7.1 Element mnemonics

Science understanding

Verbal/Linguistic

A mnemonic (*ne-mon-ik*) is a phrase or poem that helps you to remember something. Below is a mnemonic to help you remember the first ten elements in the periodic table. See if you can create your own mnemonic to help remember the next ten.

Atomic number	Chemical name	Chemical symbol	Mnemonic
1	Hydrogen	H	Harry
2	Helium	He	Helped
3	Lithium	Li	Little
4	Beryllium	Be	Betty
5	Boron	B	Brown
6	Carbon	C	Carry
7	Nitrogen	N	Nine
8	Oxygen	O	Oranges
9	Fluorine	F	For
10	Neon	Ne	Neil

Atomic number	Chemical name	Chemical symbol	Mnemonic
11	Sodium	Na	
12	Magnesium	Mg	
13	Aluminium	Al	
14	Silicon	Si	
15	Phosphorus	P	
16	Sulfur	S	
17	Chlorine	Cl	
18	Argon	Ar	
19	Potassium	K	
20	Calcium	Ca	

7.2 Periodic table quiz

Science understanding

Verbal/Linguistic

Scientists organise the elements from lightest to heaviest on a grid called the periodic table. The periodic table helps scientists to look up the names and symbols of all the known elements. Use the periodic table to answer the following questions.

H hydrogen 1																	He helium 2
Li lithium 3	Be beryllium 4											B boron 5	C carbon 6	N nitrogen 7	O oxygen 8	F fluorine 9	Ne neon 10
Na sodium 11	Mg magnesium 12											Al aluminium 13	Si silicon 14	P phosphorus 15	S sulfur 16	Cl chlorine 17	Ar argon 18
K potassium 19	Ca calcium 20	Sc scandium 21	Ti titanium 22	V vanadium 23	Cr chromium 24	Mn manganese 25	Fe iron 26	Co cobalt 27	Ni nickel 28	Cu copper 29	Zn zinc 30	Ga gallium 31	Ge germanium 32	As arsenic 33	Se selenium 34	Br bromine 35	Kr krypton 36
Rb rubidium 37	Sr strontium 38	Y yttrium 39	Zr zirconium 40	Nb niobium 41	Mo molybdenum 42	Tc technetium 43	Ru ruthenium 44	Rh rhodium 45	Pd palladium 46	Ag silver 47	Cd cadmium 48	In indium 49	Sn tin 50	Sb antimony 51	Te tellurium 52	I iodine 53	Xe xenon 54
Cs caesium 55	Ba barium 56	La lanthanum 57	Hf hafnium 72	Ta tantalum 73	W tungsten 74	Re rhenium 75	Os osmium 76	Ir iridium 77	Pt platinum 78	Au gold 79	Hg mercury 80	Tl thallium 81	Pb lead 82	Bi bismuth 83	Po polonium 84	At astatine 85	Rn radon 86
Fr francium 87	Ra radium 88	Ac actinium 89	Rf rutherfordium 104	Db dubnium 105	Sg seaborgium 106	Bh bohrium 107	Hs hassium 108	Mt meitnerium 109	Ds darmstadtium 110	Rg roentgenium 111	Cn copernicium 112	Uut ununtrium 113	Uuq ununquadium 114	Uup ununpentium 115	Uuh ununhexium 116	Uus ununseptium 117	Uuo ununoctium 118

Lanthanoids	Ce cerium 58	Pr praseodymium 59	Nd neodymium 60	Pm promethium 61	Sm samarium 62	Eu europium 63	Gd gadolinium 64	Tb terbium 65	Dy dysprosium 66	Ho holmium 67	Er erbium 68	Tm thulium 69	Yb ytterbium 70	Lu lutetium 71
Actinoids	Th thorium 90	Pa protactinium 91	U uranium 92	Np neptunium 93	Pu plutonium 94	Am americium 95	Cm curium 96	Bk berkelium 97	Cf californium 98	Es einsteinium 99	Fm fermium 100	Md mendelevium 101	No nobelium 102	Lr lawrencium 103

H — symbol
hydrogen — name
1 — atomic number

1 **State** the total number of elements listed on the periodic table. _____

2 **Identify** the chemical symbol of the following elements.

