



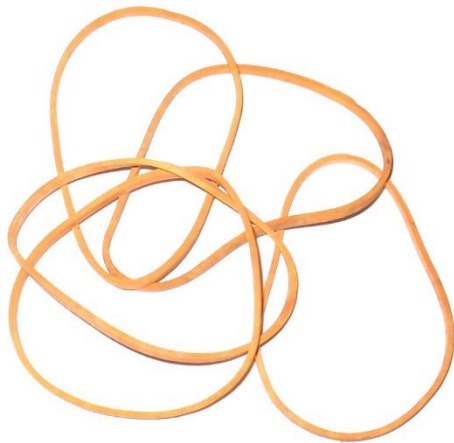
ZOOMING IN: ATOMS AND MOLECULES



MATERIALS

- Previously, we learned about **materials!**
 - **Materials:** any sort of stuff you can use to make things from.
- Different materials have different properties.

SOME MATERIALS





MATERIALS

- A **materials properties** depend on what they are **made of**, from the **large scale** to the **small scale**.
 - The **shape** of the **fibres**.
 - The **molecules** that its made of.
 - The **atoms** that make up the molecules.
- These all affect a materials properties.

MATERIALS

- A **materials properties** depend on what they are **made of**, from the **large scale** to the **small scale**.

- The **shape** of the **fibre**.

- The molecules that it's made of.

- The atoms that make up the molecules.

- These all affect a materials properties.

**BUT WHAT ARE MOLECULES
AND ATOMS?????**



ATOMS

- **Atoms** make up **all** the **matter** in the universe.

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ATOMS

- **Atoms** make up **all** the **matter** in the universe.
- They are **too small to see!**

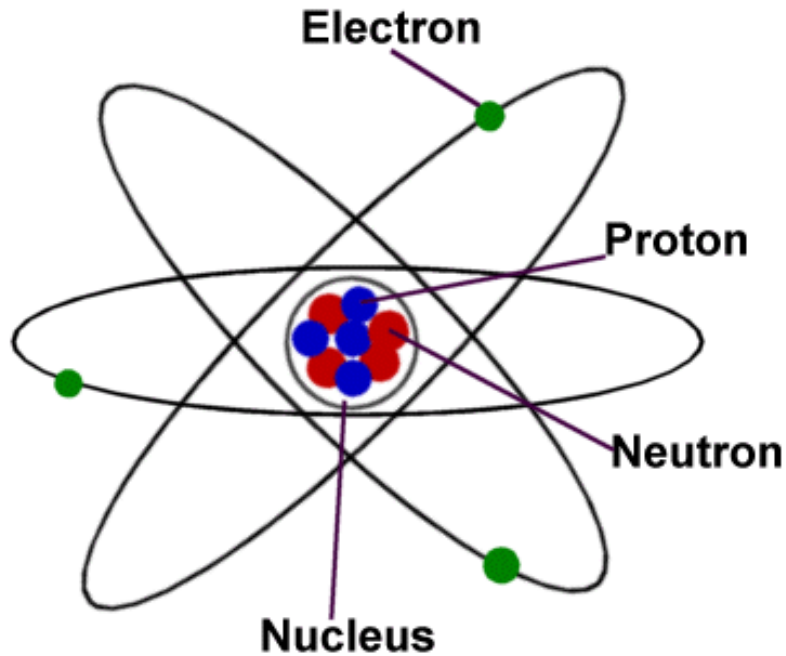


ATOMS ARE HOW SMALL?

- Atoms are \leq **0.3 *nanometres*** in diameter.

