A. DEFINITIONS

ANTIGEN

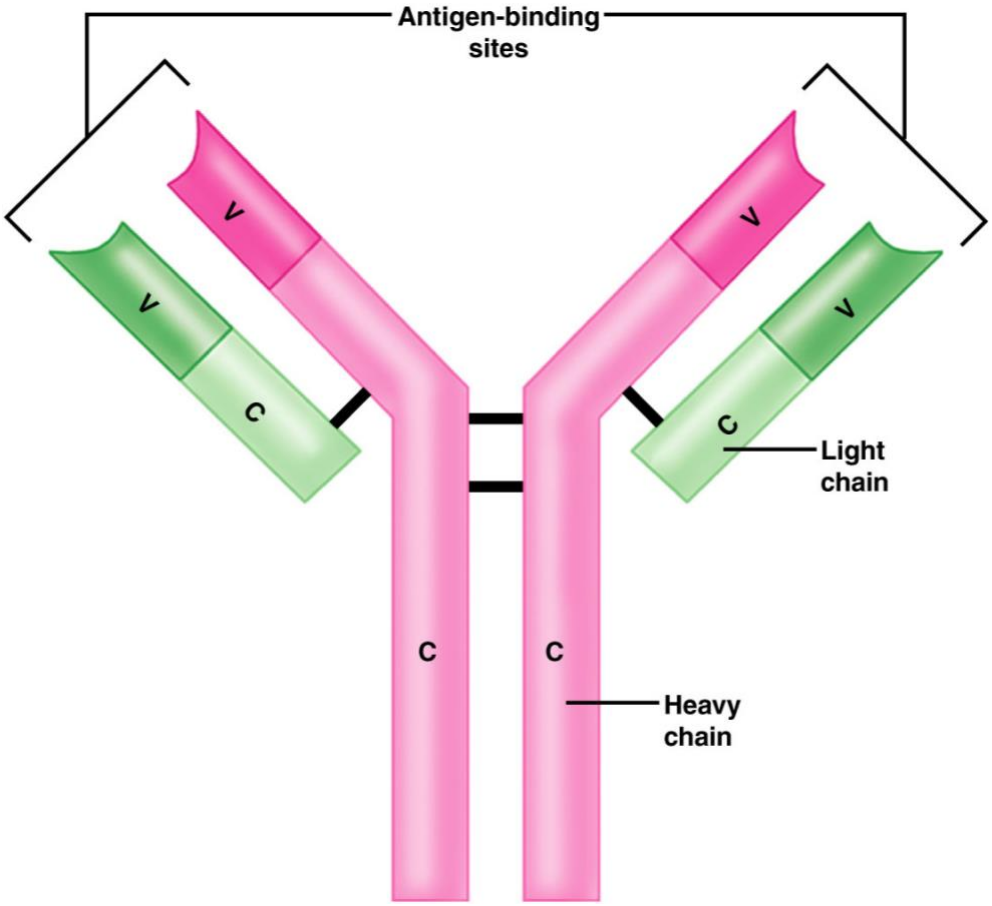
A glycoprotein on the surface of a pathogen that stimulates the production of specific antibodies

ANTIBODY (IMMUNOGLOBULIN)

A glycoprotein produced by the body in response to a specific antigen, which attaches to the antigen and destroys it

- An antibody is also known as an **immunoglobulin**. Examiners could use **either** term.

