NAME _____ CLASS _____ DATE _____

IB BIOLOGY · C3.2

Defence against disease

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

- [ ] Name the four kinds of pathogen and say how careful observation led to the control of infectious disease C3.2.1
- [ ] Explain how skin and mucous membranes act as a physical and chemical barrier C3.2.2
- [ ] Explain how platelets and the clotting cascade seal a cut C3.2.3
- [ ] Compare the innate and the adaptive immune systems C3.2.4
- [ ] Describe how phagocytes move to an infection, engulf pathogens and digest them C3.2.5
- [ ] Explain how lymphocytes cooperate to make antibodies C3.2.6
- [ ] Explain why antigens are recognition molecules that trigger antibody production C3.2.7
- [ ] Explain how helper T cells activate B cells C3.2.8
- [ ] Explain how activated B cells divide to form clones of antibody-secreting plasma cells C3.2.9
- [ ] Explain how memory cells give immunity C3.2.10
- [ ] Describe how HIV is passed on in body fluids C3.2.11
- [ ] Explain how HIV destroys lymphocytes and leads to AIDS C3.2.12
- [ ] Explain why antibiotics block bacteria but not eukaryotic cells, and why they fail against viruses C3.2.13
- [ ] Explain how bacteria evolve resistance to several antibiotics C3.2.14
- [ ] Give examples of zoonoses and the ways they reach humans C3.2.15
- [ ] Explain how vaccines produce immunity without causing the disease C3.2.16
- [ ] Explain how herd immunity prevents epidemics C3.2.17
- [ ] Evaluate data from the COVID-19 pandemic, calculating percentage change and percentage difference C3.2.18

01 Four kinds of pathogen C3.2.1

CUES

Predict: One group of microbes is often listed beside bacteria and fungi, yet no member is known to cause disease in humans. Which?

What is meant by pathogen?

NOTES

1 A _____ is one that does, and when it passes from person to person the illness is an _____.

2 _____ are not cells. They copy themselves only inside a host cell.

3 _____ are prokaryotes. Toxins they make, or damage they do, cause the disease.

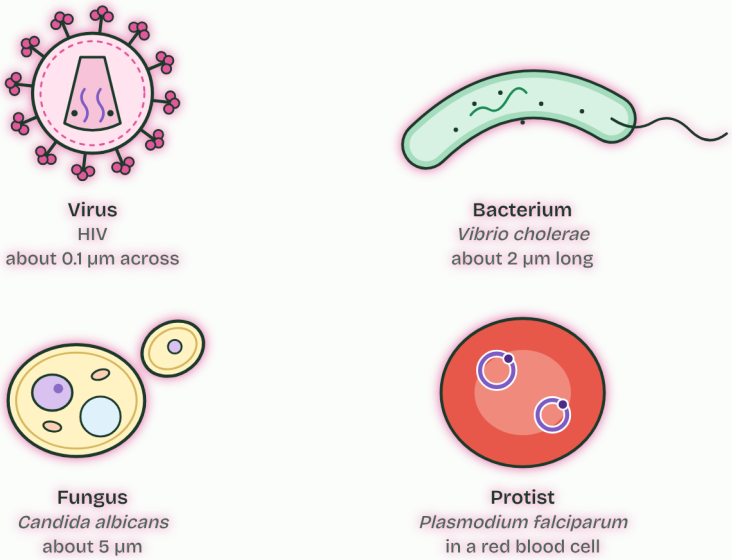
4 _____ are eukaryotes. Some are parasites that live in or on a host.

What is meant by infectious disease?

Your own notes

ANNOTATE THE FIGURE

Label each part and say what it does: virus: HIV, bacterium: Vibrio cholerae, fungus: Candida albicans, protist: Plasmodium falciparum.



SUMMARY

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

02 The first line is a wall

C3.2.2

CUES

Predict: A person with a severe burn is at high risk of infection. The best reason is:

What is meant by physical barrier?

What is meant by chemical barrier?

What is meant by mucous membrane?

NOTES

1 The skin is a _____: its outer layer is dead cells packed with the protein keratin, tough and waterproof, and sheets of it lap over each other so there are no gaps.

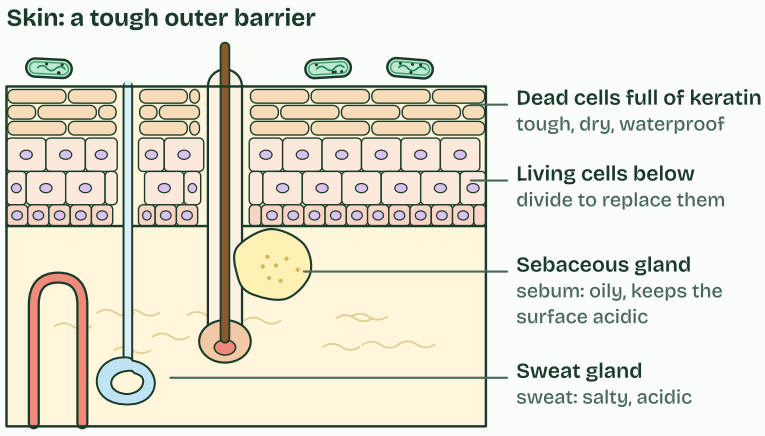
2 It is also a _____: sweat and oils make the surface acidic and sweat carries lysozyme, an enzyme that splits bacterial cell walls.

3 A thin, moist _____ lines the surface instead.

Your own notes

ANNOTATE THE FIGURE

The figure shows it as Skin and Airway lining. Note what changes each time.



SPOT THE MISTAKE

What do students often get wrong about skin and mucous membranes as a primary defence? Write 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 cut seals itself

C3.2.3

CUES

Predict: Fibrinogen is dissolved in your blood plasma all the time. Why does your blood not clot inside healthy vessels?

What is meant by platelets?

What is meant by clotting factors?

What is meant by cascade?

What is meant by thrombin?

What is meant by fibrin?

