

C1 & 2: Atoms and the periodic table

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

| 2. Detailed structure of atoms | |
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| **Alpha particle | Small positively charged particle made of two protons and two neutrons. |
| **Scattering | When particles bounce back or change direction. |
| **Rutherford's experiment | Fired alpha particles at gold leaf, used a phosphor-coated screen to track where they went. |

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

| 3. Isotopes | |
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| **Isotopes | Atoms with the same number of protons but different number of neutrons. |
| **Describing isotopes | Mass after the name (e.g. boron-10) or superscript mass before the symbol (^{10}B). |
| *Nuclear fission | Large unstable atoms break into two smaller stable ones. |
| **Uses of fission | Nuclear power, nuclear weapons. |
| **Relative atomic mass, A_r | The weighted average of the masses of all of the isotopes of an element. |
| ***Isotopic abundance | The percentage of an element that is made of a particular isotope. |
| ***Calculating A_r | <ul style="list-style-type: none"> - Multiply each mass by the decimal % - Add these up Note: (decimal % = %/100) |

| 4. Mendeleev's periodic table | |
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| *Dmitri Mendeleev | Russian chemist, developed the periodic table. |

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| *Mendeleev's periodic table | Ordered by increasing A_r , some elements switched according to their properties. |
| *Chemical properties | Includes reaction with acid and formula of oxide. |
| *Physical properties | Includes melting point and density. |
| **Gaps in Mendeleev's periodic table | Mendeleev left gaps where no known element fitted and predicted these would be filled with newly discovered elements. |
| **Eka-aluminium | 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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| *Noble gases | Gases that do not react: He, Ne, Ar, Kr. |
| **Moseley's experiment | Fired electrons at samples of elements and measured X-rays produced. |
| **Moseley's results | Energy of x-rays produced proportional to the positive charge of the element. |
| **Conc. from Moseley's work | The atomic number must be the number of protons in the atoms. |

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

| 6. Electron configuration | |
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| *Shells | Electrons orbit atoms in shells. |
| *First shell | Holds up to two electrons. |
| *Second shell | Holds up to eight electrons. |
| *Third shell | Holds up to eight electrons. |
| *Number of electrons | Given by the atomic number. |
| *Filling shells | Fill shells from the first shell out. Move up a shell when current one is full. |
| *Electron configuration | The number of electrons in each shell (e.g. Al is 2.8.3). |
| *Outer shell | The last shell with any electrons in it. |
| **Groups | Columns in the periodic table, tell you the number of electrons in the outer shell. |
| **Periods | Rows in the periodic table, tell you the number of electron shells. |

| Key | | | | | | | | | | | | | | | | | | | |
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| relative atomic mass | | | | | | | | | | | | | | | | | | | |
| atomic symbol | | | | | | | | | | | | | | | | | | | |
| atomic (proton) number | | | | | | | | | | | | | | | | | | | |
| 1 | 2 | | | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
| | | | | | | | | | | | | | | | | | | 4 He helium 2 | |
| 7 Li lithium 3 | 9 Be beryllium 4 | | | | | | | | | | | | | 11 B boron 5 | 12 C carbon 6 | 14 N nitrogen 7 | 16 O oxygen 8 | 19 F fluorine 9 | 20 Ne neon 10 |
| 23 Na sodium 11 | 24 Mg magnesium 12 | | | | | | | | | | | | | 27 Al aluminium 13 | 28 Si silicon 14 | 31 P phosphorus 15 | 32 S sulphur 16 | 35.5 Cl chlorine 17 | 40 Ar argon 18 |
| 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 | 70 Ga gallium 31 | 73 Ge germanium 32 | 75 As arsenic 33 | 79 Se selenium 34 | 80 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 dubnium 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 | | | | | | | | |