ATOMS

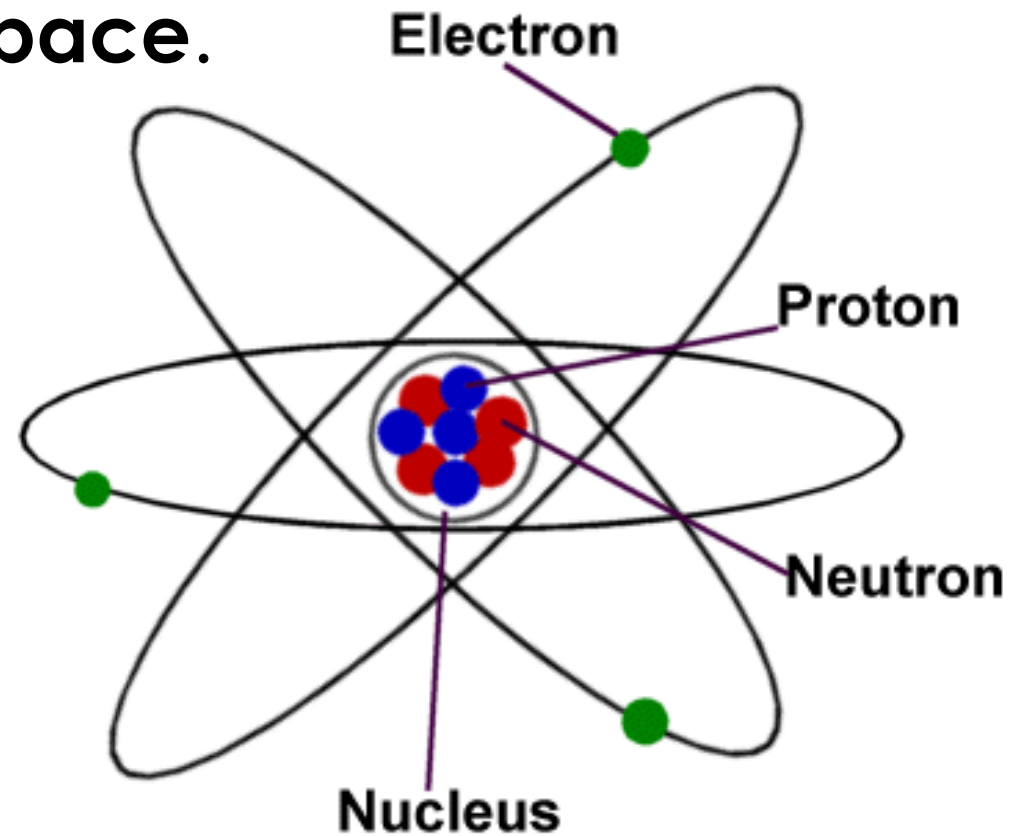
They are made of **3 types of particles**:



- **Electrons** are **very small** and have a negative **(-) electric charge**.
- **Protons** have a **positive (+)** electric charge.
- **Neutrons** have **no charge**.
- **Protons** and **neutrons** are **in the nucleus** of the atom, **electrons orbit** the nucleus.

