NAME _____ CLASS _____ DATE _____

IB BIOLOGY · B3.2

Transport

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 transpiration pulls water up from the roots: evaporation, capillary action in the leaf's cell walls, tension in the xylem and cohesion B3.2.7
- [ ] Explain how xylem vessels are built to carry water under tension B3.2.8
- [ ] Draw a plan diagram of a dicot stem from a micrograph and annotate what each tissue does B3.2.9
- [ ] Draw a plan diagram of a dicot root from a micrograph and identify its tissues B3.2.10
- [ ] Explain how pumping mineral ions into the root makes root pressure, and when a plant relies on it B3.2.17
- [ ] Explain how sieve tubes and companion cells load, carry and unload sap between sources and sinks B3.2.18
- [ ] Explain how capillaries are built for exchange: branched and narrow, thin-walled, with pores where exchange must be fast B3.2.1
- [ ] Tell an artery from a vein in a micrograph from the thickness of its wall against the width of its lumen B3.2.2
- [ ] Explain how the muscle and elastic fibres in their walls let arteries withstand and keep up a high pressure B3.2.3
- [ ] Find and count a pulse at the wrist or the neck, and compare counting by fingertip with digital methods B3.2.4
- [ ] Explain how valves and a flexible wall help veins return blood to the heart B3.2.5
- [ ] Explain how fatty deposits and clots block coronary arteries and what follows, and judge data on coronary heart disease B3.2.6
- [ ] Explain how tissue fluid forms from plasma by pressure filtration and drains back into the capillaries B3.2.11
- [ ] Compare plasma with tissue fluid, and explain the exchange between tissue fluid and the cells B3.2.12
- [ ] Explain how lymph vessels collect the leftover tissue fluid and return it to the blood B3.2.13
- [ ] Compare the single circulation of a bony fish with the double circulation of a mammal B3.2.14
- [ ] Relate each part of the mammalian heart to its job, identify it on a frontal diagram and trace the flow from veins to arteries B3.2.15
- [ ] Describe the cardiac cycle on the left side from the SA node, and read systolic and diastolic pressures from data B3.2.16

01 Water is pulled from the top

B3.2.7

CUES

Predict: An air bubble gets into one xylem vessel. What happens to the water in that vessel?

What is meant by transpiration?

NOTES

1 Leaves lose water vapour all day through the stomata they open to take in carbon dioxide. That loss is _____ (B3.1).

2 The water they lose is replaced from the soil, up through the roots and the stem: the _____.

3 Water _____ from the wet walls of the mesophyll cells into the air spaces, and the vapour diffuses out through the stomata.

What is meant by transpiration stream?

What is meant by evaporates?

What is meant by capillary action?

What is meant by tension?

What is meant by cohesion?

What is meant by adhesion?

4 The walls refill by _____: water creeps through the narrow spaces between the cellulose fibres of the walls, and is drawn out of the nearest xylem vessels to take the place of the water that evaporated.

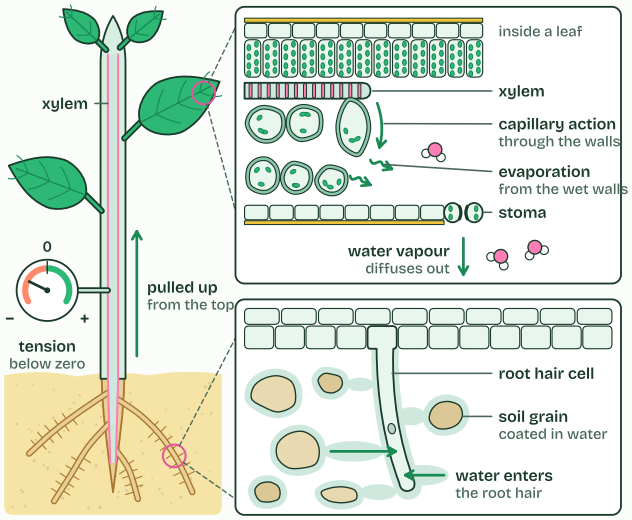
5 That leaves the water in the xylem being pulled. It is under _____: its pressure is below zero, a negative pressure potential.

6 The tension draws the whole column of water up the stem from the roots, the way a rope moves when you pull one end. _____ keeps the column whole: hydrogen bonds hold each water molecule to its neighbours (A1.1), so a pull at the top is passed all the way down. _____ to the vessel walls helps to hold the column in place.

Your own notes

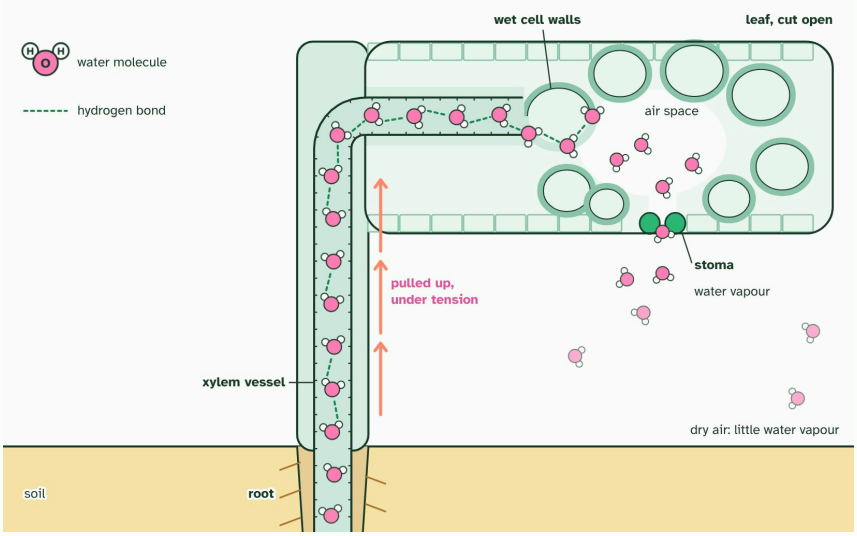
ANNOTATE THE FIGURE

Number the 4 steps on the figure and note what happens at each: 1 diffuses; 2 evaporates, capillary action; 3 tension; 4 root hairs.



ANNOTATE THE FIGURE

Annotate this still from the animation (Water in a xylem vessel): what is happening, and why?



REMEMBER IT

The pull, from the leaf down: Every Cool Tree Climbs

E Every	C Cool	T Tree	C Climbs
E	C	T	C

SPOT THE MISTAKE

A student writes: "The roots pump water up the xylem." 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 Xylem vessels are built for the pull

B3.2.8

CUES

Predict: A plant cannot make lignin. On a hot, windy day, what happens to its xylem vessels?

What is meant by xylem vessel?

What is meant by lumen?

What is meant by lignin?

What is meant by pits?

NOTES

1 A _____ is a long tube made from a column of cells joined end to end.

2 **No cell contents.** No cytoplasm, nucleus or vacuole is left in the _____, the space inside, so nothing blocks the water.

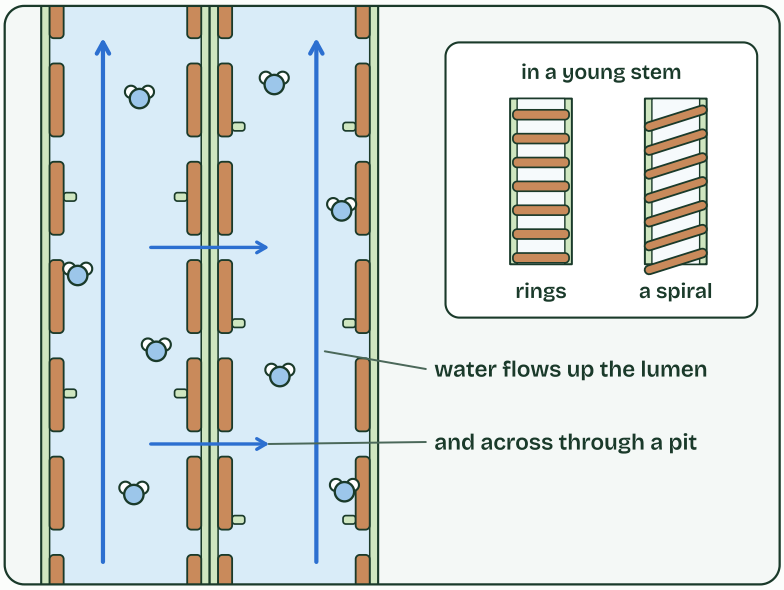
3 **Walls thickened with lignin.** _____ is hard and strong. The water inside is under tension, which pulls the walls inwards, and lignin stops them collapsing.

4 **Pits.** _____ are gaps in the lignin where only the thin primary wall (the original cellulose wall) is left. Water passes through them sideways, into and out of the vessel, and round a vessel that is blocked.

Your own notes

ANNOTATE THE FIGURE

Number the 4 steps on the figure and note what happens at each: 1 living cells; 2 lignin; 3 end walls; 4 lumen, pits.



SPOT THE MISTAKE

A student writes: “Xylem vessels are living cells.” 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 A stem in section

B3.2.9

CUES

Predict: A cut stem stands for an hour in water with a red dye in it, then is cut across. Where is the red?

What is meant by dicotyledonous plant?

What is meant by epidermis?

What is meant by cortex?

What is meant by vascular bundles?

What is meant by cambium?

What is meant by fibres?

What is meant by pith?

What is meant by plan diagram?

NOTES

1 In a _____ (a dicot, such as a bean or a sunflower), the tissues are always in the same places.

2 A _____ shows this layout without a single cell: one sharp line round each tissue, in the right place and proportion, labelled with ruled lines, with a title and a scale.

