NAME _____ CLASS _____ DATE _____

AP BIOLOGY · 1.1 AND 1.2

Water and the elements of life

Notes to fill in alongside the guide. Each numbered block matches a chapter of the guide, and of the lesson slides. Write in the gaps, answer the cues, annotate the figures, and sum up each section in your own words.

BY THE END YOU CAN

- [ ] Explain how unequal sharing of electrons makes water polar, and draw hydrogen bonds between water molecules with partial charges 1.1.A
- [ ] Explain how cohesion gives water its surface tension and lets transpiration pull a column of water up the xylem 1.1.A
- [ ] Explain how adhesion to polar surfaces, with cohesion, moves water by capillary action 1.1.A
- [ ] Explain why ions and polar molecules dissolve in water while nonpolar ones do not, and why that matters to a cell 1.1.A
- [ ] Explain water's high specific heat, evaporative cooling and floating ice in terms of hydrogen bonds 1.1.A
- [ ] Describe why carbon forms the skeleton of biological molecules, and name four functional groups 1.2.A
- [ ] Describe which elements each class of macromolecule contains, and how organisms take carbon, nitrogen and phosphorus from their environment 1.2.A

01 One lopsided molecule, and the bonds it makes

1.1.A

CUES

Predict: Water boils at 100 °C. Methane, CH4, a molecule of about the same size, is nonpolar and boils at about −160 °C. What explains the difference?

What is meant by covalent bonds?

What is meant by electronegative?

What is meant by polar covalent bond?

What is meant by polar?

NOTES

1 A water molecule is an oxygen atom joined to two hydrogen atoms by _____.

2 Oxygen is more _____ than hydrogen: it pulls the shared electrons toward itself.

3 So each O–H bond is a _____, and the molecule ends up with a slightly negative oxygen end and two slightly positive hydrogen ends.

4 A molecule with charged ends like this is _____.

5 The δ+ hydrogen of one water molecule is drawn to the δ− oxygen of a neighbor, and that attraction is a _____.

6 _____ hold the atoms of one molecule together; hydrogen bonds hold neighboring molecules to each other.

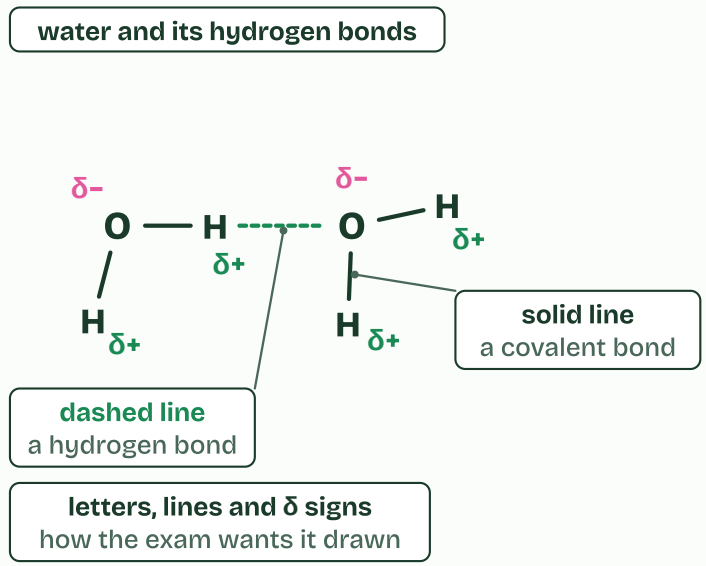
7 Draw _____ as solid lines and hydrogen bonds as dashed lines, with δ+ and δ− on the atoms.

What is meant by hydrogen bond?

