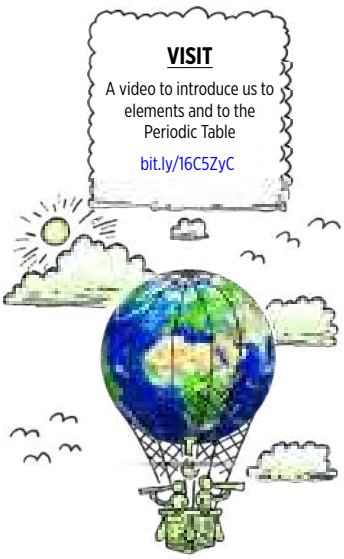
4 The Periodic Table of Elements

KEY QUESTIONS:

- What is an element?
- How can we classify the elements in our world?
- Which table helps us to make sense of the patterns we observe in the chemical properties of the elements?
- How are elements arranged on the Periodic Table?
- What does the position of an element on the Periodic Table tell us about its expected properties?
- What information can we use to represent the identity of an element?
- What are the typical properties of the
  - metals;
  - nonmetals; and
  - semi-metals?

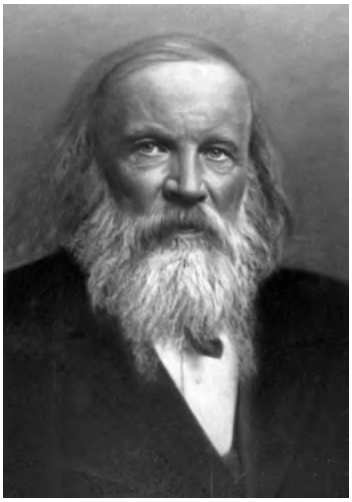


People have been interested in science from the earliest times. Early man discovered how to process natural ores into metals for ornaments, weapons and tools. At least 3000 years ago, ancient people were already using embalming fluids (chemicals) obtained from plants to preserve the bodies of dead people and animals!

Mankind has been studying and experimenting with materials to try to understand matter for thousands of years. Scientists especially, wanted some understanding of all the different substances that they were working with.

An ancient Egyptian mummy that has been embalmed to preserve it.

Over time, many different elements were discovered by scientists all over the world. These elements make up all the materials around us. But what do we mean by the word element? An element is a pure substance which cannot be broken down any further. We will find out more about elements in this chapter.



Dmitri Mendeleev.

Over time, our knowledge about the elements and their behaviour increased and scientists recognised the need to organise this information. They began to observe patterns and similarities in the way some groups of elements behaved and recorded these observations. Scientists wanted some way to **classify** the elements according to their properties that they were observing.

The version of the Periodic Table that we use today was first proposed by Dmitri Ivanovich Mendeleev in 1872. Mendeleev was a brilliant Russian scientist. While other scientists made many contributions to the design of the Periodic Table, Mendeleev was the one who first showed that the table could predict the existence and properties of elements that were still undiscovered at the time.

VISIT

This video tells us more about how Dmitri Mendeleev listed and arranged the elements on the Periodic Table and why this was such an important event in the history of science as we know it.

bit.ly/147Ql9f

Alchemists, experimenting with materials in their laboratory.

NEW WORDS

- element
- Periodic Table
- symbol (or element symbol)
- atomic number

4.1 Arrangement of elements on the Periodic Table

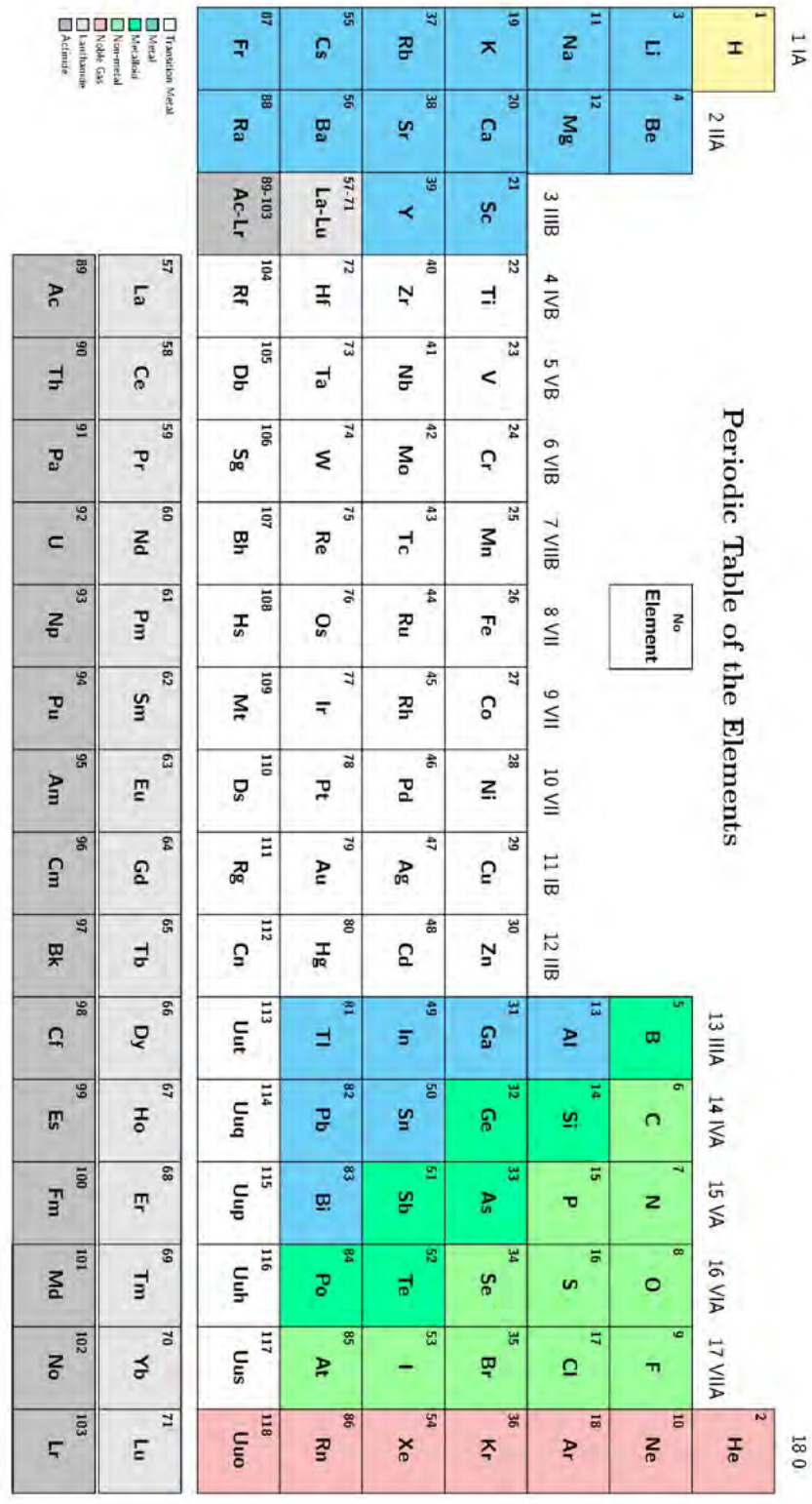
The Periodic Table is a classification system for the elements that make up the matter and materials in our world. Today, there are more than 100 different elements known! Each element has its own name, symbol, atomic number and position on the Periodic Table.

