



# Clever Carbon



Read the following article and use the information to answer the questions in your workbook.

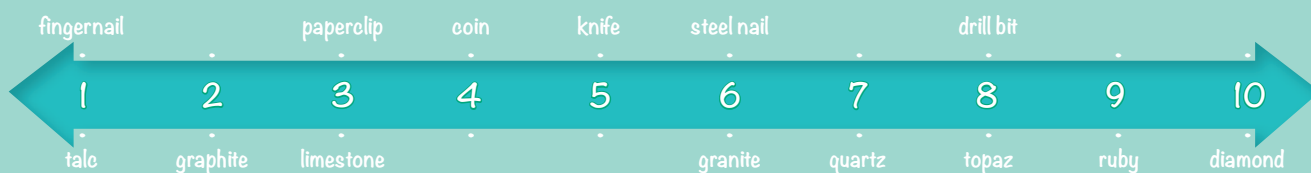
Most people don't even think about it, yet it is involved in their lives every day, in fact they owe their lives to it. Lately it has been getting a lot of negative attention because carbon dioxide is seen to be destroying our planet, even though we are the ones who make it. But did you know that life as we know it wouldn't exist without carbon. Our bodies are around 18% carbon atoms and it is in nearly all our cells, tissues and organs. 0.04% of the Earth's atmosphere is carbon dioxide and every time you breathe out you are adding more.

Carbon wasn't discovered by any specific person, ancient groups of people observed it in the black ash left over from fires. Carbon in the form of diamonds were known as early as 2800 BCE in China and the Romans used burnt wood to make charcoal.

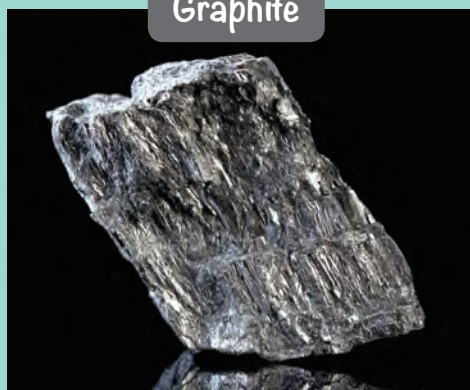
There are over 10 million compounds that contain carbon which is because carbon can bond with many other non-metals. This explains why it makes up so much of living organisms - it is no wonder humans and other animals are often referred to as carbon based life forms.

The three main ways that carbon is found in nature (not as a part of living things) is as amorphous carbon (lacking a clear obvious shape, doesn't really have any crystals) in coal and soot, diamonds and graphite. These are referred to as the three allotropes of carbon. Allotropes are different materials made from the same element - not compounds.

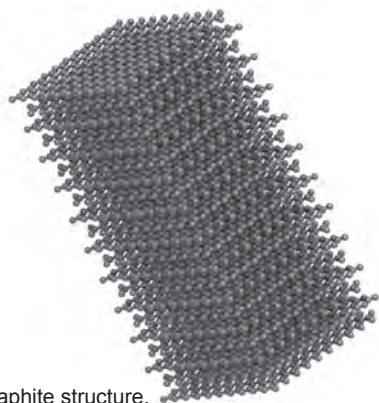
Diamond and graphite are identical in chemical terms because they are both made of carbon but physically they couldn't be much more different. Diamond is incredibly hard; in fact it is the hardest known naturally occurring substance. Mohs scale of hardness is used to compare the hardness of different minerals. Common objects are used to scratch the surface and what scratches it is where it sits on the scale.



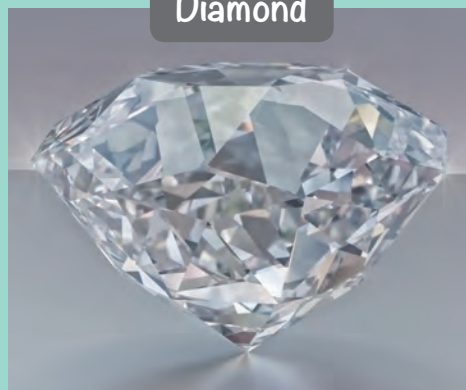
**Graphite**



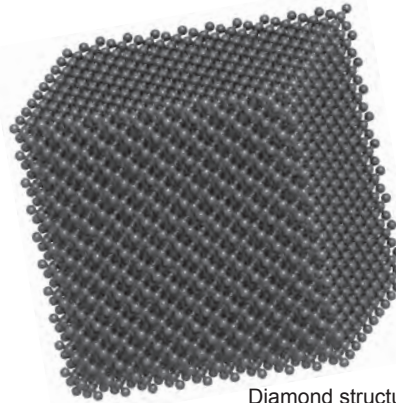
Graphite is dull, opaque, soft and common.