NOTES

1 Blood contains cell fragments called _____.

2 At a cut they stick to the damaged vessel and release _____.

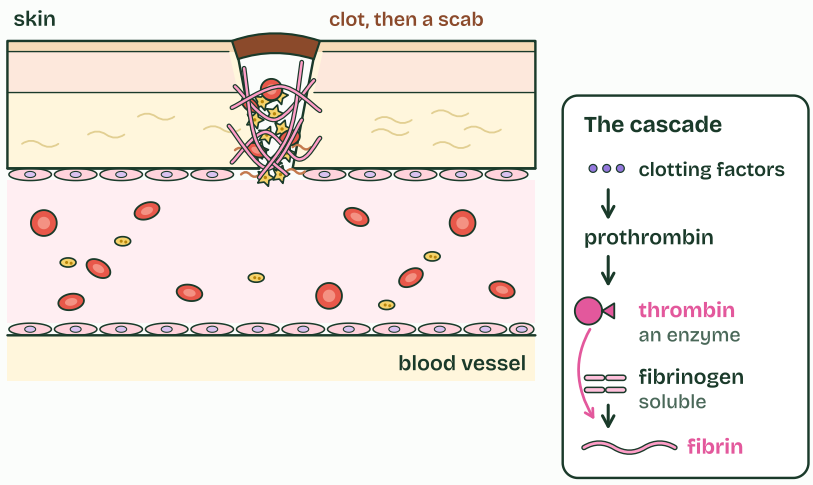
3 These start a _____.

4 The enzyme _____ (made from inactive prothrombin) converts soluble fibrinogen, which is in the plasma all the time, into insoluble _____ fibres.

Your own notes

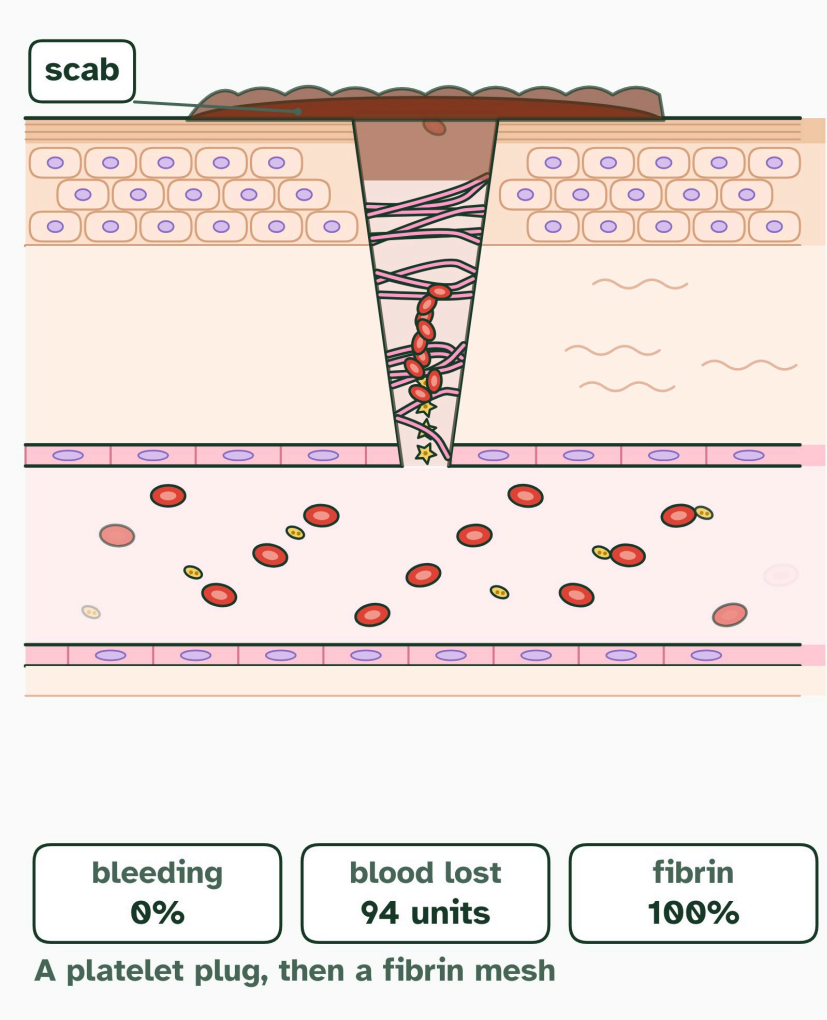
ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 cut; 2 Platelets; 3 clotting factors; 4 cascade; 5 mesh.



ANNOTATE THE FIGURE

Annotate this still from the animation (A cut and the clot): what is happening, and why?



REMEMBER IT

The clotting order

P	F	C	M
Penguins	Frequently	Catch	Minnows
P	F	C	M

SUMMARY

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

04 Two systems, one fixed and one that learns

C3.2.4

CUES

Predict: A child catches chickenpox and recovers. Meeting the virus again years later, she does not get ill. Which system explains that?

What is meant by innate immune system?

What is meant by adaptive immune system?

NOTES

1 You are born with the _____.

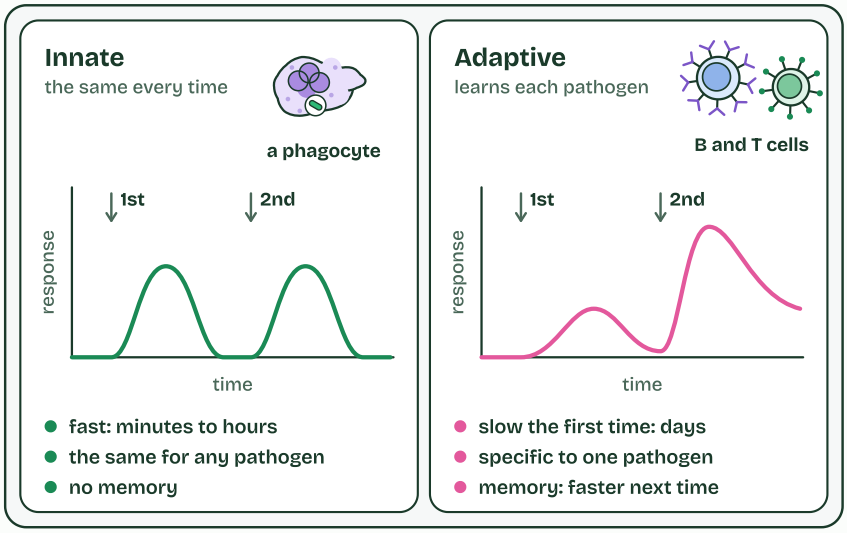
2 The _____ is different.