Element names

What is your name? Perhaps it is Thando. Or David. Or Megan. Perhaps you are lucky enough to be the only person in your class with that name. Perhaps you are lucky enough to be the only person in the world with that name! That would make your name unique.

Each element has a unique name. We can think of each name as a unique 'label' we can use to identify the element. There are two other unique labels that we

can use to identify elements. They are the chemical symbol and the atomic number. We will learn more about these in the next section. Each element has some of its own unique properties and later on we will see that those with some similar properties can be grouped together.



The Periodic Table of elements as it is today.

VISIT

There are TWO songs to help you remember the elements of the Periodic Table. Which one is your favourite? Can you learn one (or both) of them? bit.ly/18d0bLI and bit.ly/11OuoPM

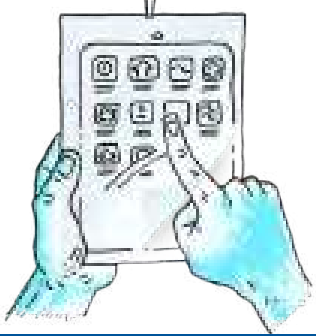
VISIT

A tour of the Periodic Table

bit.ly/147Qzgx

TAKE NOTE

There is a bigger version of the modern Periodic Table of elements on the inside cover of your workbook. You can use it for easy reference.



Chemical symbols

If you are a scientist and you work with elements every day, writing out the names can become very tedious. To make writing about elements easier, scientists have given each element a short **symbol.** To make sure we do not become confused with different elements when we write about them, the symbol for each element must be unique, just like its name is.

The names and symbols for some common elements are shown in the following table.

Element	Symbol	Element	Symbol
Aluminium	Al	Magnesium	Mg
Bromine	Br	Nitrogen	N
Calcium	Ca	Oxygen	O
Carbon	C	Phosphorus	P
Chlorine	Cl	Potassium	K
Copper	Cu	Silicon	Si
Gold	Au	Silver	Ag
Hydrogen	H	Sodium	Na
Iodine	I	Sulfur	S
Iron	Fe	Tin	Sn
Lead	Pb	Zinc	Zn

The symbol for carbon is C, the symbol for sulfur is S and the symbol for nitrogen is N. It is easy to see why these symbols were chosen: they simply represent the first letter of each name. This letter is always capitalised (upper case).

What happens when the different elements all start with the same letter? For example: calcium, carbon, chlorine and copper all start with the letter 'C'! To ensure they all have a unique symbol, a second letter was added to their symbol. This letter is always a small letter (lower case).

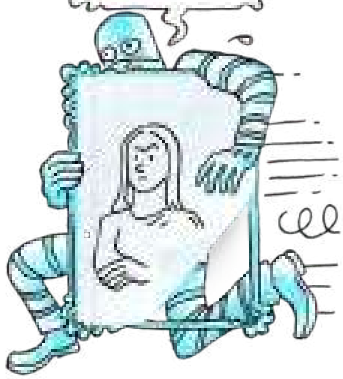
Some chemical symbols are more difficult to understand. Na, for example, is the symbol for sodium. The Na comes from the Latin name for sodium, which is *natrium*. These symbols were chosen very long ago, when many subjects were studied in Latin. Can you imagine how difficult that must have been?!

Some simple rules to remember when using chemical symbols:

1. Every element has its own, unique symbol.
2. The symbol is usually (but not always) the first one or two letters of the name of the element.
3. The first letter of the symbol is always a capital letter.
4. If the symbol has two letters, the second letter is always a small letter.
5. Some elements have symbols that come from their Latin names.

TAKE NOTE

You need to know the names and symbols of these elements listed here.



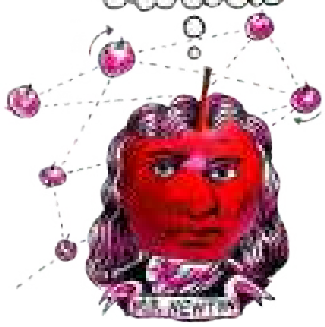
VISIT

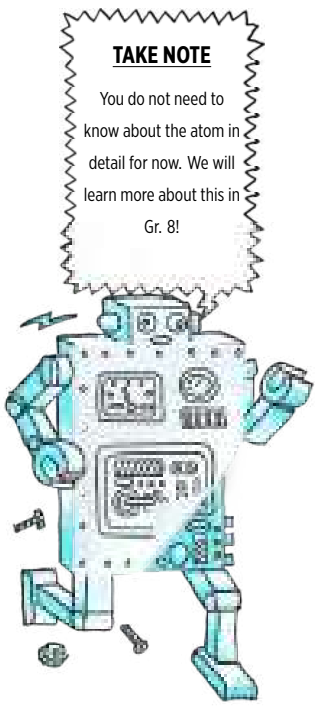
A game to learn about the Periodic Table

bit.ly/15QkMHn

DID YOU KNOW?

The symbol for lead (Pb) comes from plumbum, the Latin word for lead. For many years, lead was used to make water pipes. This is also where the word plumber comes from.





