

14–16 years

# Key terms accessible glossary: structure and bonding



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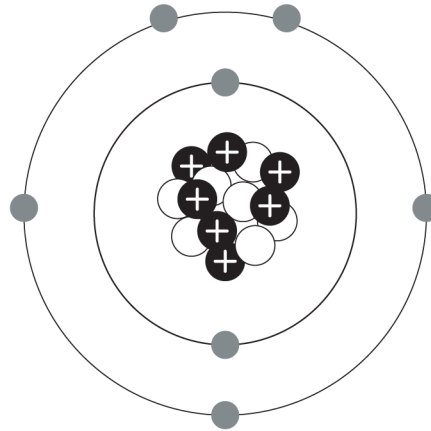
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# Atom

the smallest possible particle of an element; atoms are made up of protons, neutrons and electrons



## Sign it

Watch a video:



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## Say it

A-tuhm

## Example

One individual atom of nitrogen is the smallest form of nitrogen that can exist

## Don't confuse with...

ions. Atoms have an equal number of protons and electrons. Atoms can form ions when they lose or gain electrons

## Other contexts

In physics you will study similar topics about atomic structure and particles

# Chemical bond

a strong electrostatic force of attraction holding atoms together

## In other words...

a force that holds atoms together

## Sign it

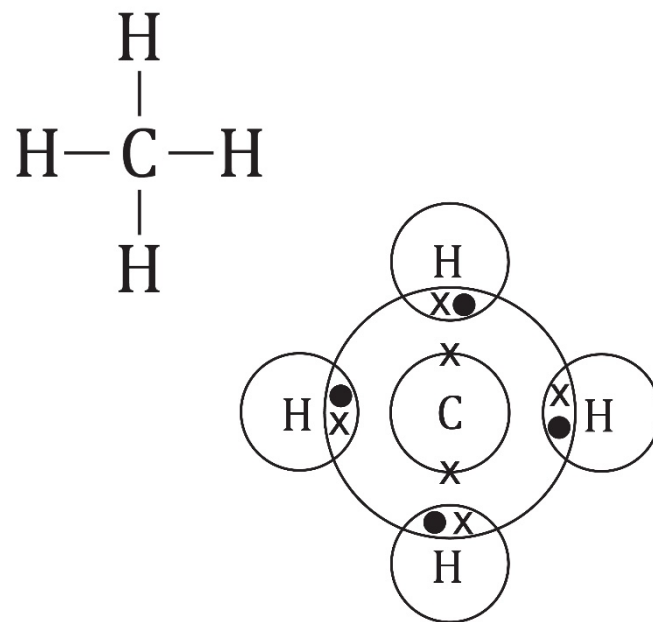
Watch a video:

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## Say it

Kem-ih-kuhl bond



## Example

Chemical bonds in methane connect each carbon atom to four hydrogen atoms

## Don't confuse with...

changes of state. Melting and boiling a substance doesn't involve breaking any chemical bonds

## Other contexts

The type of bonding present in a substance can be named as either covalent, metallic or ionic bonding

# Compound

a pure substance made of two or more different elements whose atoms are joined by chemical bonds; the atoms are in a fixed ratio

## In other words...

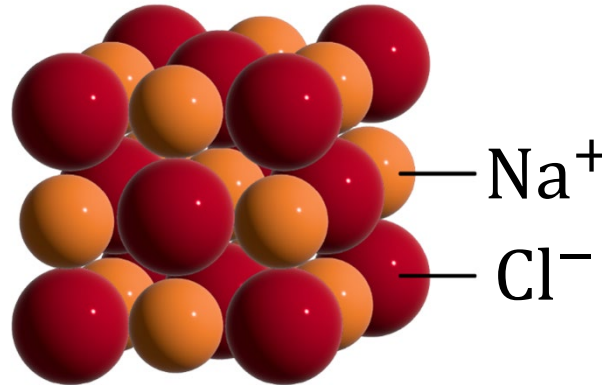
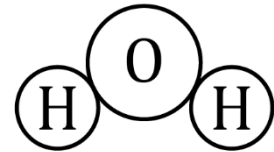
two or more different elements chemically bonded

## Sign it

Watch a video:   
[bit.ly/4jDLKJD](https://bit.ly/4jDLKJD)

## Say it

Com-pound



## Example

Water and sodium chloride are common compounds

## Don't confuse with...

Mixture. Not all the atoms in a mixture will be chemically bonded together

## Other contexts

In biology you will study the importance of glucose, carbon dioxide and many other compounds

# Conductor of electricity

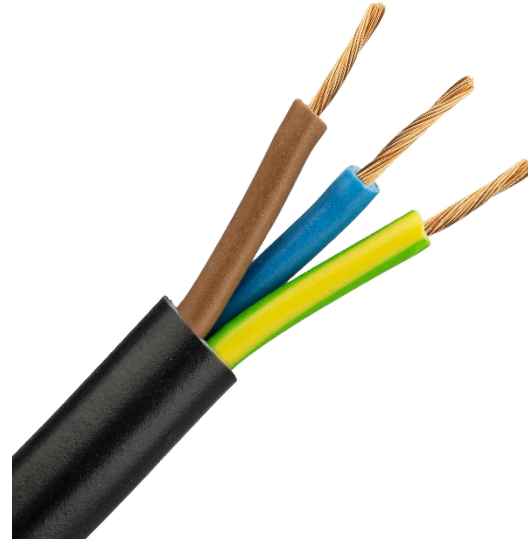
a substance that allows charged particles to move through it easily

## In other words...

a material that conducts electricity

## Say it

Con-duk-tor ov eh-lek-trih-sih-tee



## Other contexts

You will discuss conductors of electricity in physics when learning about circuits and in chemistry when learning about electrolysis

