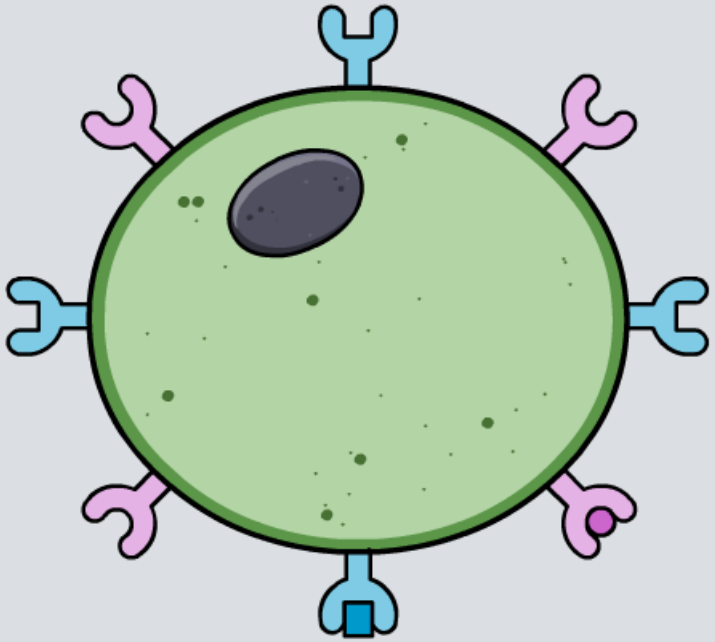
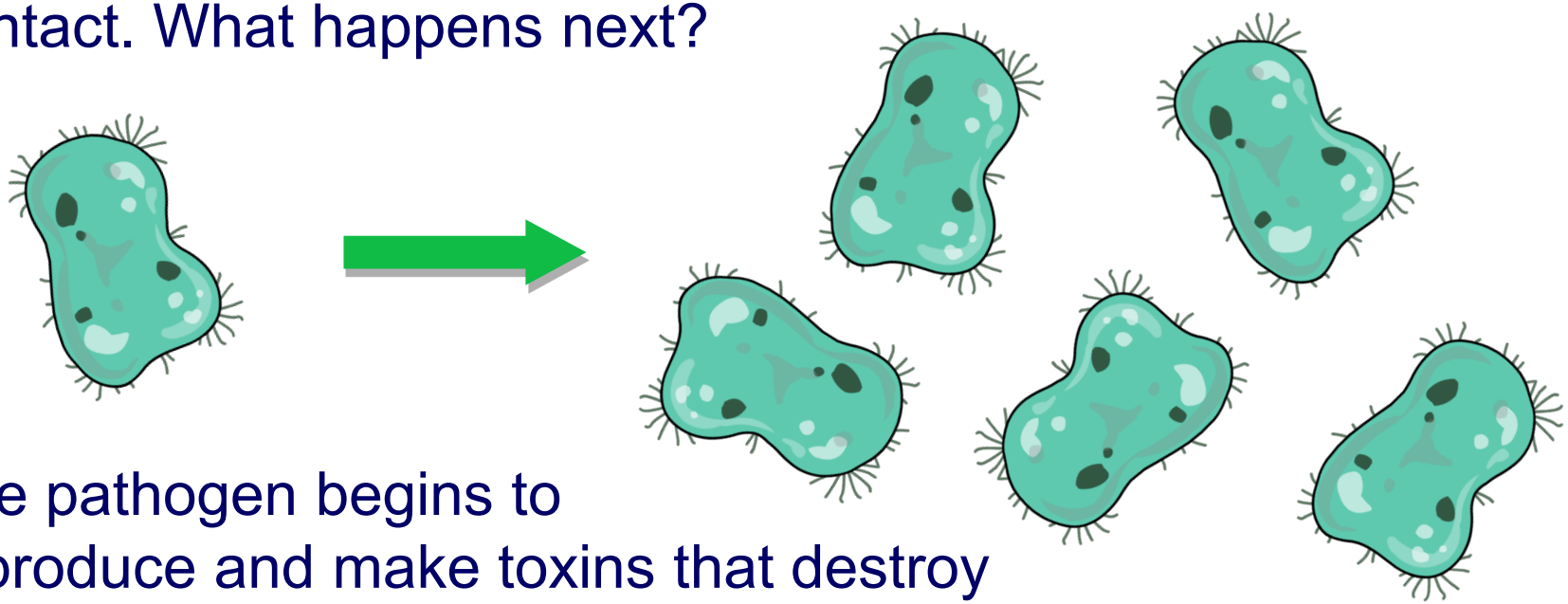
Immune System