3 _____: one layer of cells, covered in a waxy cuticle. It protects the stem, and the cuticle cuts water loss.

4 _____: a band of packing cells, a few cells deep. It stores food, and its outer cells help to hold the stem up.

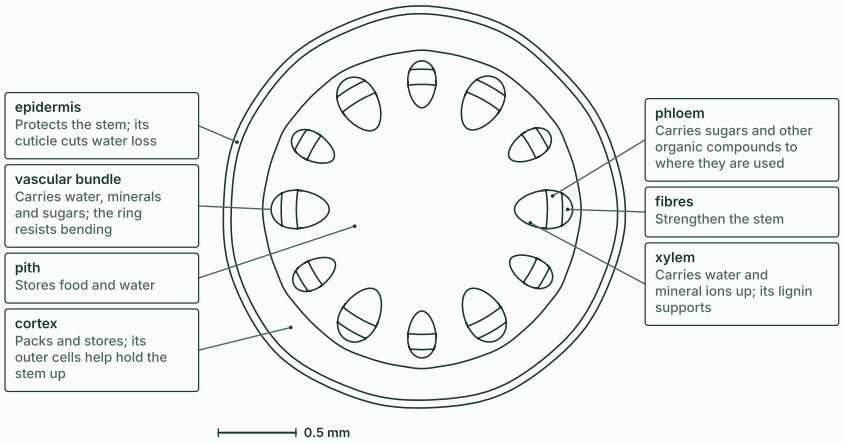
5 _____: separate bundles in a ring near the edge. Each has _____ on its outer side, carrying sugars and other organic compounds to where they are needed, and _____ on its inner side, carrying water and mineral ions up the stem; the xylem's lignin also helps support the stem. A thin layer of dividing cells, the _____, lies between the two. In many stems, a sunflower's among them, each bundle also has a cap of _____ on the outer side of its phloem: cells with thick, lignified walls that strengthen the stem. Their walls take the same stain as the xylem's, pink in the micrograph below, so do not take them for xylem.

6 _____: the centre, packing cells that store food.

Your own notes

ANNOTATE THE FIGURE

Number the 2 steps on the figure and note what happens at each.



Plan diagram: transverse section of a young dicotyledonous stem

REMEMBER IT

A stem from the outside in: Eat Cake, Pass Xmas Pudding

E	C	P	X	P
Eat	Cake	Pass	Xmas	Pudding
E	C	P	X	P

SPOT THE MISTAKE

What do students often get wrong about distribution of tissues in a transverse section of the stem of a dicotyledonous plant? Write 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 A root in section

B3.2.10

CUES

Predict: A seedling is moved to a new pot, and most of its root hairs are torn off. What happens over the next day?

What is meant by root hair?

NOTES

1 _____: the outer layer. Many of its cells grow a _____, a long, thin outgrowth that reaches out between the soil particles. Together the hairs give the root a huge surface for taking up water and mineral ions.

2 _____: a wide band of rounded packing cells. Water crosses it on its way in, and its cells store starch.

3 _____: all in one core in the middle. The xylem forms a star, often with four arms, and the phloem sits in the gaps between the arms. The IB calls it a vascular bundle; in a root it is one central column, not a ring of bundles.

4 A young root. Just behind the tip, its epidermis is covered in _____.

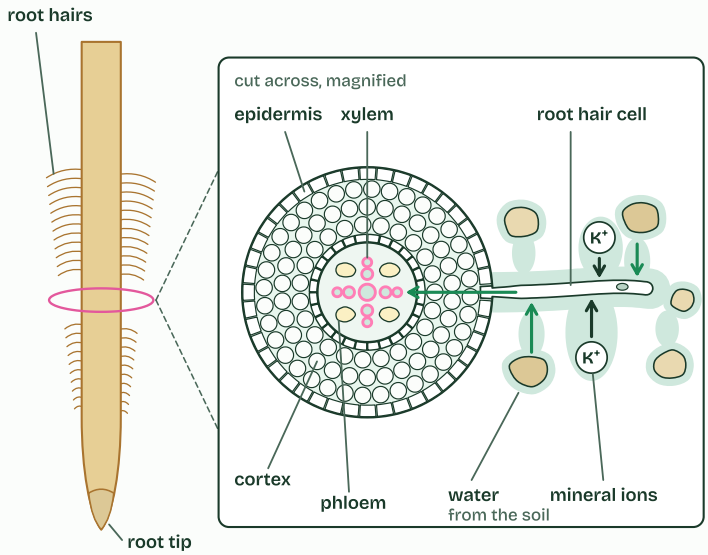
5 One root hair cell, close up: _____ and _____ from the soil go in through its long, thin hair.

6 From the root hair, water crosses the _____ to the xylem in the centre.

Your own notes

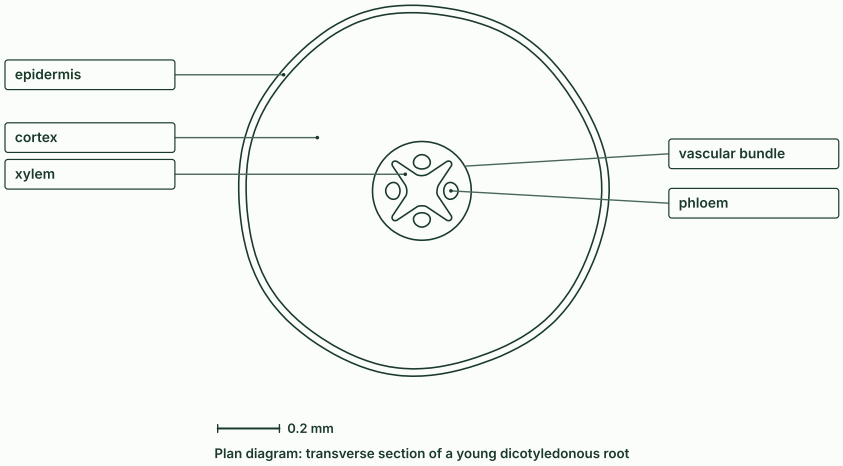
ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each: 1 root hairs; 2 water, mineral ions; 3 cortex.



ANNOTATE THE FIGURE

Number the 2 steps on the figure and note what happens at each.



Plan diagram: transverse section of a young dicotyledonous root

SPOT THE MISTAKE

What do students often get wrong about distribution of tissues in a transverse section of the root of a dicotyledonous plant? Write 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 When the leaves cannot pull: root pressure

B3.2.17 HL

CUES

Predict: A grapevine is cut back in early spring, before its leaves open. What happens at the cut stump?

What is meant by active transport?

What is meant by osmosis?

What is meant by root pressure?

What is meant by guttation?

NOTES

1 Root cells take up mineral ions from the soil by _____, spending ATP, and pump them on into the xylem.

2 The solute concentration in the xylem rises, so water follows by _____, from the root cells into the xylem.

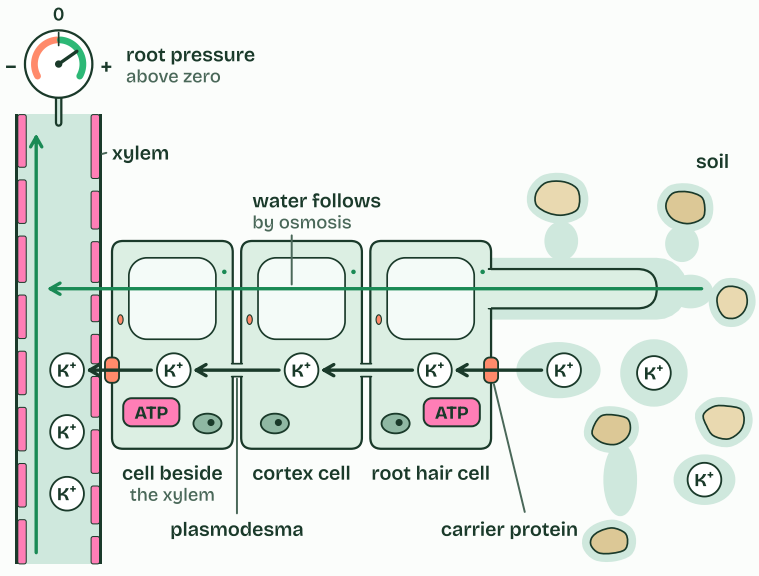
3 With no transpiration to draw it away, the water builds up there, and the pressure in the xylem rises above zero: a positive pressure potential. That is _____, and it pushes the column of water up.

4 They are not dew: root pressure has pushed water up the plant and out through pores at the vein endings. This is _____.