Hydrogen _____ Helium _____

Carbon _____ Oxygen _____

Nitrogen _____ Aluminium _____

Calcium _____ Iron _____

3 **Identify** the names of the elements with the following chemical symbols.

Li _____ B _____

Na _____ Si _____

P _____ Cl _____

Cr _____ Cu _____

4 **List** the names and symbols of all the elements whose names start with the letter 'C'.

_____

_____

_____

5 **Identify** three elements named after famous scientists.

_____

6 **Identify** three elements named after a place, country, continent or planet.

_____

7 Some chemical symbols do not appear to correspond to the chemical names. For example, the chemical symbol for silver is Ag. **List** the name and symbol of five other elements whose chemical symbols do not correspond with the name of the elements.

_____

_____

8 In the table below, **list** five elements that you might use in your everyday life and **identify** where they might be used.

Element	Uses

7.3 Elemental crossword

Science understanding

Verbal/Linguistic

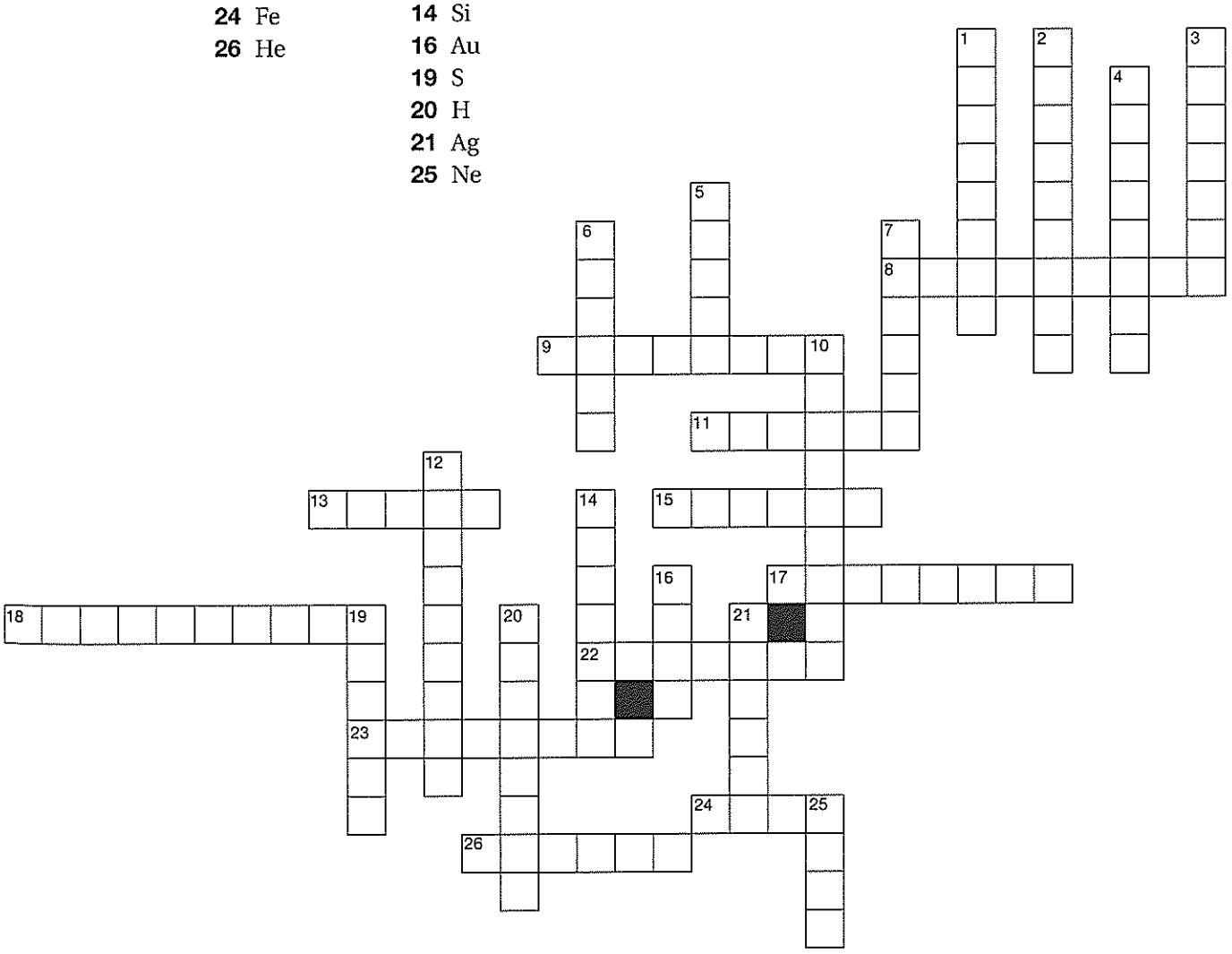
Use the periodic table on page 93 to complete the crossword below by filling in the element name that corresponds to each symbol.

