ELEMENTS & MOLECULES - AP CHEM 001

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Slide 1 (00:00-00:37)

Hi. It's Paul Andersen and this is video 1 in the chemistry essentials series. The history of chemistry goes way back to the Alchemists. The Alchemists searched for what is called the philosopher's stone. It was this magical stone that they thought could turn something like lead into gold. Now they never discovered the philosopher's stone but they did start to discover some unique properties of elements and molecules. And the whole thing eventually lead to this atomic theory. This idea that all matter is made up of smaller units. And those are going to be called atoms.

Slide 2 (00:38-01:00)

And so in this video I'm going to talk about mostly molecules and elements. And so all matter can be broken down either into mixtures or pure substances. And those pure substances are either elements or molecules. So an example of an element could be pure gold. An example of a molecule could be water. An example of a mixture could be dirt. And so if we take those elements and molecules, they're each made of atoms.

Slide 3 (01:01-01:52)

In other words gold is just going to be made of gold atoms. And then water is just going to be made up of oxygen and two hydrogen atoms. And so if we were to take a pure sample of it. It's only that element, we would find that no matter how big the size of that object is, it's going to have the same average mass. Likewise if we were to take a pure sample of a molecule, like water. We're going to find that there's the same ratio of the average masses. In other words the average mass of the oxygen and the average mass of the hydrogen. But let's say we find something else that's made of oxygen and hydrogen. A good example could be hydrogen peroxide which is actually two oxygens and two hydrogens. We would find since it has a different atom number it's going to have different ratio of average masses. It's still going to have a consistent ratio through all different size of the objects, but it's going to have a different ratio compared to that of water.

Slides 4-9 (01:53-02:34)

And so what do we mean by a pure sample again? A pure sample is just going to have those atoms from either that element or molecule inside it. So this is a pure sample of gold. If we were to look at a pure sample of silicon it's going to look like this. Or lead is going to look like this. Or uranium. In other words if we were to dig through it we would find just uranium atoms in this pure sample.

Likewise if it's a molecule, like water, we're just going to find two hydrogen and one oxygen connected together. And we're just going to find that repeating over and over and over again. Or if we were to look at something like dry ice, which is simply solid carbon dioxide, we're going to find that it's going to be the same atoms in a specific ratio over time.

Slide 10 (02:35-03:08)

And so again one of the big points is that the average mass is going to stay the same no matter how big the sample. In other words the average mass of this, which is the largest gold bar ever created. It would be worth about $11,000,000. So it's about 500 and some pounds. If we were to take the average mass of that whole gold bar, or the the average mass of a section of it or a smaller section or a smaller section, it doesn't matter how small the section is, it's going to have the same average mass. And that's because it's made up of these atoms. And so let me kind of explain that.

Slide 11 (03:09-03:48)

Let me use analogy. Imagine I'm building something out of Legos. I'm using that standard 2 x 4 Lego brick. Well that weighs about 2.5 grams. One of those Lego bricks. And so let's say I build something that was made up of 4 them. It's going to weigh 10 grams. Or let's say I build something that had 32 of them. It's going to be 80 grams. But if we were to look at the average mass of those objects, we're going to get around 2.5 grams per brick. So it doesn't matter how large or small the sample is. If I had a big structure that was the size of this room made out of these red Lego bricks it's going to still have the same average mass. And we find the same thing in matter. That's because it's made up of these atoms.

Slide 12 (03:49-04:01)

And so it doesn't matter if we have 4 atoms of gold or 32 or billions, billions, billions of atoms. It's still going to have that same average mass. Now this is just elements we're talking about.

Slide 13 (04:02-04:09)

But the same thing applies to molecules. So if we're looking at water, small and smaller and smallest sample of water are still going to have the same average mass.

Slide 14 (04:10-04:42)

And how does that work? Well imagine we go back to the Lego analogy. If we've got one Lego brick that weighs 2.5. So we could think of that like the oxygen molecule. And then we had two of these little blue bricks. Each of those weigh 0.25 grams. Then we're going to have a total mass of 3.00 grams. And so it doesn't matter if we have one of those units or 4 of those units or 32 of those units. It's still going to have the same average mass if we divide by the number of units like that. So that's an example of water.

Slide 15 (04:43-05:08)

But let's say we were to try using the same atoms in this analogy. So just the red and the blue. But we were to put it together in a different structure. And so let's say our building blocks look like this. So instead of building with 1 red and 2 blue, what if we were to build with 2 red and 2 blue? It's going to be a lot more like hydrogen peroxide. Well now we're going to get an average mass that is going to be higher, because we're adding more units to it.

Slide 16 (05:09-05:17)

And so if we were to look at two molecules that have the same atoms, oxygen and hydrogen, but they have them in a different ratio, then we're going to get a different ratio of their average masses.

Slide 17 (05:17-05:28)

And so let's kind of review. Could you pause the video and fill in these little blanks? What goes here, here, here and here?

Slide 18 (05:29-05:40)

Well up at the top, so those are going to be elements and molecules. They're made up of atoms. They're going to make the same ratio of average masses and then they're going to have a different number of atoms down here on the side. And so this is just an introduction to chemistry.

Slide 13 (05:41-06:08)

What did you learn? Well you should have learned, that was my intent, that the ratio of masses in a pure sample is identical on the basis of atomic theory. And that's going to apply for elements and molecules. And I hope that was helpful.