Invasion!

A pathogen enters your body through direct or indirect contact. What happens next?



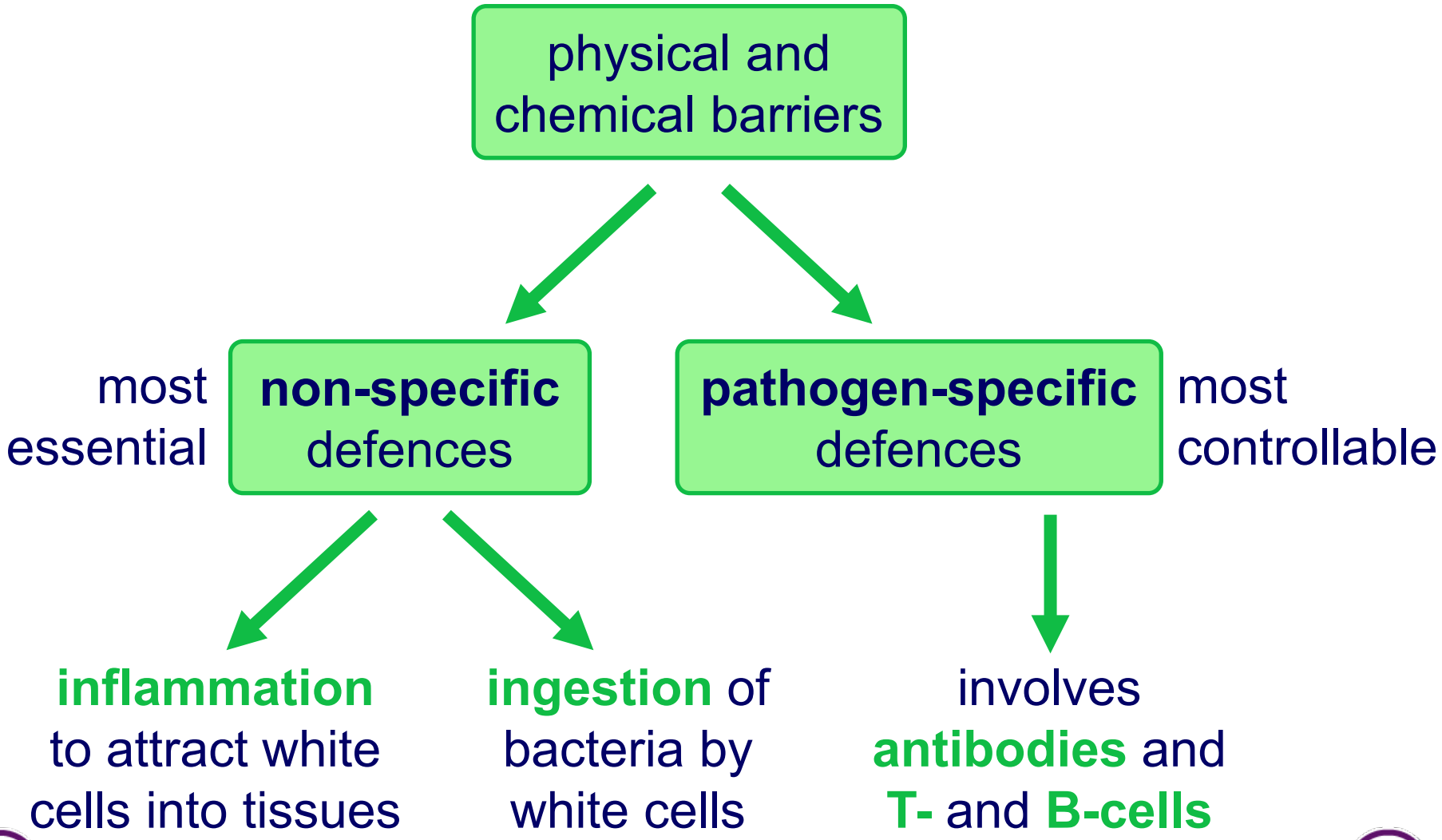
The pathogen begins to reproduce and make toxins that destroy the body's cells and make you feel unwell.