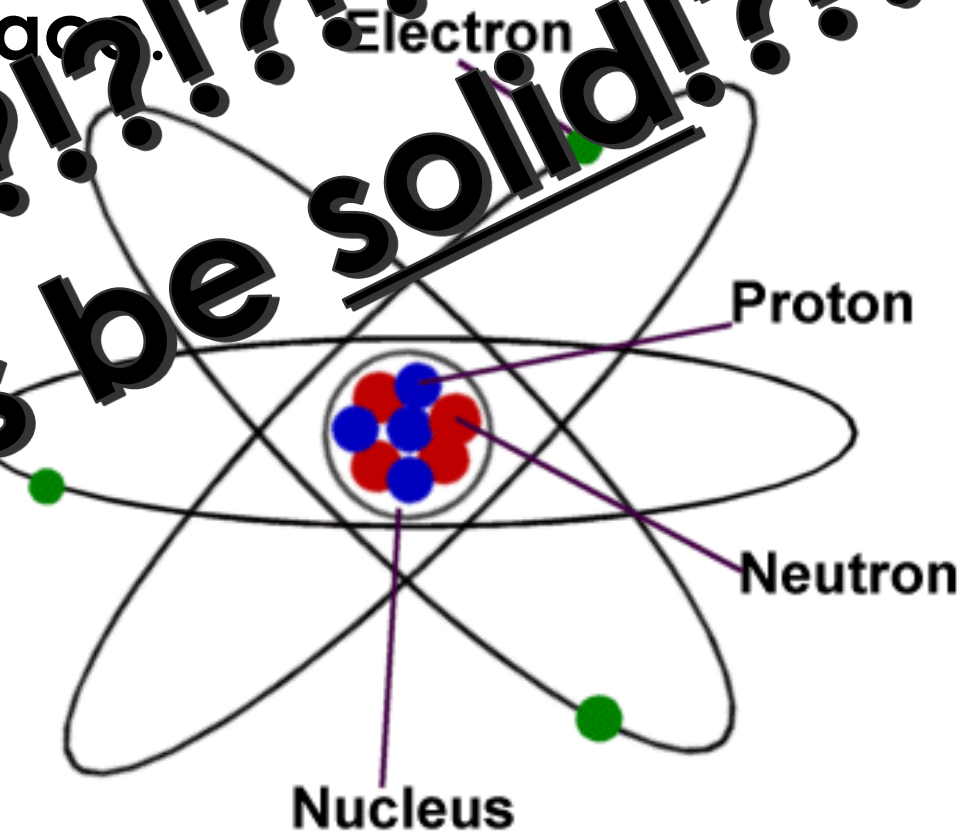
ATOMS

- Also, **atoms** are **mostly empty space**.



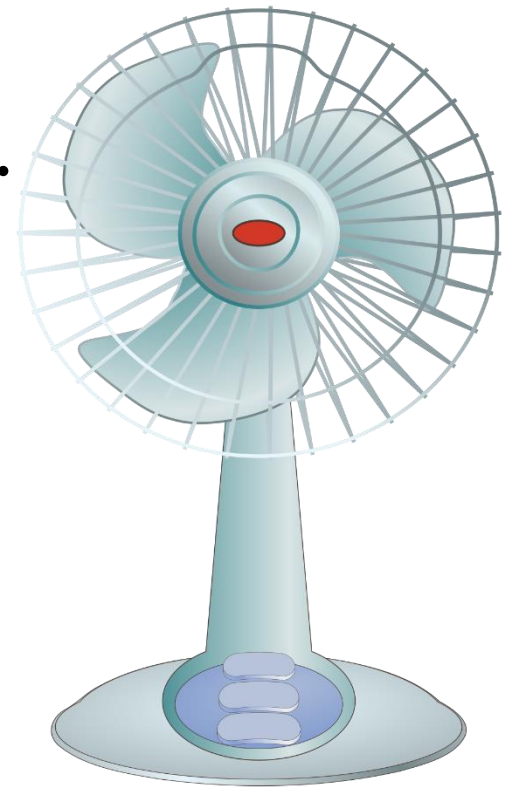
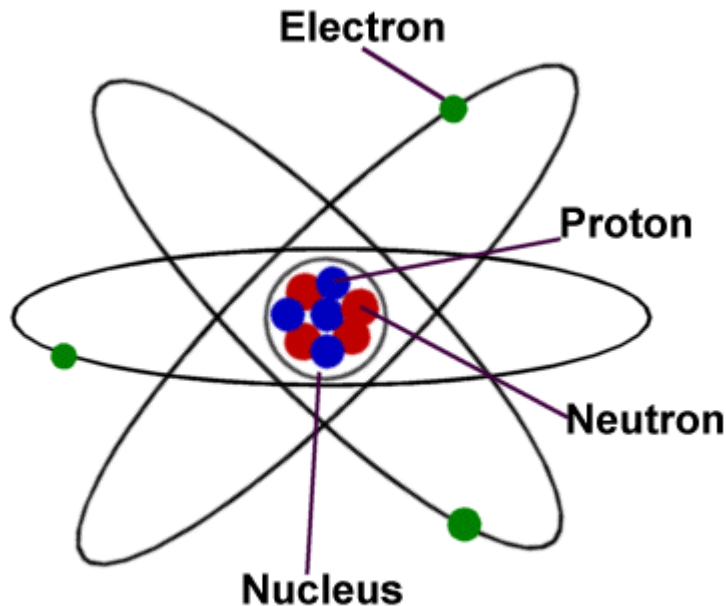
[illegible]

