Method	Description	Use in aseptic technique
Chemical agents	Disinfectants are chemicals that stop, or slow, the growth of bacteria. They are ineffective against bacterial spores, though.	Clean bench before and after working with the organisms. Dispose of wet equipment immediately, treat any spillages that occur.
Heat treatment	Naked flame- hold an object in or pass an object through a Bunsen flame. No microorganism can survive this exposure.	An inoculating loop is flamed by holding it in the hottest part of a Bunsen flame until it glows red. Needles and forceps can also be flamed during the manipulation of cultures. Flame sterilisation is often used on glass rods and glass spreaders after they have been dipped in 70% alcohol. The neck of a glass bottle, flask or tube containing a culture of microorganisms is sterilised by passing it through a Bunsen flame without allowing it to become red-hot.
	Dry heat- Place an object in a hot-air oven at 160 degrees for at least one hour.	A routine method for the sterilisation of laboratory glassware prior to its use.
	Moist heat- Place objects in an autoclave at 121 degrees for at least 15 minutes.	This is the preferred method for many items of laboratory equipment and for culture media that are not heat-sensitive. It is also used to sterilise old cultures and spent media before disposing of them.
Filtration	Pass a liquid culture through a filtration device that has itself been sterilised by dry heat. Using a filter of pore size 0.2 micrometres will remove bacteria but not viruses.	The size of the pores involved makes this unsuitable for all but the smallest volumes of liquid.
Radiation	Expose items to UV or ionising radiation.	UV radiation with a wavelength less than 330nm is most effective but, as this can damage the retina, is not used in college or school laboratories. Ionising radiation such as gamma rays, cannot be used in a college or laboratory since industrial facilities are needed. Many sterile plastic items are supplied in packages that have

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Measure	explanation	Problems that may be encountered.
Restrict addition of antibiotics to animal feeds.	Animal feeds account for about half of all antibiotic sales. Used at sub-clinical concentrations they do not destroy bacteria but favour those that develop resistance.	The agricultural industry forms a strong lobby group and would resist any restriction on practices that increase the profitability of farming or the quality of their products.
Doctors to restrict prescriptions of antibiotics.	If family doctors stop prescribing antibiotics as a precautionary measure and prescribe them only when they are needed, the selective pressure favouring resistant bacteria will lessen.	This might mean that doctors advise patients to go home to bed for a few days until their own immune systems overcome the infection. Many patients are unwilling to take this advice and pressure doctors.
Patients must complete their full course of antibiotics.	Many patients begin to feel better as their own immune system overcomes the infection, so stop taking the antibiotic. This creates the selection pressure without destroying the bacteria.	We rely on people acting in the best interests of the community at large. In general, we do whatever we feel like doing.
Create new antibiotics.	Make new antibiotics faster than bacteria can become immune to them.	The development takes years and the success rate is very low, not only making it a slow process but a very expensive one.

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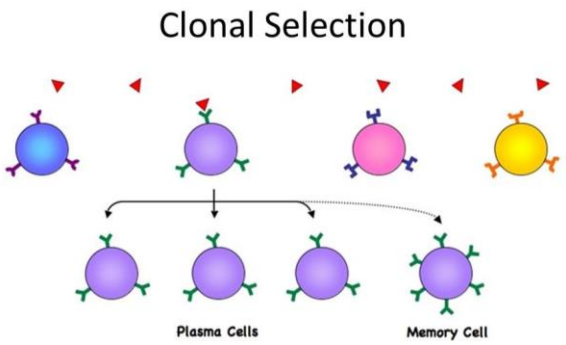
Stem rust fungus:

This parasite infects the plants stem, producing a covering that is the colour of rust. Like most fungi, the stem rust fungus produces dormant spores, which are carried in the air to new plants. On landing on a new plant, the spores germinate and produce threadlike structures called hyphae. A mass of this is called a mycelium. Like all fungi, it secretes digestive enzymes from its hyphae onto the material on which it is growing. The enzymes digest chemicals in the stem and the fungus absorbs the products of this digestion. Infection by stem rust fungus:

- Weakens the stem, often causing the plant to fall over, making mechanical harvest impossible.
- Uses nutrients that would otherwise be stored in the plant's seeds, reducing the harvest.
- Breaks the outer epidermis o the stem, increasing the rate of water loss and making the stem more susceptible to infection by other plant pathogens.



6. Stimulated by cytokine secretion from the T-helper, the activated B-cell divides rapidly by mitosis, forming a clone of cells called plasma cells, which are packed with RER. The antibody is mass-produced here and exported from the plasma cell by exocytosis. It is produced in such numbers that the antigen is overcome. The production of an activated B-cell, its rapid division, and the production of antibodies, is called clonal selection.
7. After these antibodies have destroyed the foreign matter, the antibodies disappear from the blood and tissue fluid, along with the bulk of the specific B and T cells that correspond. However, some of these activated cells are retained as memory cells, which are long-lived, and in the event of re-infection by the same antigen, these memory cells make an early and effective response possible.

The Cell-mediated Immune Response:

This response is brought about by T-cell activity. T-cells will bind to an antigen-presenting cell that has antigens from a pathogen on its surface. In doing so, the activated T-helper cell is formed that releases cytokines. The release of cytokines stimulates the activated T-helper cell to divide repeatedly to form a clone. Within this clone are three types of T cell:

1. **T-killer cells:** Destroy body cells infected by viruses.
2. **T-helper cells:** Release cytokines that stimulate production of B-cells.
3. **Memory cells:** Remain in the body and bring about the secondary response.

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Immunity and Vaccination:

There are multiple types of immunity, acquired in different ways.

	ARTIFICIAL IMMUNITY	**NATURAL IMMUNITY**	**LONGEVITY OF IMMUNITY**
ACTIVE IMMUNITY (ANTIBODIES MADE BY SUBJECT)	Antibodies made following administration of a vaccine. B cells, T cells, and memory cells are made.	Production of antibodies following infection by, and recovery from, a disease. B, T, and memory cells are made.	Long-lasting since memory cells are maintained throughout life.
PASSIVE IMMUNITY (ANTIBODIES MADE BY ANOTHER ORGANISM)	Antibodies administered by injection (immunisation).	Mother's antibodies cross placenta to foetus or ingested by baby in mothers' milk.	Fades with time, since the recipient has not made memory cells and the antibodies received are themselves treated as non-self-antigens and destroyed by the recipient's active immunity.

Vaccination is the deliberate administration of antigenic material to stimulate the recipient to develop active immunity against a pathogen. The active agent can be,