## Example

Metals like copper and gold are good conductors of electricity

## Don't confuse with...

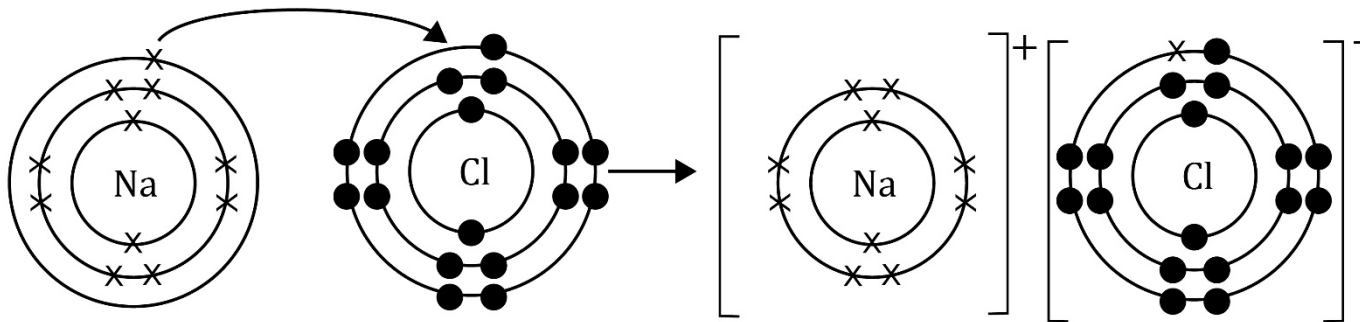
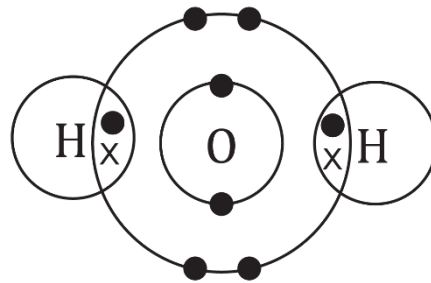
thermal conductor. The explanations for why a substance is a good electrical conductor vs. a conductor of thermal energy are different

# Dot and cross diagram

used to show how electrons from the outer shells/energy levels of atoms are shared or transferred when atoms form molecules or ions

## In other words...

a diagram to represent covalent and ionic bonding



## Don't confuse with...

the full electron configuration of an individual atom. It is common in dot and cross diagrams to only represent the outer shell electrons of the atoms or ions involved



# Electron

a negatively charged subatomic particle with very little mass found in the electron shells/energy levels of atoms

## In other words...

negative subatomic particles found within atoms

## Sign it

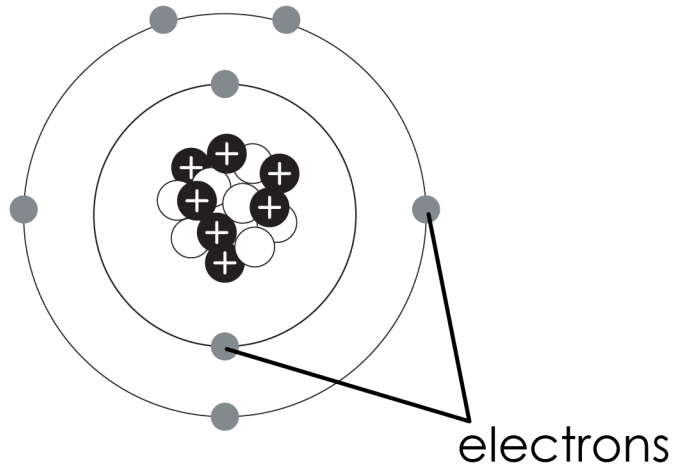
Watch a video:

[bit.ly/4lxieqC](https://bit.ly/4lxieqC)



## Say it

Eh-lek-tron



## Example

Nitrogen atoms will contain seven electrons because the atomic number of nitrogen is 7

## Don't confuse with...

Ion. Electrons are found within atoms and ions

## Other contexts

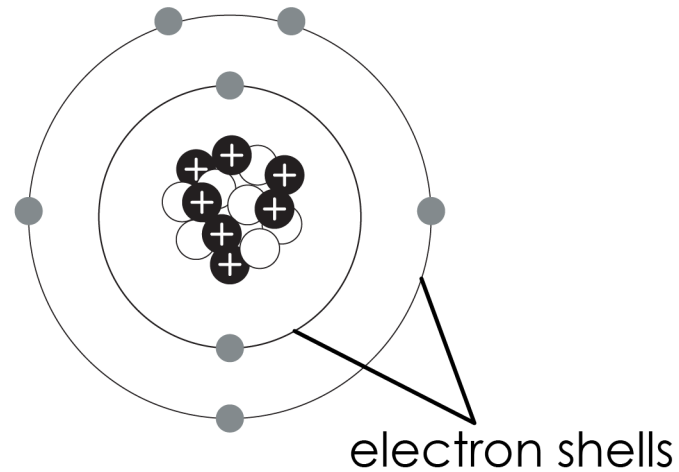
In physics you will study electrons in the context of electrical circuits

# Electron shell (or energy level)

a region surrounding the nucleus of an atom where electrons are found; each level has a maximum number of electrons it can hold

## In other words...

where electrons are found in an atom



## Say it

Eh-lek-tron sh-ells

## Example

An atom of nitrogen has two electron shells, so it is located in the second period of the periodic table

## Don't confuse with...

delocalised electrons. They are not in the electron shells of any particular atom. Unless they are delocalised, electrons occupy space in an electron shell/energy level

# Element

a pure substance made of only one type of atom

## Sign it

Watch a video:   
[bit.ly/4jAYL6M](https://bit.ly/4jAYL6M)

<b>O</b> Oxygen 8	<b>Na</b> Sodium 11	<b>P</b> Phosphorus 15
-------------------------	---------------------------	------------------------------

## Example

Oxygen, sodium and phosphorus are pure substances made of only one type of atom, so they are found on the periodic table

## Say it

Eh-le-ment

## Other contexts

In biology you will study how oxygen, carbon, nitrogen and several other elements are necessary for life

## Don't confuse with...

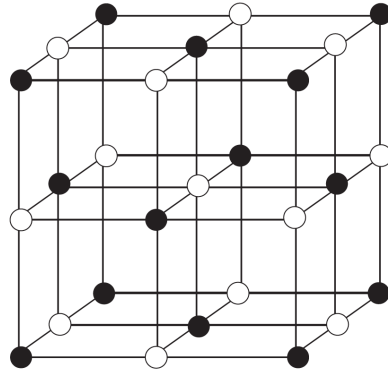
atoms, which are the individual particles that make up an element or compound