Your own notes

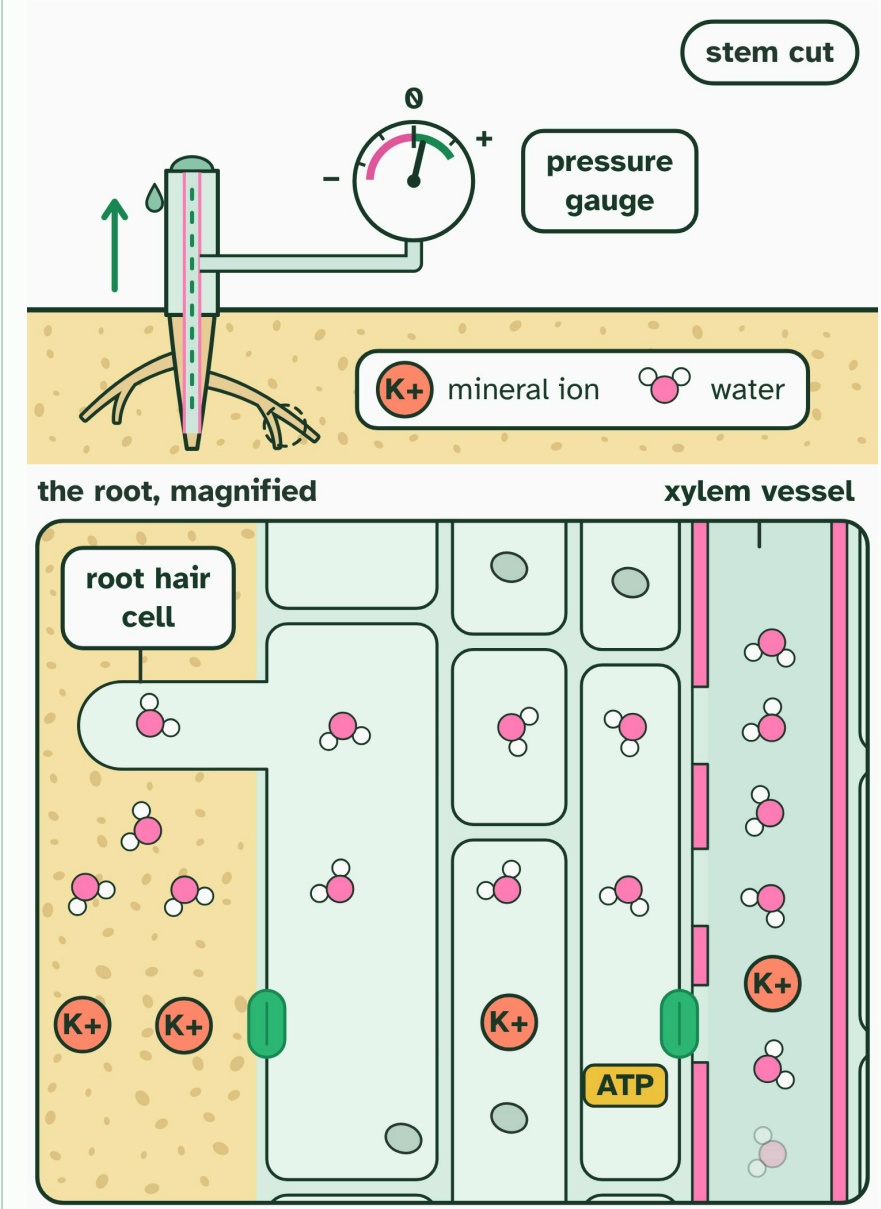
ANNOTATE THE FIGURE

Number the 4 steps on the figure and note what happens at each: 1 mineral ions; 2 into the xylem; 3 water follows by osmosis; 4 above zero.



ANNOTATE THE FIGURE

Annotate this still from the animation (Root pressure): what is happening, and why?



SPOT THE MISTAKE

A student writes: "Water is actively transported into the xylem." 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 Sieve tubes and companion cells

B3.2.18 HL

CUES

Predict: Why do companion cells have so many mitochondria?

What is meant by translocation?

What is meant by sap?

What is meant by source?

What is meant by sink?

What is meant by sieve tube elements?

What is meant by companion cell?

What is meant by sieve plates?

What is meant by plasmodesmata?

NOTES

1 The phloem carries food: the sugar a leaf makes, and other carbon compounds, to every part of the plant that needs them. This is _____.

2 Phloem _____ is a solution, mostly of sucrose, with amino acids and other substances.

3 A _____ is where sugars are made or released: a leaf in the light, or a storage organ such as a potato tuber when it sprouts in spring.

4 A _____ is where they are used or stored: roots, growing tips, young leaves, fruits and seeds.

5 Sap travels in sieve tubes, columns of living cells called _____, joined end to end.

6 Beside each one is a _____, which does the work the element no longer can.

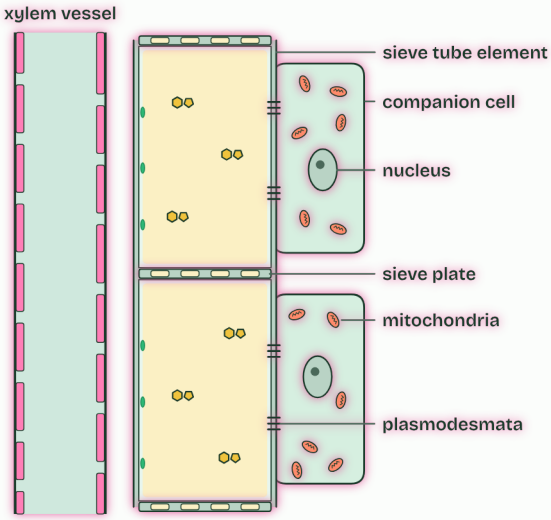
7 _____: the end walls between the elements are perforated with pores, so sap flows from one element to the next.

8 _____: each element keeps only a thin layer of cytoplasm and a few organelles, and it has no nucleus, so little blocks the flow.

Your own notes

ANNOTATE THE FIGURE

Label each part and say what it does: xylem vessel, companion cell, nucleus, mitochondria, sieve tube element, sieve plate, plasmodesmata.



SUMMARY

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

07 Loading, flow and unloading

B3.2.18 HL

CUES

Predict: The fruit on a branch is picked off. What happens to the flow in the sieve tube that fed it?

What is meant by co-transporter?

What is meant by mass flow?

NOTES

1 The hydrogen ions flow back in through a _____ protein, which brings a sucrose molecule in with each one, from the cell walls around it, where the cells of the leaf release it, against the sucrose's own concentration gradient.

2 **Flow.** With high pressure at the source and low pressure at the sink, the sap flows from one to the other by _____: the whole solution moves together, as water does along a hose.

3 At the source, companion cells _____ sucrose into the sieve tube, spending ATP.

4 Water follows the sucrose in from the xylem by _____.

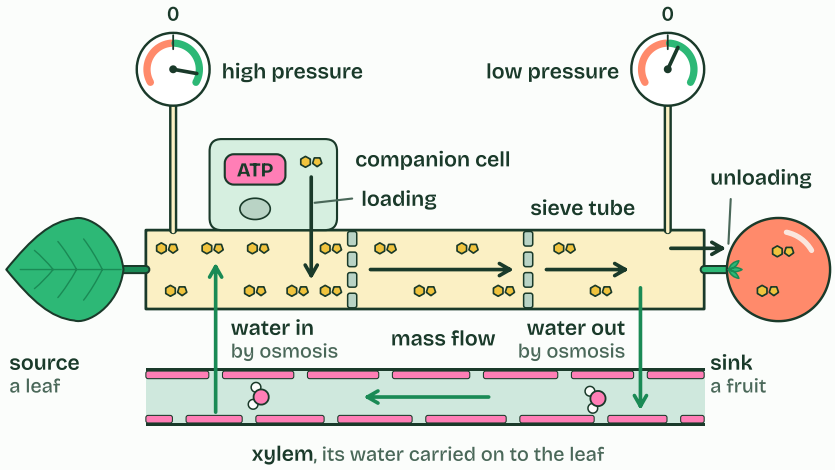
5 The water raises the _____ at the source end of the sieve tube.

6 At the sink, sucrose is _____ and water leaves by osmosis, so the pressure there stays low.

Your own notes

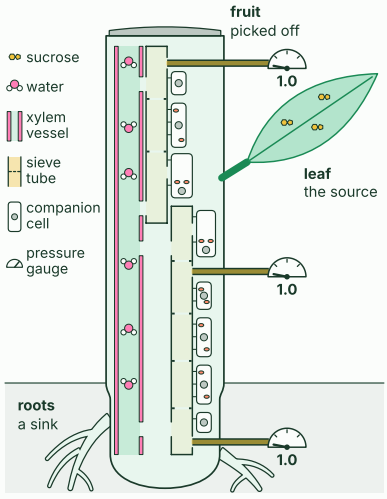
ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 load; 2 osmosis; 3 pressure; 4 unloaded; 5 flows.



ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each.



REMEMBER IT

Source to sink: Lazy Otters Push Fish Upstream

L	O	P	F	U
Lazy	Otters	Push	Fish	Upstream
L	O	P	F	U

SPOT THE MISTAKE

A student writes: “Phloem only flows downwards.” 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.

08 How we know: aphids and labels

B3.2.18 HL

CUES

Predict: Use the arrival times in the figure. How fast did the label travel down the stem?

What is meant by stylet?

NOTES

1 An aphid pushes its _____, a mouthpart as fine as a hair, into a stem until the tip is inside a single sieve tube.

2 One leaf is given carbon dioxide made with _____, and builds it into sugars.

3 Aphids feed on the stem below it, each with its _____ in one sieve tube.

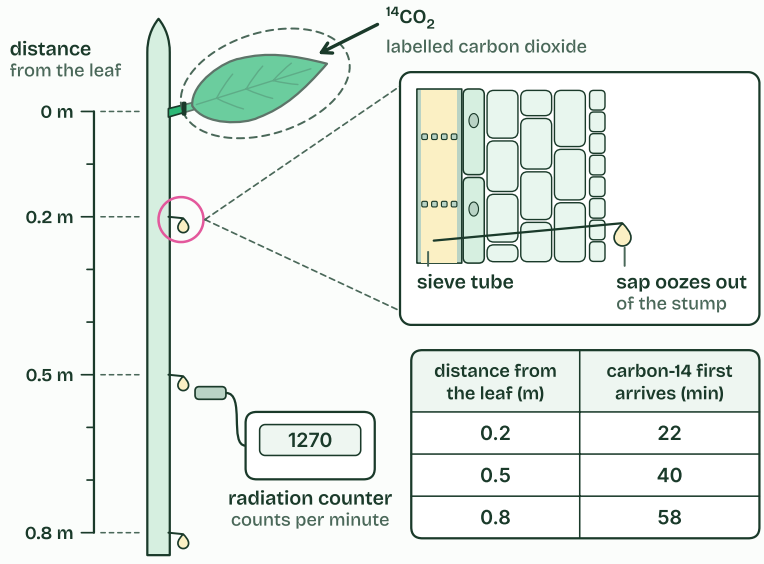
4 The aphids are cut away, and sap oozes from each stylet _____.

