

Water Why is water called the medium for life?	Water Why are the O-H bonds in water polar?
Water Hydrogen bond (between water molecules)	Water How should hydrogen bonds be drawn?
Water Cohesion	Water Two consequences of cohesion for organisms
Water Adhesion	Water Where does capillary action matter to plants?

Electrons are shared unequally: oxygen attracts them more strongly, so oxygen is δ^- and hydrogen δ^+ .

The first cells originated in water, and most processes of life still occur in water.

At least two water molecules, δ^+ on H and δ^- on O, with a dashed line from H of one to O of the other.

Attraction between the δ^+ hydrogen of one water molecule and the δ^- oxygen of another. Weak, but very numerous.

Water is pulled up xylem under tension without the column breaking; surface tension lets water surfaces be habitats, e.g. for pond skaters.

Attraction of water molecules to each other due to hydrogen bonding.

In soil, drawing water through narrow pores, and in cell walls, where water adheres to hydrophilic cellulose.

Attraction of water to materials that are polar or charged.

Water

Why do ions and polar molecules dissolve in water?

Water

Why is water the medium for metabolism?

Water

Give an example of a molecule whose function depends on being hydrophobic.

Water

Four physical properties of water to contrast with air

Water

Ringed seal: adaptation linked to thermal conductivity

Water

Black-throated loon: adaptations for water and air

Water

Why is water a thermally stable habitat?

Water **HL only**

Hypothesis for the origin of Earth's water

Many hydrophilic molecules dissolve in it and most enzymes catalyse reactions in aqueous solution.

They are hydrophilic: water molecules are attracted to them and surround them, separating them from each other.

Buoyancy, viscosity, thermal conductivity and specific heat capacity: all much higher in water.

Phospholipids: hydrophobic tails form the membrane core, a barrier to ions and polar molecules. Also stored triglycerides.

Streamlined body and rear legs for swimming against viscous water; denser bones for diving; air-trapping feathers for insulation.

Thick blubber insulates against fast heat loss to cold water, which conducts heat over 20 times faster than air.

Water was delivered by asteroids that collided with the early Earth.

Its high specific heat capacity, due to hydrogen bonding, means a lot of energy is needed to change its temperature.

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Two reasons Earth retained its water

Water **HL only**

Goldilocks zone

Nucleic acids

What is the genetic material of all living organisms?

Nucleic acids

Components of a nucleotide (and IB diagram shapes)

Nucleic acids

Sugar-phosphate backbone

Nucleic acids

Bases in DNA and in RNA

Nucleic acids

How is RNA formed from nucleotides?

Nucleic acids

Describe the structure of DNA

The range of distances from a star where a planet's surface is neither too hot nor too cold for liquid water.

Gravity strong enough to hold the atmosphere; temperatures low enough for water to condense into liquid.

Phosphate (circle), pentose sugar (pentagon), nitrogenous base (rectangle).

DNA. Some viruses use RNA, but viruses are not considered living.

DNA: adenine, thymine, guanine, cytosine.
RNA: adenine, uracil, guanine, cytosine.

A continuous chain of covalently bonded atoms formed by the phosphate of each nucleotide bonding to the sugar of the next.

Double helix of two antiparallel strands linked by hydrogen bonds between complementary bases: A with T, G with C.

By condensation: phosphate of one nucleotide bonds to the ribose of the next and water is released.

Nucleic acids

Antiparallel

Nucleic acids

Three differences between DNA and RNA

Nucleic acids

Ribose vs deoxyribose

Nucleic acids

Examples of nucleic acids

Nucleic acids

What is complementary base pairing based on?

Nucleic acids

Where does complementary base pairing occur?

Nucleic acids

Possible sequences for DNA n nucleotides long

Nucleic acids

Why is the universal genetic code evidence for common ancestry?

Strands: two vs one. Bases: thymine vs uracil. Sugar: deoxyribose vs ribose.

The two strands of DNA run in opposite directions.

DNA, messenger RNA (mRNA), transfer RNA (tRNA) and ribosomal RNA (rRNA).

Ribose has OH on carbon 2; deoxyribose has only H there, one oxygen fewer.

Replication (template strands), transcription (mRNA from DNA) and translation (tRNA anticodon to mRNA codon).

Hydrogen bonding between specific bases:
A with T (or U), G with C.

The same codons code for the same amino acids in almost all organisms; this is best explained by inheritance from one common ancestor.

4ⁿ. Any length and any sequence is possible, so storage capacity is effectively limitless.

Nucleic acids **HL only**

What gives a nucleic acid strand direction?

Nucleic acids **HL only**

Significance of 5' to 3' direction

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Purines and pyrimidines

Nucleic acids **HL only**

Why is the DNA helix stable and uniform?

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Structure of a nucleosome

Nucleic acids **HL only**

Why does DNA bind tightly to histones?

Nucleic acids **HL only**

Hershey-Chase: isotopes and results

Nucleic acids **HL only**

Which technology made the Hershey-Chase experiment possible?

Polymerases add nucleotides only to the 3' end (build 5' to 3'); ribosomes read mRNA 5' to 3'.

Each backbone link joins carbon 3' of one sugar to carbon 5' of the next, giving a 5' end and a 3' end.

Each pair is a purine with a pyrimidine, so A-T and C-G are equal length and the helix has the same shape for any sequence.

Purines (two rings): adenine, guanine.
Pyrimidines (one ring): cytosine, thymine, uracil.

Positively charged amino acids on histones attract the negatively charged phosphates of DNA.

DNA wrapped around a core of eight histone proteins, held by an additional histone attached to linker DNA.

Radioisotopes becoming available to scientists as research tools.

^{35}S labelled protein and stayed outside bacteria; ^{32}P labelled DNA and entered bacteria. So DNA is the genetic material.

Nucleic acids **HL only**

Chargaff's findings

Nucleic acids **HL only**

Tetranucleotide hypothesis and its falsification

Claimed DNA is a repeating sequence of the four bases (equal amounts). Chargaff's unequal, species-specific base ratios falsified it.

In DNA of all species $A \approx T$ and $G \approx C$ (purines = pyrimidines), but $A + T$ vs $G + C$ proportions vary between species.