# Giant lattice

the regular arrangement of atoms or ions that form extended structures

## In other words...

a large repeating structure made of atoms or ions

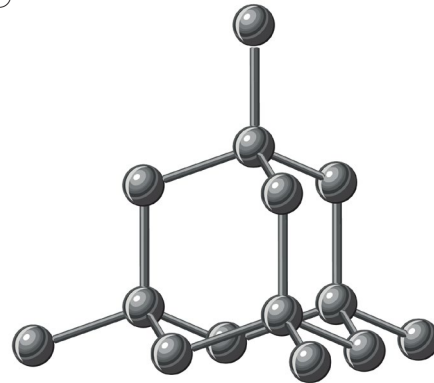


## Say it

J-eye-ant lah-tiss

## Other contexts

In physics, the particles of a solid are often represented as a giant lattice structure



## Example

Diamond, silicon dioxide and sodium chloride are substances that all have their atoms arranged in a giant lattice structure

## Don't confuse with...

simple molecules. These images only show a small section of the structures. These sections are repeated many times to make giant lattices

# Inelastic

is not flexible

## In other words...

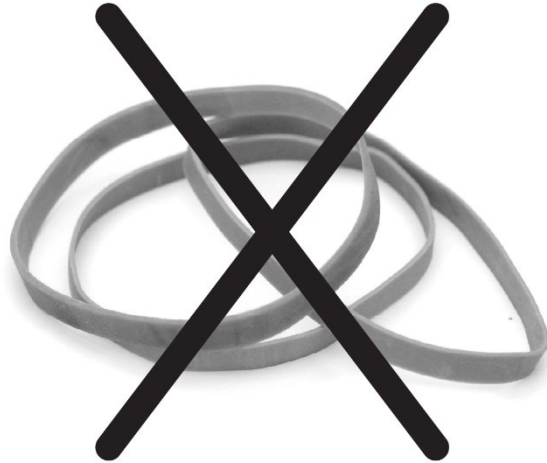
will not stretch or bend

## Say it

In-el-as-tik

## Break it down

'In' means not



## Example

Metal drinks cans and glass bottles are common inelastic materials

## Other contexts

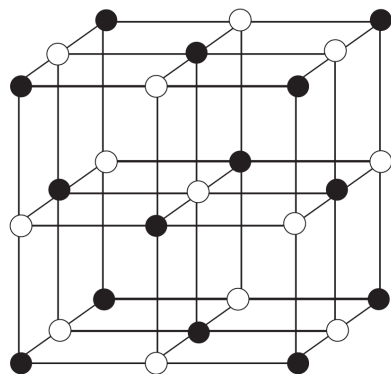
An inelastic object changes shape permanently when a force is applied to it. In physics you will investigate the properties of elastic and inelastic objects

# Regular lattice

an arrangement of repeating atoms or ions that form a 3D structure

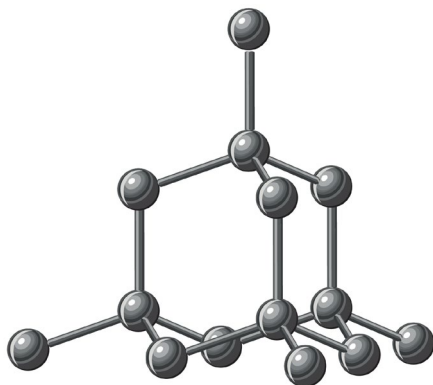
## In other words...

particles arranged in a 3D repeating structure



## Say it

Reh-gyu-lar lah-tiss



## Other contexts

In physics you will learn about the arrangement of particles in solids

## Example

Sodium chloride and diamond are substances that you will study that have a regular lattice structure

## Don't confuse with...

simple molecules.

# Subatomic particle

a particle smaller than an atom

## In other words...

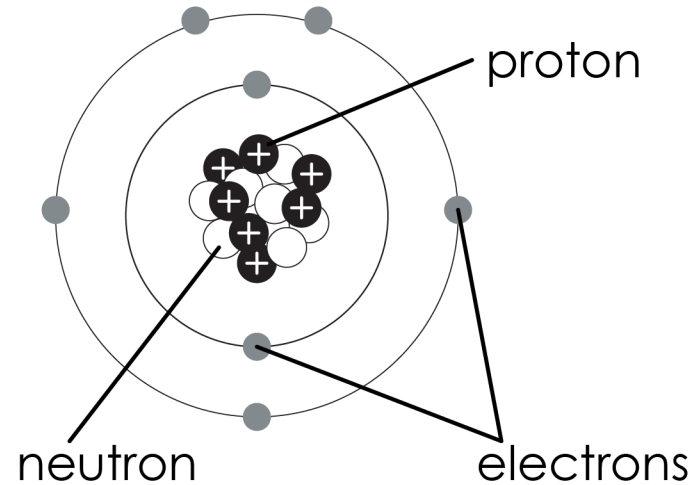
small particles that make up all elements

## Say it

Sub-a-tom-ik par-tih-kuhl

## Break it down

'Sub' means lower



## Example

Protons, neutrons and electrons are subatomic particles

## Don't confuse with...

atoms. Subatomic particles are what atoms are made from. They are found within the atom, not outside it

## Other contexts

In physics you will encounter the same three subatomic particles that we learn about in chemistry: protons, neutrons and electrons

# Covalent bond

a type of bond formed by atoms sharing one or more pairs of electrons

## In other words...

a way for atoms to bond together by sharing pairs of electrons

## Sign it

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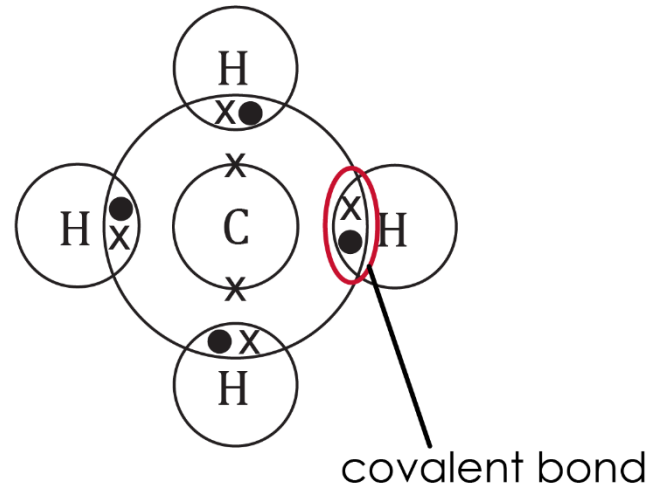