Atomic numbers

If you look at the Periodic Table, you will see that each element also has a unique number. This is called the **atomic number**. To properly understand what the atomic number is, we need to know what an **atom** is. We will learn more about atoms in Gr. 8, but for now, let's briefly go back to our history lesson!

Do you remember we said Mendeleev developed the first periodic table in 1869? Well before that, at the beginning of the 1800's, a man by the name of John Dalton said that all matter is made up of very small particles called atoms. These atoms vary in mass and size. Do you remember we said an element is a pure substance? We can now also say that an element is a substance that contains *only one particular type of atom.* The atoms of one element are different from the atoms of any other element.

All atoms are made up of even smaller particles which we call subatomic particles. These are protons, neutrons and electrons. All you must remember for now is that the protons, electrons, and neutrons of one element *are exactly the same* as the protons, electrons, and neutrons of any other element. It is their number and arrangement that make the elements different.

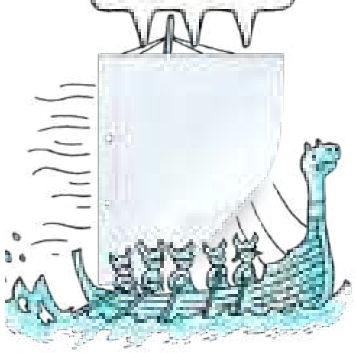
The atomic number of an element refers to *how many protons* that element has in its atoms. Since each element has a different number of protons in its atoms, each element also has a unique atomic number.

Have a look at the Periodic Table. What is the atomic number of hydrogen? How many protons are there in its atoms?

What is the atomic number of carbon? How many protons are there in its atoms?

TAKE NOTE

When things show a regular, repeating pattern, we say it is **periodic**. When the elements were arranged in order of increasing mass, Mendeleev observed a pattern in their properties, which allowed him to arrange the elements into rows and columns in a table, the **Periodic** Table. Elements in the same rows and columns in the table, have similar properties to each other.



Reihen	Gruppe I. — R^1O	Gruppe II. — RO	Gruppe III. — R^2O^3	Gruppe IV. RH^4 RO^2	Gruppe V. RH^3 R^2O^5	Gruppe VI. RH^2 RO^3	Gruppe VII. RH R^2O^7	Gruppe VIII. — RO^4
1	H=1							
2	Li=7	Be=9,4	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24	Al=27,3	Si=28	P=31	S=32	Cl=35,5	
4	K=39	Ca=40	—=44	Ti=48	V=51	Cr=52	Mn=55	Fe=56, Co=59, Ni=59, Cu=63.
5	(Cu=63)	Zn=65	—=68	—=72	As=75	Se=78	Br=80	
6	Rb=85	Sr=87	?Yt=88	Zr=90	Nb=94	Mo=96	—=100	Ru=104, Rh=104, Pd=106, Ag=108.
7	(Ag=108)	Cd=112	In=113	Sn=118	Sb=122	Te=125	J=127	
8	Cs=133	Ba=137	?Di=138	?Ce=140	—	—	—	— — — —
9	(—)	—	—	—	—	—	—	
10	—	—	?Er=178	?La=180	Ta=182	W=184	—	Os=195, Ir=197, Pt=198, Au=199.
11	(Au=199)	Hg=200	Tl=204	Pb=207	Bi=208	—	—	
12	—	—	—	Th=231	—	U=240	—	— — — —

Mendeleev's Periodic Table from 1872. The spaces marked with blank lines represent elements that Mendeleev thought existed, but they were not yet discovered at the time, so he left places for them.

Can you see how the elements are arranged so that their atomic numbers increase from left to right across the Periodic Table? This is not a coincidence!

When Mendeleev first created the Periodic Table, he arranged the 60 elements that he knew of at the time in order of increasing mass. He then saw that there was a regular pattern in other characteristics of these elements. Mendeleev then grouped them into columns and rows according to their properties. These were physical and chemical properties which the scientists had observed from doing many different experiments. This resulted in the arrangement of the elements on the Periodic Table.

The Periodic Table that we use today looks a lot more modern than Mendeleev's original version. You will notice that there are no empty blocks in the modern version of the table. That tells us that all the elements that were still undiscovered in Mendeleev's lifetime, are now known.

In the next activity, we will compare Mendeleev's original Periodic Table with the version that we use today. This will help show us how scientific discovery is sometimes a slow process.

ACTIVITY: Comparing Mendeleev's table with the modern version of the Periodic Table

When Mendeleev first arranged the elements according to their mass and their properties, it resulted in there being some gaps in the rows. But, as a good scientist, Mendeleev did not see this as a problem! Instead, he thought it simply meant that there were elements that had not been discovered yet. And he was right!

Mendeleev put a blank line and the atomic number to show that he thought there is an element which should go there, but it had not been discovered. Look carefully at Mendeleev's original table. See if you can find where it says '__ = 44' in the table.

See if you can find the 2 other elements that had not been discovered at that time. Write their numbers down in the space below.

_____

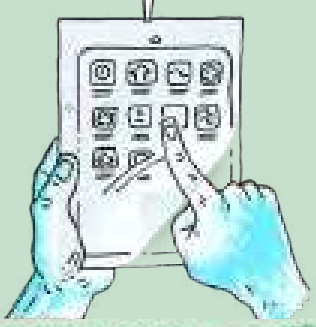
Now look at the modern version of the Periodic Table. Can you find the elements with these numbers? What are their symbols? What are their names? Write your answers in the table provided.

As an extension of this activity you could look up the names of these elements, and research when they were discovered, and add this information to the table.

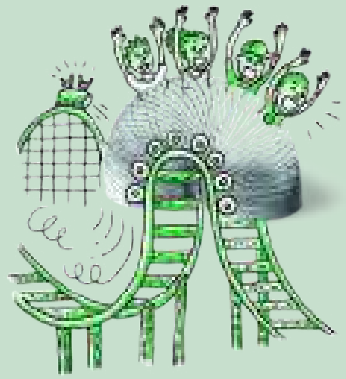
Number of the element	Symbol of the element	Name of the element	When was this element discovered?

TAKE NOTE

In Life and Living, we looked at the classification of living organisms in our world. Now in Matter and Materials, we are looking at the classification system for elements!