Across

8 Al
9 Ti
11 O
13 B
15 Cu
17 N
18 P
22 Ca
23 F
24 Fe
26 He

Down

1 Pt
2 Be
3 Li
4 Cl
5 Ar
6 Na
7 C
10 Mg
12 K
14 Si
16 Au
19 S
20 H
21 Ag
25 Ne



7.4 Which element am I?

Science understanding

Verbal/Linguistic

Use what you know about the elements that you find in your everyday life to match the elements below to the properties listed in the table.

Carbon C	Helium He	Sulfur S	Gold Au	Aluminium Al
Chlorine Cl	Iron Fe	Copper Cu	Oxygen O	Nitrogen N

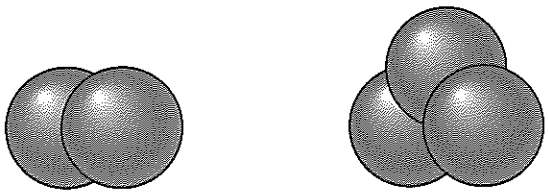
Description of properties		Chemical name	Chemical symbol
1	I am lightweight and shiny and conduct electricity very well. For these reasons, I am used in overhead power lines. I am also used in soft-drink cans because I can be recycled.		
2	At room temperature I am a solid, bright yellow powder. I am a typical non-metal. I don't conduct electricity and I crumble easily. I can be found under oxygen on the periodic table.		
3	I can be found in many different forms. Sometimes I am a black crumbly solid called charcoal. However, I can also form very hard, beautiful and expensive crystal lattices called diamond.		
4	I am a colourless, odourless gas that makes up most of the air you breathe but I am not oxygen. I am one of the first 10 elements listed in the periodic table.		
5	I am a yellow gas with a pungent smell. But don't breathe me in or I will damage your lungs. I am also used in swimming pools to kill bacteria. I am between elements 10 and 20 on the periodic table.		
6	I am yellow and shiny. I conduct electricity very well so am sometimes used for wiring in electrical equipment. However, I am more commonly used in jewellery because I am rare and expensive.		
7	I am strong and hard and can be bent into many different shapes. That's why I am used in construction. However, I am often mixed with metals and carbon. Otherwise I will rust.		
8	I am a very light and non-toxic gas. I do not react with other substances so I am often used to make party balloons that float.		
9	I am an invisible, non-toxic gas. I am one of the most important elements on Earth. I am in water, sand and air. You need me to breathe and stay alive. Plants produce me through photosynthesis.		
10	I am shiny and orange-brown in colour. I can be drawn into wires or hammered into sheets. I conduct electricity very well and am cheap to produce, which makes me perfect for household wiring and electrical equipment.		

7.5 The ozone allotrope of oxygen

Science as a human endeavour

Visual/Spatial Verbal/Linguistic

Ozone (O_3) is a very important allotrope of oxygen. The oxygen you breathe (O_2) consists of molecules made up of two oxygen atoms. Ozone is made up of molecules with three oxygen atoms as shown below.