## Say it

Co-vay-lent

## Break it down

'Co-' means together with



## Example

The atoms in methane molecules are held together by covalent bonds

## Don't confuse with...

intermolecular forces. There are covalent bonds within small molecules but not between them

## Other contexts

In biology the digestive enzymes amylase, protease and lipase work by breaking the covalent bonds in certain food molecules



# Diatomic

when a molecule is composed of two atoms

## In other words...

a bonded pair of atoms

## Sign it

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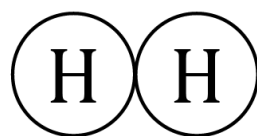
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## Say it

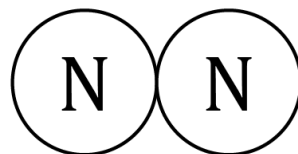
D-eye-a-tom-ik

## Break it down

'Di-' means two



hydrogen molecule



nitrogen molecule



## Example

Hydrogen ( $\text{H}_2$ ) and nitrogen ( $\text{N}_2$ ) are diatomic molecules

## Don't confuse with...

compound; a diatomic molecule has two atoms, but they don't need to be different atoms. So, a diatomic molecule can be an element or a compound

## Other contexts

In biology you will use the formula for diatomic oxygen,  $\text{O}_2$ , in symbol equations

# Intermolecular forces

the relatively weak attractive and repulsive forces between molecules

## Say it

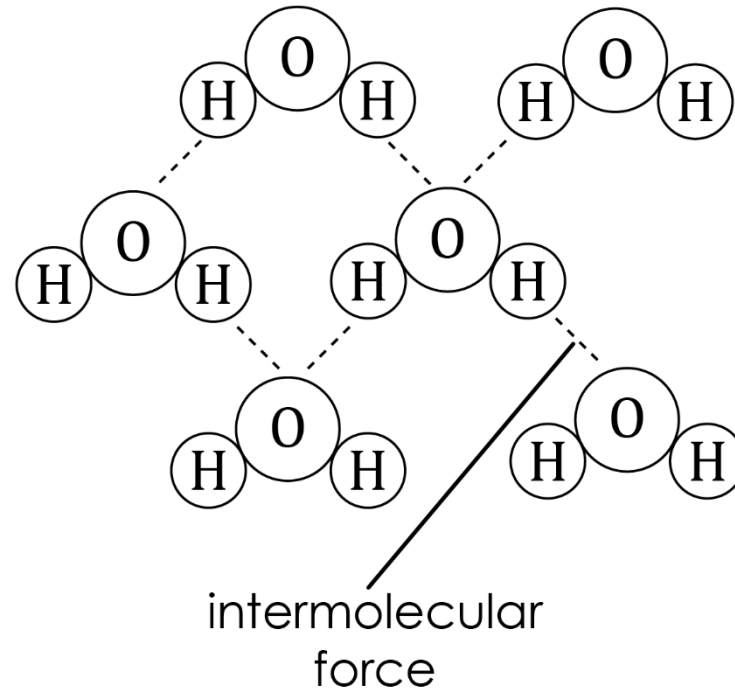
In-tur-mol-leh-kyu-lar  
for-sez

## Break it down

'Inter' means  
between or among

## Other contexts

In physics you may discuss intermolecular forces when learning about the particle model



## Example

The water molecules in ice are held together by attractive forces between the molecules

## Don't confuse with...

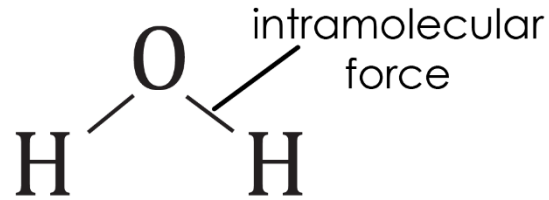
chemical bonds. No covalent bonds are broken when substances made of small covalent molecules undergo melting or boiling – it is the intermolecular forces that are overcome

# Intramolecular forces

the attractive and repulsive forces within a molecule

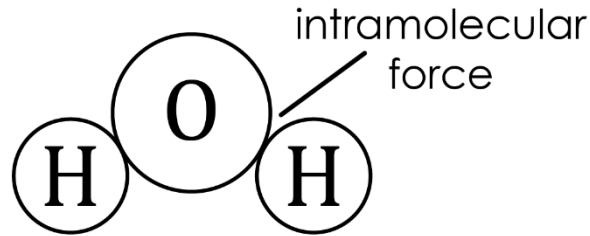
## In other words...

the forces that keep atoms held together within a molecule



## Say it

In-tra-mol-leh-kyu-lar  
for-sez



## Break it down

'Intra-' means inside  
or within

## Example

Covalent, ionic and metallic bonds are examples of intramolecular forces of attraction

## Don't confuse with...

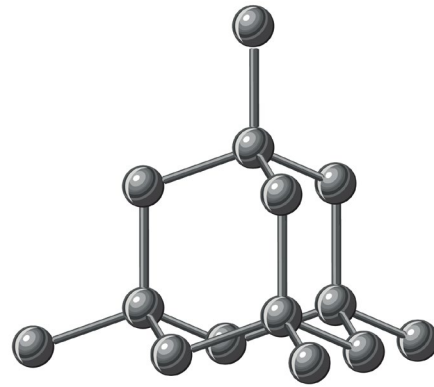
intermolecular forces. Molecules can have intramolecular and intermolecular forces, not just one or the other

# Macromolecule

a very large molecule

## Say it

Mac-ro-mol-eh-kyul



## Break it down

'Macro-' means large

## Example

A diamond is a macromolecule - one giant molecule made up of covalently bonded carbon atoms

**Don't confuse with...**  
a lattice.

## Similar words

The macromolecules silicon dioxide and diamond can be described as giant covalent structures

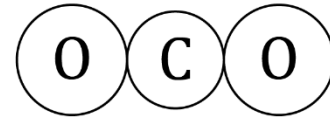
# Molecule

two or more atoms connected by chemical bonds

## Sign it

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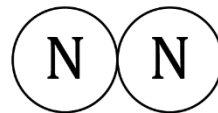
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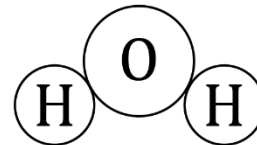
carbon dioxide  
molecule



hydrogen  
molecule



nitrogen  
molecule



water  
molecule

## Say it

Mol-eh-kyul

## Similar words

Molecules of gases and liquids could also be described as gas and liquid particles