3 Innate: _____.

Your own notes

ANNOTATE THE FIGURE

Number the 2 steps on the figure and note what happens at each: 1 Innate:; 2 Adaptive:.



SUMMARY

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

05 Cells that eat microbes

C3.2.5

CUES

Predict: Why can a phagocyte digest a bacterium without digesting its own cytoplasm?

What is meant by phagocytes?

What is meant by amoeboid movement?

What is meant by endocytosis?

What is meant by lysosomes?

NOTES

1 Whatever gets past the barriers meets _____, white blood cells that eat pathogens.

2 They circulate in the blood and, at an infection, squeeze out between the cells of the capillary wall and move through the tissue by _____, following chemicals released by the damaged tissue and the microbes.

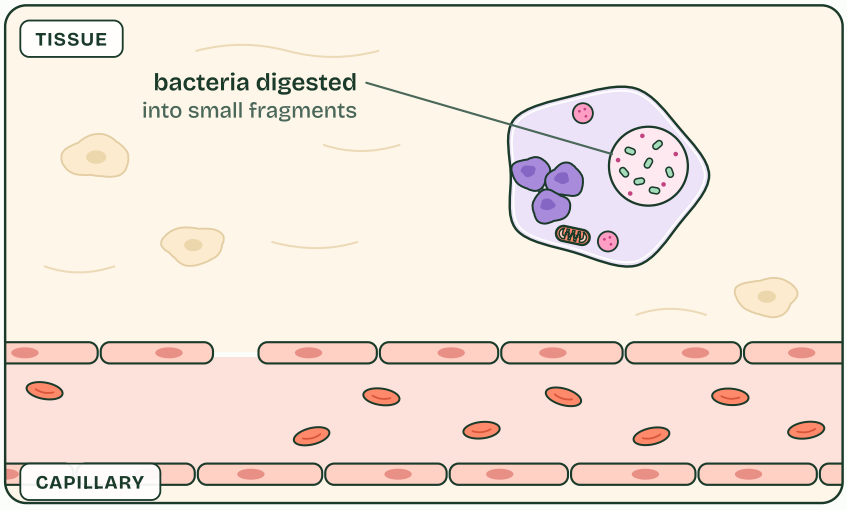
3 A phagocyte recognizes a pathogen by receptors that bind to molecules on its surface and engulfs it by _____.

4 The pathogen is inside a vesicle, which fuses with _____.

Your own notes

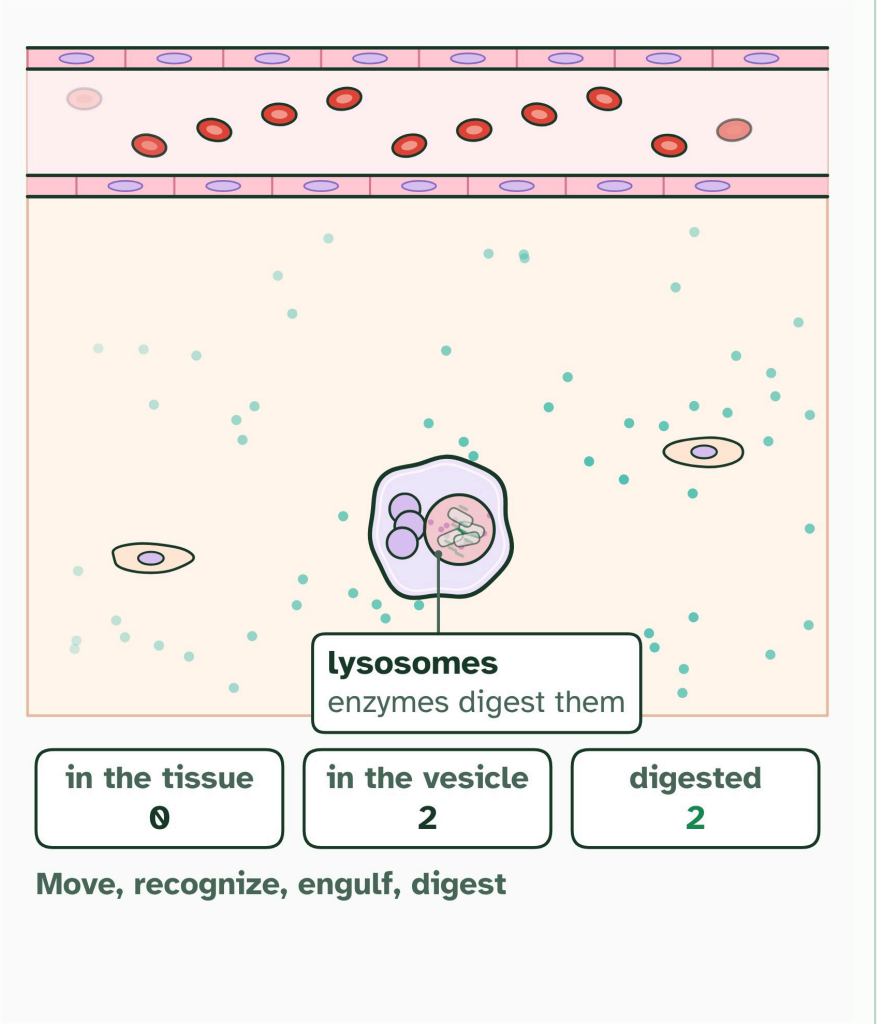
ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 chemicals; 2 amoeboid movement; 3 recognizes, endocytosis; 4 Lysosomes; 5 digested.



ANNOTATE THE FIGURE

Annotate this still from the animation (A phagocyte at work): what is happening, and why?



REMEMBER IT

The four stages of phagocytosis

M My	R Rhino	E Eats	D Dinner
M	R	E	D

SUMMARY

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

06 A lock for every key

C3.2.6 C3.2.7

CUES

Predict: A B cell with receptors that fit a measles antigen meets a mumps virus. What happens?

What is meant by antigen?

What is meant by lymphocytes?

What is meant by b cell?

What is meant by antibody?

NOTES

1 An _____ is a recognition molecule.

2 _____ are the cells that do the recognizing, and they circulate in the blood and gather in lymph nodes.