Painkillers can relieve the symptoms of an infection but do not kill the pathogen.

Your immune system begins to mount an attack.

Lines of defense

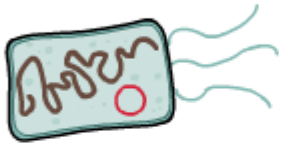
The body has many different lines of defence:



What is phagocytosis?

How do macrophages destroy pathogens such as bacteria?

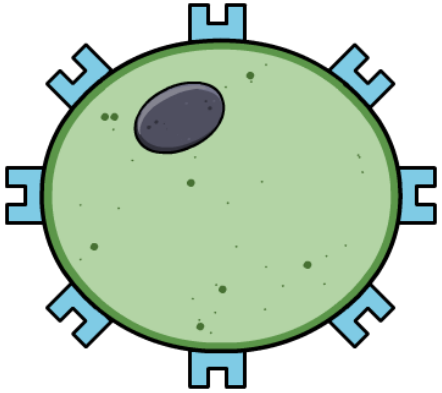
Click "**play**" to find out more about phagocytosis.



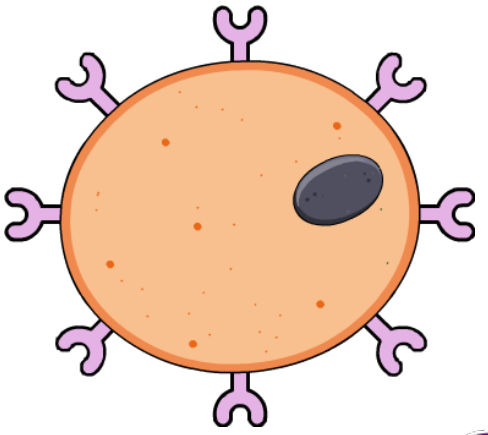
What are lymphocytes?

Lymphocytes are a type of white blood cell found in the blood or lymph nodes and made by bone marrow. There are several types of lymphocyte, including:

- **T-lymphocytes** – recognize antigens on pathogens and either attack them directly or co-ordinate the activity of other cells of the immune system.