Your own notes

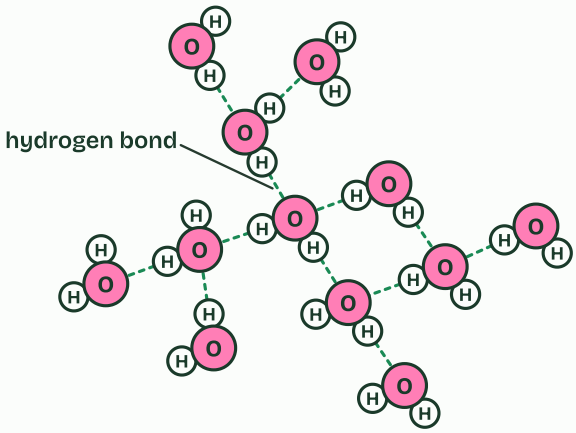
ANNOTATE THE FIGURE

Number the 6 steps on the figure and note what happens at each: 1 bent; 2 electrons; 3 partial; 4 hydrogen bond; 5 four; 6 Draw it like this.



ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each: 1 polar; 2 hydrogen bond; 3 break and form.



REMEMBER IT

What hydrogen bonds give water

C	A	S	H	S
Cats	Always	Skip	Hot	Showers
C	A	S	H	S

SPOT THE MISTAKE

A student writes: "The hydrogen bond is the bond between O and H inside the molecule." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 01 in two or three sentences of your own.

02 Water holds on to itself

1.1.A

CUES

Predict: Ground pepper floats on a bowl of water. You touch the middle of the surface with a finger dipped in dish soap. What does the pepper do?

What is meant by cohesion?

What is meant by surface tension?

What is meant by transpiration?

What is meant by xylem?

NOTES

1 Because of hydrogen bonds, water molecules stick to each other. That is _____.

2 The surface holds together like a stretched film. That is _____, and water's is one of the highest of any liquid.

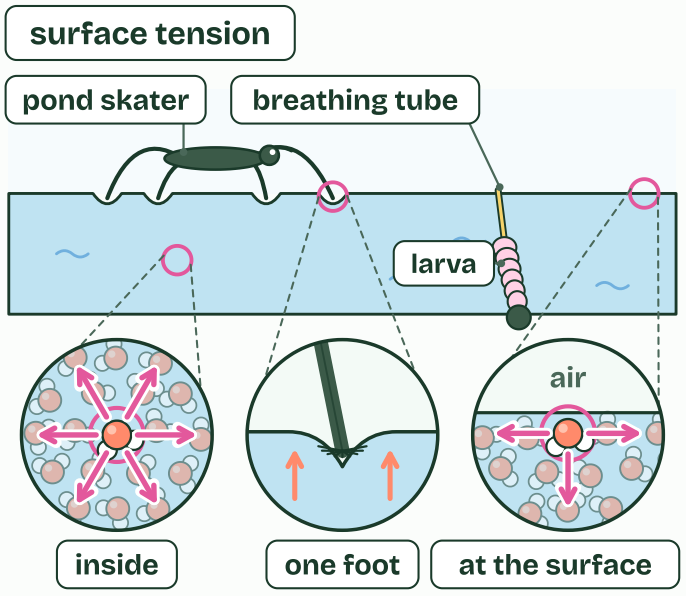
3 Water evaporates from leaves through tiny pores, a loss called _____.

4 The pull passes all the way down the thin tubes of _____ to the roots, so a whole column of water is drawn up, like a rope pulled from the top.