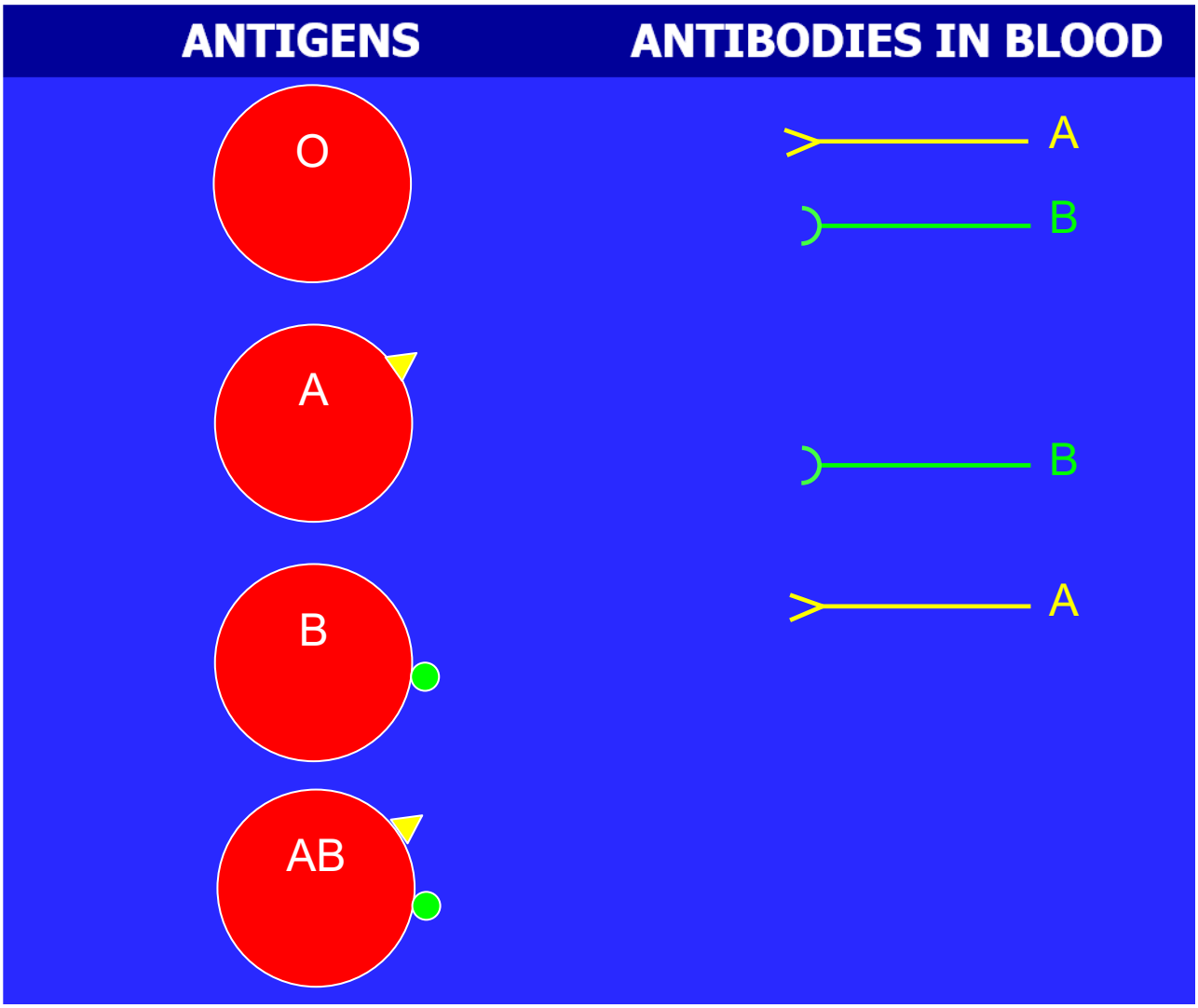
B. ANTIBODY STRUCTURE



- **Four** protein chains.
- Each antibody has a **different variable (V) region**, to give a **different-shaped antigen binding site**.
- The **constant region (C)** is **recognised** by **phagocytes** (macrophages).

C. THE ABO BLOOD SYSTEM

Red blood cell antigens and antibodies in the blood



- **Blood group O** is the **universal donor.** It **does not contain any foreign antigens**, so it can be **given** to **all other blood groups**, without being attacked.

- **Blood group AB** is the **universal recipient.** Antigens **A** and **B** are **self-antigens**, so a person who is AB can **receive any blood group**, without attacking it.

- In both situations, **antibodies cannot attach to antigens**, so **no blood clot** can form.

C. BLOOD TRANSFUSIONS

Donor / recipient	O	A	B	AB
O	✓	✓	✓	✓
A	x	✓	x	✓
B	x	x	✓	✓
AB	x	x	x	✓

✓ = no blood clot (successful)

x = blood clot (failure)