- Also, **atoms** are **mostly empty space!**



ATOMS AND SOLIDS

- The electrons in atoms repel each other so strongly and they are moving so quickly that it acts like a solid.
- This is why we have objects that are solids.



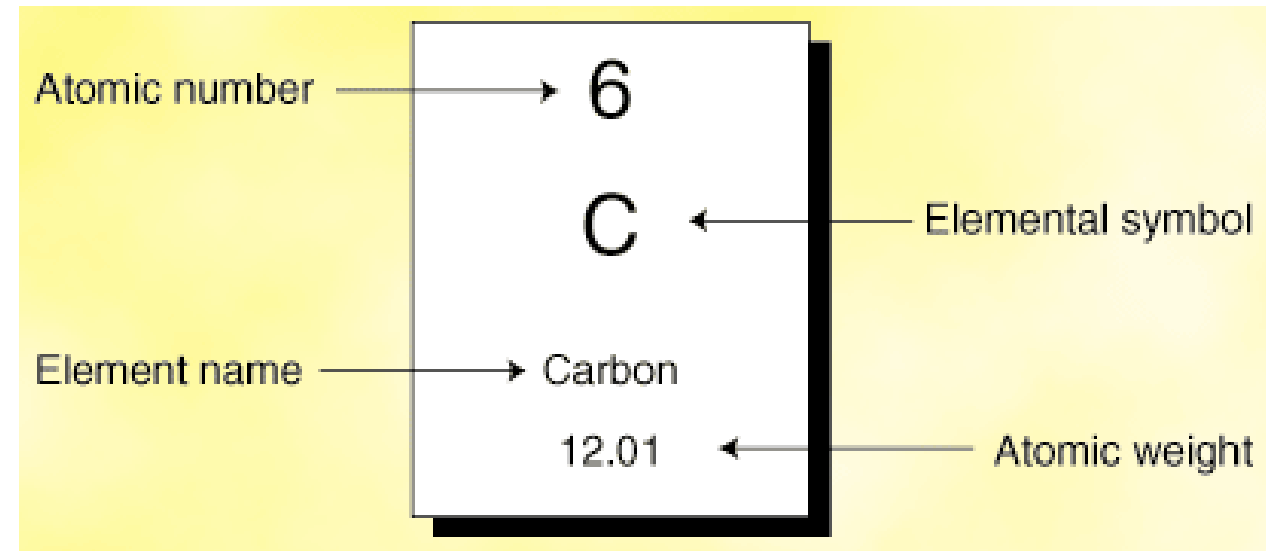
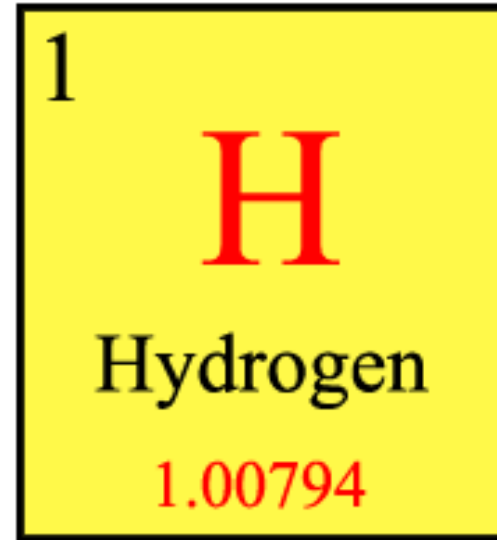
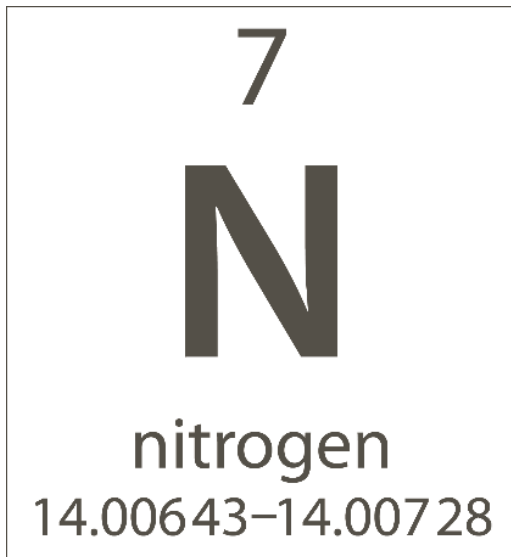