Your own notes

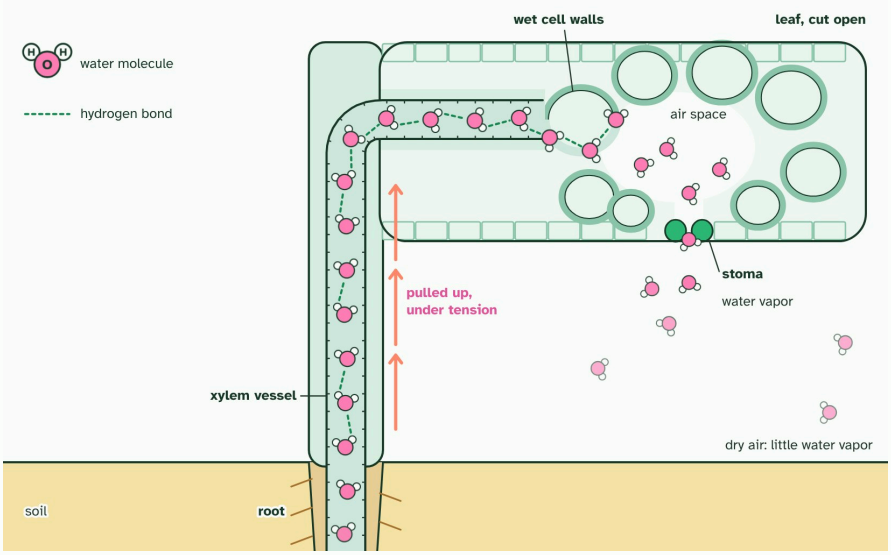
ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 dimple; 2 every direction; 3 sideways and inwards, surface tension; 4 hairs; 5 larva.



ANNOTATE THE FIGURE

Annotate this still from the animation (Watch it happen: pulling water up a stem): what is happening, and why?



SPOT THE MISTAKE

A student writes: "Water is pushed up the tree from the roots." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 02 in two or three sentences of your own.

03 Water clings to other surfaces

1.1.A

CUES

Predict: Three cups in a row: red water, an empty cup, blue water. A strip of paper towel bridges each full cup and the empty one. What is in the middle cup a few hours later?

What is meant by adhesion?

What is meant by cellulose?

What is meant by capillary action?

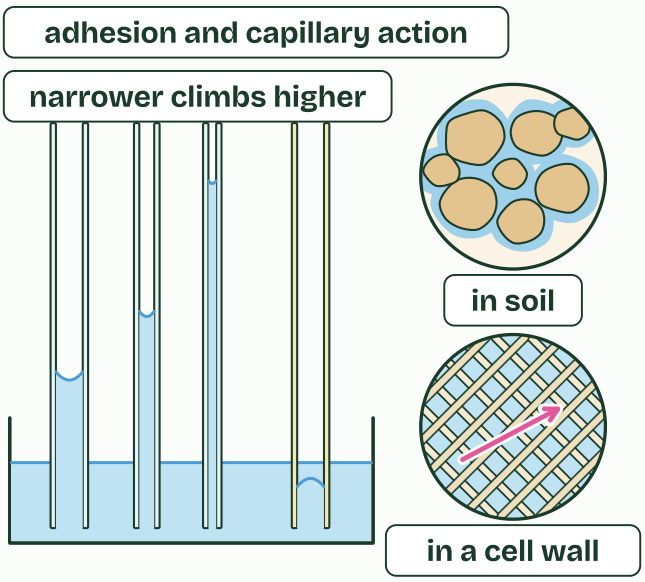
NOTES

1. Water does not only stick to itself. It is attracted to any surface that is polar or charged, and that attraction is _____.
2. So is _____, the stuff of plant cell walls and paper, and so are the charged particles of soil.
3. Water adheres to the walls and climbs them, and cohesion drags the water behind it along. That is _____, and the narrower the tube, the higher the water goes.
4. Water is attracted to the polar glass wall and forms bonds with it: _____. The water's edge curves up where it meets the glass.
5. _____ drags more water up behind the edge, and the column rises until its weight balances the pull.
6. The _____ the tube, the higher the water climbs.

Your own notes

ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 adhesion; 2 Cohesion; 3 narrower; 4 below; 5 soil, cellulose.



REMEMBER IT

Cohesion or adhesion?

C Copies	A Anything
C	A

SPOT THE MISTAKE

A student writes: "Capillary action lifts water to the top of a tree." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 03 in two or three sentences of your own.

04 The solvent a cell runs in

1.1.A

CUES

Predict: Fish take all their oxygen from water, and oxygen molecules (O2) are nonpolar. How does the oxygen get into the water?