5 A counter checks each stump's sap. The time the label _____, counted from when the leaf was given it, goes in the table.

Your own notes

ANNOTATE THE FIGURE

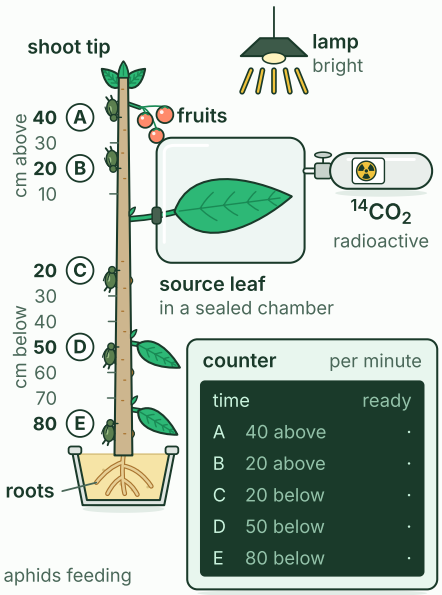
Number the 4 steps on the figure and note what happens at each: 1 carbon-14; 2 stylet; 3 stump; 4 first arrives.



distance from the leaf (m)	carbon-14 first arrives (min)
0.2	22
0.5	40
0.8	58

ANNOTATE THE FIGURE

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



A to E: aphids feeding

Stylet	Distance from the leaf / cm	Arrival time / min
A	40 above	----------
B	20 above	----------
C	20 below	----------
D	50 below	----------
E	80 below	----------

SUMMARY

Sum up section 08 in two or three sentences of your own.

09 Inside the heart

B3.2.15 HL

CUES

Predict: Both ventricles pump the same volume of blood at each beat. Which one has the thicker wall, and why?

What is meant by atrium?

What is meant by ventricle?

What is meant by septum?

What is meant by atrioventricular valve?

What is meant by semilunar valve?

What is meant by coronary arteries?

NOTES

1 An _____ on top receives blood from the veins; a _____ below pumps it out into an artery.

2 Down the middle runs the _____, a wall of muscle.

3 Between each atrium and its ventricle is an _____: the tricuspid on the right and the bicuspid, or mitral, on the left.

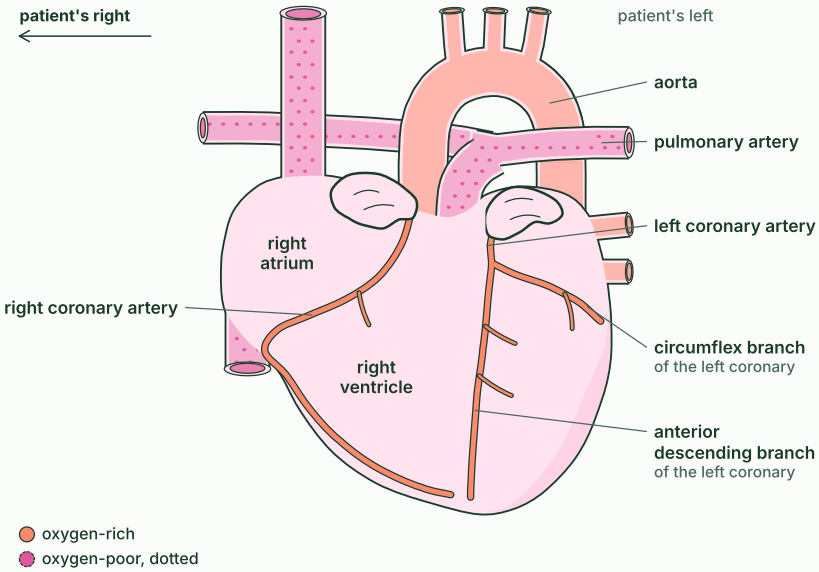
4 Where each ventricle opens into its artery is a _____, three pocket-shaped cusps: the pulmonary valve and the aortic valve.

5 The _____ branch from the aorta just above the aortic valve and run over the heart's surface in its grooves (chapter 15 is what happens when one blocks).

Your own notes

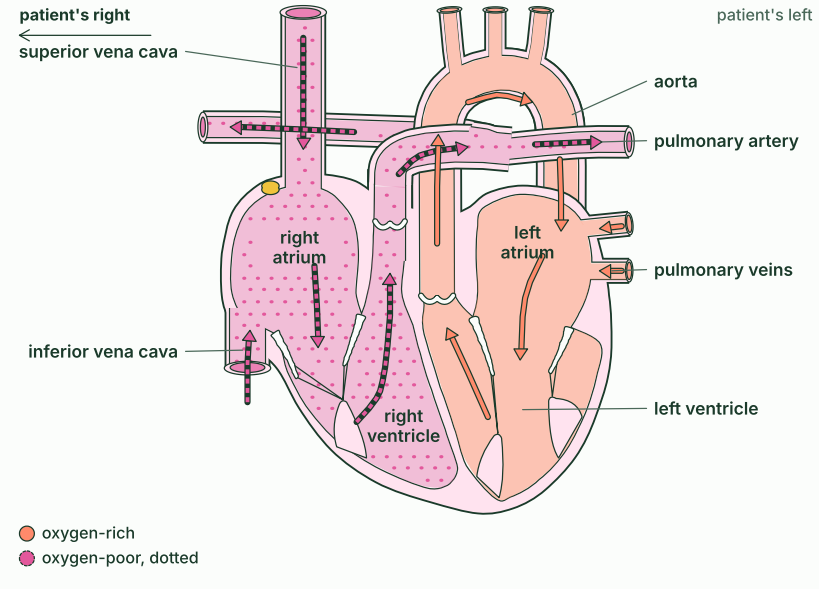
ANNOTATE THE FIGURE

Number the 6 steps on the figure and note what happens at each: 1 septum; 2 atrium, ventricle; 3 atrioventricular, semilunar; 4 venae cavae, aorta; 5 muscle; 6 coronary arteries.



ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each.



REMEMBER IT

The valves in the order the blood meets them: Tiny Penguins Bake Apples

T Tiny	P Penguins	B Bake	A Apples
T	P	B	A

SPOT THE MISTAKE

A student writes: “The left of the diagram is the left side of the heart.” Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 09 in two or three sentences of your own.

10 Capillaries: where the swap happens

B3.2.1

CUES

Predict: Blood leaves the heart fast. How fast is it moving by the time it reaches the capillaries, and why does that matter?

What is meant by capillaries?

What is meant by endothelium?

What is meant by fenestrations?

NOTES

1 Blood does its work only where it can swap things with the cells around it, and that happens in the _____.

2 **Branched and narrow.** An artery divides into arterioles, and each arteriole into a bed of _____ threaded between the cells, each only 5 to 10 micrometres across. No cell is far from one, and together their walls give a huge surface area for exchange.

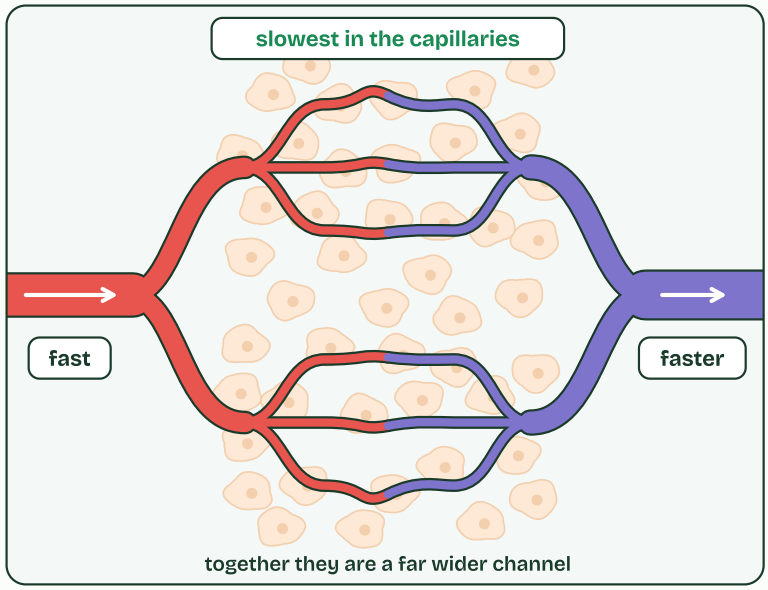
3 **Thin walls.** The wall is a single layer of flattened _____ on a thin basement membrane, so substances diffuse well under a micrometre between the blood and the tissue. Red blood cells, about 7 to 8 micrometres across, squeeze through in single file, pressed close to the wall.

4 **Pores where exchange must be fastest.** Some capillaries have _____, tiny pores through their endothelial cells: in the villi of the small intestine, where digested food is absorbed, in the kidney, where the blood is filtered, and in glands that release hormones into the blood. Most capillaries, such as those in muscle and the lungs, have none.

Your own notes

ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 artery, bed of capillaries; 2 red blood cells; 3 one cell thick; 4 fenestrations; 5 slowest in the capillaries.