## Example

Carbon dioxide ( $\text{CO}_2$ ), water ( $\text{H}_2\text{O}$ ) and all other compounds are molecules

## Don't confuse with...

elements and compounds. A molecule can be either an element or a compound

## Other contexts

In biology you will study many different molecules found within living organisms, such as glucose and carbon dioxide

# Anion

a negative ion

## In other words...

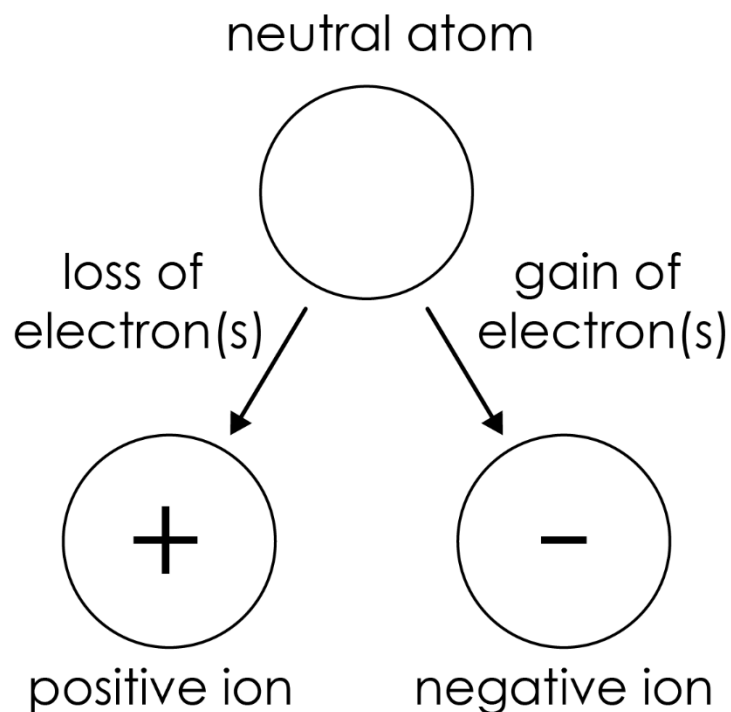
a particle with a negative charge

## Say it

An-eye-on

## Similar words

Negative ion



## Example

Non-metals like chlorine and bromine can form chloride and bromide anions

## Don't confuse with...

electrons. Both anions and electrons are negatively charged. But anions are negatively charged because an atom has gained more electrons in its outer shell

# Brittle

something that cracks or breaks when force is applied to it

## In other words...

objects that will break,  
not bend or stretch

## Sign it

Watch a video:   
[bit.ly/3RfV1eN](https://bit.ly/3RfV1eN)



## Example

A rock will crack  
when a strong  
enough force is  
applied to it  
because rock is  
brittle

## Say it

Brit-uhl

## Similar words

Inelastic

## Don't confuse with...

fragile (easy to  
break). Not all brittle  
objects are fragile

# Ion

a charged particle formed when one or more electrons are lost or gained from an atom or molecule

## In other words...

a particle with a positive or negative charge

## Sign it

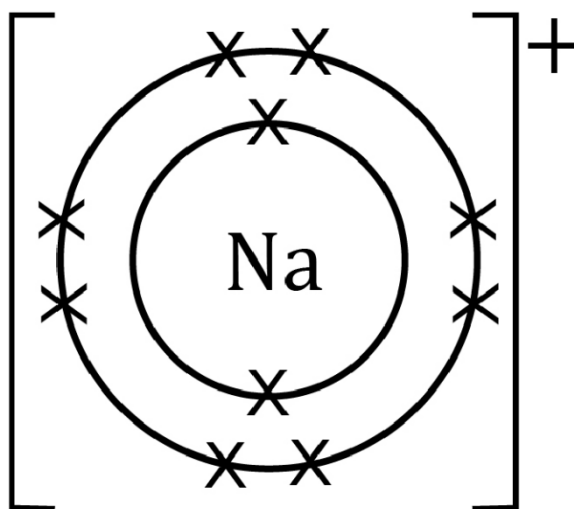
Watch a video:



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## Say it

Eye-on



## Similar words

Cations are ions with a positive charge and anions are ions with a negative charge

## Example

When a sodium atom loses an electron, it becomes a positively charged ion

## Don't confuse with...

protons (positive) or electrons (negative)

## Other contexts

In physics you may discuss ions when learning about electricity



# Ionic bond

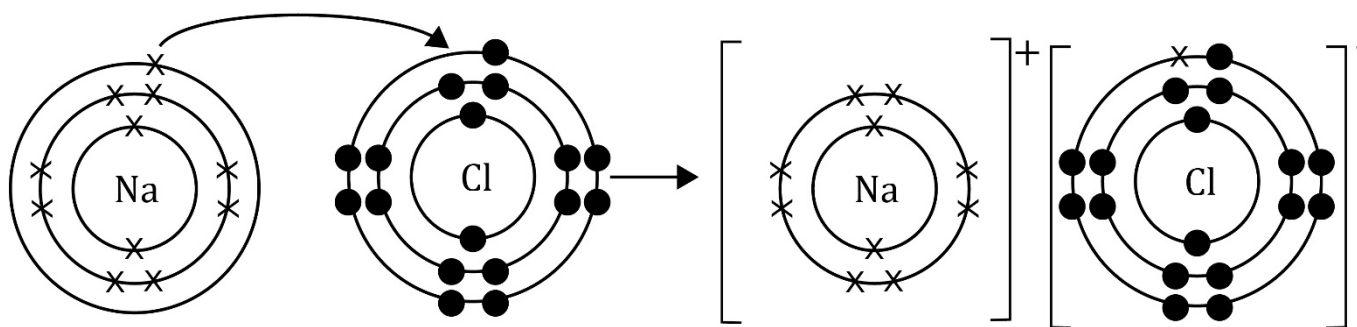
an electrostatic force of attraction between oppositely charged ions in a regular lattice that forms between a metal and a non-metal