What is meant by solution?

What is meant by solute?

What is meant by solvent?

What is meant by hydrophilic?

What is meant by hydrophobic?

What is meant by cytoplasm?

NOTES

1 A _____ is a _____ dissolved in a _____, and water dissolves more substances than almost any other liquid.

2 Substances that dissolve in water, ions and polar molecules, are _____, "water loving."

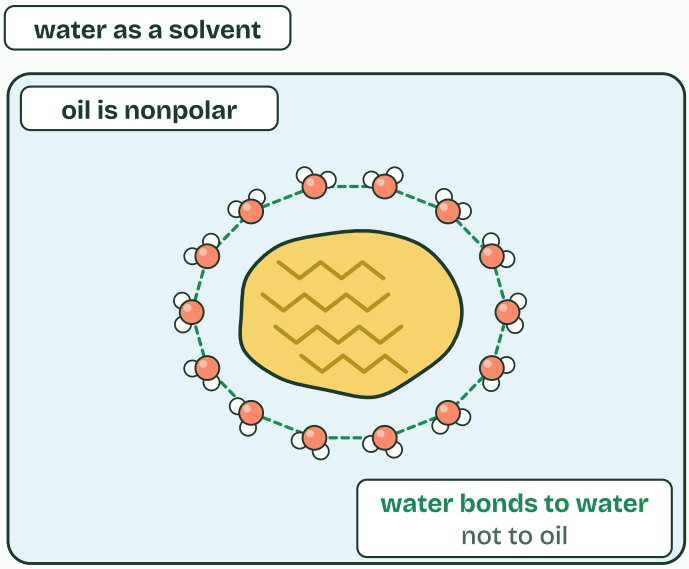
3 Nonpolar substances such as fats, oils and waxes are _____.

4 The _____ is a water solution in which enzymes and the molecules they work on move about and meet.

Your own notes

ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 ions; 2 oxygen, hydrogens; 3 shell; 4 hydrogen bonds; 5 nonpolar.



ANNOTATE THE FIGURE

Label the key parts and add a note on what it shows.

Dissolves in water	Does not dissolve
sodium chloride ions wrapped by water	**fat (a triglyceride)** hydrophobic
glucose OH groups bond with water	**leaf wax** hydrophobic
an amino acid charged and polar groups	**cholesterol** hydrophobic
urea so urine can carry it away	**cellulose** hydrophilic, but insoluble
vitamin C polar, lost in urine	**calcium phosphate** hydrophilic, but insoluble

SPOT THE MISTAKE

A student writes: “Water dissolves everything.” Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 04 in two or three sentences of your own.

05 Slow to warm, cooled by evaporating, lighter as ice

1.1.A

CUES

Predict: A coastal town and a town far inland are on the same line of latitude. Which has the bigger difference between summer and winter temperatures, and why?

What is meant by specific heat?

What is meant by heat of vaporization?

What is meant by evaporative cooling?

NOTES

1 **It is slow to heat up.** The _____ of a substance is the energy it takes to warm a gram of it by 1 °C. Water's is unusually high, because much of the energy you put in goes into breaking hydrogen bonds before the molecules can move any faster.

