

ATOMIC COMICS

THE GREEK DETECTIVES: THE CASE OF THE FOUR ELEMENTS

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YOUR GRAPHIC GUIDE TO DISCOVERING THE ELEMENTS

THE CONCEPT OF 'ATOMS' GOES BACK TO THE ANCIENT GREEKS.

Ancient? I'm only 25!
Lucky you.

(5TH CENTURY BCE)

THE IDEA IS ATTRIBUTED TO PHILOSOPHER LEUCIPPUS OF MILETUS AND HIS PUPIL DEMOCRITUS...

Done your chemistry homework, Democritus?
Er, the dog ate it...

HOWEVER, IT'S POSSIBLE THAT LEUCIPPUS DIDN'T ACTUALLY EXIST.

HOORAY!
P'ING

DEMOCRITUS ARGUED THAT IF YOU CUT SOMETHING INTO INCREASINGLY SMALLER PIECES...

Greek salad, anyone?

...EVENTUALLY THE PIECES COULD GET NO SMALLER. HE CALLED THESE FINAL PIECES 'ATOMS'.

Er, atom salad, anyone?

THE WORD 'ATOM' IS GREEK FOR 'UNCUTTABLE' OR 'INDIVISIBLE'.

'Inedible', more like.

DEMOCRITUS THOUGHT ATOMS HAD DIFFERENT SIZES (CORRECT!) AND DIFFERENT SHAPES (WRONG!)...

IRON

Iron atoms have hooks that lock them into a solid.

BUT HE WAS RIGHT ABOUT SOME THINGS...

There are gaps between atoms which I call a void.

BUT NOT EVERYONE AGREED, INCLUDING GREEK SUPER-GEEK ARISTOTLE...

The real void is in here.

INSTEAD, ARISTOTLE BELIEVED THERE WERE JUST FOUR ELEMENTS – EARTH, AIR, FIRE AND WATER – EACH WITH THEIR OWN UNIQUE SHAPE.

EARTH

AIR

FIRE

WATER

ARISTOTLE CLAIMED THAT ALL MATTER WAS MADE FROM THESE...

Your water, sir.

BUT ACTUALLY DEMOCRITUS WAS CLOSER TO THE TRUTH...

Your hydrogen and oxygen atoms, sir.

Beryllium

⁴Be

- 👁 Light, silvery metal
- ⚠ Don't inhale ☆ X-ray vision

Beryllium is a rare metal element only found naturally in certain minerals in the ground. A beryllium compound called beryl forms beautiful aquamarine (pale blue) and emerald (deep green) gemstones.



The Bahia Emerald, one of the largest in the world, has been valued at \$400 million.

X-ray specks

Inhaling dust from beryllium and its compounds can cause a serious lung condition called berylliosis. But beryllium also plays an important part in healthcare. Because its atoms are so small, beryllium metal is transparent to X-rays – they just pass straight through it. So you will discover this element in X-ray machines!



Alloy there!

Beryllium is often added to other metals to make alloys. Mixed with copper it is used in super-safe tools that don't generate sparks if they hit steel surfaces (useful when working near explosive chemicals!). Because beryllium metals are light, they are also used in aircraft, guided missiles and satellites.

FIND IT IN:

- ❑ GEMSTONES
- ❑ X-RAY MACHINES
- ❑ SATELLITES
- ❑ TOOLS

Boron

⁵B

- 👁 Black-brown metalloid
- ⚠ Essential ☆ Shape changer

Boron is vital for life. It helps to keep our bones strong and healthy, and can be found in foods including beans, bananas and broccoli – all beginning with its code name B! Lots of washing powders and cleaning products (such as borax) also contain boron compounds.

Boron is used in fibreglass, a kind of plastic mixed with glass fibres that provide extra strength. This can be moulded into amazing shapes and is used to make everything from cars to crash helmets, surfboards to ships.