In the next activity we are going to use our new knowledge of element symbols and atomic numbers to hunt for a very valuable 'treasure'. We will find the treasure by following some clues about the Periodic Table.



ACTIVITY: Periodic Table treasure hunt

Your job is to follow the clues, in order to find the treasure. The instructions will help you to spell out the name of the treasure in the blocks below.

1. Clue 1: What is the symbol for carbon (atomic number 6)? Write this symbol in the first block above.
2. Clue 2: Hydrogen is the lightest element. Can you find it on the Periodic Table? Write its symbol in the second block.
3. Clue 3: Which element represents the gas that we breathe to stay alive? Here is a hint: It is represented by atomic number 8. Write its symbol in the third block and give the name of the element below.

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4. Clue 4: This element is in the fourth row and the ninth column of the Periodic Table. It is a metal that is used in magnets. Write its symbol in the fourth block. Do you know its name? Write its name below.

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5. Clue 5: This element is represented by atomic number 57. Write its symbol in the fifth block. See if you can find out the name of this element and write it down below.

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6. Clue 6: This element is represented by atomic number 52. It is a semi-metal that is used in the manufacture of solar panels. Write its symbol in the last (sixth) block. See if you can find out the name of this element and write it down below.

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7. What is the 'treasure' that you have found?

Complete the following sentence by replacing the names of the elements with chemical symbols. You would have to look up some of the symbols!

SCIENCE...Fluorine Arsenic Carbon Iodine Nitrogen Astatine Einsteinium... ME!

Complete the following table to see how many of the names and symbols of the elements you remember. Try to do this without referring to the Periodic Table.

Element	Symbol	Element	Symbol
	Al		Mg
Bromine			N
Calcium		Oxygen	
	C	Phosphorus	
	Cl		K
Copper			Si
	Au	Silver	
	H		Na
Iodine		Sulfur	
	Fe	Tin	
Lead			Zn

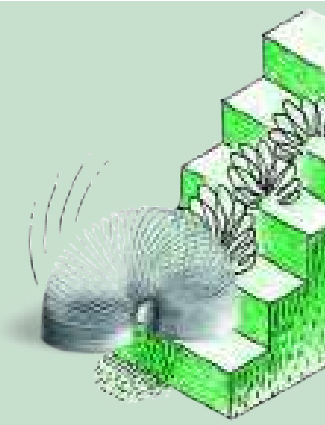
NEW WORDS

- semi-metal
- semi-conductor

4.2 Properties of metals, semi-metals and non-metals

The Periodic Table is an amazing tool! Did you know that the position of an element on the Periodic Table can tell a scientist what properties the element can be expected to have? This is because the elements have not just been arranged randomly! But, rather, they are grouped and arranged according to similar properties. Let's find out what this means.

ACTIVITY: What do some of the elements look like?



INSTRUCTIONS:

1. Your teacher will guide you through this activity. You will either look at real samples of some of the elements, or else refer to the photos below of some of the elements.
2. Your task as a class is to identify the different elements and find their place on the Periodic Table. You will either stick the real samples onto a large blank Periodic Table, or use the blank one here in your workbook, or both.

3. You must then look at what the different elements look like and see if you can identify any similar properties. The questions at the end will help guide you through this.

Here are some photos of the different elements:

DID YOU KNOW?

The Periodic Table is made up of more than 100 elements, but only 90 of the elements occur in nature. The rest have been made by man.

Aluminium foil.

Carbon (graphite).

Copper.

Magnesium.

Sulfur.

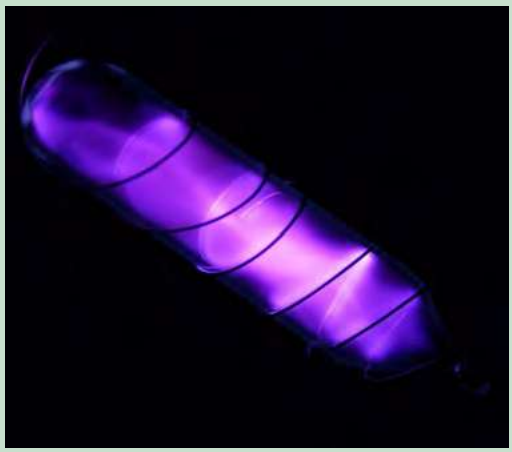
Bromine in tube.

Chlorine gas.

Calcium.

Phosphorus.

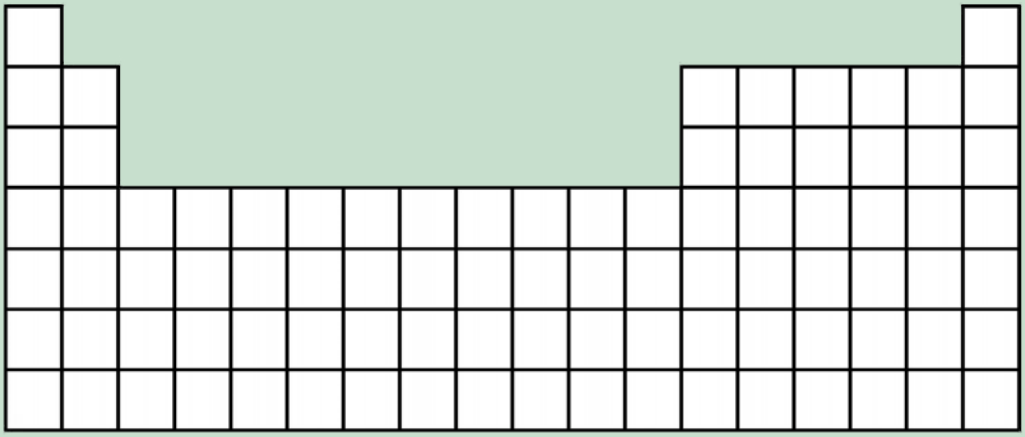
Potassium.



Nitrogen gas.

Iron.

If you do not have a large cardboard Periodic Table to work with at the front of the class, write the names of the elements you discuss on the blank table provided here:



After completing this activity, either by sticking actual samples onto a cardboard cut out, or looking at the photos provided here in your workbook and seeing where they are positioned on the Periodic Table, answer these questions.