2 Water's _____ is high, so a little evaporating water carries off a lot of heat.

3 That is _____: how sweat cools you and how transpiration cools a leaf.

4 Liquid water is a crowd of molecules held by _____. Put energy in, and watch the thermometer.

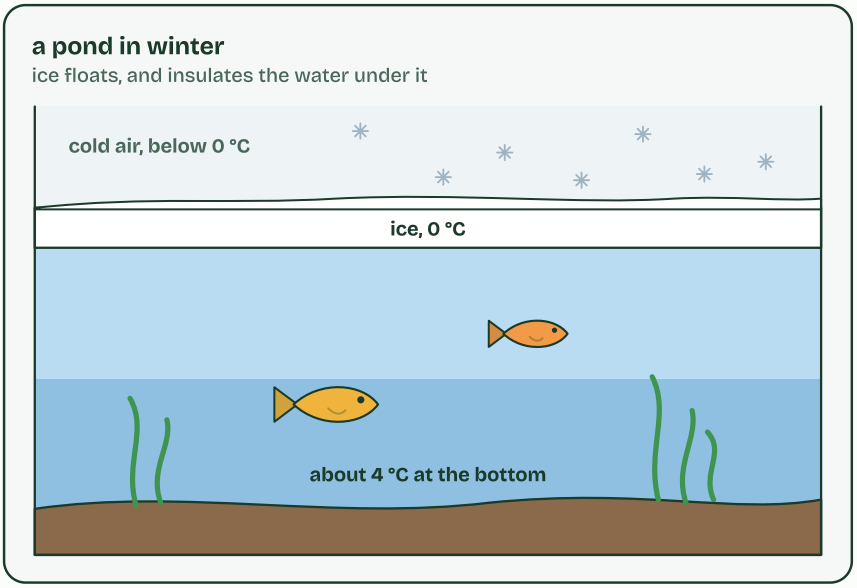
5 Much of the energy goes into _____ before the molecules can move faster, so the temperature rises slowly: a high _____.

6 On skin, the fastest molecules break free and _____, carrying energy away. The sweat left behind, and the skin, cool.

Your own notes

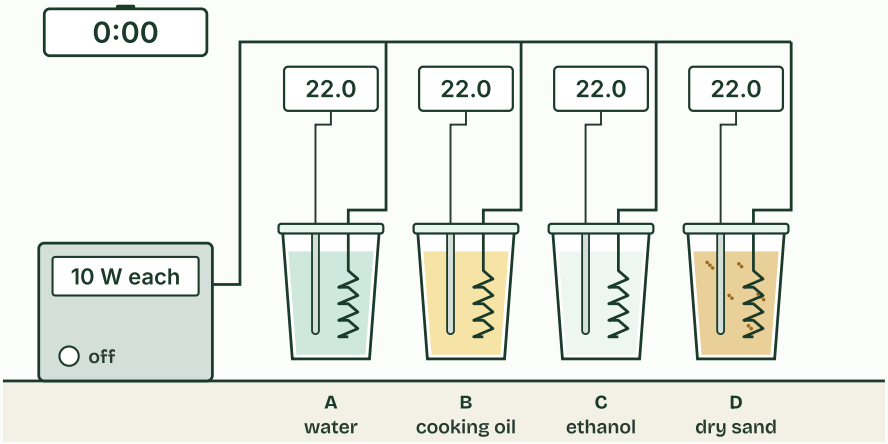
ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 hydrogen bonds; 2 breaking hydrogen bonds, specific heat; 3 evaporate; 4 farther apart; 5 floats.



ANNOTATE THE FIGURE

Label the key parts and add a note on what it shows.



SPOT THE MISTAKE

A student writes: “Sweat cools you because it is cold.” Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 05 in two or three sentences of your own.

06 Why life is built on carbon

1.2.A

CUES

Predict: Silicon sits just below carbon in the periodic table and can also make four bonds. Why is life built on carbon and not silicon?

What is meant by organic molecules?

What is meant by functional group?

NOTES

1 The molecules of life, carbohydrates, lipids, proteins and nucleic acids, are _____: carbon skeletons with other atoms attached.