3 Each _____ makes one type of _____, with binding sites that fit one antigen.

4 A bacterium carries _____ on its surface: here, triangles.

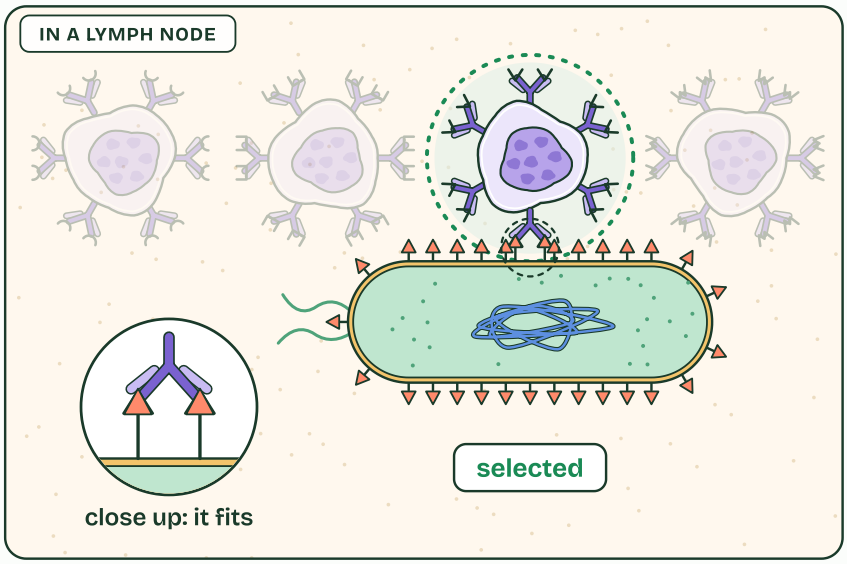
5 You have many _____, each with receptors of one shape. Between them they fit millions of antigens.

6 An antigen _____ only the receptor that matches it, like a key in a lock.

Your own notes

ANNOTATE THE FIGURE

Number the 4 steps on the figure and note what happens at each: 1 antigens; 2 B cells; 3 fits; 4 selected.



SPOT THE MISTAKE

What do students often get wrong about lymphocytes as cells in the adaptive immune system Antigens as recognition molecules that trigger antibody production? Write 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 A B cell needs a second opinion

C3.2.8

CUES

Predict: A B cell binds its antigen but no helper T cell has been activated by that antigen. What does the B cell do?

What is meant by activated?

What is meant by helper T cell?

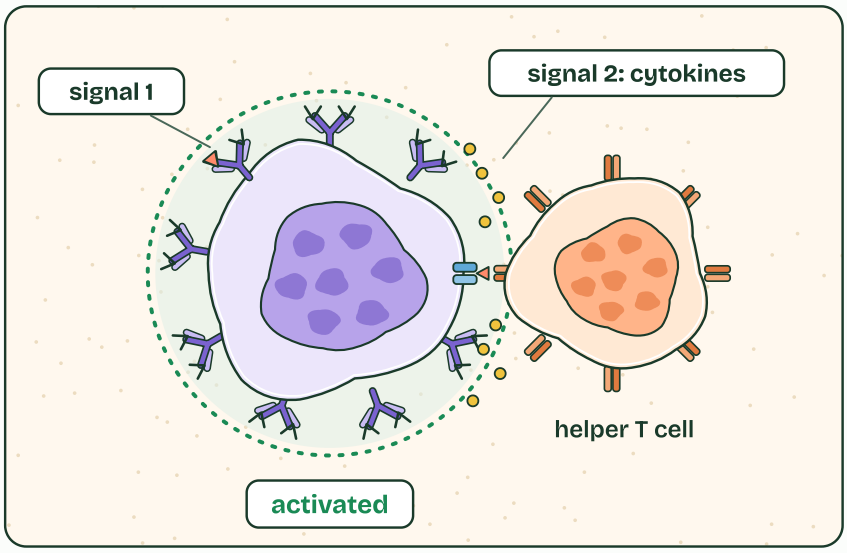
NOTES

1. A B cell does not start making antibodies just because an antigen fits. It must be _____, and that needs two things.
2. Second, a _____ that has been activated by the same type of antigen makes contact and releases chemical signals.
3. A B cell with a matching _____, and the antigen about to bind.
4. A _____ that was activated by the same antigen approaches.
5. The two cells make _____: the T cell's receptor binds the antigen the B cell now shows.
6. **Signal 2:** the T cell releases chemical signals called _____.

Your own notes

ANNOTATE THE FIGURE

Number the 6 steps on the figure and note what happens at each: 1 receptor; 2 Signal 1:; 3 helper T cell; 4 contact; 5 Signal 2:, cytokines; 6 activated.



SUMMARY

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

08 One cell becomes an army

C3.2.9

CUES

Predict: Why are the plasma cells packed with rough endoplasmic reticulum?

What is meant by mitosis?

What is meant by clone?

What is meant by plasma cells?

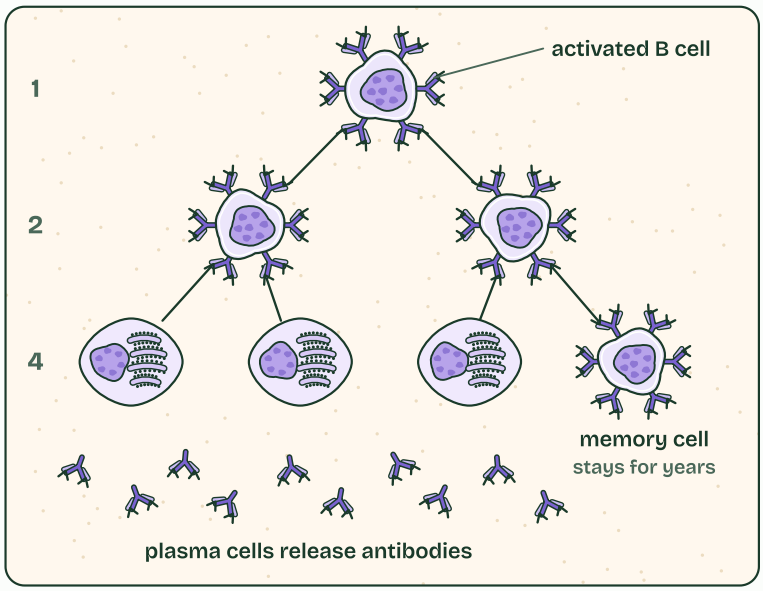
NOTES

1. So an activated B cell first divides by _____, again and again, to make a _____ of identical cells.
2. Most become _____: big cells full of rough endoplasmic reticulum, built to make one type of antibody, the one the original B cell's receptor fits, and release it in huge quantity.
3. One _____ B cell.
4. It divides by _____: two identical cells.
5. They divide again, and again. The _____ grows quickly, every cell with the same receptor.
6. Most of the clone become _____ that release antibodies. Some stay as _____.