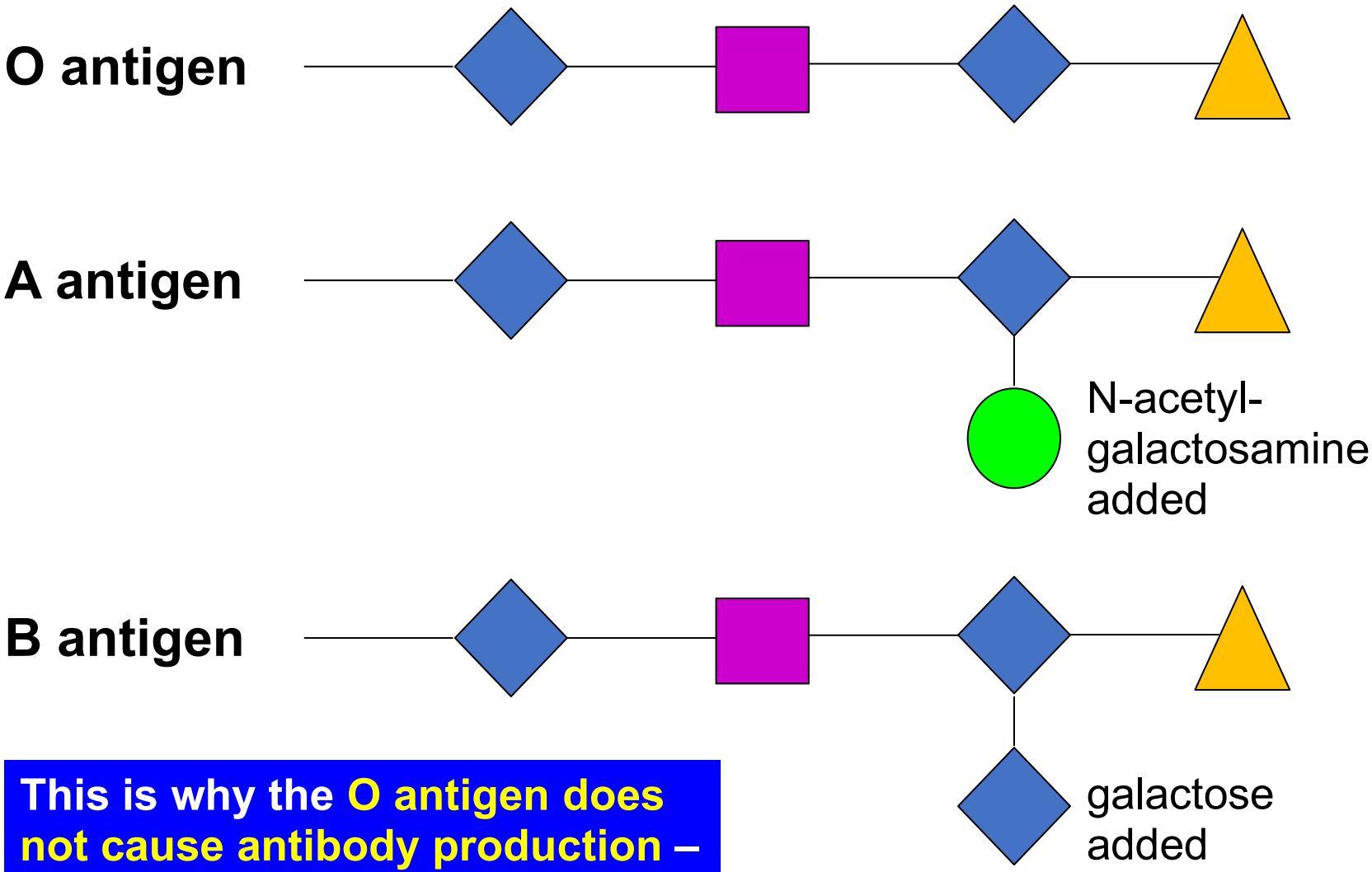
Blood group O can be given to all other blood groups.
Explain why. [3 marks]

Contains no foreign antigen(s)
(So) antibodies cannot attach/attack
(So) no blood clot (forms)

Blood group AB can receive all other blood groups.
Explain why. [4 marks]

A and B are self-antigens/not foreign antigens
(So) no antibodies to A and B antigens
(So) antibodies cannot attach/attack
(So) no blood clot (forms)