2 What makes a molecule react is the small group of atoms attached to it, a _____.

3 Chains, branches and rings: _____.

4 A _____ is a pair of electrons shared by two atoms.

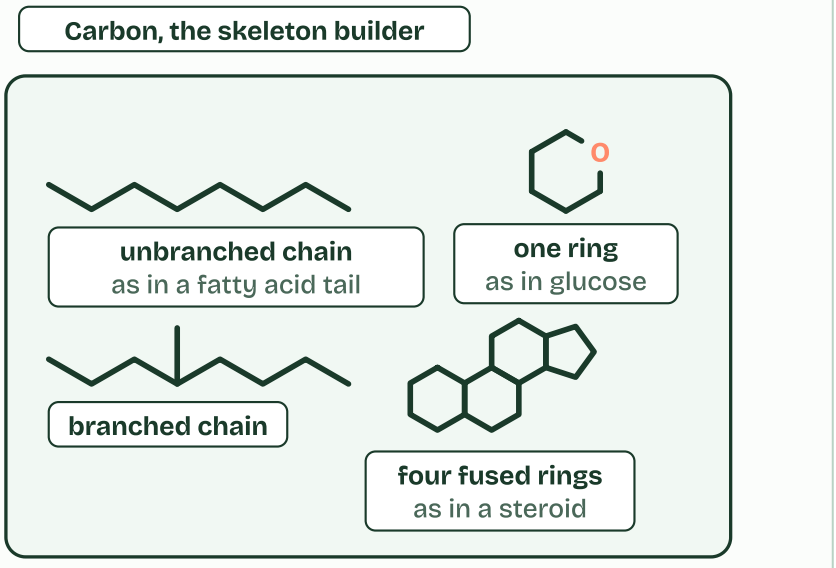
5 Carbon has four electrons to share, so it makes _____ bonds.

6 A _____ shares two pairs: it uses two of carbon's four.

Your own notes

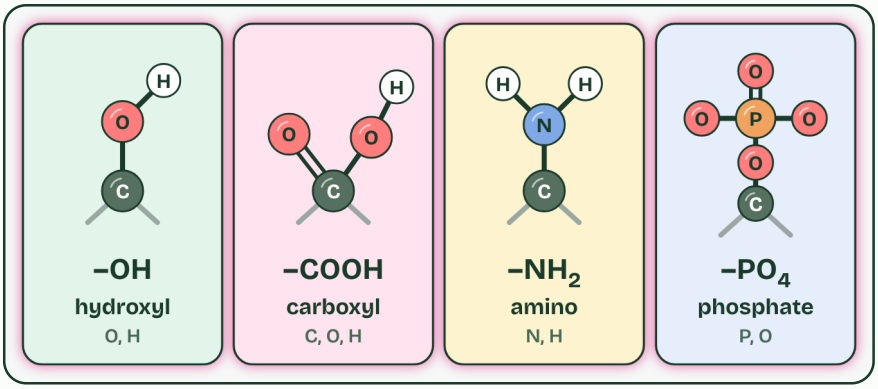
ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 covalent bond; 2 four; 3 double bond; 4 chains; 5 rings.



ANNOTATE THE FIGURE

Label each part and say what it does: hydroxyl, –OH., carboxyl, –COOH., amino, –NH2., phosphate, –PO4..



SPOT THE MISTAKE

A student writes: "Organic means natural or grown without pesticides." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 06 in two or three sentences of your own.

07 Where the atoms come from

1.2.A

CUES

Predict: A farmer adds a fertilizer rich in nitrogen to a crop. Which molecules in the plants is that nitrogen most needed for?

What is meant by autotroph?

What is meant by heterotroph?

NOTES

1 A plant, an _____, takes its carbon from carbon dioxide in the air and fixes it into sugars in photosynthesis (Unit 3).