Your own notes

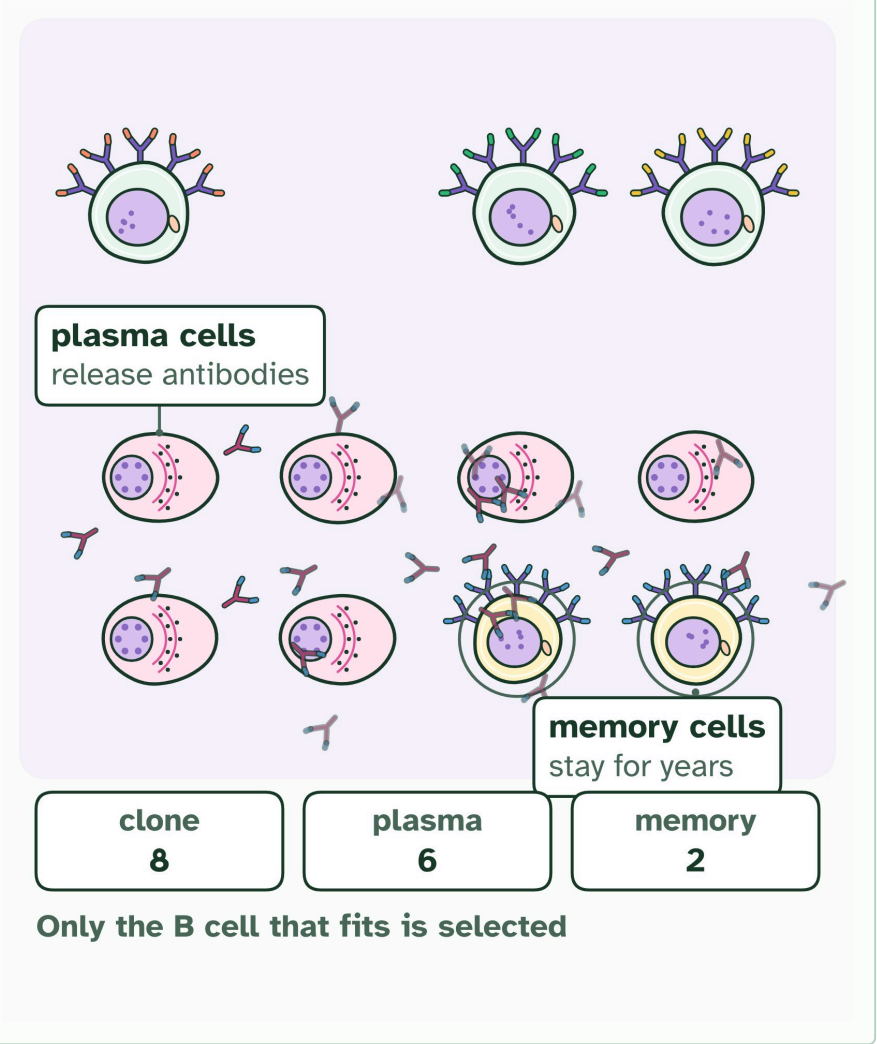
ANNOTATE THE FIGURE

Number the 4 steps on the figure and note what happens at each: 1 activated; 2 mitosis; 3 clone; 4 plasma cells, memory cells.



ANNOTATE THE FIGURE

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



REMEMBER IT

Clonal selection in five steps

R Rude	A Aliens	M Might	S Steal	R Rockets
R	A	M	S	R

SUMMARY

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

09 From pathogen to antibodies and memory

C3.2.6

CUES

NOTES

1 **Engulf.** A _____, a kind of phagocyte, reaches round a pathogen and takes it in by endocytosis.

2 **Present.** Lysosomes digest the pathogen, but the macrophage keeps pieces of its _____ and shows them on its own surface.

3 **Activate.** A _____ whose receptor fits that antigen binds it, and the macrophage's chemical signals activate the T cell.

4 **Bind.** Free antigen reaches a _____ whose receptor fits the same antigen, and binds to it.

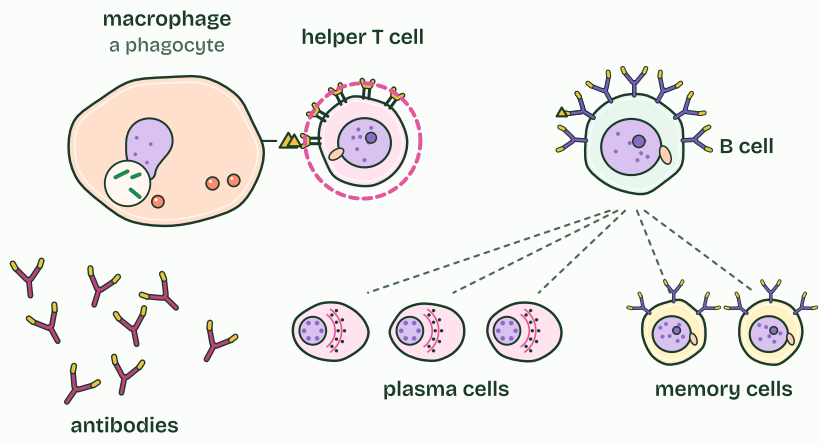
5 **Help.** The activated helper T cell binds the same B cell and releases _____. With both signals the B cell is activated.

6 **Multiply.** The activated B cell divides by _____, again and again, into a _____ of identical cells.

Your own notes

ANNOTATE THE FIGURE

Number the 8 steps on the figure and note what happens at each: 1 Engulf., macrophage; 2 Present., antigen; 3 Activate., helper T cell; 4 Bind., B cell; 5 Help., cytokines; 6 Multiply., mitosis, clone; 7 Secrete., plasma cells, antibody; 8 Remember., memory cells.