Oxygen O_2 Ozone O_3

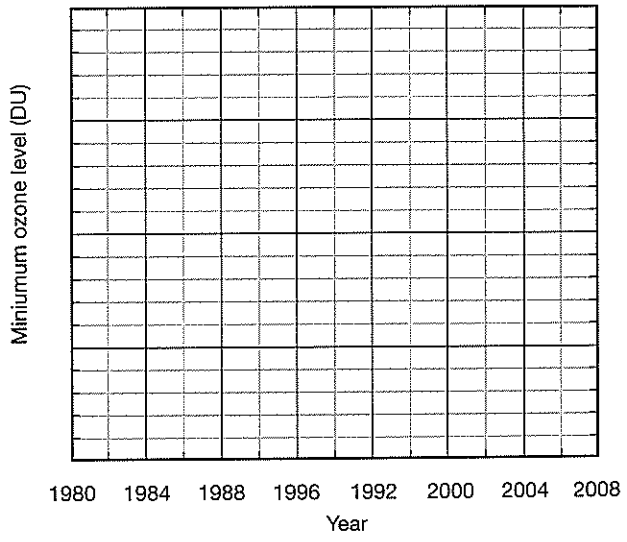
The highest concentrations of ozone are found in the stratosphere, about 10–50 km above the Earth's surface. This layer of ozone that surrounds the Earth is known as the ozone layer. The ozone layer absorbs ultraviolet light from the Sun and therefore plays an important role in protecting you from damaging ultraviolet rays.

However, 25 years ago it was discovered that industrial gases were depleting the ozone layer near the North and South Poles. As a result, the Earth's natural protection was being destroyed and people were more susceptible to sunburn and skin cancers.

The table below records the minimum level of ozone recorded every two years above the South Pole in Dobson units (DU). Dobson units are units of measurement developed specially to measure the concentration of ozone.

Year	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	2000	2002	2004	2006
Ozone minimum (DU)	194	195	154	124	109	108	84	–	–	99	97	91	91	102

1 **Construct** a line graph using the axes provided to show how the level of ozone has varied from 1980 to 2006.



2 **Deduce** from the graph what you might expect the minimum ozone level to be in 1994 and 1996.

1994 _____ 1996 _____

3 **Describe** what happened to the ozone levels over this 26-year period.

_____

_____

_____

4 **Calculate** how the minimum ozone level in 2006 compares to the minimum ozone level in 1980.

$\frac{\text{ozone level in 2006}}{\text{ozone level in 1980}} =$ _____

5 **Predict** what the minimum level of ozone might be this year.

_____

6 **Propose** what you think will happen to the minimum ozone level over the next 10 years based on the data in the graph. **Justify** your answer.

_____

_____

_____

_____

_____

_____

7.6 Math-o-mat molecules

Science understanding

Visual/Spatial

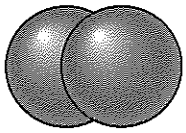
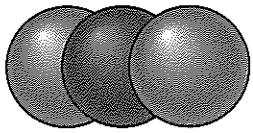
The elements and compounds found in the world around you can exist as single atoms, molecules or large grid-like structures called crystal lattices. The single atoms, molecules and lattices formed by elements contain only one type of atom, while the molecules and lattices formed by compounds contain more than one type of atom.

Molecules

Molecules are clusters of atoms. The molecules that make up pure substances such as elements and compounds are all identical.

The molecular formulas for elements and compounds tell you which type of atoms are in the molecule and how many of each type there are. For example, the molecular formula for the element oxygen is O_2, which means that each molecule contains two oxygen atoms. The molecular formula for the compound carbon dioxide is CO_2, which means that there is one carbon atom and two oxygen atoms in each carbon dioxide molecule.

