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Hello and welcome to the first episode of atoms, molecules and ions.

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This short video series will give you a quick overview of the atom and the particles that make it up, along with the nomenclature used to refer to chemical compounds and ions.

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As you almost certainly already know, the atom is made up of three major particles, the proton, the neutron and the electron.

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Each one of these particles plays an important role in the atom and we will briefly describe it along with some characteristics of each of these particles.

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Let's begin by pointing out that the masses of protons or neutrons are almost identical.

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In fact, they don't differ until we compare the 4th significant digit.

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They are both made of three quarks.

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Wait, no TMI, sorry.

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In contrast, an electron is almost one two thousandth of their mass.

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To call it a lightweight is quite the understatement.

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Another interesting fact is that the electrical charge.

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Of both the proton and the electron are identical in magnitude but have opposite sign.

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This is why atoms having the same number of protons and electrons will be electrically neutral.

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That is to say, all atoms until they become ions.

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Protons are identical regardless of what type of atom they belong to.

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So gold protons are identical to arsenic protons.

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The same is true of neutrons and electrons.

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Those facts beg the question.

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What makes atoms of different elements different from each other then?

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The answer is simply the number of protons in each atom.

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The atomic number of an element is the number of protons that that atom has.

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The atomic number is always an integer (You cannot have half a proton).

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And it can be found in the periodic table.

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Its symbol is the letter Z as in Zulu.

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So what are neutrons good for then why have them?

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Well, the atom's nucleus is rather small and all those protons with their large positive charges and all that repulsion taking place, requires some additional particles to stabilize it.

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So some neutrons are required.

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The actual number of neutrons can sometimes vary within atoms of the same element.

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The mass number is the total number of both protons and neutrons in the nucleus.

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Isotopes are atoms of the same element which have different number of neutrons and therefore different mass numbers.

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The mass numbers are not written in the periodic table.

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If a sample of any given element is obtained.

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That sample will contain a mixture of all the isotopes of that element.

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And it can be represented by the chemical symbol alone.

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The weighted average of the mass numbers for the isotopes of an element is called the atomic mass, and that number is written for each element in the periodic table.

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If a sample of a given element is enriched, then a single isotope will be prevalent and the chemical symbol will not be sufficient to describe such a sample.

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To write the symbol of an isotope.

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The following convention is used.

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X represents the elements one or two letter symbol.

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The mass number will be written as a superscript to the eft of the chemical symbol.

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And the atomic number will be written as a subscript to the left of the chemical symbol.

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If there is no charge written as a superscript to the right of the chemical symbol, then the atom is neutral because it has equal number of protons and electrons.

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These are the three isotopes of hydrogen.

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Most isotopes are called by the name of the element followed by the mass number.

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Such as hydrogen, one hydrogen two and hydrogen 3.

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However, hydrogen two is most often called deuterium.

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And hydrogen three is called tritium.

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This is a unique situation for hydrogen.

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These are the isotopes of uranium, uranium 235 and uranium 238.

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As previously mentioned,

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The atomic mass in the periodic table is not the same as the mass number which characterizes a given isotope.

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The atomic mass is the sum of the mass numbers of all the isotopes multiplied by their respective abundances.

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To illustrate this, we will assume we have the element.

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Xaviorum.

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Named after Professor Xavier.

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Which has three isotopes and their relative abundances and mass numbers are listed here.

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The atomic mass.

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Of Xaviorum is calculated by adding the product of each mass number and its abundance.

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Giving us an atomic mass of 48.80 AMU.

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AMU, by the way, stands for atomic mass units.

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I know it's not very creative, but it is what it is.

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Here we are revisiting the three isotopes of hydrogen.

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Having a diagram allows one to appreciate the meaning behind the mass number and the atomic number.

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Notice that the mass number corresponds to the number of particles in the nucleus.

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But all of them have a single red proton.

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Because they are all hydrogen.

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Now we can practice determining the number of subatomic particles in each of the following isotopes.

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Pause the video, write down your answers, and then come back and check.

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Welcome back.

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Let's go ahead and check your answers now.

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Our first example has 11 protons.

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And because there is no charge, it also has 11 electrons.

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The number of neutrons is 20 - 11.

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Our second example has 11 protons and electrons...because there is no charge.

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22 - 11 neutrons is 11.

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Our third example.

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Has 8 protons because we know to look for the atomic number in the periodic table.

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8 electrons, because it has no charge and 17 - 8 neutrons.

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And our fourth example.