## In other words...

the bond between a metal and a non-metal

## Say it

Eye-on-ik bond



## Don't confuse with...

diatomic molecule. Ionic bonds will not always form in a 1:1 ratio of metal to non-metal ions. For example,  $\text{MgCl}_2$  has two  $\text{Cl}^-$  chloride ions for every  $\text{Mg}^{2+}$  magnesium ion

## Example

Sodium chloride  $\text{NaCl}$  (table salt) is a compound held together by ionic bonds. If you crush a large grain of salt, you are breaking the ionic bonds between the sodium and chloride ions

# Polyatomic ion

a charged particle made of two or more atoms joined together

## In other words...

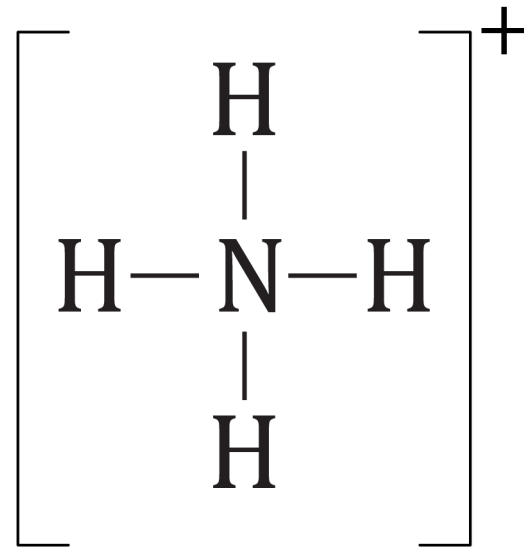
two or more atoms bonded together to form a molecule that has an overall positive or negative charge

## Say it

Polly-a-tom-ik eye-on

## Break it down

'Poly-' means many



## Other contexts

In biology nitrate and phosphate ions are polyatomic ions important for plant nutrition

## Example

$\text{OH}^-$  (hydroxide) and  $\text{NH}_4^+$  (ammonium) are polyatomic ions that you will frequently encounter in chemistry

## Don't confuse with...

ionic compound. Ionic compounds are overall neutral so there is no charge shown in the formula. A polyatomic ion within the compound has a charge which always needs to be shown

# Alloy

a mixture of two or more elements at least one of which is a metal, where the resulting mixture has metallic properties

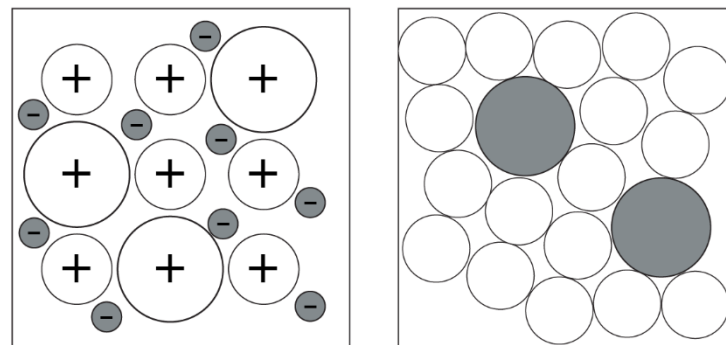
## In other words...

a metal element mixed with another element to improve the properties of the metal, such as making it harder

## Sign it

Watch a video:

[bit.ly/3RNROrl](https://bit.ly/3RNROrl)



## Example

Bronze is an alloy of the two metals copper and tin

## Don't confuse with...

ionic compounds, even though alloys may contain a non-metallic element mixed with the metal

## Say it

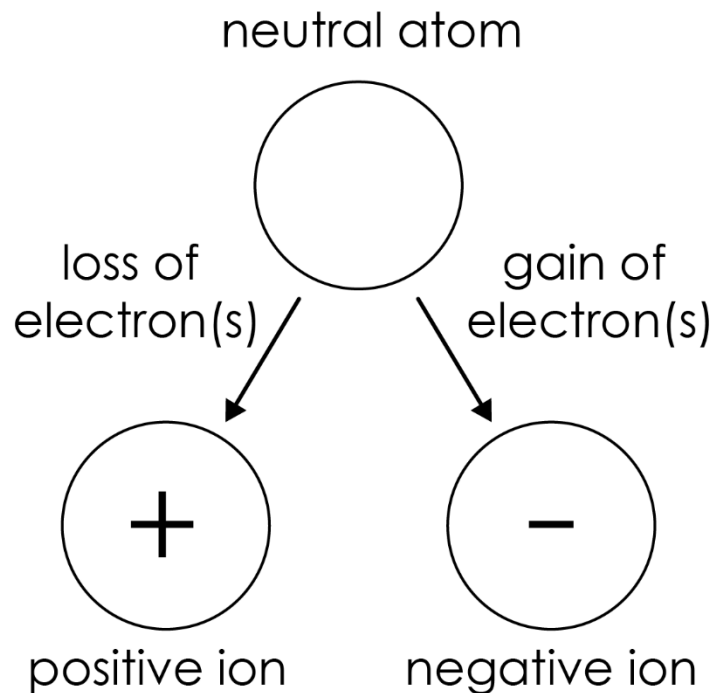
Ah-loy

# Cation

a positive ion

**Say it**

Cat-eye-on



**Example**

Metallic elements can form cations like  $\text{Na}^+$  and  $\text{Mg}^{2+}$

**Don't confuse with...**

protons. Both are positive particles, but protons are found within atoms and ions

# Delocalised electron

an electron in a molecule or structure that is not associated with any particular atom, ion, or covalent bond and which is free to move

## In other words...

electrons that are free to move throughout a structure because they are not bound to one particular atom or ion

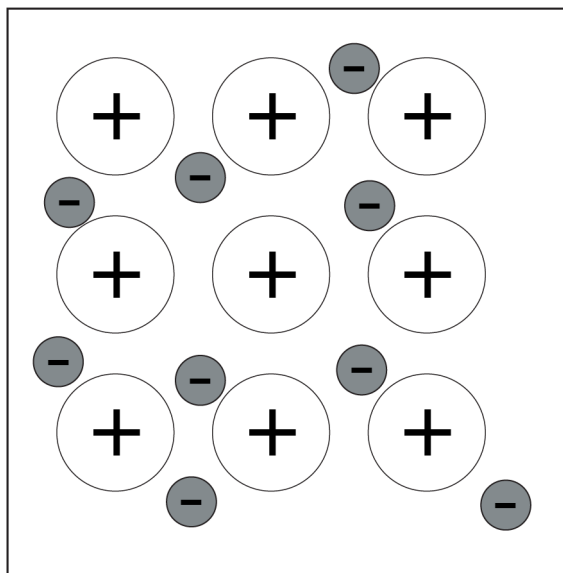
## Sign it

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[bit.ly/4jCGh5R](https://bit.ly/4jCGh5R)

