Remembering an antigen

After a primary response, some antigen-specific B and T lymphocytes persist as memory cells. A later encounter can therefore trigger a quicker, more effective response.

1. A LIVING MEMORY, NOT A STORE OF ANTIBODIES

Memory cells are long-lived lymphocytes with specific receptors. They remain after the original infection has been controlled. An antibody is a protein; a memory cell is a living cell able to respond and produce descendants.

2. RECALL THROUGH MEMORY B CELLS

1. **Same antigen encountered**

   Matching memory B cells are activated.

2. **Rapid clonal expansion**

   They divide by mitosis and differentiate.

3. **Many plasma cells**

   Plasma cells secrete specific antibodies.

3. MEMORY T CELLS ALSO CONTRIBUTE

On re-exposure to a matching presented antigen, memory T cells can respond rapidly. Helper T-cell responses support other immune cells; cytotoxic T-cell responses destroy infected host cells. T cells do not become antibody-secreting plasma cells.

The key advantage: a population of antigen-experienced cells is already available. The body is not starting with only rare, unactivated matching lymphocytes.

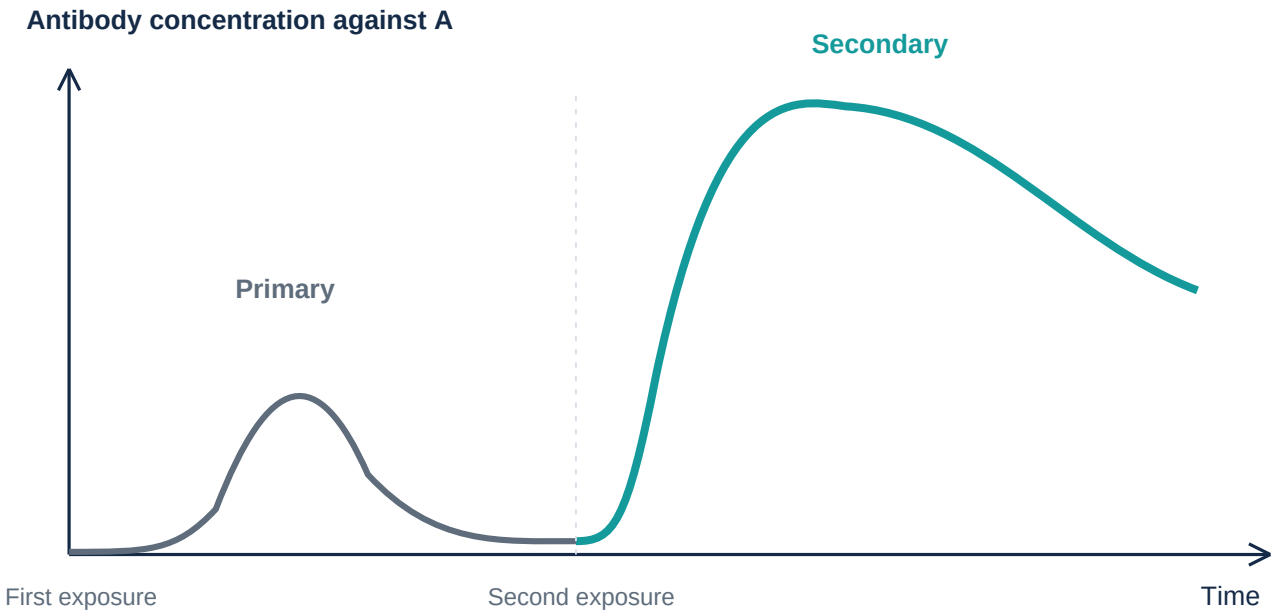
B-cell recall and plasma cells: OpenStax, Microbiology 18.4.
Memory T-cell roles: OpenStax, Microbiology 18.3.

Scope: Cambridge Biology 9700 syllabus, section 11.1, outcome 4, p. 31.

A faster, stronger response

A secondary response follows re-exposure to an antigen already encountered. Compare the delay, peak and persistence of the antibody response to that same antigen.

1. TWO EXPOSURES TO ANTIGEN A



Schematic, not measured data. Timing and antibody levels vary; the interval between exposures is not specified.

2. READ THE COMPARISON

Feature	Primary response	Secondary response
Delay before rise	Longer lag	Shorter lag
Antibody peak	Usually lower	Usually higher
Raised antibody level	Less sustained	More sustained

Explain the pattern: memory cells respond rapidly, expand and form effector cells. More plasma cells can supply a larger antibody response sooner.

Primary versus secondary antibody curves: OpenStax, A&P 2e, 21.4.
Secondary-response features: OpenStax, Microbiology 18.4.

Scope: Cambridge Biology 9700 syllabus, section 11.1, outcome 4, p. 31.

Protection is specific

Immune memory is directed at recognised antigens. Faster recall can control a familiar pathogen before it causes serious disease, but it is not universal protection.

1. ANTIGEN A DOES NOT MEAN EVERY ANTIGEN

After exposure to antigen A, memory cells recognising A remain. A later encounter with A can trigger recall. An unrelated antigen B, with no matching pre-existing memory, requires its own primary response.

2. KEEP THREE COMPONENTS DISTINCT

Memory B cells provide rapid recall and new plasma cells. Long-lived plasma cells can continue secreting antibodies. Circulating antibodies can act immediately while recall develops. Memory cells and existing antibody therefore offer different forms of protection.

3. WHY A LOWER ANTIBODY LEVEL IS NOT THE WHOLE STORY

Antibodies are gradually removed from circulation. Their concentration may fall even when memory cells remain. An antibody graph alone cannot show all B-cell and T-cell memory or establish exactly how well an individual is protected.

Long-term does not automatically mean lifelong or complete: protection varies with the pathogen, the individual and the immune response.

4. THE CAUSAL CHAIN TO REMEMBER

First exposure selects and expands matching lymphocytes. Some persist as memory cells. Re-exposure to the same antigen triggers rapid recall, producing effector cells and a faster, stronger response. This reduces the time a familiar pathogen has to multiply.

Memory, existing antibody and lasting protection: Immunobiology, NCBI Bookshelf.
Memory and antibody production: OpenStax, A&P 2e, 21.4.

Scope: Cambridge Biology 9700 syllabus, section 11.1, outcome 4, p. 31.