

### C3 & 4: Atoms and the periodic table

## Lesson sequence

1. Structure of atoms
2. Detailed structure of atoms
3. Isotopes
4. Mendeleev's periodic table
5. The modern periodic table
6. Electron configuration

1. Structure of atoms	

<b>*Particle</b>	The tiny pieces that all matter is made from.
<b>*Atom</b>	The smallest independent particle. Everything is made of atoms.
<b>**Size of atoms</b>	About $1 \times 10^{-10}$ m in diameter.
<b>**Dalton's model of atoms</b>	<ul style="list-style-type: none"> <li>- Tiny hard spheres</li> <li>- Can't be broken down</li> <li>- Can't be created or destroyed</li> <li>- Atoms of an element are identical</li> <li>- Different elements have different atoms</li> </ul>
<b>*Subatomic particles</b>	Smaller particles that atoms are made from.
<b>*Proton</b>	Mass = 1 Charge = +1 Location = nucleus
<b>*Neutron</b>	Mass = 1 Charge = 0 Location = nucleus
<b>*Electron</b>	Mass = $1/1835$ (negligible) Charge = -1 Location = shells orbiting nucleus
<b>*Nucleus</b>	Central part of an atom, 100,000 times smaller than the overall atom

<b>2. Detailed structure of atoms</b>	

<b>**Alpha particle</b>	Small positively charged particle made of two protons and two neutrons.
<b>**Scattering</b>	When particles bounce back or change direction.
<b>**Rutherford's experiment</b>	Fired alpha particles at gold leaf, used a phosphor-coated screen to track where they went.

<b>**Rutherford's results</b>	Most alpha particles went through, some scattered (changed direction).
<b>**Rutherford's explanation</b>	Scattered particles hit a solid nucleus. Most did not hit it, therefore nucleus is small
<b>*Atomic number</b>	The bottom number on the periodic table, gives the number of protons and electrons.
<b>*Atomic mass</b>	The top number on the periodic table, gives the total protons and neutrons together.
<b>*Number of protons</b>	The atomic number.
<b>*Number of electrons</b>	The atomic number.
<b>*Number of neutrons</b>	Atomic mass minus atomic number.
<b>*Number of protons and electrons</b>	Equal, because each negative electron is attracted to a positive proton in the nucleus.

<b>3. Isotopes</b>	

<b>**Isotopes</b>	Atoms with the same number of protons but different number of neutrons.
<b>**Describing isotopes</b>	Mass after the name (e.g. boron-10) or superscript mass before the symbol ( $^{10}\text{B}$ ).
<b>*Nuclear fission</b>	Large unstable atoms break into two smaller stable ones.
<b>**Uses of fission</b>	Nuclear power, nuclear weapons.
<b>**Relative atomic mass, <math>A_r</math></b>	The weighted average of the masses of all of the isotopes of an element.
<b>***Isotopic abundance</b>	The percentage of an element that is made of a particular isotope.
<b>***Calculating <math>A_r</math></b>	<p>- Multiply each mass by the decimal %</p> <p>- Add these up</p> <p><b>Note:</b> (decimal % = %/100)</p>

4. Mendeleev's periodic table
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<b>*Dmitri Mendeleev</b>	Russian chemist, developed the periodic table.
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<b>*Mendeleev's periodic table</b>	Ordered by increasing $A_r$ , some elements switched according to their properties.
<b>*Chemical properties</b>	Includes reaction with acid and formula of oxide.
<b>*Physical properties</b>	Includes melting point and density.
<b>**Gaps in Mendeleev's periodic table</b>	Mendeleev left gaps where no known element fitted and predicted these would be filled with newly discovered elements.
<b>**Eka-aluminium</b>	An element that Mendeleev thought would fill a gap. He predicted its properties, which matched gallium when discovered.

5. The modern periodic table
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<b>*Noble gases</b>	Gases that do not react: He, Ne, Ar, Kr.
<b>**Moseley's experiment</b>	Fired electrons at samples of elements and measured X-rays produced.
<b>**Moseley's results</b>	Energy of x-rays produced proportional to the positive charge of the element.
<b>**Conc. from Moseley's work</b>	The atomic number must be the number of protons in the atoms.

<b>**Pair reversals</b>	Elements (like Ar and K) that are not in order of increasing mass.
<b>**Explaining pair reversals</b>	It means elements should be order elements by increasing atomic number instead.

6. Electron configuration	

<b>*Shells</b>	Electrons orbit atoms in shells.
<b>*First shell</b>	Holds up to two electrons.
<b>*Second shell</b>	Holds up to eight electrons.
<b>*Third shell</b>	Holds up to eight electrons.
<b>*Number of electrons</b>	Given by the atomic number.
<b>*Filling shells</b>	Fill shells from the first shell out. Move up a shell when current one is full.
<b>*Electron configuration</b>	The number of electrons in each shell (e.g. Al is 2.8.3).
<b>*Outer shell</b>	The last shell with any electrons in it.
<b>**Groups</b>	Columns in the periodic table, tell you the number of electrons in the outer shell.
<b>**Periods</b>	Rows in the periodic table, tell you the number of electron shells.

1

2

3

4

5

6

7

8

9

10

1

H

hydrogen

1

7

Li

lithium

3

9

Be

beryllium

4

23

Na

sodium

11

24

Mg

magnesium

12

39

K

potassium

19

40

Ca

calcium

20

45

Sc

scandium

21

48

Ti

titanium

22

51

V

vanadium

23

52

Cr

chromium

24

55

Mn

manganese

25

56

Fe

iron

26

59

Co

cobalt

27

59

Ni

nickel

28

63.5

Cu

copper

29

65

Zn

zinc

30

27

Al

aluminum

13

28

Si

silicon

14

31

P

phosphorus

15

32

S

sulfur

16

35.5

Cl

chlorine

17

40

Ar

argon

18

79

Br

bromine

35

84

Kr

krypton

36

85

Rb

rubidium

37

88

Sr

strontium

38

89

Y

yttrium

39

91

Zr

zirconium

40

93

Nb

niobium

41

96

Mo

molybdenum

42

[98]

Tc

technetium

43

101

Ru

ruthenium

44

103

Rh

rhodium

45

106

Pd

palladium

46

108

Ag

silver

47

112

Cd

cadmium

48

115

In

indium

49

119

Sn

tin

50

122

Sb

antimony

51

128

Te

tellurium

52

127

I

iodine

53

131

Xe

xenon

54

133

Cs

caesium

55

137

Ba

barium

56

139

La\*

lanthanum

57

178

Hf

hafnium

72

181

Ta

tantalum

73

184

W

tungsten

74

186

Re

rhenium

75

190

Os

osmium

76

192

Ir

iridium

77

195

Pt

platinum

78

197

Au

gold

79

201

Hg

mercury

80

204

Tl

thallium

81

207

Pb

lead

82

209

Bi

bismuth

83

[209]

Po

polonium

84

[210]

At

astatine

85

[222]

Rn

radon

86

223

Fr

francium

87

[226]

Ra

radium

88

[227]

Ac\*

actinium

89

[261]

Rf

rutherfordium

104

[262]

Db

dundium

105

[266]

Sg

seaborgium

106

[264]

Bh

bohrium

107

[277]

Hs

hassium

108

[268]

Mt

meitnerium

109

[271]

Ds

darmstadtium

110

[272]

Rg

roentgenium

111

Elements with atomic numbers 112-116 have been reported but not fully  
authenticated