1 Use a math-o-mat or compass to **construct** diagrams of the following molecules.

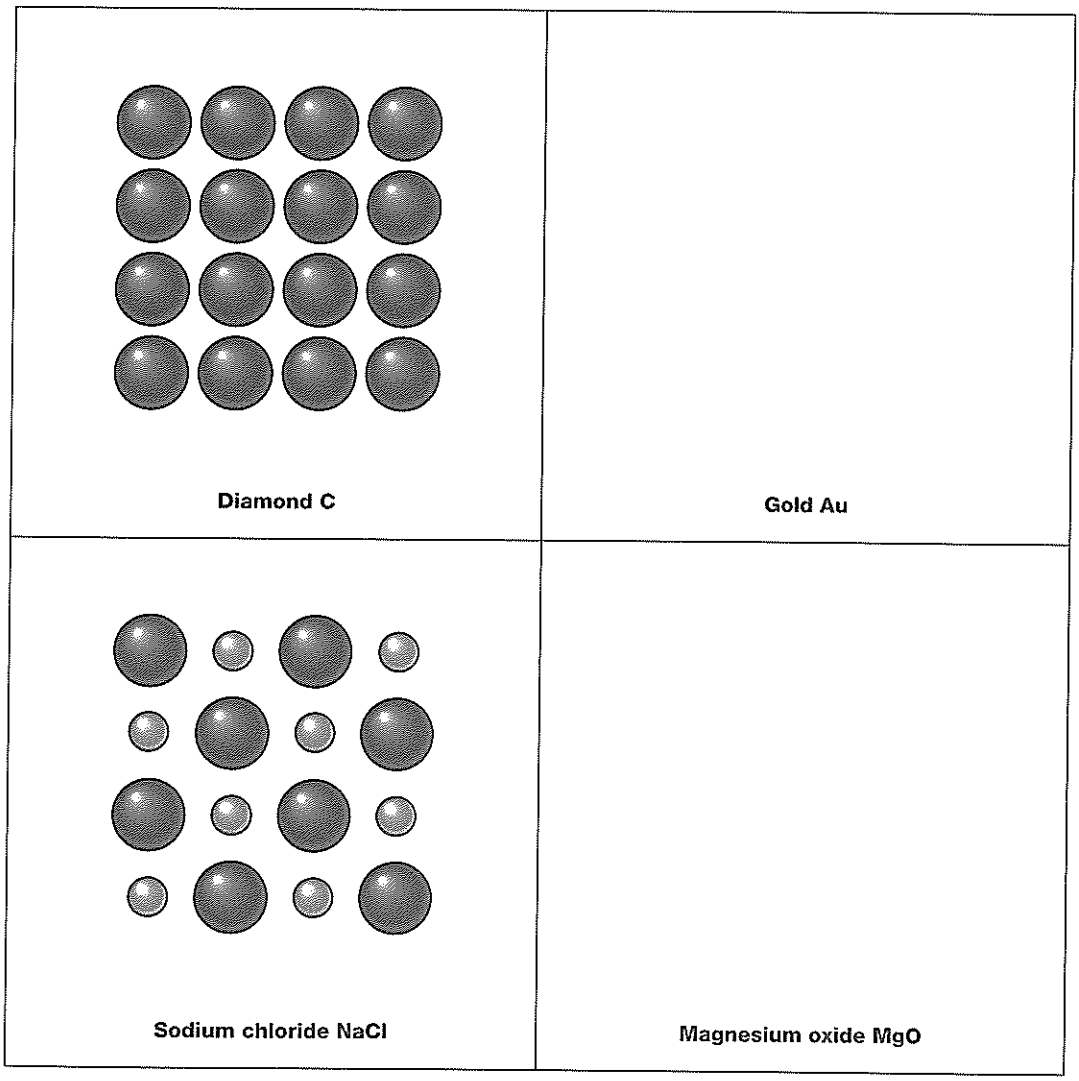
 **Oxygen O_2**	 **Carbon dioxide CO_2**	**Nitrogen N_2**
Water H_2O	**Ozone O_3**	**Carbon monoxide CO**
Phosphorus P_4	**Methane CH_4**	**Hydrogen peroxide H_2O_2**

