

As the particles in a gas bounce against the walls of a container they apply force on the walls. This force is called **pressure**.

If you ride over a bump in the road on your bike, the pressure in your tyres helps protect you against the bumps in the road.



Gas particles hit the walls of the container and cause pressure.

The more particles that hit the walls of the container, the higher the pressure.

Heating increases pressure. If a gas is heated, its particles move more quickly, and this causes them to hit the container harder and more often.

- This is why deodorant cans and soft drink cans explode if they are heated too much!! The container expands because pressure of air particles is greater on the inside than the outside.

Experiment 2

Aim: To observe the expansion and contraction of a gas.

Equipment

2 balloons, fridge, hair dryer or toaster

Method

1. Blow up both balloons to the same size and tie them.
2. Place one balloon on a table or bench. This balloon will be your control.
3. Place the second balloon in the fridge or freezer.
4. Compare the size of the cold balloon to the control balloon after 1 hour.
5. Warm the cold balloon by blowing warm air from a hair dryer or holding it above a toaster. Leave the control balloon on the table or bench.
6. Compare the size of the warm balloon to the control balloon.

Results: Draw your results in the boxes below and write a brief description of your observations for each picture – use the words 'expand' and 'contract'.

Cooled balloon	Control balloon

Heated balloon	Control balloon

_____ _____

_____ _____

Conclusion:

The gas particles were furthest apart in the _____ balloon.

The gas particles were closest together in the _____ balloon.

Activity 5

To recap how solids, liquids and gases react when heated and cooled, **scan this QR code with your smartphone.** [You will need a QR reader app]

Or visit website:
http://www.bbc.co.uk/bitesize/ks3/science/chemical_material_behaviour/behaviour_of_matter/activity/

Watch the video and then answer the questions below.

1. Why do gases exert pressure on the walls of their container?
   A – the gas particles hit each other.
   B – the gas particles move quickly in all directions.
   C – the gas particles hit the container walls.

2. What happens to particles when they are heated up?
   A – they get smaller.
   B – they stay the same size.
   C – they get bigger.

3. When particles are cooled down they:
   A – vibrate more and move further apart.
   B – vibrate less and stay in the same place.
   C – vibrate less and move closer together.

4. Which of these are able to flow?
   A – liquids, solids and gases.
   B – liquids and gases.
   C – solids and gases.

5. Solids, liquids and gases expand when you heat them up, what happens to them when they are cooled down?
   A – they contract.
   B – they expand further.
   C – they stay the same.

6. What happens to the pressure in a metal spray can when it is heated up?

   A – it increases.

   B – it decreases.

   C – it stays the same.

7. A spray can, even when it is almost empty, contains compressed gases. Why does the safety warning on the label tell you not to dispose of the can by putting it in a fire?

_____

_____

_____

Properties Explained Using the Particle Model

The following tables outline the properties of solids, liquids and gases and explain the property using the particle model.

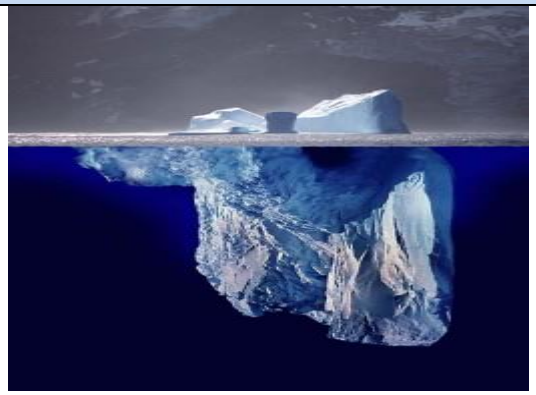
Property of solids	**Explanation using the particle model**
Solids cannot flow and have a defined shape.	The particles in a solid are strongly bonded to their neighbours, holding them in a fixed position.
Solids cannot be compressed.	The particles in a solid cannot be pushed closer to each other because they are so closely packed that there is almost no space between them.
Solids expand when heated and contract when cooled.	Heating causes the particles in a solid to vibrate faster; making them spread further apart causing the solid to expand. Cooling slows down vibrations and the opposite happens.