QUESTIONS:

1. How would you describe the elements that are mostly on the left side of the Periodic Table?

2. How would you describe the elements that are mostly on the right side of the Periodic Table?

DID YOU KNOW?

Francium (Fr) is the rarest element on Earth. Only 20 to 30 g exists at any one time on Earth in nature!

You probably saw from the last activity that there is a difference in the elements on the left and right of the Periodic Table. Were you able to identify what these elements are classified as. You have learnt about them before in previous grades. They are **metals** and **non-metals**.

Let's do a quick revision of what we have already learnt about metals and non-metals in previous grades.

The properties of metals and non-metals

Metals and non-metals have distinct properties. That means their properties are unique and different from each other. Can you remember what the unique properties of metals and non-metals are? The next activity will refresh your memory.

ACTIVITY: Blitz revision of the properties of metals and non-metals

Here is a block with different properties of metals and non-metals in it. They have been jumbled and are not sorted. You need to decide whether these properties describe metals or non-metals and sort them into the columns in the table which has been provided. Make sure that all the properties in the block are in your table. If you can think of properties that are not listed in the block, you may also add them to the table.

Properties

- shiny
- lustrous
- dull
- brittle
- malleable
- ductile
- conducts electricity
- conducts heat
- usually a solid
- can be solid/liquid/gas
- electrical insulator
- thermal insulator
- (other)

Do the activity as quickly (but also as neatly) as you can, and time yourself!

Properties of metals	Properties of non-metals

Most elements fall into one of these two categories: metals and non-metals. We use the *properties* of an element to categorise it as a metal or a non-metal.

Think of chromium, for example, which is shiny (lustrous), bends easily (malleable) and conducts heat and electricity well.

A piece of chromium.

1. What are the properties of chromium?

2. Based on these properties, would you categorise chromium as a metal or a non-metal?

3. Can you find chromium on the Periodic Table? (Hint: It may help to find its symbol first.) What is its atomic number?

Sulfur crystals forming on a rock wall inside a volcano.

Now think of sulfur.

Sulfur is usually a dull, yellow powder.

It does not conduct electricity or heat well and large crystals of sulfur break easily when they are dropped.

1. What are the properties of sulfur?

2. Based on these properties, would you categorise sulfur as a metal or a non-metal?

3. Can you find sulfur on the Periodic Table? (Hint: It may help to find its symbol first.) What is its atomic number?

We have now looked at the properties of metals and non-metals. But, when scientists were doing their experiments to observe the properties of the elements, they sometimes found some elements which were difficult to classify as either a metal or a non-metal.

The properties of semi-metals

Some elements are not quite metals, but they are not quite non-metals either. They just don't fit into either category! Does this sound strange to you? Let us explore.

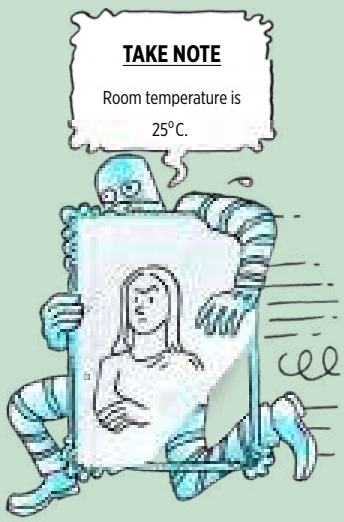
ACTIVITY: Classifying element X

Pretend that you are a member of a team of scientists that has just discovered a new element. The element has not been named yet, so it is simply referred to as 'element X'.

The team has a sufficient amount of element X to make several disks of the material. They create a file about element X. In the file, they place the following picture of one of the disks.

A disk of element X.

Look carefully at the picture. How would you describe the appearance of element X?



The team performs experiments on element X and adds the following data to the file:

1. In an attempt to bend a disk of element X, the disk shattered, like glass. The same result was observed when a second disk was dropped from a height.
2. The material is found to be a poor conductor of heat and electricity at room temperature. Element X was then cooled down significantly by placing it in a freezer. At very low temperatures, it becomes a good conductor of electricity.

Fill out the following checklist for element X by placing crosses next to each property that was observed.

Metallic properties	**YES**	**NO**
Is the material shiny (lustrous)?		
Is the material malleable and ductile?		
Does the material conduct electricity at room temperature?		
Does the material conduct heat?		
Non-metallic properties	**YES**	**NO**
Is the material brittle?		
Does the material have a dull appearance?		
Is the material an insulator?		
Additional comments (what else did you observe?):		

QUESTIONS:

1. Which of the properties of element X are typical of metals?

2. Which of the properties of element X are typical of non-metals?

3. Would you classify element X as a metal or a non-metal?

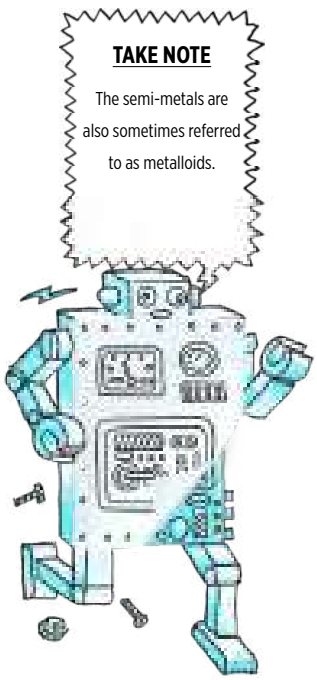
Element X does not quite fit into either category. Some of its properties are metallic and others are non-metallic. Element X is a real element, and its name is tellurium (chemical symbol: Te). Can you find it on the Periodic Table?

There are other elements, like tellurium, that are difficult to classify as either metals or non-metals. This is because they have some properties that are typical of metals and some properties that are typical of non-metals. A special category was invented for these elements: they are called **semi-metals**.

There are not many semi-metals. They are all listed in the following table. You do not have to remember all their names.