Lattices

Crystal lattices such as diamond or sodium chloride are made up of a huge number of atoms stuck together in large grid-like structures. For this reason, crystal lattices do not have molecular formulas. Instead they are referred to by their chemical formulas. The chemical formula of a lattice tells you which type of atoms make up the lattice and the ratio of each type of atom in the lattice. For example, the chemical formula for sodium chloride (table salt) is NaCl. This means that in the crystal lattice there is one sodium atom for every chlorine atom. For silicon dioxide (beach sand), the chemical formula of SiO_2 means that for every silicon atom in the lattice there are two oxygen atoms.

The crystal lattices of elements are made up of only one type of atom so their chemical formulas are exactly the same as the chemical symbols for the elements. For example, diamond is a crystal lattice made up of only carbon atoms, so its chemical formula is just C.

2 **Construct** diagrams of lattices of gold and magnesium oxide.



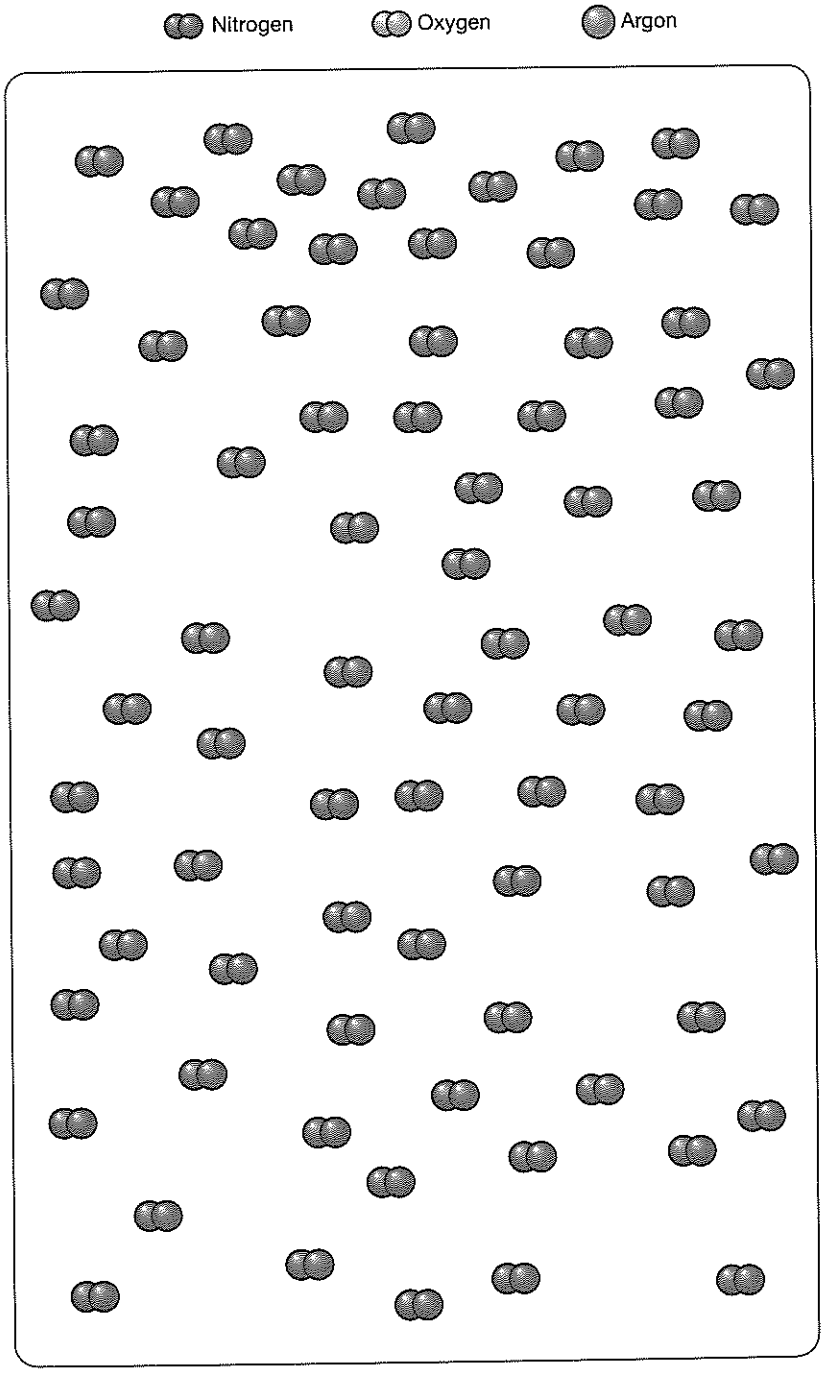
7.7 Air mixture

Science inquiry

Visual/Spatial

The air you breathe is actually a mixture of elements and compounds. It contains approximately 78% nitrogen (N_2), 21% oxygen (O_2) and 1% argon (Ar). It also contains very small amounts of carbon dioxide (CO_2), neon (Ne), helium (He) and methane (CH_4). The box below contains 78 molecules of nitrogen (N).