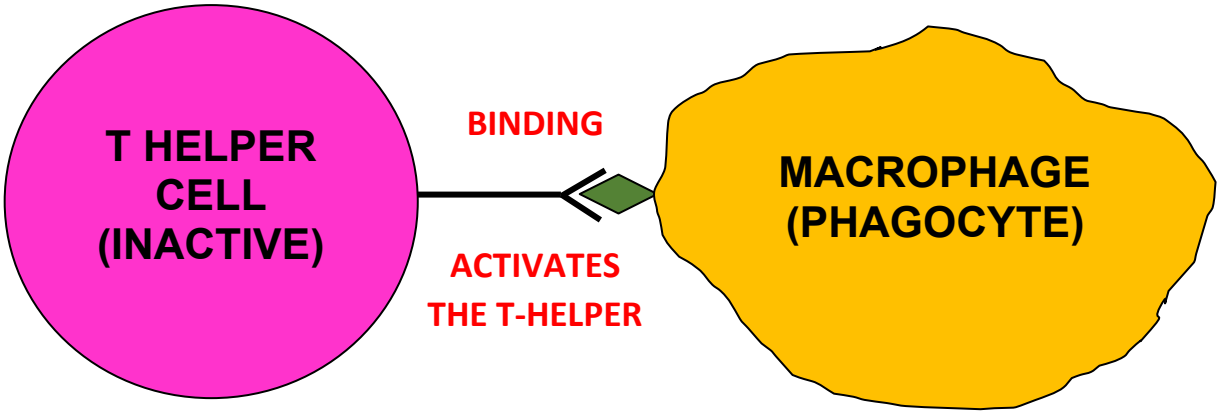
D. ANTIGENS O, A AND B



This is why the O antigen does not cause antibody production – it is recognised as a self-antigen