2 An animal, a _____, gets all of these ready-made by eating plants or other animals.

Your own notes

ANNOTATE THE FIGURE

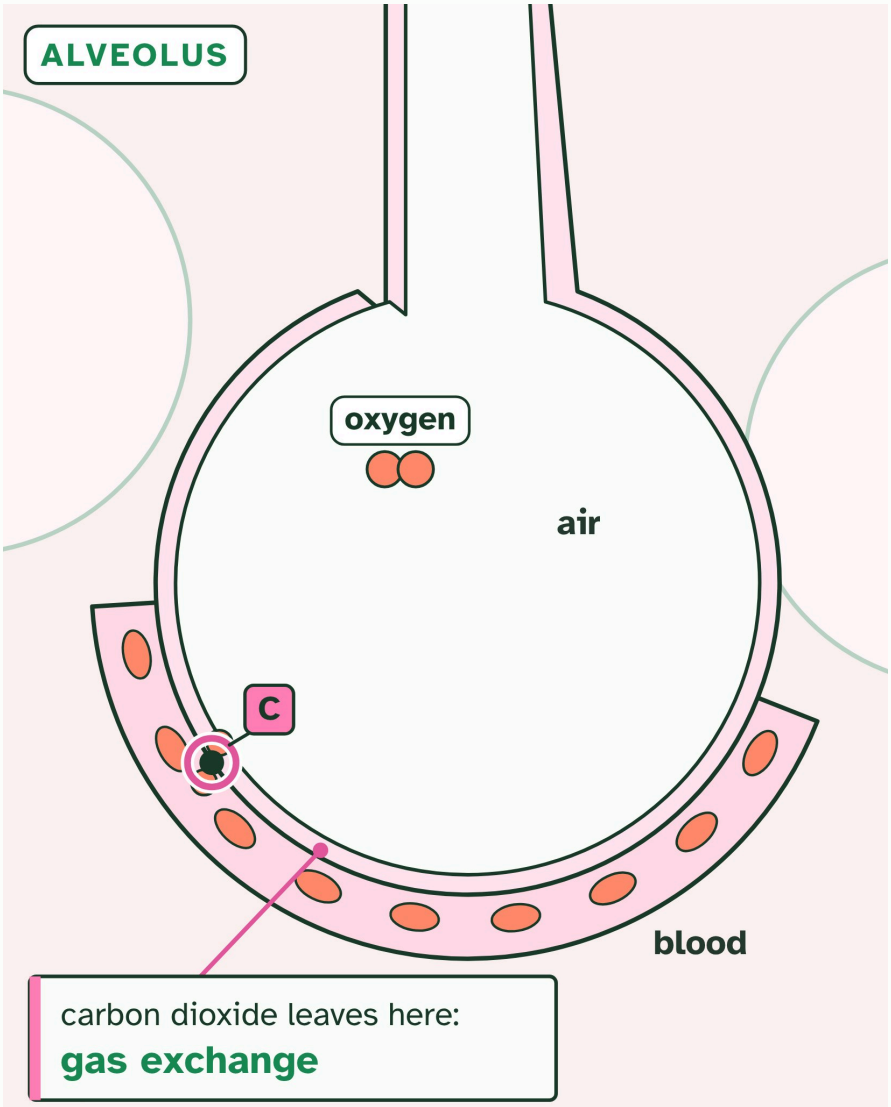
The figure shows it as Carbohydrates, Lipids, Proteins and Nucleic acids. Note what changes each time.



Carbohydrates: C, H and O only.

ANNOTATE THE FIGURE

Annotate this still from the animation (Watch it happen: one carbon atom, from air to plant to animal): what is happening, and why?



REMEMBER IT

The six elements of life

C	H	O	N	P	S
Cows	Have	Odd	Names	Personally	Speaking
C	H	O	N	P	S

SPOT THE MISTAKE

A student writes: “Plants get their mass from the soil.” Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 07 in two or three sentences of your own.

Check yourself

The check for this guide is online: a fresh paper of past-paper style questions from the exam bank on 1.1 and 1.2 each time, marked as you go, and saved to your Exam practice progress when you are signed in. Scan the code, or type the link.

biologybybradford.com/exam-maker/sit?program=ap&units=U1&ced=1.1,1.2&paper=quiz&marks=15&src=ep

How this was made. The course structure, the activities and the teaching choices come from my own classroom, my presentations and my years of teaching IB and AP Biology. I use Claude, an AI, to help write and build the interactive guides, lesson plans, slides and practice questions, and to draw the diagrams and code the interactives. I direct the work and review it against the IB and AP specifications before it goes live.