REMEMBER IT

Antibody production, from pathogen to memory, in eight steps

E	P	A	B	H	M	S	R
Every	Pink	Aardvark	Bring	Hot	Mango	Smoothie	Regularly
E	P	A	B	H	M	S	R

SUMMARY

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

10 The second time is faster and bigger

C3.2.10

CUES

Predict: On the second exposure to the same pathogen, compared with the first, which description is right?

What is meant by memory cells?

What is meant by immunity?

NOTES

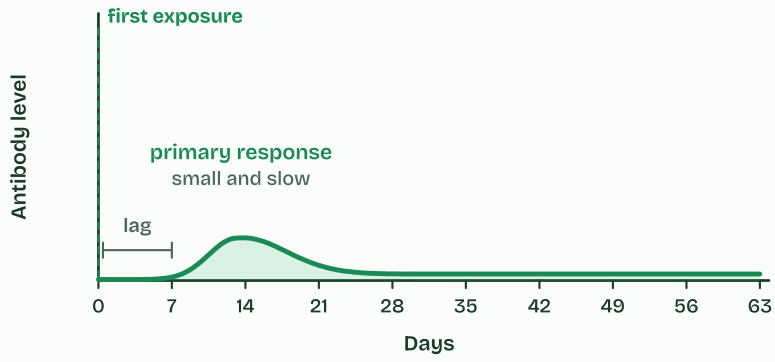
1 When the infection is over, the plasma cells die and the antibody level falls, but some of the clone survive for years as _____.

2 This is _____: if the same pathogen returns, memory cells are already there, so the response starts at once, rises higher and lasts longer.

Your own notes

ANNOTATE THE FIGURE

The figure shows it as First exposure and Both exposures. Note what changes each time.



SUMMARY

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

11 The virus that takes out the commander

C3.2.11 C3.2.12

CUES

Predict: A person with AIDS dies of an ordinary lung infection. What is the best explanation?

What is meant by HIV?

What is meant by AIDS?

What is meant by opportunistic infections?

NOTES

1 _____ is carried in body fluids: blood, semen, vaginal fluids and breast milk.

2 When the count falls far enough, the person has _____.

3 They die from _____, not from HIV itself.

4 The number of _____ dips early, then falls slowly over years in an untreated infection.

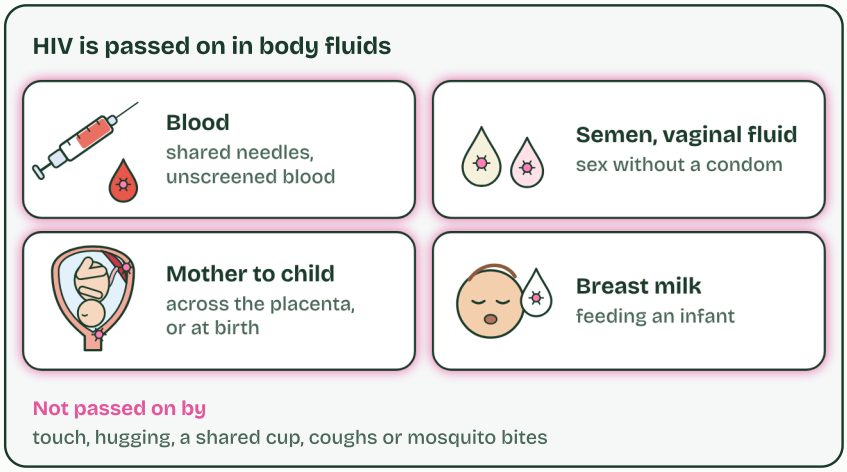
5 The _____ in the blood peaks early, is held down for years, then rises as the immune system fails.

6 When helper T cells fall below about 200 per mm^3, the person has _____, and opportunistic infections take hold.

Your own notes

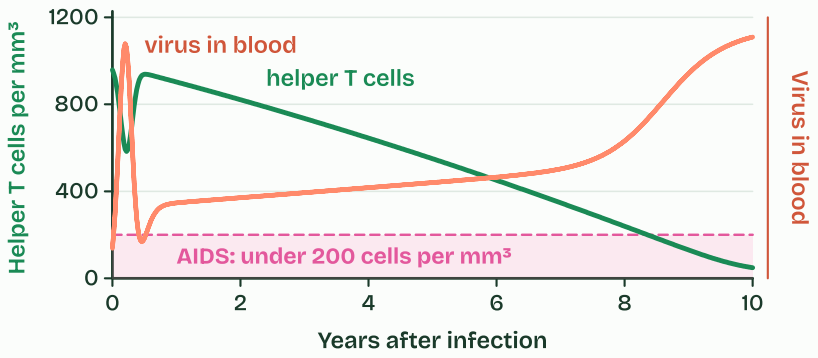
ANNOTATE THE FIGURE

Label each part and say what it does: blood, semen and vaginal fluids, mother to child, breast milk.



ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each: 1 helper T cells; 2 virus; 3 AIDS.



SUMMARY

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

12 Poisons that aim at bacteria

C3.2.13

CUES

Predict: A doctor refuses to give antibiotics for a patient's flu. The best reason is:

What is meant by antibiotics?

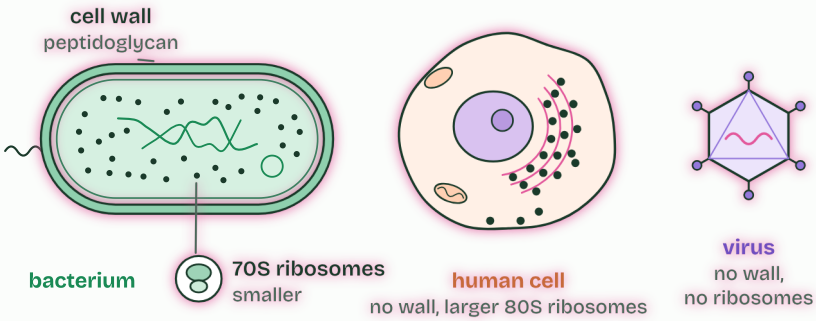
NOTES

1 _____ are chemicals that block a process in bacteria that does not occur, or differs, in eukaryotic cells.