SPOT THE MISTAKE

A student writes: "Capillary walls have muscle in them." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 10 in two or three sentences of your own.

11 Arteries: built to hold the pressure

B3.2.3

CUES

Predict: Between heartbeats the ventricles relax and the aortic valve is shut, yet the blood in your arteries keeps flowing on. What keeps it moving?

What is meant by arteries?

What is meant by left ventricle?

What is meant by aortic valve?

What is meant by elastic fibres?

What is meant by elastic recoil?

NOTES

1 _____ carry blood away from the heart: to the lungs in the pulmonary artery, and to the rest of the body in the aorta and its branches.

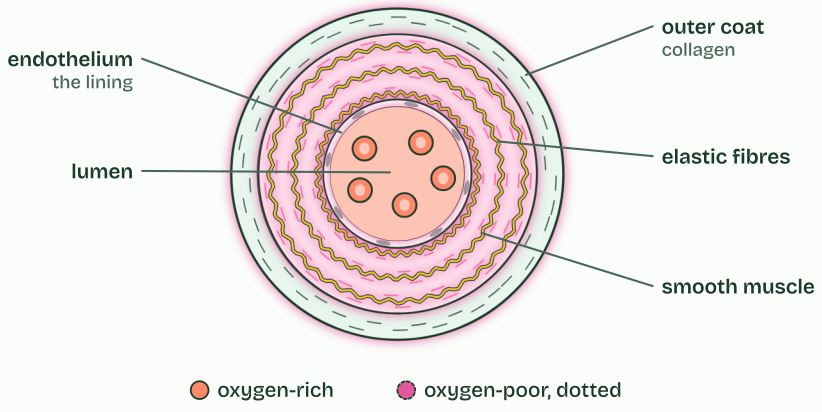
2 The blood comes in surges, one with each beat, at a high pressure: in the aorta of a resting young adult it rises to about 120 mmHg as the _____, the heart's main pumping chamber, contracts and pushes blood out through the _____.

3 **A thick middle layer of smooth muscle and elastic fibres.** The muscle makes the wall thick and strong, so it can withstand the high pressure without bursting, and it can narrow the artery a little. The elastic fibres stretch with each surge and then recoil. This _____ pushes the blood on between beats, so it maintains the pressure and evens out the surges.

Your own notes

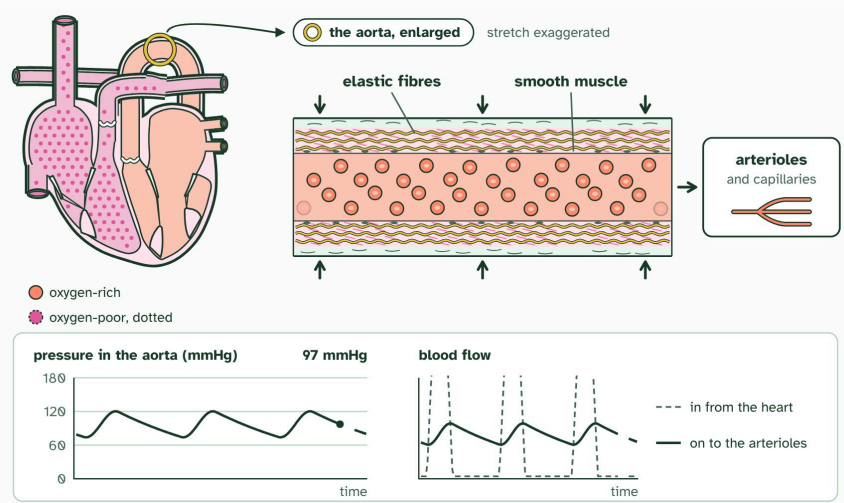
ANNOTATE THE FIGURE

Label each part and say what it does: outer coat, smooth muscle, elastic fibres, endothelium, lumen.



ANNOTATE THE FIGURE

Annotate this still from the animation (Surge in, steady out): what is happening, and why?



SPOT THE MISTAKE

A student writes: "Arteries carry oxygen-rich blood." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 11 in two or three sentences of your own.

12 Veins: the way home

B3.2.5

CUES

Predict: You are walking. Each time your calf muscle contracts, what happens to the blood in a vein that runs through it?

What is meant by veins?

What is meant by pocket valves?

What is meant by backflow?

NOTES

1 _____ carry blood back to the heart.

2 **Pocket valves.** Two or three flaps, each shaped like a pocket. Blood moving towards the heart presses them flat against the wall; blood falling back fills the pockets, which meet in the middle and shut the vein. So any squeeze moves blood one way only, and the valves stop _____ between squeezes.

3 A vein cut along its length, with two _____. Blood moving towards the heart presses their flaps flat against the wall.

4 Blood falling back fills the pockets: the flaps meet in the middle and the valves _____. No backflow.

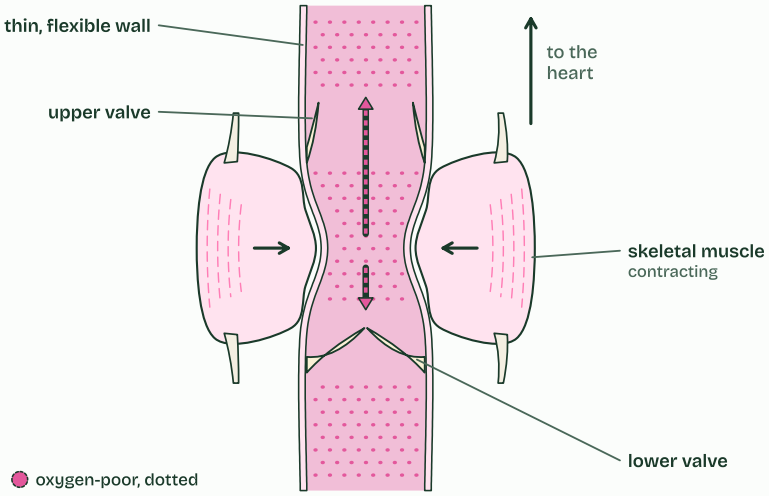
5 The skeletal _____ on either side contract, and the thin, flexible wall is squeezed in.

6 The squeeze pushes blood both ways, but the lower valve shuts and the upper one opens: it can go only _____.

Your own notes

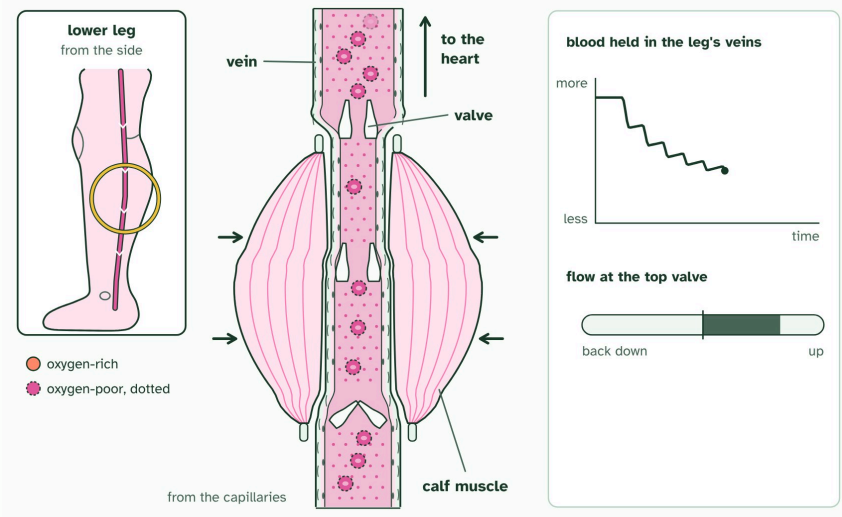
ANNOTATE THE FIGURE

Number the 4 steps on the figure and note what happens at each: 1 pocket valves; 2 shut; 3 muscles; 4 towards the heart.



ANNOTATE THE FIGURE

Annotate this still from the animation (The muscle pump and the valves): what is happening, and why?



SPOT THE MISTAKE

A student writes: “All veins carry oxygen-poor blood.” Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 12 in two or three sentences of your own.

13 Which is which? Reading a vessel in section

B3.2.2

CUES

Predict: Two vessels in a micrograph are about the same width overall. Which single measurement best tells you which one is the artery?

What is meant by micrograph?

NOTES

1 The IB asks you to tell them apart in a _____.

2 _____: a thick wall for the size of its lumen, most of it the muscle and elastic middle layer, often with wavy lines of elastic tissue. The lumen is usually small and round, its lining slightly scalloped.

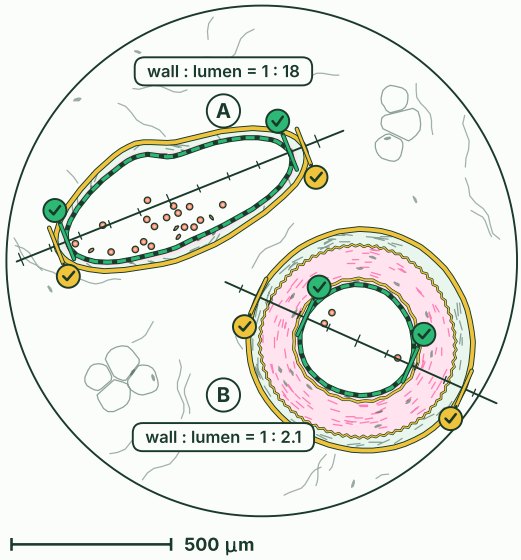
3 _____: a thin wall round a wide lumen that is often flattened or crumpled, because the thin wall collapses when the tissue is cut. In a section along its length you may catch a valve.

