*This is the **Higher Separate** version — includes all Higher Tier content (marked ★) and all Separate Science content.*

The immune system defends against pathogens through non-specific and specific responses.

Required Practical: Aseptic technique — culturing bacteria, testing antibiotic effectiveness.

- Non-specific: skin barrier, mucus, cilia, stomach acid, phagocytosis
- Specific: lymphocytes produce antibodies complementary to specific antigens
- Memory cells: remain after infection → rapid response on re-exposure → immunity
- Vaccination: harmless antigen → antibodies + memory cells → protection without disease
- Herd immunity: enough vaccinated → pathogen cannot spread → unvaccinated protected

★ **HT** Monoclonal antibodies: from single lymphocyte clone → very specific. Used in pregnancy tests, cancer treatment

Key Terms

Antibody	Specific protein binding to one antigen — produced by lymphocytes
Memory cell	Long-lived lymphocyte — enables rapid response on re-exposure
Monoclonal antibody	Antibody from single clone — highly specific — used diagnostically and therapeutically

■ **Exam Tip:** Specific immune response: antigen detected → lymphocytes produce antibodies → antibodies bind antigens → memory cells remain. This sequence must be correct.