The case of the boron-based slime

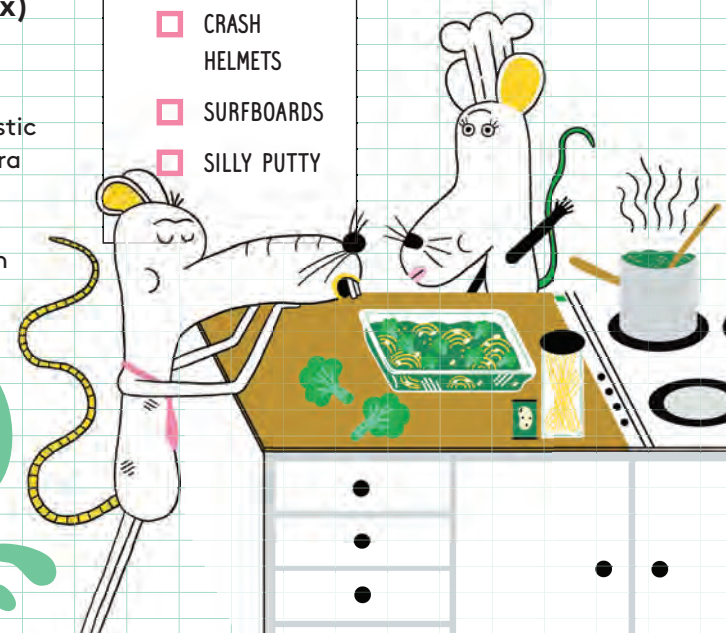
Make your own Silly Putty by dissolving a spoonful of borax in a cup with a small amount of cold water. Add a dollop of white PVA glue and mix together. It should form a slimy ball that can be squished like a liquid, but also bounce and be torn in half! The boron atoms in the borax link the long chains of molecules (called polymers) in the glue to turn them into super-slime. (Keep it covered in the fridge.)

FIND IT IN:

- ❑ BEANS
- ❑ BANANAS
- ❑ BROCCOLI
- ❑ CLEANING PRODUCTS
- ❑ CRASH HELMETS
- ❑ SURFBOARDS
- ❑ SILLY PUTTY

Pyrex marks the spot

Boron is combined with silicon to make borosilicate glass, which won't crack during sudden changes in temperature. This makes it perfect for laboratory test tubes and Pyrex cookware.



Carbon

- 👁 Often dark, sometimes shiny
- ⚠ Possible planetary menace!
- ☆ Master of disguise

Carbon is common! It's the second most common element in the human body after oxygen. It's the fourth most common element by mass in the universe. It's the fifteenth most common element in the Earth's crust. And yet carbon is also super-special – it is essential to all known life.

Carbon atoms are very versatile in the bonds they can form with other elements. There are over 10 million carbon compounds, and the study of these is called organic chemistry. Carbon is found in every living thing – including us. It's also in the things we eat, drink, wear and use. Everything made of plastic contains carbon.

6
C



Carbon copy

To get on the trail of carbon, just look at the pages of this book and the ink printed on them: they both contain carbon.



It's a steel

Adding a small percentage of carbon to steel makes it stronger and harder. Carbon steel is used to build bridges, houses, washing machines and fridges. Adding even more carbon creates cast iron. This is a brittle but strong metal, and you can track it down in railings, manhole covers, pots and pans.

Master of disguise

Carbon is a master of disguise. It can arrange its atoms in different ways to produce different materials, known as allotropes, all of which are still 'pure' carbon. Some occur naturally, others are manmade. Allotropes of carbon include diamonds, coal, graphite, charcoal and graphene.

FIND IT IN:

- YOU
- PETS
- FOOD
- TOAST
- SUGARY DRINKS
- PLANTS
- COAL
- CHARCOAL
- OIL
- PETROL
- CLOTHES
- PLASTICS
- RUBBER
- THIS BOOK
- PENCILS

Global warming

Coal, the fossilised remains of plants that died over 250 million years ago in the Carboniferous Period, is full of carbon. Billions of tonnes of coal are mined every year and burned to generate electricity. This produces carbon dioxide, a 'greenhouse gas', which contributes to global warming. That's why we are trying to find cleaner forms of energy than carbon-rich fossil fuels such as coal, gas and oil.

2B or not 2B

Make a sketch of your suspect, and you will be sure to track down carbon: it is contained in the pencil you are using! The 'lead' in pencils is not actually made from the element lead, but rather from graphite, an allotrope of carbon. In graphite, carbon atoms are arranged in weakly bonded layers that slide over each other to leave a mark when rubbed on paper.



The case of the electric pencil

Graphite is highly unusual for a non-metal, as it will conduct electricity. Ask an adult to help you split open a pencil to reveal the 'lead' inside. Then, make a simple circuit with a bulb and a battery (see diagram). Complete the circuit by touching the wires to the pencil 'lead', and the bulb should light up.



The case of the lemon fire extinguisher

Carbon dioxide is a compound of one atom of carbon (C) and two atoms of oxygen (O₂), with the code name CO₂. It is the gas that makes drinks fizzy and is also used in some fire extinguishers.

You can produce your own carbon dioxide by mixing some bicarbonate of soda or baking powder with lemon juice in a cup or glass. The chemical reaction gives off CO₂, which is heavier than air. If you very gently tilt the cup or glass over a lit candle, the flame should go out.

WARNING!
Get an adult to help, and don't touch the flame.

- Pets ☐
- Food ☐
- Clothes ☐
- Plants ☐
- Coal ☐



BAKING POWDER
100g