4 _____: a lumen only just wide enough for one red blood cell, and a wall of one flattened cell.

Your own notes

ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each.



SPOT THE MISTAKE

A student writes: “The bigger vessel is the artery.” Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 13 in two or three sentences of your own.

14 Feeling the pulse

B3.2.4

CUES

Predict: You count your pulse for 15 seconds and get 18 beats. A friend counts theirs for a whole minute and gets 68. Whose estimate of the resting rate is likely to be more precise, and why?

What is meant by pulse?

What is meant by pulse oximeter?

NOTES

1 Where an artery runs close to the skin over a bone, you can feel each wave as a tap: that is your _____.

2 The _____ pulse is at the wrist, on the thumb side, just below the base of the thumb.

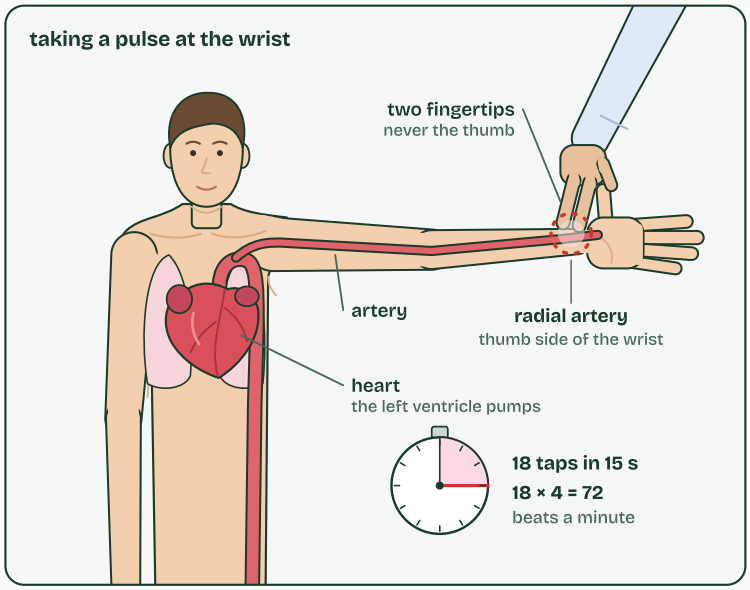
3 The _____ pulse is in the neck, in the groove beside the windpipe, under the angle of the jaw.

4 A _____ on a fingertip, a smartwatch or a chest strap count beats continuously and average them, but they need a moment to settle, and a watch on a cold or small wrist can misread.

Your own notes

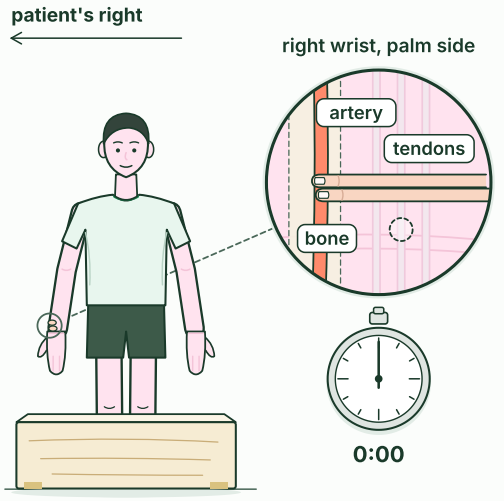
ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each: 1 wave of stretch; 2 radial artery; 3 beats a minute.



ANNOTATE THE FIGURE

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



volunteer B — ready
count for — 15 s
beats — ·
× 4 = — ·

Time after stepping / min	Beats in 15 s	Pulse rate / beats min^{-1}
before 1		
before 2		
before 3		
0		
0.5		
1.0		
1.5		

SPOT THE MISTAKE

A student writes: "The pulse is the blood rushing past." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 14 in two or three sentences of your own.

15 When a coronary artery blocks

B3.2.6

CUES

Predict: A man's coronary artery is narrowed by about two thirds. At rest he feels nothing, but climbing the stairs gives him chest pain. Why?

What is meant by coronary arteries?

What is meant by atherosclerosis?

What is meant by atheroma?

What is meant by thrombus?

What is meant by angina?

What is meant by myocardial infarction?

NOTES

1 The _____ feed the heart's own muscle.

2 Over years, fatty deposits can build up in the wall of an artery, under its lining. This is _____.

3 The deposit, an _____ or plaque, grows, hardens as calcium is laid down in it, and bulges into the lumen, narrowing it.

4 The plaque roughens and damages the lining, and if it cracks, a blood clot, a _____, forms on it.

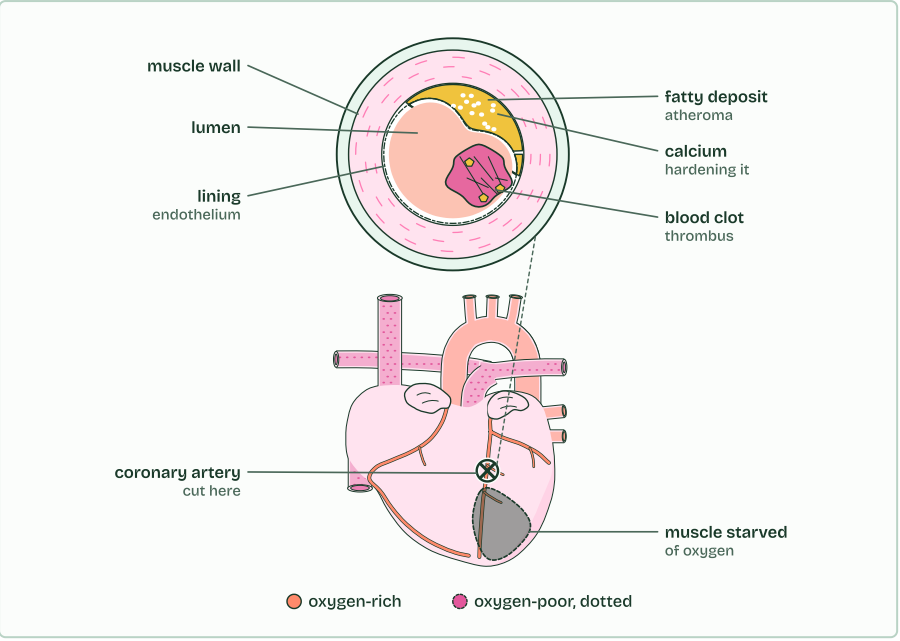
5 A clot can block the artery completely: the coronary artery is _____.

6 **Consequences.** Muscle beyond a narrowed artery gets too little oxygen when it works hard (ischaemia), felt as _____. When an artery is occluded, the muscle it feeds gets no oxygen at all and starts to die within about half an hour: a heart attack, or _____. The dead muscle cannot contract, so the heart pumps less well, and a large infarct can be fatal. All of this is coronary heart disease (CHD).

Your own notes

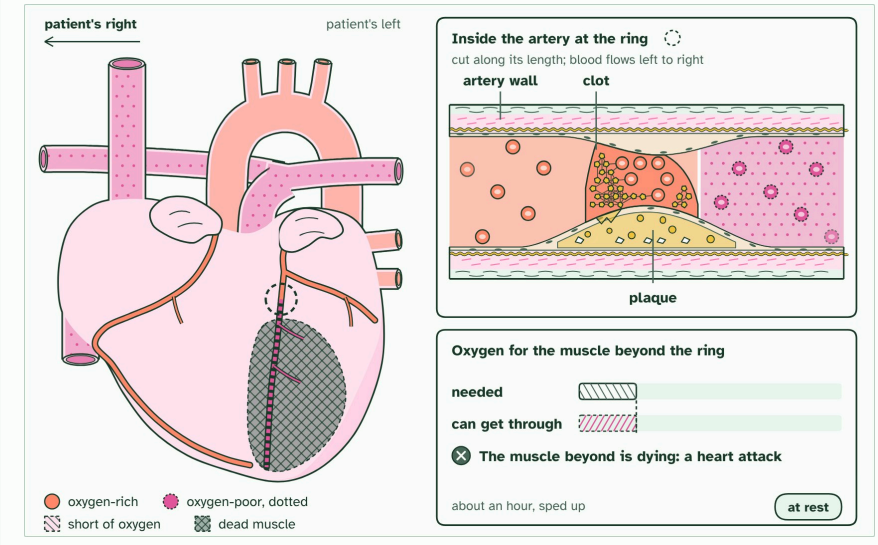
ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 coronary artery; 2 fatty deposit; 3 atheroma; 4 blood clot; 5 heart attack.



ANNOTATE THE FIGURE

Annotate this still from the animation (A coronary artery, over the years): what is happening, and why?



SPOT THE MISTAKE

A student writes: “A heart attack is when the heart stops.” Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 15 in two or three sentences of your own.

16 Fat and heart disease: what the data can show

B3.2.6

CUES

Predict: Across 30 seaside towns, ice-cream sales and cases of sunburn rise and fall together through the year. The correlation coefficient is 0.9. What can you conclude?

What is meant by epidemiology?

What is meant by incidence?

What is meant by correlated?

What is meant by correlation coefficient?

NOTES

1 Much of the evidence comes from _____: counting how often a disease occurs in different groups and looking for what goes with it.

2 The count is often given as the _____, new cases per 100 000 people a year, so groups of different sizes can be compared.

3 If the points rise together, the two are _____.

4 The strength of a correlation is measured by the _____, r.

5 _____ can count against a hypothesis: if a factor caused a disease, the disease should be commoner where the factor is commoner.

6 _____: a mechanism that makes sense (atheroma, chapter 15); a dose-response, more of the factor and more disease; the same link found in many studies of different kinds; and trials that change the factor and watch what happens.