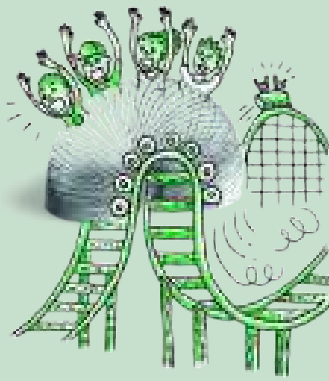
Names and symbols of the semi-metals:

Name	Chemical symbol	Atomic number
Boron	B	5
Silicon	Si	14
Germanium	Ge	32
Arsenic	As	33
Antimony	Sb	51
Tellurium	Te	52
Polonium	Po	84



Now that we have looked at some of the elements and where they are found on the Periodic Table, you might have already recognised that there is a trend in where the metals, semi-metals and non-metals are positioned on the Periodic Table. We are now going to do a colouring activity to see where on the Periodic Table we will find each of the categories of elements.

ACTIVITY: The regions of the Periodic Table



We are going to colour areas on the following version of the Periodic Table. This will help us identify the regions on the table where the metals, non-metals and semi-metals are located.

MATERIALS:

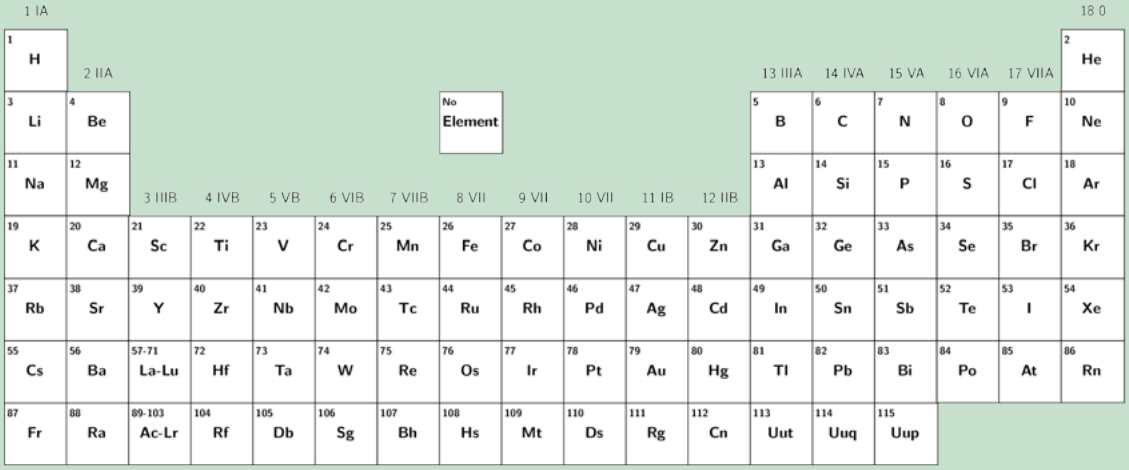
For this activity you will need coloured pencils or kokis or crayons in the following colours:

- Blue
- Yellow
- Red

INSTRUCTIONS:

1. **Semi-metals:**
   Find all the semi-metals on the Periodic Table. You will need to consult the table (names and symbols of the semi-metals) to help you remember which elements are semi-metals. Colour the block representing each of the semi-metals yellow.
2. **Metals:**
   Colour all the blocks to the left of the semi-metals blue. Do not colour hydrogen (H), as it is not strictly a metal. All these elements are metals.
3. **Non-metals:**
   Colour all the blocks to the right of the semi-metals red. All these elements

are non-metals. Now you can also colour hydrogen (H) red. On most versions of the Periodic Table hydrogen is placed with the metals, even though it has physical properties similar to those of the non-metals (it is a gas at room temperature). Hydrogen is placed with the metals, because it tends to behave like the other members of its column in chemical reactions.



Now answer the following questions, using your colourful Periodic Table.

QUESTIONS:

1. Which category contains the most (biggest number of) elements: metals, non-metals or semi-metals?

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2. Which category contains the least (smallest number of) elements: metals, non-metals or semi-metals?

---

3. State which category of material (metal, non-metal or semi-metal) each of the following elements belongs to:

Element	Chemical symbol	Category: (Metal, non-metal or semi-metal?)
Iron	Fe	
Silicon	Si	
Fluorine	F	
Titanium	Ti	
Nitrogen	N	

We have learnt that the Periodic Table can be divided into regions where metals, non-metals and semi-metals can be found. This is useful information because the elements in different regions share similar properties. Their properties help us to decide what we can use them for. For example, metals are durable, malleable and shiny so they are suitable for making jewellery, pots and pans and motor car parts.

Let's look at some more examples. Where can we find all these elements in the real world? Where do they occur, and what are they used for?

We all know that oxygen (O) is one of the elements in the air we breathe. Rings and other jewellery are often made of gold (Au), silver (Ag) or platinum (Pt). But what do we know about calcium? And what is nickel used for?

DID YOU KNOW?

Stainless steel is an alloy, meaning it is made up of a mixture of elements, including iron, carbon, chromium and nickel.

1. Think about how long coins are used for. How are properties of metals useful to us when making coins?

Our South African coins are made from various metals and mixtures of metals, such as copper, nickel and stainless steel.

2. Why do you think we make jewellery out of the metals gold, silver and platinum, and not for example out of a non-metal such as sulfur? What are the properties of these metals?

Jewellery is made from metals such as gold, silver and platinum.

3. Why do you think these electrical wires are made out of copper? What property of copper is useful in this situation?

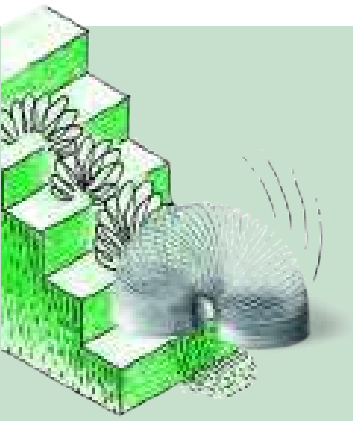
These electrical wires are made out of copper.

VISIT

These websites of the Periodic Table highlight some of the uses of the elements: bit.ly/1euHmVi and bit.ly/17zr35Q .

4. Do you think you could make electrical wires out of a non-metal such as bromine or phosphorus? Why or why not?

What do we use some of the non-metals for? We use carbon (coal) as a fuel, we use chlorine as a disinfectant to purify water, iodine is used as an antiseptic for wounds and helium is used to fill balloons. Arsenic, a semi-metal, is poisonous and therefore used as a pesticide for insects, bacteria and fungi. Another semi-metal, antimony, is used to make an alloy with lead which is very hard and has many applications. As you can see, the elements have many uses all around us! In the final activity of this chapter, we will explore some of the uses of the elements in more detail.