Property of liquids	Explanation using the particle model
Liquids flow to take the shape of the bottom of their container.	Bonds are strong but can still allow the particles in liquids to slip over one another.
Liquids cannot be compressed.	The particles in a liquid cannot be pushed together because they are so closely packed that there is almost no space between them.
Liquids expand when heated and contract when cooled.	Heating causes the particles in a liquid to move faster, making them spread further apart and causing the liquid to expand. Cooling slows down this movement and the opposite happens.

Property of gases	Explanation using the particle model
Gases are often invisible.	Particles in a gas are spread so far apart that you cannot see the gas.
Gases can be compressed.	Particles in a gas are spread so far that there is lots of empty space between them. This space allows them to be pushed closer together.
Gases spread to fill their container.	There are no bonds between gas particles and so they are able to move unrestricted by other particles. They travel until they hit the walls of the container.
Gases expand when heated and contract when cooled.	Heating causes the particles in a gas to move faster, making them spread further apart and causing the gas to expand. Cooling slows down this movement and the opposite happens.

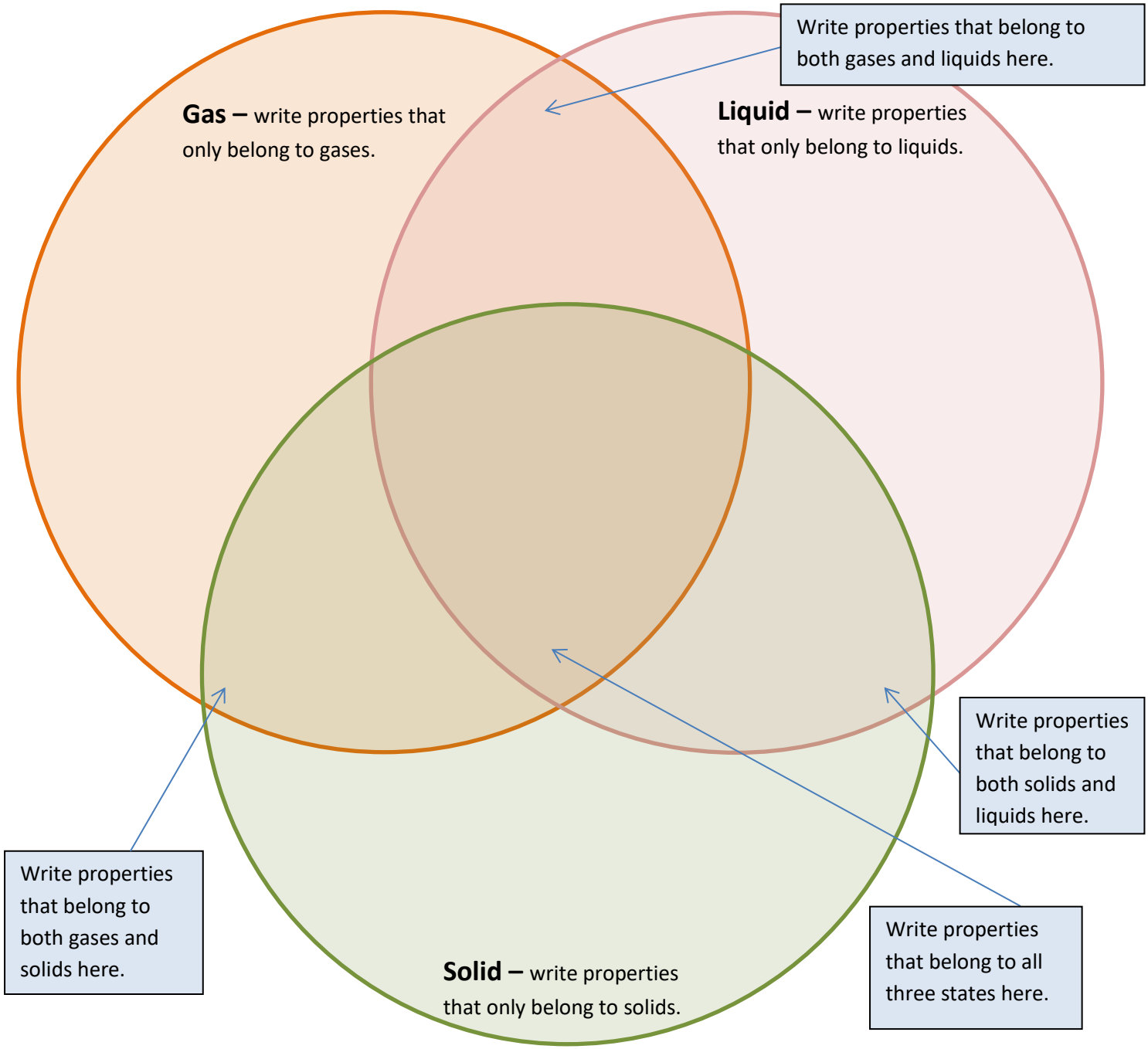
Activity 6

1. Use the information from the tables on pages 15 and 16 to name a property of the state of matter that is shown in each picture below.

State of Matter	Image	Property Shown
Solid		
Liquid		
Gas		

2. Complete the Venn diagram below showing which properties are shared between solids, liquids and gases and which properties below only belong to one state.

fixed shape	**changing shape**	**fixed volume**	**changing volume**
can be compressed	**cannot be compressed**	**closely packed**	**loosely packed**
	expands when heated	**contracts when cooled**	



Cause and Effect

Cause and effect occurs when one event causes another to happen.

- A cause is something that makes something happen.
- An effect is the thing that happens.

The cause is WHY it happens.

The effect is WHAT happens.

The two things are connected. Therefore we can say that there is a **relationship** between them.

Cause: I pushed the domino.

Effect: It fell over and knocked over the other dominoes.

By observing effects we can try to find the possible causes for the event.