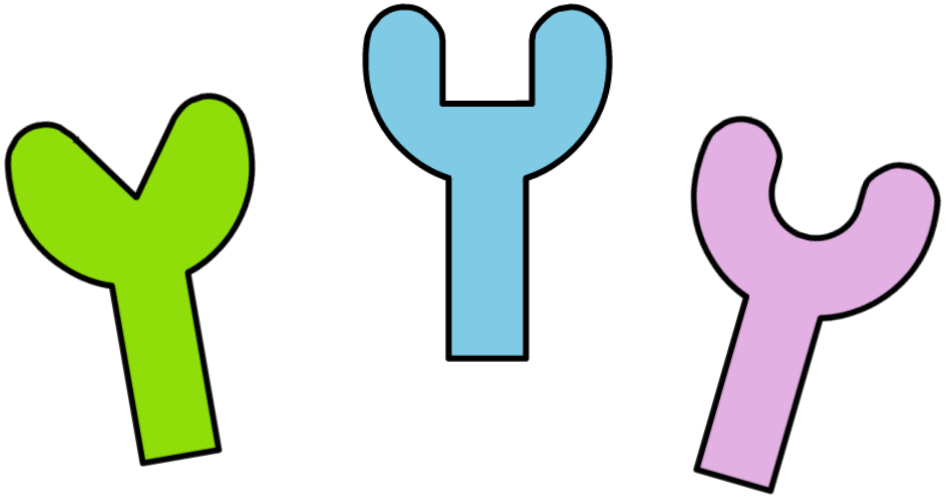


- **B-lymphocytes** – recognize antigens and produce special chemicals called **antibodies**.



The third line of defense

Antibodies are special Y-shaped proteins produced by B-lymphocytes in response to antigens.



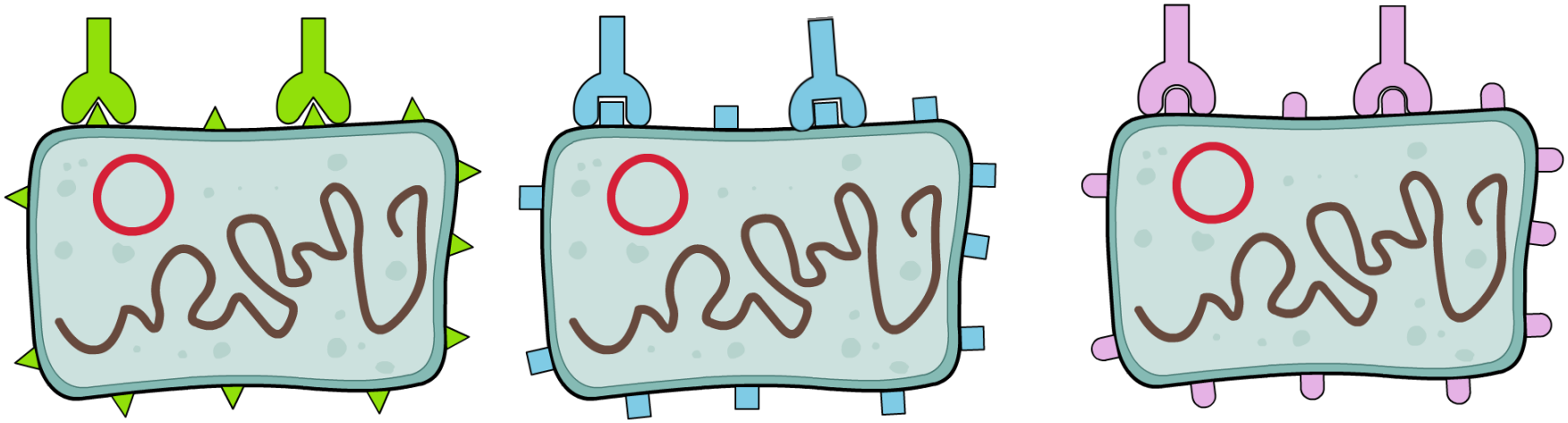
Antibodies work by binding to antigens on pathogens, ‘labeling’ them and causing them to clump together. The pathogen can then be destroyed by:

- phagocytosis by macrophages
- T-lymphocytes
- the antibodies themselves.

Antibodies

Each different type of antigen causes a different type of antibody to be produced.

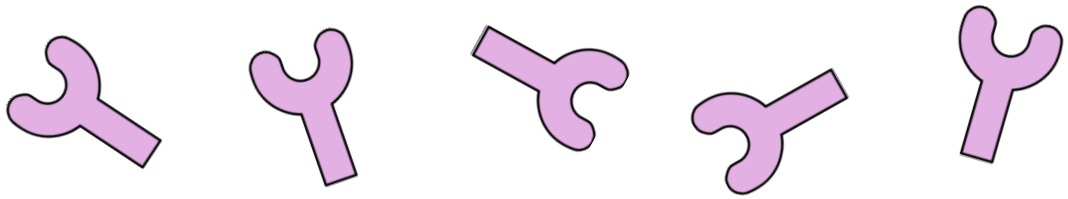
An antibody can only bind to the antigen that caused it to be produced.