Identify how many molecules of oxygen and argon are required to make this a box of air and add them to the diagram.



7.8 Super molecules!

Science as a human endeavour

Verbal/Linguistic **Visual/Spatial**

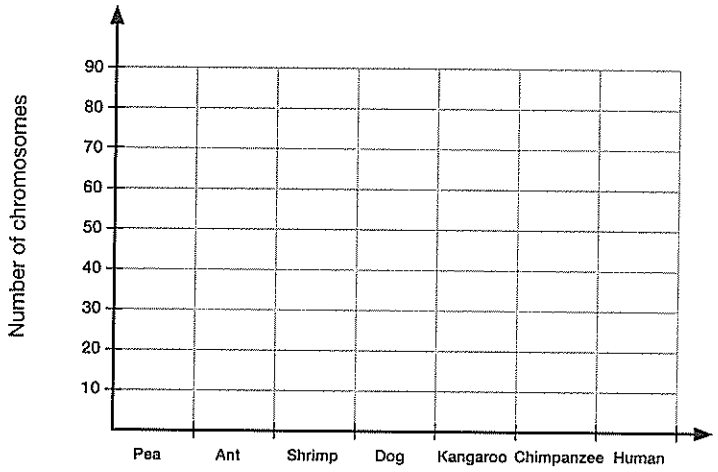
The DNA molecule is one of nature's most important supramolecules or molecular machines. It provides the blueprint for every characteristic of every living thing. The DNA molecule is made up of two very long molecules that are twisted together in a spiral called a double helix. This double helix can be stretched to over a metre in length.

The very large DNA molecules can combine with other molecules to create even bigger supramolecules called chromosomes. Chromosomes are so large that they can be seen with a strong optical microscope.

Every cell in your body contains 46 chromosomes. Other living things have different numbers of chromosomes in their cells, as shown in the following table.

Organism	Pea	Ant	Shrimp	Dog	Kangaroo	Chimpanzee	Human
Number of chromosomes	14	2	90	78	12	48	46

1 **Construct** a bar graph of the data in the table on the axes below.



2 **Identify** which organism has the most similar number of chromosomes to humans and **propose** why.

_____

_____

3 Before examining the data, Tamera makes the hypothesis that 'The cells of more complex organisms must contain more chromosomes'. **State** whether you think this hypothesis is correct or incorrect. Refer to the data from the table to **justify** your argument.