## Say it

Dee-lo-cul-eyes-d eh-lek-tron



## Similar words

Free electron

## Example

Metals are good electrical conductors because they have delocalised electrons

## Don't confuse with...

electrons in a metal. Graphite, an allotrope of carbon, also has delocalised electrons

## Other contexts

In physics delocalised electrons flow through a circuit to produce a current

# Ductile

## In other words...

a material that can be stretched or drawn out into thin wires without breaking

## Say it

Duk-tah-yul

can be drawn out into wires



## Example

Copper is used to make wires in electrical circuits because it is ductile

# Electrostatic force of attraction

a force of attraction between particles with opposite charges

## In other words...

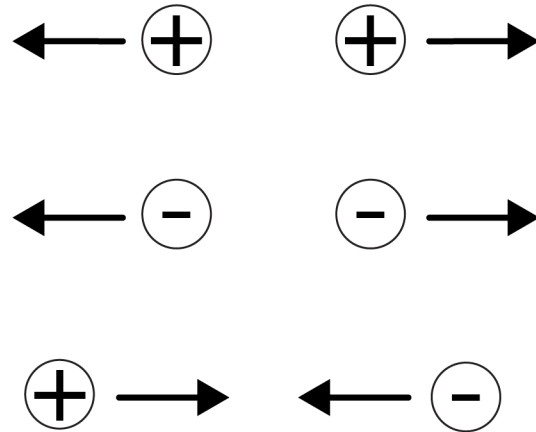
positive and negative particles will attract each other

## Say it

Eh-lek-tro-stah-tik for-ss  
ov at-rak-shuhn

## Other contexts

In physics you will study electrostatics during the electricity topic



## Example

There is an electrostatic force of attraction between positively charged protons and negatively charged electrons

## Don't confuse with...

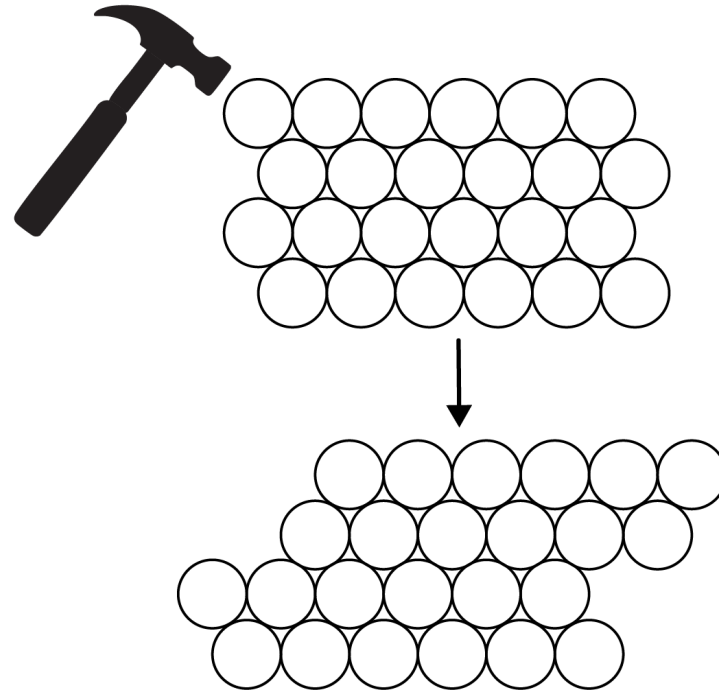
chemical bonding. All types of bonding involve an electrostatic force of attraction, but this force is also what causes protons and electrons to attract within individual atoms

# Malleable

can be hammered or bent into shape

## Say it

Mah-lee-ah-buhl



## Example

Metals can be used for the bodywork of vehicles such as cars and planes because metals can be easily shaped – they are malleable



# Metal

an element that is shiny when cut, malleable and conducts electricity well; metals are found on the left and middle of the periodic table and tend to lose electrons to form positive ions

## In other words...

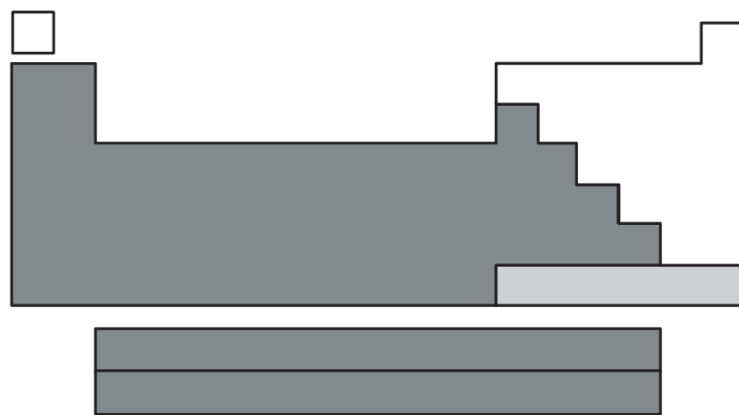
elements which can be bent into shape and conduct electricity. Most are shiny solids at room temperature

## Sign it

Watch a video:   
[bit.ly/42fFYYP](https://bit.ly/42fFYYP)

## Say it

Met-uhl



## Example

Iron, aluminium and copper are metals commonly used to manufacture useful products

## Don't confuse with...

metallic bonding. Pure metals will have metallic bonding, but metals can form ionic bonds with non-metals