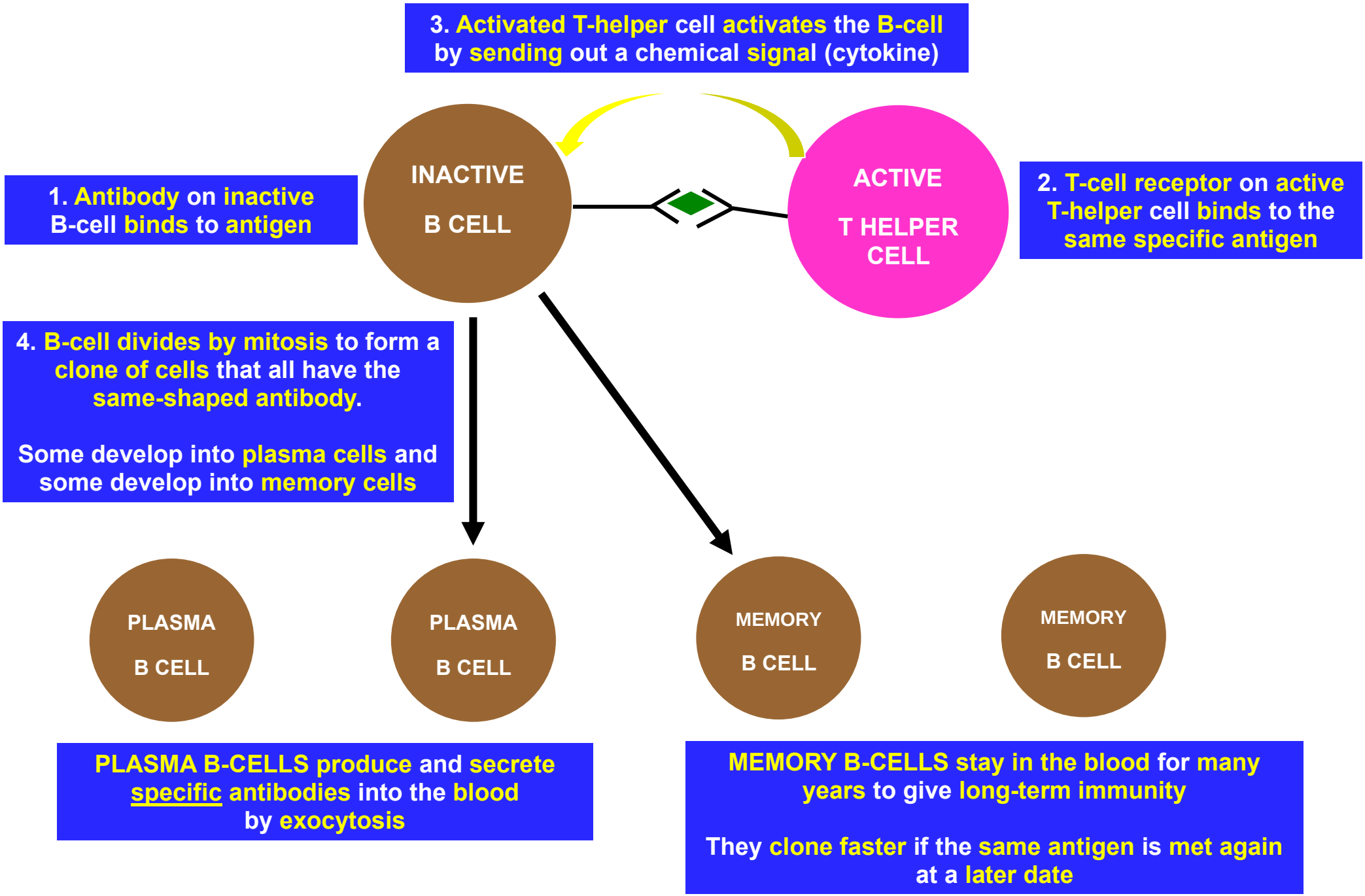
E. HOW ANTIBODIES ARE PRODUCED

1. ACTIVATION OF T-HELPER CELLS



- A macrophage (phagocyte) **engulfs** and **digests** a pathogen.
- The macrophage **presents** the pathogen's **antigen** on its **membrane** to an **inactive T-helper cell**.
- When the **antigen binds** to the **T-helper cell receptor**, this **activates** the **T-helper** cell.

2. ACTIVATION OF B-CELLS



F. HOW ANTIBODIES DESTROY PATHOGENS (P.A.N.I.C.)

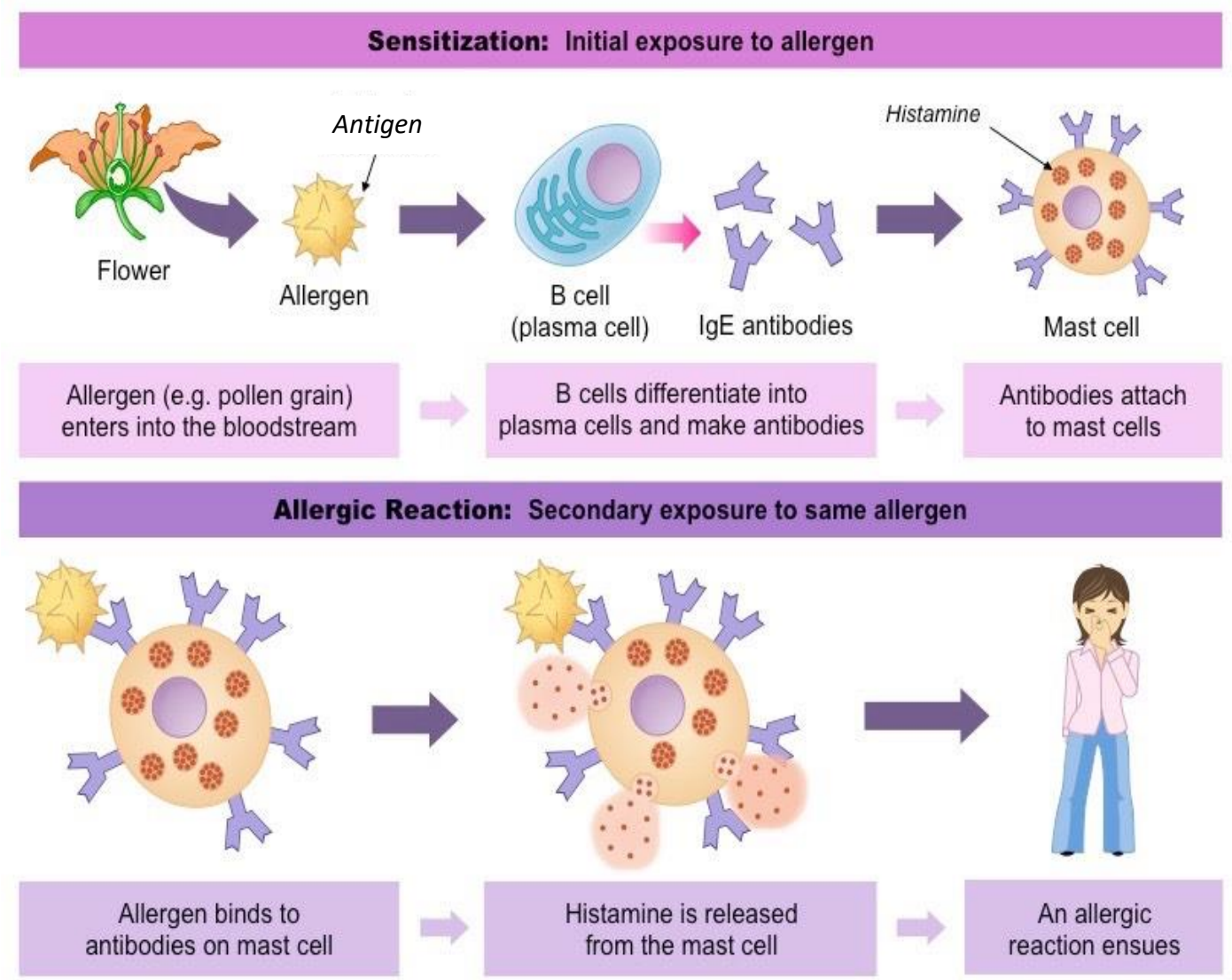
P	**REVENT** viruses from attaching to host cells
A	**GGLUTINATE** pathogens: they stick them together so they cannot enter host cells
N	**EUTRALISE** toxins produced by pathogens
I	**DENTIFIED** by phagocytes more readily so pathogens are engulfed and destroyed faster
C	**ELL LYSIS**: they bind to the surface of pathogens and cause pathogens to burst