Your own notes

ANNOTATE THE FIGURE

Label each part and say what it does: bacterial cell wall, bacterial ribosomes, human cell, virus.



SUMMARY

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

13 Antibiotics select for the resistant

C3.2.14

CUES

Predict: A patient stops taking antibiotics after three days because they feel better. The best description of the risk is:

What is meant by selection pressure?

What is meant by multiresistant?

NOTES

1 The antibiotic acts as a _____.

2 A strain that picks up resistance genes for several drugs becomes _____.

3 A population of bacteria. By chance one carries a _____, here on a plasmid.

4 The _____ is added.

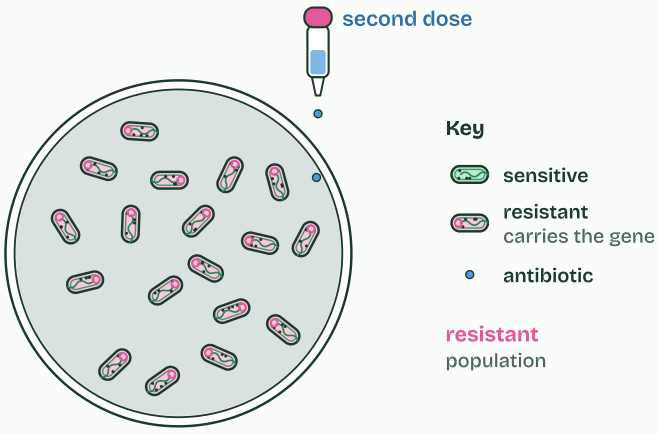
5 The _____ bacteria die. The resistant one survives.

6 It _____, and so do its descendants: all carry the gene.

Your own notes

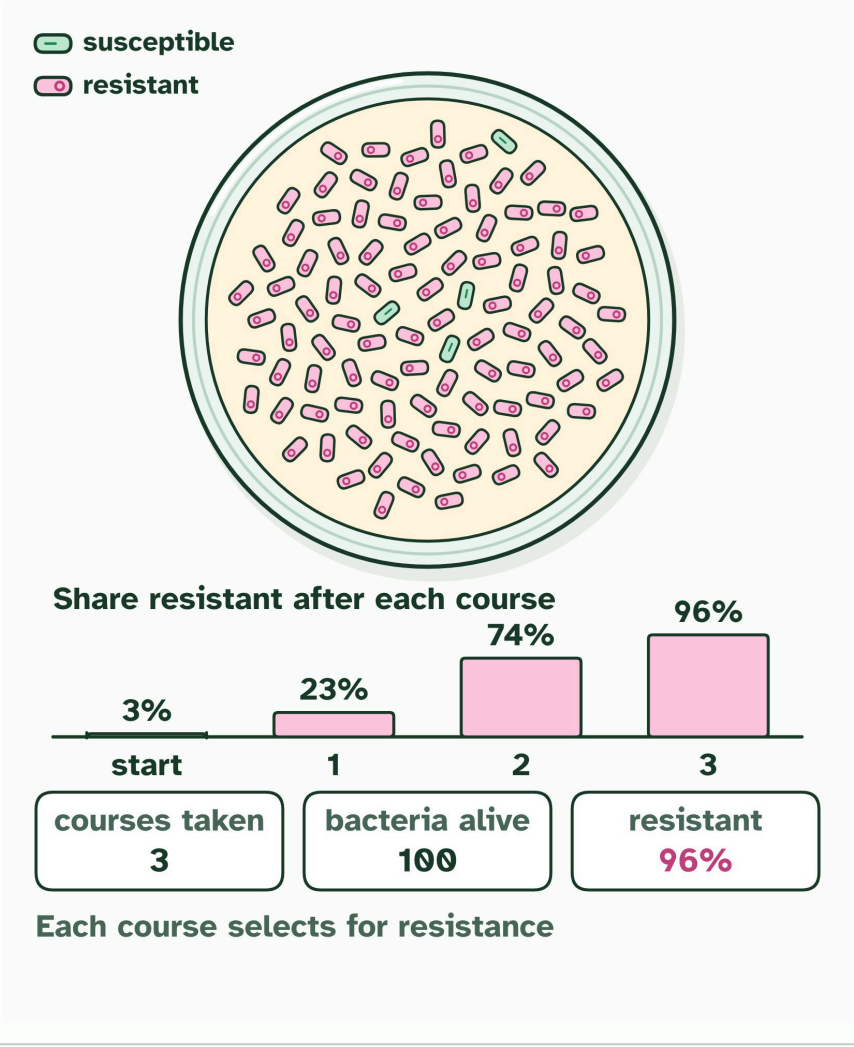
ANNOTATE THE FIGURE

Number the 5 steps on the figure and note what happens at each: 1 resistance gene; 2 antibiotic; 3 sensitive; 4 divides; 5 resistant.



ANNOTATE THE FIGURE

Annotate this still from the animation (Resistance on a plate): what is happening, and why?



SUMMARY

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

14 Diseases that cross species

C3.2.15

CUES

Predict: Which of these is a zoonosis?

What is meant by zoonosis?

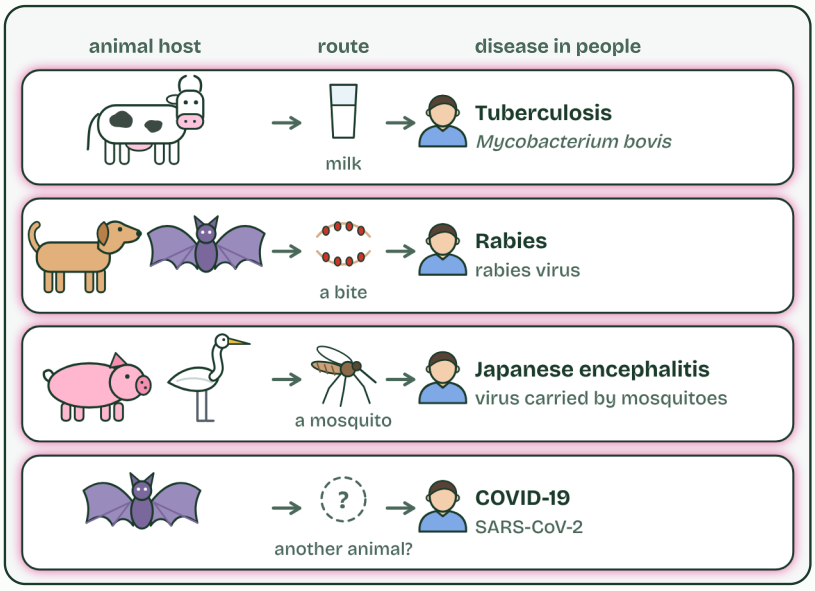
NOTES

1 A _____ is an infectious disease that can pass from other animals to people.

Your own notes

ANNOTATE THE FIGURE

Label each part and say what it does: tuberculosis, rabies, japanese encephalitis, COVID-19.