Sometimes there can be more than one possible cause for an event.

For example:

Effect: I put up an umbrella.

Cause: 1. It started to rain.

2. It was very sunny and I didn't want to get sunburnt.

Many events in science are better understood by describing their cause and effect. Almost all parts of science involve cause and effect. For example;
Why does the ocean tide rise and fall? (EFFECT – this is what we see happen)
The moon's gravitational pull causes the ocean tides. (CAUSE – this is what makes what we see happen)

Sometimes scientists observe an effect and need to determine the cause for the event.

Activity 7

1. Match the cause with an appropriate effect.

Cause	Effect
I planted seeds in my garden.	The ball expanded and no longer fit in a metal ring.
A metal ball was heated.	Ice caps began to melt.
I placed a bottle of water in the freezer.	Plants began to grow.
The temperature on earth increased.	The water froze and changed state from liquid to solid.

2. Write an effect for the following cause.

   Cause: The ocean was polluted by rubbish.

   Effect: _____

   _____

3. Write a cause for the following effect.

   Effect: The water began to boil and change state from liquid to gas.

   Cause: _____

   _____

4. On a very hot summer day, the unopened can was left in the back of my car. Several hours later, when I returned to my car, the soft drink was all over the car seat and this is what the can looked like.

Write a cause and effect for what you can observe about the can.

Cause: _____

_____

_____

Effect: _____

_____

_____

Activity 8

Following are a number of illustrations highlighting applications of our understanding of the properties of matter. For each illustration, write a statement that links an **effect** to its **cause**. Some have been started for you.

 An iron rim has been fitted to the wooden wagon wheel by a blacksmith.	**Cause 1:** The rim was heated. **Effect 1:** The metal expands so the iron rim could be placed over the wooden wheel. **Cause 2:** The metal cools down. **Effect 2:** The metal rim contracts, making it fit tightly on the wooden rim.

 On a cold day the electricity wires are very tightly strung between the poles.	**Cause:** **Effect:** The electricity wires become very tight.
 When the bottle containing cold water was placed under running hot water, the glass shattered.	
 The roadway has soft rubber inserted between the concrete slabs.	
 When the balloonists want the balloon to go up, they ignite the gas burners.	