G. HOW HIV CAUSES AIDS

- HIV infects **T-helper** cells.
- Eventually, **HIV lyses (bursts) infected T-helper cells** so their **number decreases**.
- This means that **less B-cells are activated**, so **less antibodies are produced**.
- Therefore, **P.A.N.I.C. happens less** so a person with **A.I.D.S**. is **immunosuppressed**.
- They can **die** from **infections** that are **usually harmless** to a **healthy person**.

H. HOW ALLERGIES ARE CAUSED

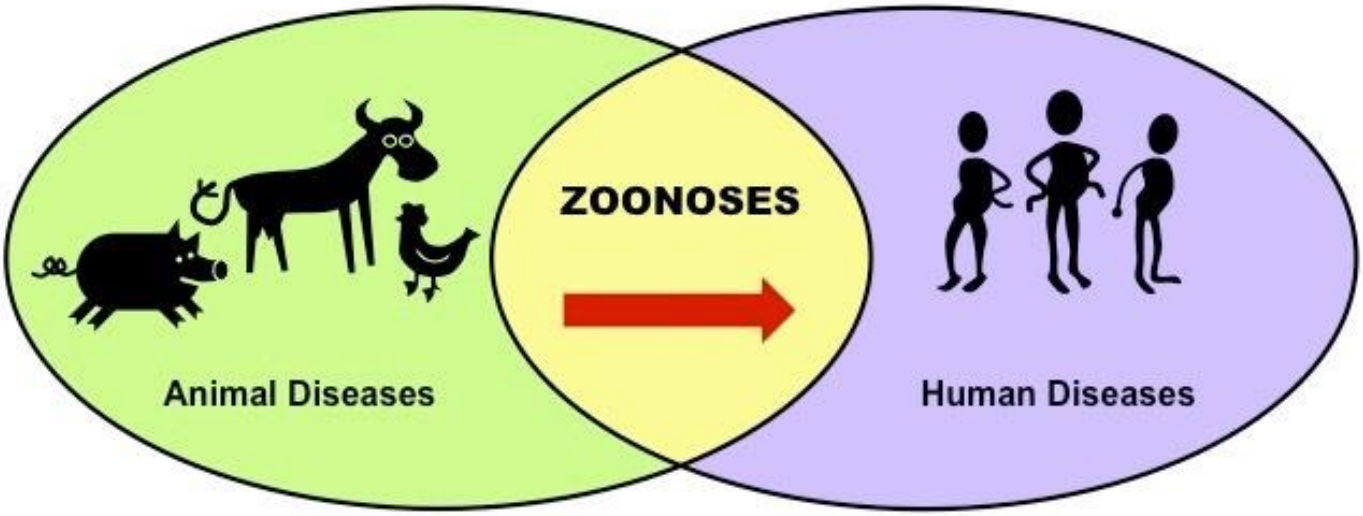
- An **allergen** is an **antigen** that **overstimulates** the **immune system**.
- Examples include chemicals in **pollen** and **peanuts**.
- It is the **second** exposure to the same **allergen** that causes the **allergic reaction**.



I. EFFECTS OF HISTAMINE

- **Dilates (widens) blood vessels** so **immune system cells** can **travel** to the **infected area faster**
- **Leakier blood vessels** so **immune system cells** can **leave them easier**
- **Inflammation, itching, mucus secretion, sneezing and rashes**
- **Anaphylactic shock** is **rarer** and much **more dangerous**

J. ZOONOSES



- **Certain pathogens** may **cross the species barrier** and be able to **infect** and **cause disease** in a **range** of **hosts**.

- **Diseases** from **animals** that can be **transmitted** to **humans** are called **zoonotic diseases (or zoonoses)**.

- **Examples** of **zoonotic diseases** include **rabies (dogs),** certain strains of **influenza (e.g. bird flu)** and the **bubonic plague (rats)**.