Your own notes

ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each: 1 Invented data; 2 correlation coefficient; 3 third factor.



SPOT THE MISTAKE

A student writes: "Correlation means causation." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 16 in two or three sentences of your own.

17 One loop or two

B3.2.14 HL

CUES

Predict: On one complete lap round the body, how many times does the blood pass through the heart in a bony fish, and in a mammal?

What is meant by single circulation?

What is meant by double circulation?

NOTES

1 _____ has a heart with one atrium and one ventricle.

2 From the gills the blood flows straight on to the body's organs and back to the heart. This is a _____: heart, gills, body, heart.

3 _____ has a _____.

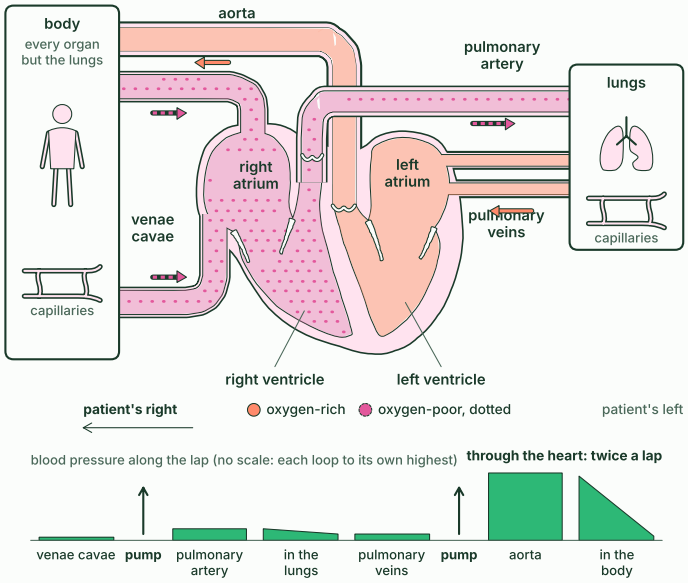
4 A bony fish: a _____. The two-chambered heart pumps blood to the gills; it flows straight on to the body and back. Once through the heart a lap, and the body gets blood that has lost pressure in the gill capillaries.

5 A mammal: a _____. The right side pumps blood to the lungs and back (pulmonary), the left side to the body and back (systemic). Twice through the heart a lap: the body gets freshly pumped, high-pressure blood.

Your own notes

ANNOTATE THE FIGURE

Number the 2 steps on the figure and note what happens at each: 1 single circulation; 2 double circulation.



SPOT THE MISTAKE

A student writes: "A fish's heart has four chambers." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 17 in two or three sentences of your own.

18 A muscle that sets its own pace

B3.2.15 HL

CUES

Predict: A heart is taken out of an animal and kept in a warm salt solution with oxygen bubbled through it. It goes on beating for some time. What does this show?

What is meant by cardiac muscle?

What is meant by intercalated discs?

What is meant by myogenic?

What is meant by sinoatrial (SA) node?

NOTES

1 The heart's wall is _____, found nowhere else in the body.

2 Each beat starts at the _____, the pacemaker, a patch of special muscle cells in the wall of the right atrium where the superior vena cava enters.

3 **Branched cells, joined end to end.** The cells branch and meet at _____, where gap junctions let the electrical signal pass straight from one cell to the next. So a signal spreads through the wall as a wave and the wall contracts as one.

4 The _____, the pacemaker: a patch of special muscle in the wall of the right atrium. Each beat starts when it fires.

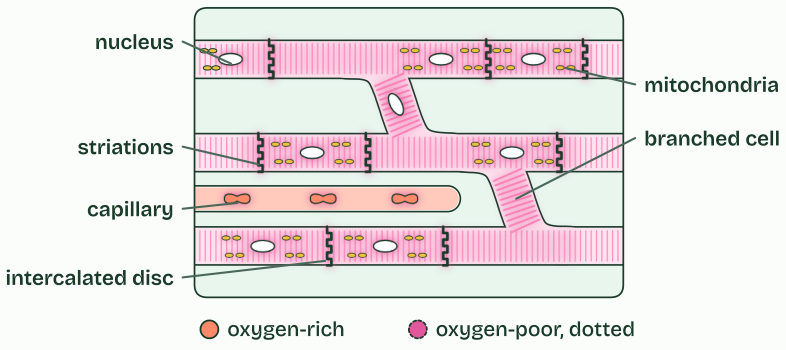
5 The signal spreads through the walls of _____, and they contract together.

6 A _____ between the atria and the ventricles blocks it. Its only way through is the _____.

Your own notes

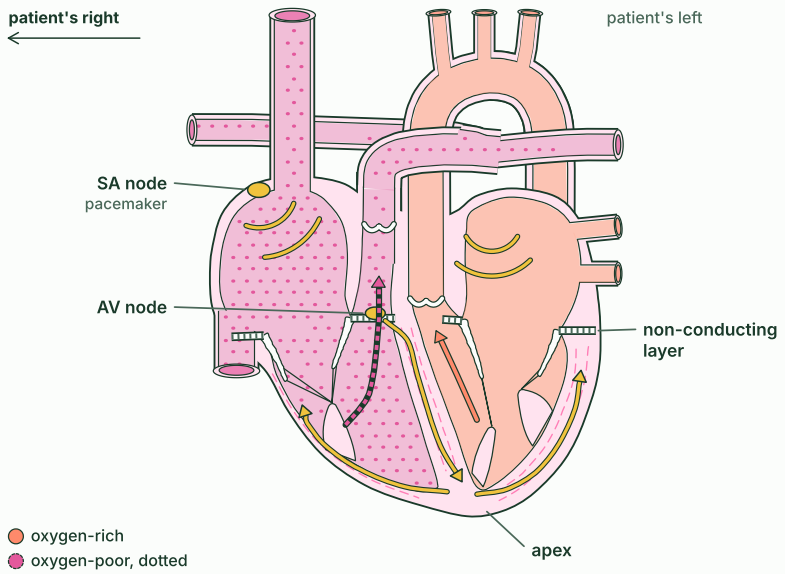
ANNOTATE THE FIGURE

Label each part and say what it does: capillary, striations, branched cell, intercalated disc, nucleus, mitochondria.



ANNOTATE THE FIGURE

Number the 6 steps on the figure and note what happens at each: 1 SA node; 2 both atria; 3 non-conducting layer, AV node; 4 0.1 s; 5 down the septum; 6 apex.



SPOT THE MISTAKE

A student writes: "The brain makes the heart beat." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 18 in two or three sentences of your own.

19 The cardiac cycle

B3.2.16 HL

CUES

Predict: The left ventricle starts to contract. A moment later the aortic valve opens. What opens it?

What is meant by cardiac cycle?

What is meant by systole?

What is meant by diastole?

NOTES

1 One heartbeat is one _____.

2 A chamber contracting is in _____; relaxing, it is in _____.

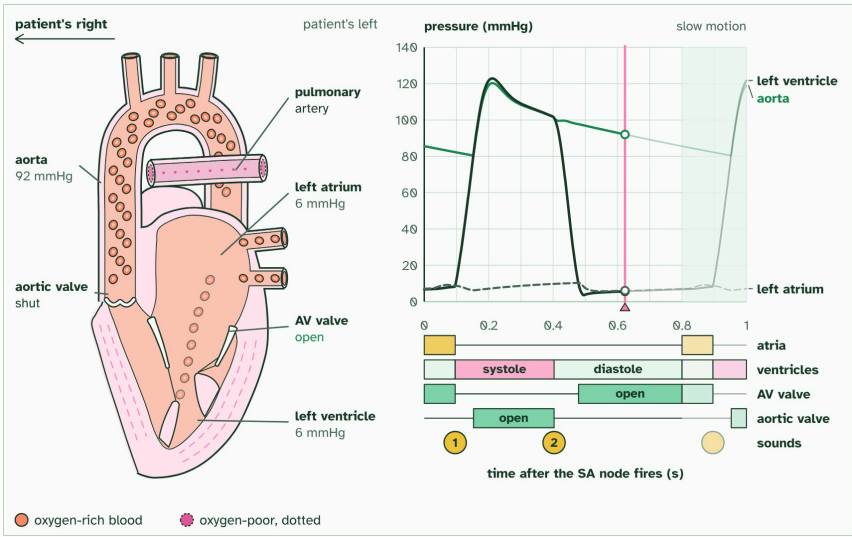
3 So one rule runs every valve:

_____ Follow the left side through one beat:

Your own notes

ANNOTATE THE FIGURE

Annotate this still from the animation (One heartbeat, left side): what is happening, and why?



REMEMBER IT

One beat on the left side: All Valves Swing Open Shut Fill

A	V	S	O	S	F
All	Valves	Swing	Open	Shut	Fill
A	V	S	O	S	F

SPOT THE MISTAKE

A student writes: “The ventricles fill only when the atria contract.” Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 19 in two or three sentences of your own.

20 Reading blood pressure

B3.2.16 HL

CUES

Predict: Read the figure's first trace, the person at rest. What is their blood pressure?

What is meant by systolic pressure?

What is meant by diastolic pressure?