**Diamond**



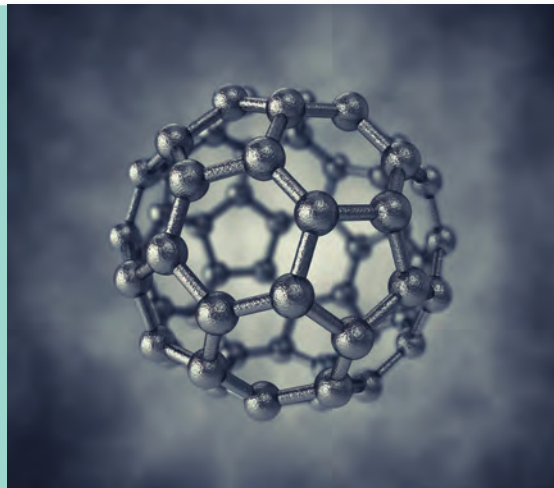
Diamond is brilliant, transparent, hard and rare.



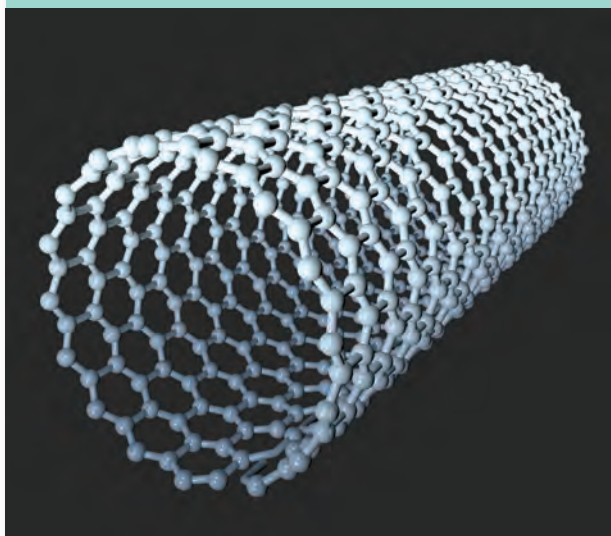
Diamond is also transparent and reflects light so it sparkles. Graphite is grey, black and soft (so soft that you can write with it, which is what pencil 'lead' is). Graphite looks almost like a metal. The reason that they have such different properties is because of how the carbon atoms are arranged. In graphite they are in hexagonal sheets but in diamond they are in a strong tetrahedron (four sided pyramid) shapes.

Graphite means 'to write' and comes from the Greek word 'graphos', whereas diamond means 'the invincible' and is from the Greek word 'adamas'.

More recently (in 1985) new formations of carbon were observed. The first is called buckminsterfullerene or buckyballs for short. This is a structure of sixty carbons in a soccer ball type shape. It is found naturally in soot in small amounts. Currently no use has been found for this type of carbon structure but  $C_{60}$  is able to inhibit the HIV virus and prevent it turning into AIDS.



buckyball



nanotube

Another newly discovered structure of carbon are nanotubes which are tiny microscopic tubes made up of hexagon shaped carbon molecules. Nanotubes can come in a variety of shapes and this causes them to have a huge range of different properties. For example the peapod has a rare magnetic property and the N-doped nanotube (which contains Nitrogen) is making lithium batteries last up to three times longer. Nanotubes are amazing because they possess the following properties:

- **Strength:** Strongest and stiffest materials yet to be discovered. Tests have shown that 1 mm<sup>2</sup> thick nanotube can hold over six tonne.
- **Hardness:** It is harder than diamond.
- **Movement:** Having nanotubes inside other nanotubes allows them to slide on top of each other, like a telescope. This has been used to make the worlds smallest motor.
- **Temperature:** They are estimated to be able to withstand 750°C in air.

Carbon is also a main component in plastics and fuels. Fuels like petrol and diesel are derived from oil which in turn is from decomposed, pressurised living things such as plant material and sea life. Because it is made from living things it is mostly carbon. Plastics can also be made from oil, these are long chains of carbon molecules. Not only this but steel is an alloy of iron and carbon. The addition of the carbon makes the iron harder and stronger but also less malleable (able to be shaped). Different amounts of carbon are added to make different strength steels. As you can see life would not exist without carbon, so let's stop giving it a hard time by blaming it for Earth's climate problems, it is here to stay. Instead look at all the positive things that carbon is part of and try to help the Earth. I think I will go and plant a tree now so that it can recycle some carbon for me.