Delayed response

The B-lymphocyte that produces the correct antibody for the antigen begins dividing to produce many more antibody-producing cells.

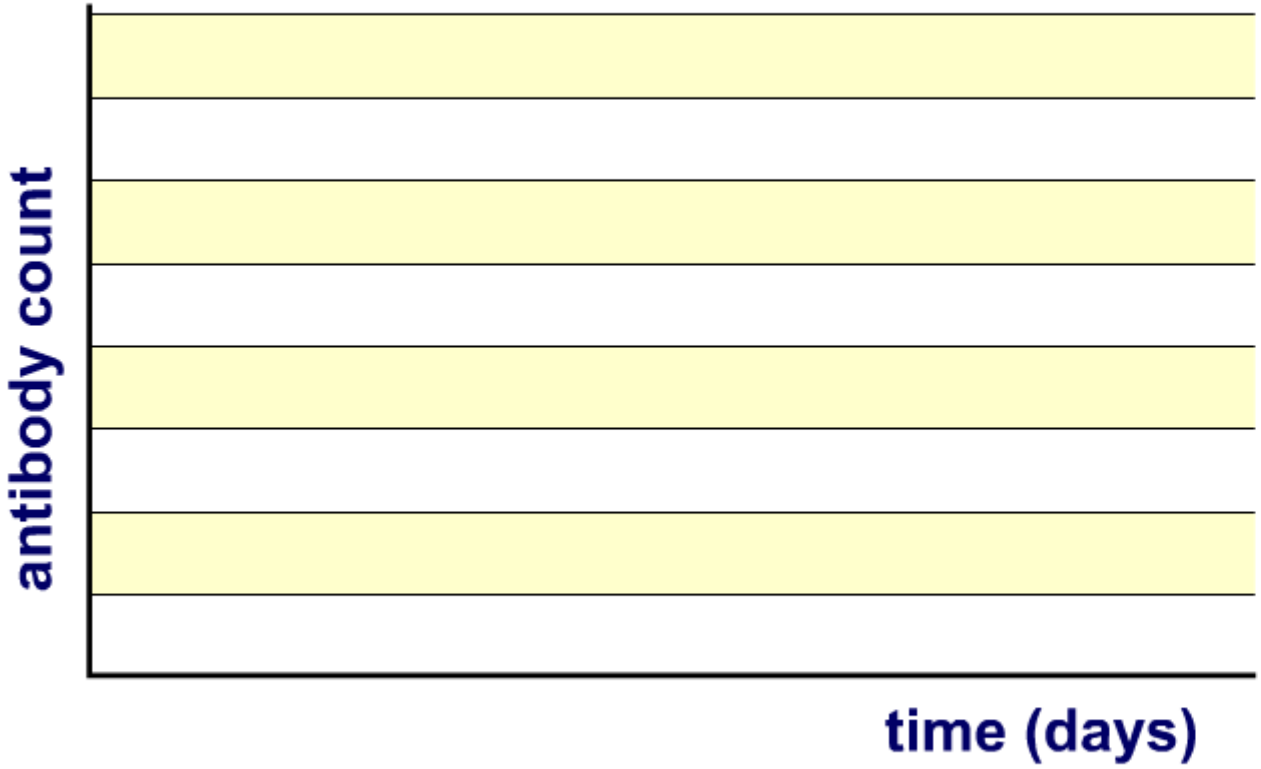
It takes a few days to produce enough antibodies to destroy the pathogen. This means there is delay between infection and the person beginning to feel better.