NOTES

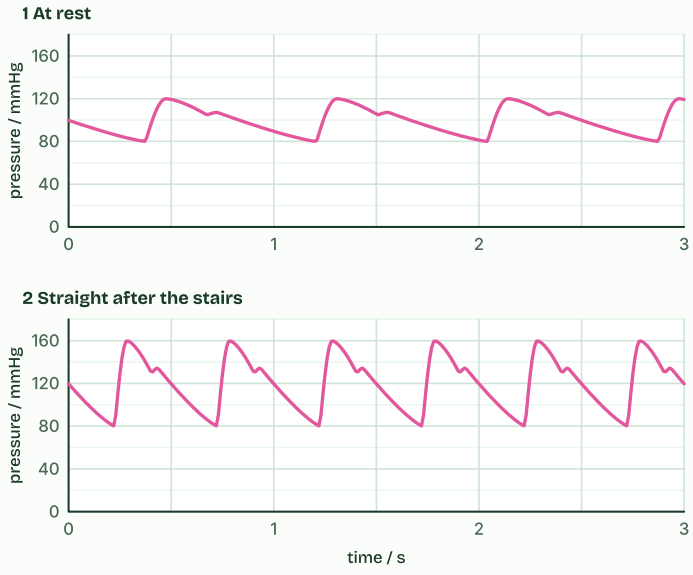
1 The pressure in your arteries rises and falls with every beat. It peaks as the left ventricle pushes blood into the aorta: the _____.

2 It sinks to its lowest just before the next beat, held up by the elastic recoil of the artery walls (chapter 11): the _____.

Your own notes

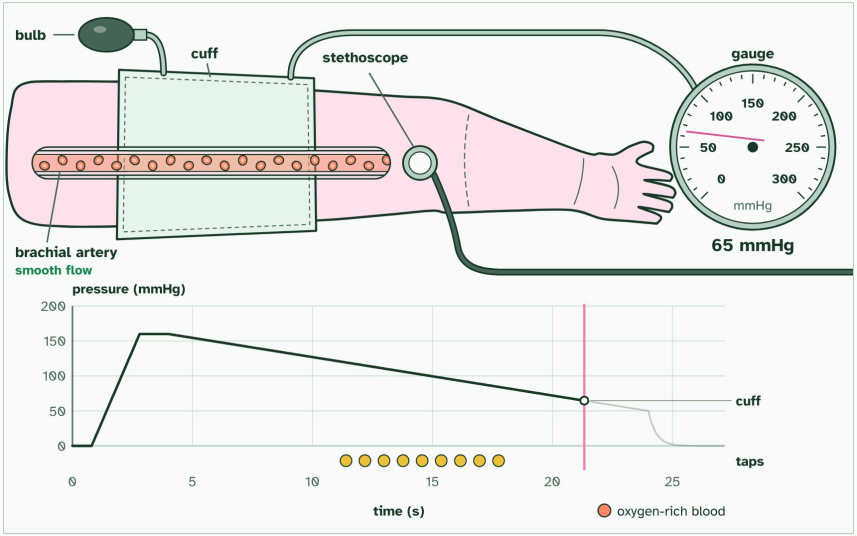
ANNOTATE THE FIGURE

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



ANNOTATE THE FIGURE

Annotate this still from the animation (Taking a blood pressure): what is happening, and why?



SPOT THE MISTAKE

A student writes: "The top number is the pulse rate." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 20 in two or three sentences of your own.

21 Tissue fluid: out and back

B3.2.11 HL B3.2.12 HL

CUES

Predict: At the arteriolar end of a capillary, the start of it, fluid is forced out into the tissue. What does that fluid carry?

What is meant by tissue fluid?

What is meant by pressure filtration?

NOTES

1 Between them and the cells is a thin layer of liquid, _____, and everything the blood brings and takes away passes through it.

2 **Out.** Blood arrives at the arteriolar end of a capillary at a fairly high pressure, about 35 mmHg, from the arterioles. That pressure forces plasma out through the wall: _____.

3 A capillary bed: blood arrives from the _____ at a high pressure, about 35 mmHg, and runs on through a capillary whose wall is one cell thick. Predict: what will the pressure force out?

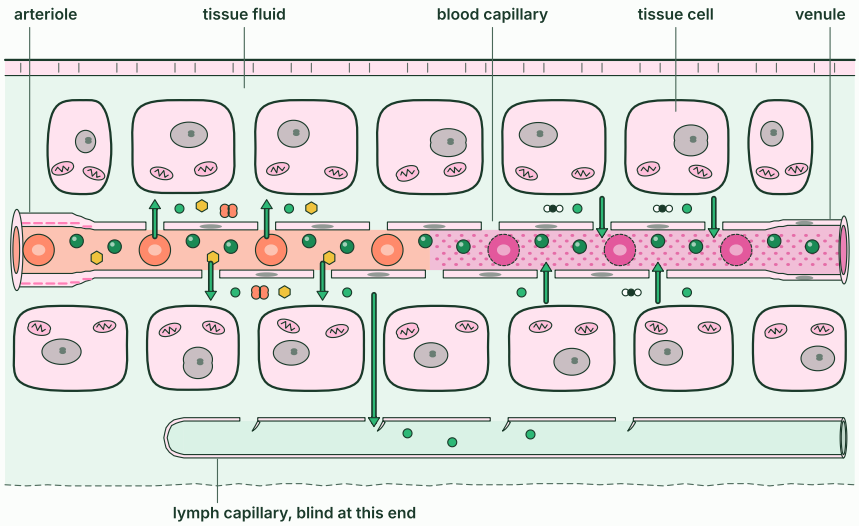
4 **Pressure filtration.** At the arteriolar end the pressure forces plasma out through the gaps in the wall: water with small molecules such as glucose, oxygen and ions. Proteins and blood cells are too big and stay in. The fluid that leaves is _____.

5 By the _____ the pressure has fallen, and most of the tissue fluid drains back into the capillary, bringing carbon dioxide and other wastes. The rest drains into a _____.

Your own notes

ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each: 1 arteriole; 2 Pressure filtration., tissue fluid; 3 venular end, lymph capillary.



SPOT THE MISTAKE

A student writes: "Tissue fluid is blood." Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 21 in two or three sentences of your own.

22 Lymph: the drain

B3.2.13 HL

CUES

Predict: Lymph vessels have valves, but there is no heart pumping lymph. What keeps it moving?

What is meant by lymphatic system?

What is meant by lymph?

What is meant by oedema?

NOTES

1 The rest, a few litres a day across the whole body, would build up in the tissues if nothing took it away. It is taken up by the _____, and once it is inside a lymph vessel it is called _____.

2 The lymph capillaries join into larger lymph vessels, which have _____, as veins do.

3 If drainage fails, fluid collects in the tissues and they swell: _____.

4 Not all the tissue fluid goes back into the capillary. The rest drains into a _____: a blind-ended tube with a very thin wall, whose cells overlap leaving _____ that let fluid in but not out. Inside it the fluid is called _____.

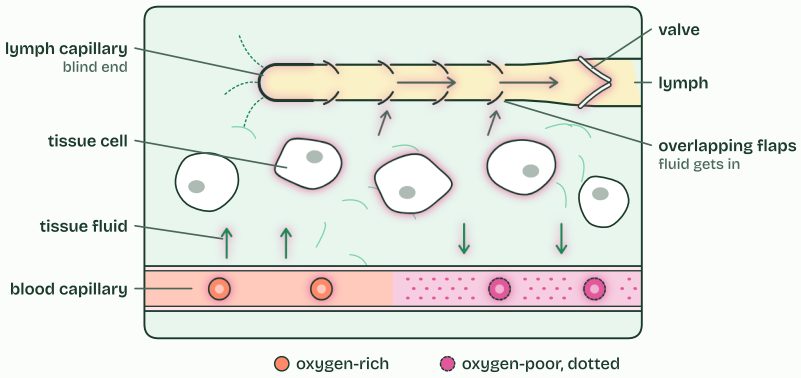
5 Lymph capillaries join into larger lymph vessels with _____, which let lymph go one way only; the vessels empty into a _____, so the fluid is returned to the blood.

6 If the lymph is _____, the surplus fluid stays in the tissue, the spaces between the cells widen and the tissue swells: oedema.

Your own notes

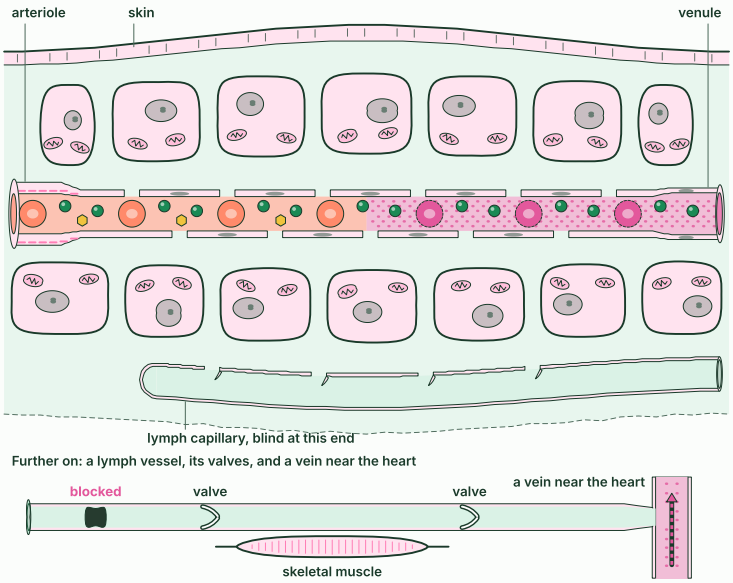
ANNOTATE THE FIGURE

Label each part and say what it does: tissue cell, blood capillary, tissue fluid, lymph, lymph capillary, overlapping flaps, valve.



ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each: 1 lymph capillary, gaps, lymph; 2 valves, vein near the heart; 3 blocked.



SPOT THE MISTAKE

A student writes: “Lymph vessels carry blood.” Spot the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 22 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 B3.2 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?topics=B3.2&level=HL&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.