BBC Bitesize - Chemistry

Episode 1 – Atoms, elements and compounds

TULELA: I'm Tulela Pea, a science communicator and podcaster.

SUNAYANA: And I'm Dr Sunayana Bhargava, scientist and poet.

TULELA: And this is Bitesize Chemistry.

SUNAYANA: In this first series, we'll be looking at atomic structure and the periodic table.

TULELA: In each episode, we'll focus on just one topic, reminding you of the key facts and some tricks we've used that have helped us to remember them to help you revise for your chemistry and combined science exams.

SUNAYANA: With some real-world examples, some analogies to help us understand the ideas in different ways and we'll round off each episode with a quick quiz and the key facts to remember.

TULELA: And we'll be aided by our snazzy AI bot that's got lots of attitude – his name is NNICK.

SUNAYANA: So get ready for episode one - elements, compounds and mixtures, none of which are possible without ... dah, dah, dah…

BOTH: The atom!

SUNAYANA: Most of chemistry boils down to what is happening to atoms, their properties, how they combine, their effect on each other – they're like the VIPs of the molecular world. Without atoms, there is no chemistry.

TULELA: Which might make learning it a little easier.

SUNAYANA: But far less exciting! If chemistry were a movie, atoms would be the stars of the show.

TULELA: The atom indeed! Cut up anything, cut it again and again and keep going and eventually you'll get down the atom. So take a bar of gold, keep dividing it and eventually – atoms of gold. Take a bar of pure copper, or zinc or iron, and keep dividing and eventually – individual atoms of copper, zinc or iron.

SUNAYANA: Atoms are the smallest parts of the element that exist and pretty much all the stuff we see in the universe, otherwise known as that matter you mentioned, is made up of atoms.

TULELA: A substance made of only one type of atom is called an element. Elements of copper or zinc or iron are made only from atoms of copper or zinc or iron.

SUNAYANA: And different elements are represented by a different letter or letters – also known as the chemical symbol.

TULELA: For example, zinc is Zn, copper is Cu, iron Fe.

SUNAYANA: And that gold?

TULELA: Au.

SUNAYANA: In the next few episodes, we'll revise how the atoms of different elements are different from each other.

TULELA: Spoiler alert – it's about the numbers of protons.

SUNAYANA: But for now, let's look at how early chemists looked at the different elements and tried to sort them into some kind of order by understanding the patterns in their properties in relation to each other.

TULELA: And we're talking about the periodic table.

SUNAYANA: We absolutely are. Time for some AI lowdown. Hi NNICK, can you give us some background on the periodic table?

NNICK: Nothing I'd like better. Well, I could be out hand gliding, or playing golf or having my hair done. The periodic table is a way of arranging elements according to their properties. But why, oh why, is it called the periodic table? Well, 'periodic' – because it orders elements so that their properties repeat periodically, and 'table' because it's a table.

TULELA: Thanks, NNICK. So about 100 elements in the periodic table, arranged according to their properties and we'll have more to say on the periodic table in other episodes.

SUNAYANA: So, as a recap, an element is something that is made from only one type of atom, and all elements are found on the periodic table.

TULELA: But there are only about 100 elements and there are many more substances and materials that exist.

SUNAYANA: Made from all those elements which make the periodic table.

TULELA: So in order for more complex chemistry to happen, atoms combine to make molecules. This occurs when two or more atoms combine chemically, either two atoms of the same element, say two hydrogen atoms combining to produce a hydrogen molecule. Or when two or more different

atoms combine. So for example, when one oxygen atom combines chemically with two hydrogen atoms to produce a molecule of water, i.e. H2O.

SUNAYANA: So that's a molecule, two or more atoms combining chemically. What about a compound?

TULELA: So when atoms from two or more different elements combine chemically in a fixed proportion for example, a sodium atom combining with one chlorine atom, we get sodium chloride or salt. So that's an example of a compound.

SUNAYANA: The difference between molecules and compounds can sometimes be a bit tricky as they are describing similar ideas. Think of a molecule as the smallest unit building block of a larger structure.

TULELA: A good analogy is when you build a castle with those colourful plastic building bricks which we're not allowed to mention on the BBC. The individual bricks are atoms, and different colours are different elements. We can click two or more coloured bricks together in a specific ratio that forms a molecule. If they are a different colour say one red and one green and then we build the whole castle based on that, then the whole castle is the compound.

SUNAYANA: So compounds always contain two or more different elements that combine chemically in fixed proportions. And a molecule is two or more atoms combining chemically – and these could be the same or different atoms.

TULELA: A way to think about what combining chemically means is that those individual hydrogen atoms in the compound of water are bonded in a very particular way to the oxygen atom.

SUNAYANA: We'll have more about bonding in other episodes.

TULELA: The property of the water – H2O - is very different to the individual property of the hydrogen or oxygen. And it's very hard to separate the compound back to its original individual elements.

SUNAYANA: So it's like, in coming together those elements lose their individual properties, but in combining chemically with other different elements in a specific ratio, they create a compound with a new unique identity and therefore different properties.

TULELA: Yes, exactly that! A good example is table salt – on their own you have an explosive metal, sodium, and a poisonous gas, chlorine. But together in sodium chloride – or table salt – you can make your food taste way better.

SUNAYANA: So that's a compound. What about going the other way? Say we start with a compound and want to end up with the elements?

TULELA: Absolutely – but it's not as simple as just pulling them apart physically, those individual elements can only be recovered from compounds by chemical reactions.

SUNAYANA: So that's a compound. Let's look at what a mixture is.

TULELA: This can be often confused, I know I often did. A mixture is where two or more elements or compounds are mixed together.

SUNAYANA: So they are not chemically bonded together.

TULELA: Any amount of one compound added to any amount of another….and hey, presto! A mixture. An example includes a mixture of sand and water.

SUNAYANA: Which we can separate easily using filtration.

TULELA: And we'll have more on separating mixtures later on in the series.

SUNAYANA: Can't wait.

TULELA: Time for a quick quiz, Sunayana. Here's some substances, you have 5 seconds to decide whether they are an element, a compound or a mixture and why. Grab a pen and paper. Ready? Sea water.

SUNAYANA: That's a mixture because it's not chemically bonded and can be separated.

TULELA: Carbon dioxide.

SUNAYANA: Compound because it's a combination of fixed proportions of carbon and oxygen atoms that are chemically bonded.

TULELA: Air.

SUNAYANA: That's also a mixture – of nitrogen and oxygen and other gases also.

TULELA: And a bar of gold.

SUNAYANA: That's an element. It's only one type of atom.

TULELA: So time for a quick summary of the key facts from this episode, Sunayana. Let's go.

SUNAYANA: An atom is the smallest part of an element that can exist.

TULELA: An element is a substance made from only one type of atom.

SUNAYANA: And there are about 100 elements in the periodic table.

TULELA: Which is how we arrange those elements into some kind of order.

SUNAYANA: A compound is two or more different elements chemically combined in fixed proportions.

TULELA: And a mixture consists of different elements or compounds that are not chemically combined. Mixtures can be separated by physical processes, such as filtration.

SUNAYANA: In episode two of this series, we'll be looking at how our ideas of the structure of the atom developed and what our best model looks like today.

SUNAYANA: I'm Dr Sunayana Bhargava.

TULELA: And I'm Tulela Pea.

SUNAYANA: And this is Bitesize Chemistry. To hear more, search Bitesize Chemistry on BBC Sounds.

TULELA: Say bye Sunayana.

SUNAYANA: Bye Sunayana.

TULELA: Thanks for listening! See ya!