ACTIVITY: Uses of the elements

Your teacher will divide the class into small groups. Your group must choose one element from the Periodic Table (if you are unsure, your teacher will help you choose) and research the following questions about this element:

1. Where is this element found?
2. What do we use this element for?
3. What are some of the properties if the element?

Your group must make a poster to present all the information you found about your element.

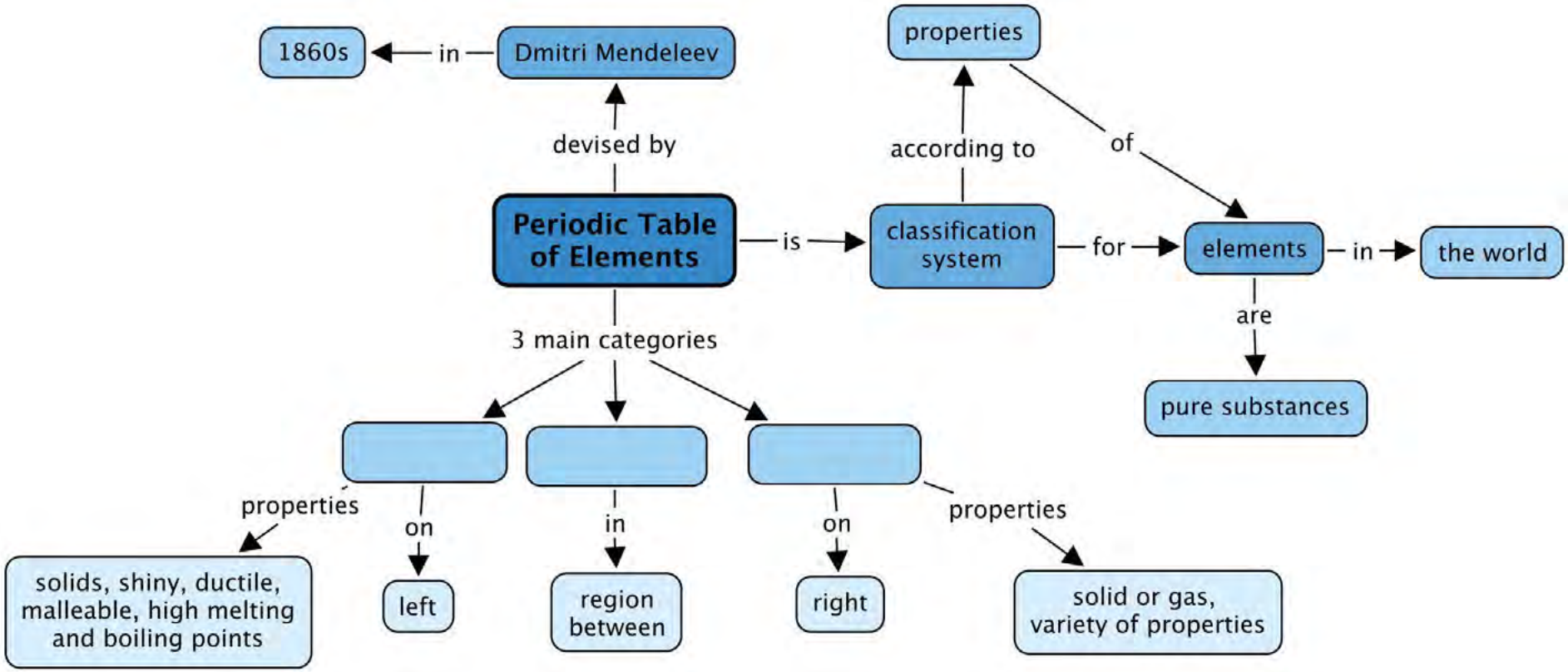
SUMMARY:

Key Concepts

- All the elements that are known, can be arranged in a table called the Periodic Table.
- The discoveries of many scientists over many years contributed to the information in the Periodic Table, but the version of the table that we use today was originally proposed by Dmitri Mendeleev in the 1800s.
- Each element has a fixed position on the Periodic Table. The elements are arranged in order of increasing atomic number, with the lightest element (hydrogen: H) in the top left hand corner.
- An element's position on the Periodic Table tells us whether it is a metal, a non-metal or a semi-metal.
  - metals are found on the left hand side of the table;
  - non-metals are found on the far right hand side of the table; and
  - semi-metals are found in the region between the metals and non-metals.
- An element can be identified in 3 different ways:
  - each element has a unique name;
  - each element has a unique chemical symbol; and
  - each element has a unique atomic number.
- Metals are usually shiny, ductile and malleable. Most are solids at room temperature, and have high melting and boiling points.
- Non-metals can be solids, liquids or gases at room temperature. They have a great variety of properties that usually depend on the state they are in.
- The semi-metals are all solids at room temperature. They usually have a combination of metallic and non-metallic properties.

Concept Map

We learnt that the elements in the Periodic Table fall into 3 main categories. What are these? Fill these in the concept map by looking at the concepts which come after each category.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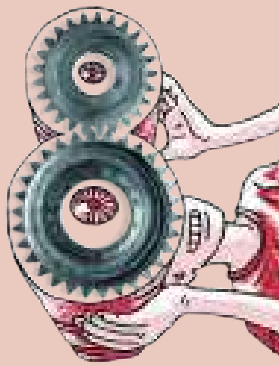
REVISION:



1. What information can we tell from an element's position in the Periodic Table? In other words: [2 marks]
   a) What does it tell us when an element occurs on the left hand side of the Periodic Table?

   b) What does it tell us when an atom occurs on the right hand side of the Periodic Table?