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Has six protons, thank you, periodic table.

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6 electrons, because it has no charge.

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Add 14 - 6 neutrons.

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This next set has charges.

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A positive charge indicates that an atom has more protons than electrons because it has lost one or more electrons.

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A negative charge indicates the atom has more electrons than protons because it has gained one or more electrons.

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Pause the video, write down your answers, and let's check on them in a bit.

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Welcome back.

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Our first example has 11 protons.

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10 electrons, because the plus one charge.

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Means one missing electron.

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And 20 - 11 neutrons.

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Our second example.

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Has 35 protons.

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36 electrons, because the negative one charge means it has gained an electron.

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And 80 - 35 neutrons.

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Our third example.

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Has 38 protons.

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36 electrons because the +2 charge means it has misplaced 2 electrons.

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And 86 - 38 neutrons.

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Our fourth example.

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Has 16 protons.

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16 electrons, because it has no charge.

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And 33 - 16 neutrons.

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This is our modern periodic table.

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I would like to point out a few features which will help you when it comes to naming compounds and writing the formulas.

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Notice that there are three broad categories of elements.

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Metals, metalloids and nonmetals.

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Metals and nonmetals are very different in their chemical properties, with metalloids having properties somewhere in between them.

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This makes them very useful, but this is not about metalloids.

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For naming purposes.

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We will pretend that there is no such thing as a metalloid and we will classify all elements as either metals or nonmetals.

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Just for naming though.

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The horizontal rows of elements are called periods.

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Not all periods have the same number of elements.

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The first period, for instance, has only two.

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That's the bare minimum.

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The vertical columns are called groups.

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Elements in the same group tend to have similar chemical properties.

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Some groups have names that are descriptive of their properties.

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For example.

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Group One is called the alkali metals.

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Group two is called the alkaline earth metals.

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Group 17 is called the halogens.

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And Group 18 is called the noble gases.

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There is also a feature often referred to as the staircase because.

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Well, let's not point out the obvious.

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Elements to the right and above the staircase are the nonmetals.

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Elements to the left and under the staircase are the metals.

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Except for hydrogen, hydrogen is a nonmetal.

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There are two sets of rules for naming compounds depending on whether they are ionic compounds or molecular compounds.

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Sometimes molecular compounds are called covalent compounds, but that is a bad habit, so try not to do it.

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It will be important to determine whether a compound is molecular or ionic before trying to name it.

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Ionic compounds form between a metal and a nonmetal.

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Usually, we will talk about exceptions to this rule later.

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And they always involve electron transfer and the consequential formation of ions.

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Molecular compounds take place between 2 nonmetals.

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And involve the sharing of electrons between atoms with consequent formation of molecules.

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Hence the name.

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A molecule is an aggregate of two or more atoms which share electrons and have definite geometry.

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Diatomic molecules are formed by only two atoms.

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And while we are on the topic of diatomic molecules, there are seven elements which always form diatomic molecules when they are not forming compounds.

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That is, when they are pure elements.

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Hydrogen, nitrogen, oxygen, fluorine, chlorine, bromine and iodine.

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Or iodine depending on where you come from.

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You will notice that they are clustered together, so you can remember them by their position on the periodic table.

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Or perhaps you can use some sort of mnemonic device, such as “Have No Fear Of Ice Cold Beer”.

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Diatomic molecules are also formed by many compounds like hydrogen chloride and carbon monoxide.

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Polyatomic molecules have more than two atoms.

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And they include many familiar substances like ozone., water, ammonia, and methane.

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An ion is an atom or group of atoms with a charge.

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Cations have a positive charge.

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Because they have donated one or more electrons.

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Your textbook uses the word lose, but I hate that word because you cannot lose an electron, It has to be placed out.

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Metals like sodium tend to donate electrons when they combine.

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It's the metal thing.

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A sodium ion has a positive one charge because it donated an electron.

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Anions have negative charges because they have accepted electrons.

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Nonmetals like chlorine tend to accept electrons when they combine.

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And it is not your imagination.

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Atoms really do get bigger when they gain electrons and they get smaller when they donate them.

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Cations are positive, Anions are negative.

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Cations are metals. Anions are nonmetals. Generally speaking.

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Cations do not change their name when they donate electrons.

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An aluminum atom becomes an aluminum ion.

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But anions change the ending of their name to have an ‘-ide” ending.

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So carbon becomes carbide.

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Oxygen becomes oxide.

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Chlorine becomes chloride and so on.

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And that's all there is.

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There isn't any more.