Once a pathogen has been destroyed, a few **memory cells** remain. These recognize the pathogen if it re-infects, and make the immune response much quicker and more effective. This is called **active immunity**.

Antibody levels during infection

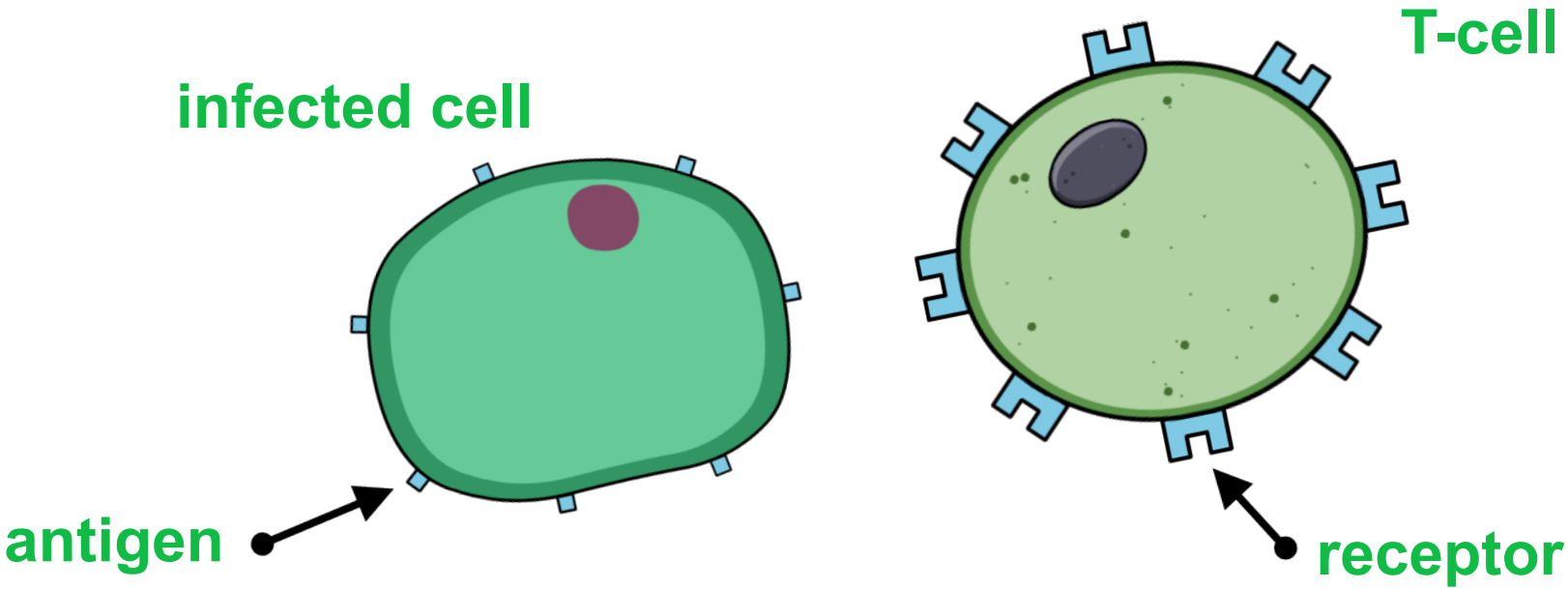
Antibody count during two infections by the same pathogen



Hidden pathogens

How does the body deal with pathogens that are inside cells?

Viruses and bacteria that infect cells leave antigens on the surface of the cell they infect.



T-lymphocytes recognize these antigens by receptors on their surface and destroy the whole infected cell.

Fighting an infection

What is the order of stages in the life cycle of a star the size of the Sun?

1. Nuclear reactions start in central mass.
2. Star shines.
3. Outer layer of red giant drifts off into space.
4. Hydrogen runs out and a red giant forms.
5. Nebula contracts under its own gravity.
6. White dwarf is formed.
7. Central mass of matter in nebula heats up.

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C solve