2. There are 3 unique 'labels' that can be used to identify an element. The first is its name. What are the other two? [2 marks]

3. What is the relationship between the atomic number of an element and its place on the Periodic Table? [1 mark]

4. Which element has the lowest atomic number? Write both its name and its symbol. [2 marks]

5. Extension question: What does the atomic number of hydrogen tell us about it? [1 mark]

6. Write the chemical symbols of all the elements that are in the same column as the element with the atomic number 9. (Note: The columns on the Periodic Table are called Groups.) [2 marks: 1/2 mark each]

7. The following table contains some names of elements. There is also a box of chemical symbols. You should place the chemical symbols in the right hand column of the table so that they match the names in the left hand column. [8 marks]

Chemical symbols

- C
- Na
- Si
- N
- He
- Cl
- S
- O

Names of elements	Chemical symbols
Sulfur	
Carbon	
Nitrogen	
Sodium	
Oxygen	
Silicon	
Chlorine	
Helium	

8. Write a short paragraph to explain what a semi-metal is. Also give an example of one semi-metal and say where in the Periodic Table the semi-metals can be found. [3 marks]

9. Name two properties of metals and two properties of non-metals. [4 marks]

Total [25 marks]

GLOSSARY

abundant:	when something exists, or is available, in large quantities; plentiful
acid:	a substance which is corrosive, has a sour taste and feels rough (grippy) between your fingers
alkali:	a base that is dissolved in water
alloy:	a mixture of two or more metals (stainless steel is an example of an alloy)
altitude:	the height of a place above sea level; places that are inland, or on mountains, are said to be at a higher altitude than places on the coast
ascorbic acid:	a natural acid that occurs in some fruits and vegetables; also known as Vitamin C
atomic number:	a unique number that represents a given element and shows its position on the Periodic Table
base:	a substance that can also be corrosive, has a bitter taste, and feels slippery between your fingers
boiling point:	the temperature at which a particular material changes from the liquid to the gas state (boils)
capillary action:	the process by which liquid is drawn up in a narrow tube
chemical formula:	a representation of chemicals using symbols that tell us which elements a compound contains and in what ratio
chemoreceptor:	a sensory nerve cell or sense organ that detects chemical signals
chromatogram:	the pattern formed on the paper by the components separated by chromatography
chromatography:	a process in which a mixture carried by a liquid is separated into components
citric acid:	a natural acid that occurs in citrus fruit
clear:	transparent; see-through
concern:	(noun) something that you are worried about
condensation:	the process of changing a gas to a liquid
condense:	when particles come together; to change from the gaseous state to the liquid state
constant:	a variable, or physical quantity, that is constant or does not change over time
contract:	(verb) the physical size of an object gets smaller
controversial:	controversial issues are issues that people do not agree about; issues that people argue about because they hold different opinions
corrosive:	a corrosive substance damages ('eats away') other materials by chemical action (the related verb is corrode)
dependent variable:	a dependent variable is one that we do not directly choose values for, but can only measure as we go along

disperse:	to spread evenly throughout
distillation:	a technique for separating the components of a liquid solution through evaporation and condensation
ductile:	the property of a material that allows it to be pulled and stretched out into thin wires
durable:	a material that is durable can last for a long time without breaking down
element:	a pure substance which cannot be broken down further
emulsion:	a mixture of two or more liquids that usually do not mix, such as tiny oil droplets in water
environmental concerns:	worries about the negative effects on habitats and ecosystems in our environment, caused by humans and their activities
essential:	necessary and important; required
evaporation:	the process of changing a liquid to a gas
expand:	(verb) the physical size of an object gets bigger
filtrate:	the liquid that has passed through a filter is called the filtrate
filtration:	the process of passing something through a filter
flavour:	the taste and smell of food in the mouth
flexible:	a material that is flexible will change shape easily without breaking when it is bent, and will return to its original shape when it is released
formic acid:	a natural acid found inside the bodies of some ant species
grain:	a very small piece of something
heat:	is the transfer of energy, from a hotter object to a colder object
immune system:	the biological system inside our bodies that protects us from disease and infection
impact:	to have an effect on something else
independent variable:	an independent variable is one whose values we can choose (manipulate); we still have to be able to measure it
indicator:	a substance that changes colour in the presence of another substance, showing that that substance is present
instinct:	a natural or inborn way of responding to something
litmus:	a well known acid-base indicator that turns red when mixed with an acid and blue when mixed with a base
magnetic:	a property of some materials that allows them to be attracted to a magnet
malleable:	the property of a material that allows it to be shaped by flattening with a hammer or squeezing it between rollers
melting point:	the temperature beyond which a particular material changes from the solid to the liquid state (melts)

mixture:	matter consisting of two or more components (substances) that retain their own properties
moulding:	a process that involves melting a substance and then pouring it into a specially shaped hollow container (mould) that will give it that particular shape when it cools down and returns to the solid state; clay can also be moulded
neutral substance:	a substance that is*neither* acidic *nor* basic
neutralise:	to make something chemically neutral
opaque:	something that we cannot see through is opaque; opaque is the opposite of transparent
Periodic Table:	a table in which the chemical elements are arranged in order of increasing atomic number
pigment:	a substance that gives colour to other materials
property:	a distinctive attribute, characteristic or quality (of a certain material)
residue:	the substances that are left behind in the filter after filtering
savoury:	refers to salty or spicy food (not sweet)
semi-conductor:	a material that conducts electricity only under special conditions, for instance at very low temperatures
semi-metal:	an element that has properties of both metals and non-metals
sense:	to become aware of something (specifically through our sense organs, e.g. by smelling tasting, feeling, hearing or seeing something)
sieve:	a device with small holes through which finer particles of a mixture may be passed to separate them from coarser ones
solute:	the substance that is dissolved in a solvent to make a solution, for example sugar (solute) dissolved in water (solvent)
solution:	when a solid, liquid or gas dissolves in a liquid, we call the resulting mixture a solution; a mixture that has no cloudiness
solvent:	the substance that the solute is dissolved in to make a solution
soot and ash:	small particles of burnt material that are the solid components in smoke
still:	the apparatus used for distillation
suspension:	a mixture in which the tiny clumps and pieces are mixed in a liquid but they are undissolved; all suspensions are milky/cloudy in appearance
symbol (or element symbol):	a unique letter (or letters) that represents a given element
taste buds:	taste buds are very small structures contained within papillae on the surface of the tongue responsible for taste
temperature:	a measurement of how hot or cold something is

thermometer:	a device for measuring the temperature of an object or a material
tongue map:	a map of the human tongue, showing which areas on the tongue are sensitive to which flavours; some scientists do not believe that the 'tongue map' is accurate

Here is your chance to discover the possibilities. What else can this beaker be?

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