_____

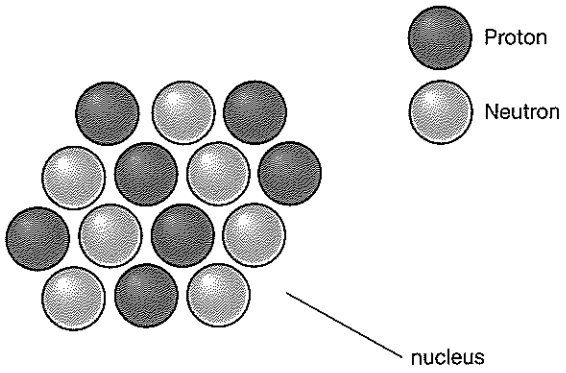
_____

7.9 Nuclear numbers

Science inquiry

Visual/Spatial

Atoms are the building blocks that make up all the elements and compounds in the world around you. Every atom has its own unique properties but all atoms are made up of three subatomic particles known as electrons, protons and neutrons. The protons and neutrons form a cluster at the centre of the atom known as the nucleus. Electrons form a cloud around the nucleus.



The number of protons in the nucleus is called the atomic number. The number of protons and neutrons in the nucleus is called the mass number. For example, a nitrogen atom has seven protons and seven neutrons in its nucleus. Therefore the atomic number of nitrogen is 7 and its mass number is 7 + 7 = 14. This information is often written next to the chemical symbol as shown below. When written like this, the symbol is referred to as the atomic symbol.

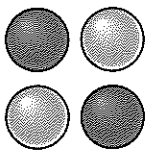
Mass number
Atomic number
$^{14}_{7}N$ } Atomic symbol

Identify the atoms and subatomic particles by completing the following atomic symbols and diagrams.

Hydrogen atom

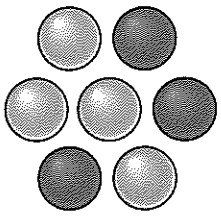
$\square^{\square}_{1}H$

Helium atom



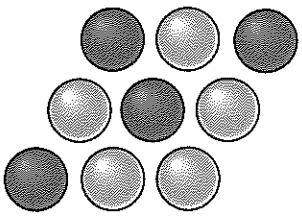
$^{4}_{\square}He$

Lithium atom



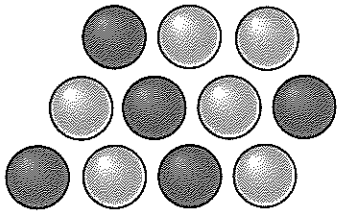
$\square^{\square}_{3}Li$

Beryllium atom



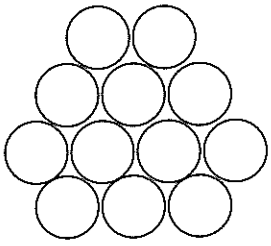
$\square^{\square}_{\square}Be$

Boron atom



$\square^{\square}_{\square}B$

Carbon atom



$^{12}_{6}C$

7.10 Literacy review

Science understanding

Verbal/Linguistic

Recall your knowledge of elements and compounds by choosing words from the list to complete the statements below. Some words may be used more than once.

solid	nucleus	break	liquid	cloud
molecules	compounds	mixtures	atomic	atoms
protons	neutrons	negatively	positively	mass
lattices	electrons	elements	conduct	

1 _____ are the smallest building blocks that make up all the substances around you. Substances made up of just one type of atom are known as _____.

2 Metallic elements are shiny, _____ electricity and heat, and can be drawn into wires or hammered into sheets. They are usually _____ at room temperature.

3 Non-metallic elements are usually dull, do not conduct electricity or heat and _____ when a force is applied. Most non-metals are solid or _____ at room temperature.

4 The atoms that make up the elements can be monatomic, in clusters called _____ or in large crystal _____. Most non-metallic elements are made up of _____. The atoms in all metallic elements form _____.

5 Pure substances made up of more than one type of atom are known as _____. These substances can be made up of atoms in crystal lattices. They can also be made up of identical _____.

6 Substances that are made up of a combination of different elements and compounds are known as _____.

7 The atoms that make up elements and compounds are all made up of the same three subatomic particles called _____, _____ and _____. The smallest of the three are the _____, which are _____ charged. The _____ are _____ charged and the _____ are neutral.

8 The protons and neutrons form a cluster at the centre of the atom called the _____. This is surrounded by a _____ of electrons.

9 The number of protons in the nucleus is the _____ number. The number of protons and neutrons is the _____ number.