HOW ARE ATOMS DIFFERENT FROM EACH OTHER?

- We can tell the **difference between atoms** based on the **number of protons** in the nucleus.
- The **number of protons** affects an element's **properties**.

HOW ARE ATOMS DIFFERENT FROM EACH OTHER?

- We **call** these **different atoms elements**. For example:



Periodic Table of Elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	1 H Hydrogen 1.00794	Atomic # Symbol Name Atomic Mass																2 He Helium 4.002602	
2	3 Li Lithium 6.941	4 Be Beryllium 9.012182	<div><div>C Solid</div><div>Hg Liquid</div><div>H Gas</div><div>Rf Unknown</div></div> <div><div>Metals</div><div>Alkali metals</div><div>Alkaline earth metals</div><div>Lanthanoids</div><div>Actinoids</div><div>Transition metals</div><div>Poor metals</div><div>Other nonmetals</div><div>Noble gases</div></div>										5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797	
3	11 Na Sodium 22.98976928	12 Mg Magnesium 24.3050											13 Al Aluminium 26.9815386	14 Si Silicon 28.0855	15 P Phosphorus 30.973762	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948	
4	19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955912	22 Ti Titanium 47.887	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938045	26 Fe Iron 55.845	27 Co Cobalt 58.933195	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798	
5	37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.96	43 Tc Technetium (97.9072)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.293	
6	55 Cs Caesium 132.9054519	56 Ba Barium 137.327	57–71		72 Hf Hafnium 178.49	73 Ta Tantalum 180.94788	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.084	79 Au Gold 196.966569	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98040	84 Po Polonium (209.9824)	85 At Astatine (209.9871)	86 Rn Radon (222.0176)
7	87 Fr Francium (223)	88 Ra Radium (226)	89–103		104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (277)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (271)	111 Rg Roentgenium (272)	112 Uub Ununbium (285)	113 Uut Ununtrium (284)	114 Uuq Ununquadium (289)	115 Uup Ununpentium (288)	116 Uuh Ununhexium (292)	117 Uus Ununseptium (291)	118 Uuo Ununoctium (294)

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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57 La Lanthanum 138.90547	58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.242	61 Pm Promethium (145)	62 Sm Samarium 150.38	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92535	66 Dy Dysprosium 162.500	67 Ho Holmium 164.93032	68 Er Erbium 167.259	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.054	71 Lu Lutetium 174.9668
89 Ac Actinium (227)	90 Th Thorium 232.03806	91 Pa Protactinium 231.03688	92 U Uranium 238.02891	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)



MOLECULES

- **Molecules** are made of **many atoms**. The **atoms** are bonded together with **atomic bonds**.