## Other contexts

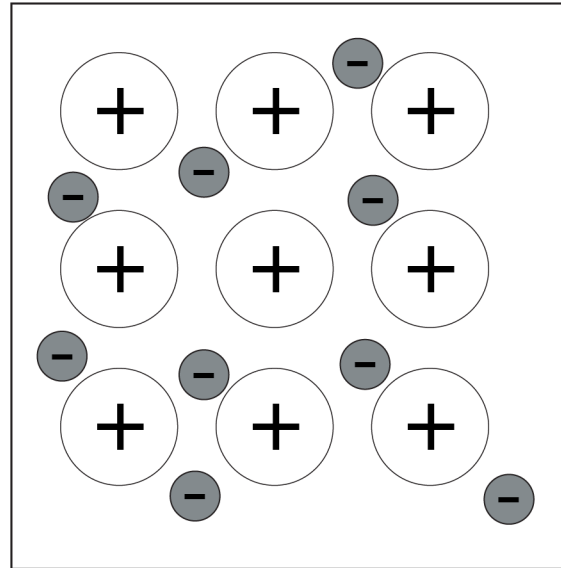
In physics you will study the magnetic metals iron, nickel and cobalt

# Metallic bond

an electrostatic force of attraction between delocalised electrons and the positive ions in a regular lattice

## In other words...

a type of bonding between metal atoms when the outer shell electrons become delocalised but remain attracted to the positive metal ions that have formed



## Example

'Tin foil' (a very thin sheet of aluminium) has metallic bonds, so when you tear the foil you are actually breaking the metallic bonds

## Say it

Met-ah-lik bond

## Don't confuse with...

ionic bonds. Only the positive metal ions are in a fixed position in a metallic bond, the delocalised electrons can move freely through the structure

# Thermal conductivity

## In other words...

substances with a high thermal conductivity are good at transferring heat

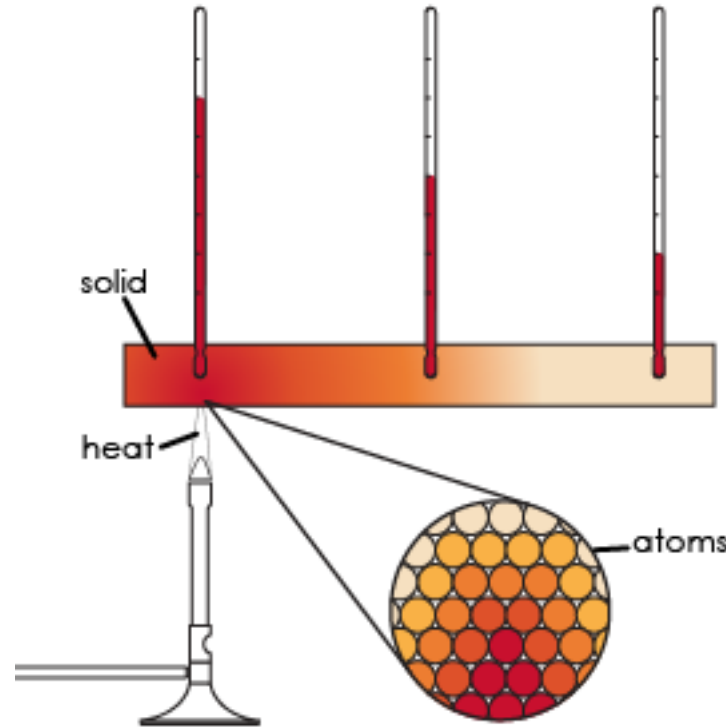
## Say it

Th-ur-mul con-duk-tiv-ih-tee

## Similar words

Thermal conductors can also be described as conductors of heat

a measure of how easily a substance allows heat to move through it



## Example

Most metals are good thermal conductors, so they are used in applications such as saucepans and radiators

## Don't confuse with...

electrical conductivity. The explanations for why a substance is a conductor of electricity or conductor of thermal energy will be different

# Allotropes

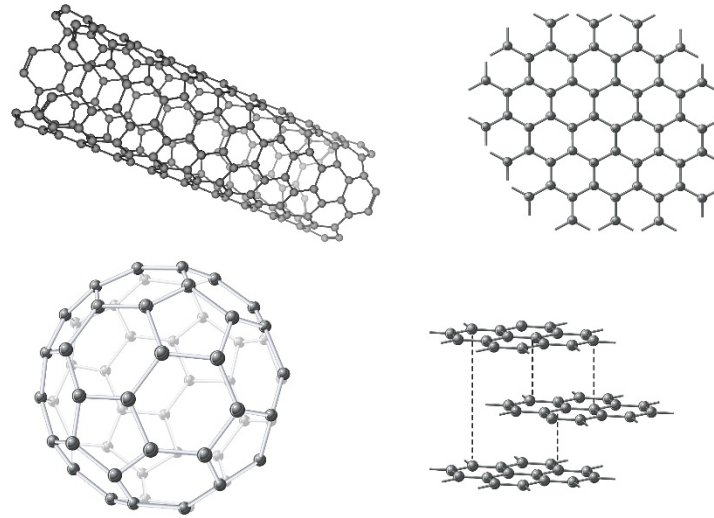
different forms of the same element in the same physical state; for example, allotropes of carbon are diamond, graphite, graphene and fullerenes

## In other words...

different forms of the same element where the atoms are arranged in different ways, giving each allotrope different properties

## Say it

Ah-lo-troh-ps



## Example

Diamond and graphite are two allotropes of carbon

## Don't confuse with...

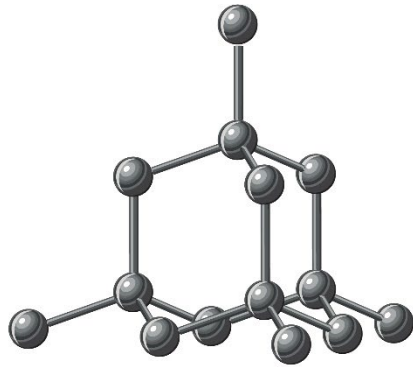
isotope. Allotropes are described in terms of their structure and bonding, not the number of subatomic particles within the atomic nucleus

# Tetrahedral

molecules and structures that have one atom in the centre and four atoms at the corners of a triangular pyramid

## Say it

Teh-trah-heed-rahl



## Example

Carbon atoms are arranged in a tetrahedral structure within a diamond molecule

## Break it down

'Tetra-' means four

## Don't confuse with...

diamond. It does have a tetrahedral structure, but so do many other molecules. Silicon is another macromolecule with a tetrahedral structure and some small molecules like methane ( $\text{CH}_4$ ) also have a tetrahedral shape

# Acknowledgements

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