SUMMARY

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

15 A rehearsal without the disease

C3.2.16

CUES

Predict: Why can a vaccine not give you the disease it protects against?

What is meant by vaccine?

NOTES

1 A _____ gives your immune system a look at a pathogen's antigen without the disease.

2 The vaccine carries an _____, or the genetic code for one, but cannot cause the disease.

3 The immune system _____ to it: a matching B cell is selected and plasma cells make antibodies.

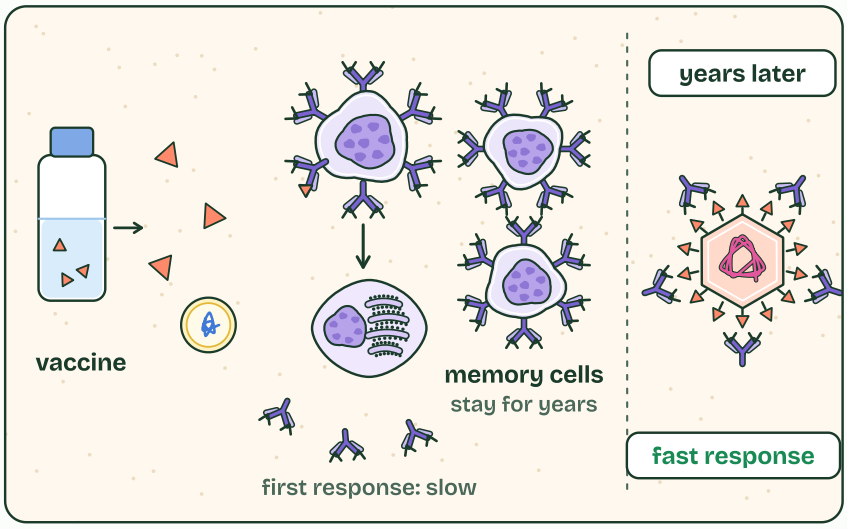
4 _____ are left behind, and stay for years.

5 If the real pathogen arrives, it meets memory cells and a fast _____.

Your own notes

ANNOTATE THE FIGURE

Number the 4 steps on the figure and note what happens at each: 1 antigen; 2 responds; 3 Memory cells; 4 secondary response.



SUMMARY

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

16 Protecting people who cannot be protected

C3.2.17

CUES

Predict: Vaccination coverage for a disease falls from 95% to 85%. The most likely result is:

What is meant by herd immunity?

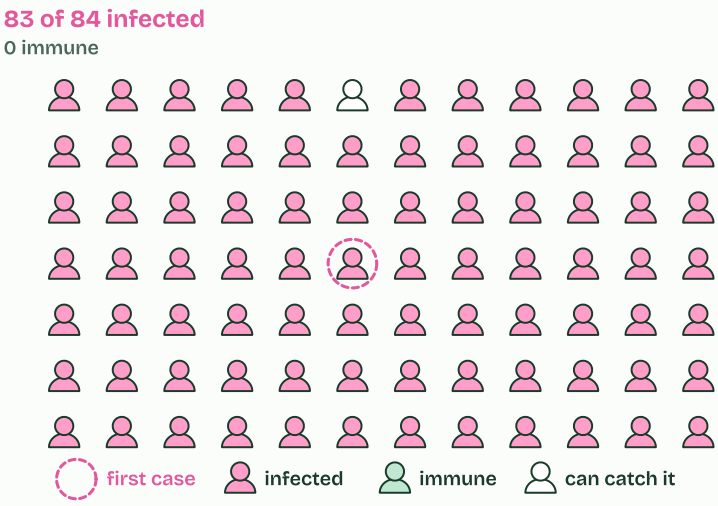
NOTES

1 If enough of a population is immune, most of the people it reaches cannot pass it on, so outbreaks die out. This is _____.

Your own notes

ANNOTATE THE FIGURE

The figure shows it as Nobody immune, Half immune and Nearly all immune. Note what changes each time.



SUMMARY

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

17 Reading the numbers carefully

C3.2.18

CUES

Predict: Weekly cases rose from 40 to 160 per 100 000. What is the percentage change?

What is meant by percentage change?

What is meant by percentage difference?

NOTES

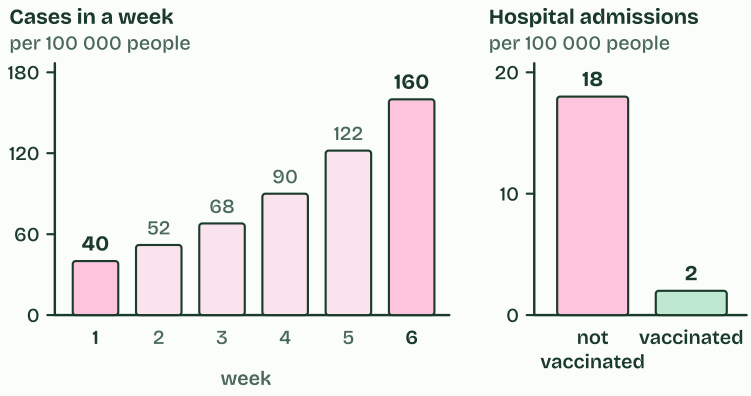
1 Two calculations come up. _____ compares a value with where it started: (new − old) ÷ old × 100.

_____ compares two values with neither being the starting point: the difference divided by their mean, × 100.

Your own notes

ANNOTATE THE FIGURE

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



SUMMARY

Sum up section 17 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 C3.2 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=C3.2&level=SL&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.