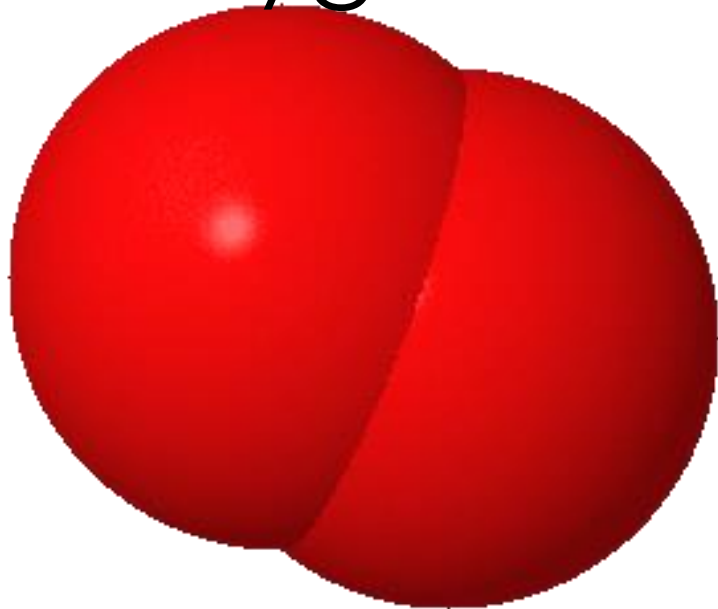
For example:

MOLECULES

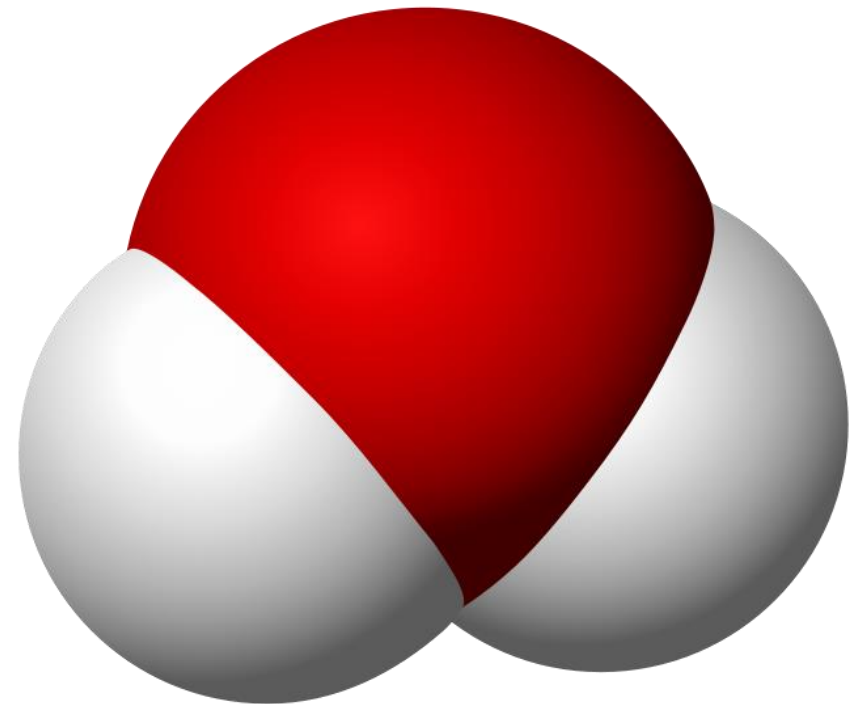
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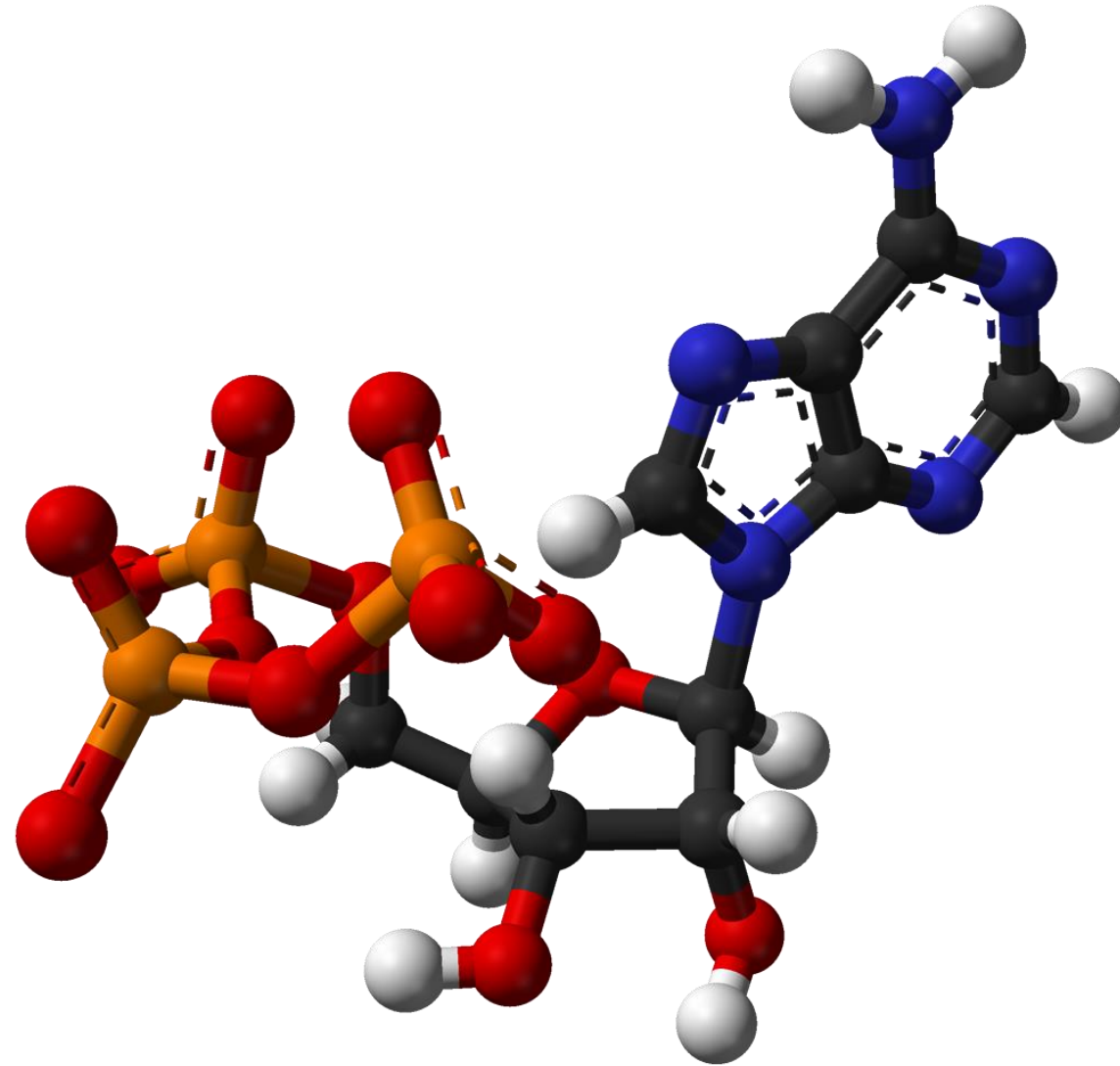
Oxygen O_2



Water H_2O



ATP (Adenosine triphosphate) $\text{C}_{10}\text{H}_{16}\text{N}_5\text{O}_{13}\text{P}_3$





REFERENCES

- GCSE Science Foundation textbook, pgs. 142-143, Oxford university press. 2011
- Bill Nye The Science Guy: Atoms. Published: ??? . <http://www.dep-store.com/ProductDetails.asp?ProductCode=77A02VL00>.