

Learning Intention: -To learn about the innate immune response and components of the first line of defence in animals and plants.

Success Criteria:

- I can name the barriers that prevent pathogenic infection in animals and plants.
- I can explain the preventive mechanism of pathogenic infection in animals and plants.

Study design dot point

- physical, chemical, and microbiota barriers as preventative mechanisms of pathogenic infection in animals and plants



Previous Knowledge:

- Immune system differentiates between ‘SELF’ and ‘NON-SELF’ **based on antigens**
- Self antigens are made by our own body’s cell and include the MHC markers (class I and II)
- Non-self antigens are from foreign materials, and are pathogenic if they cause harm to our own body
- Pathogens are disease causing agents and can be cellular or non-cellular
- Our skin, mucous, stomach, gut bacteria make up our first line of defense and protect us from most pathogens.

Warm up

While watching this video...

Take some quick notes how the body responds after infection, including any key terms

<https://www.youtube.com/watch?v=Vm9T6QoDnck>

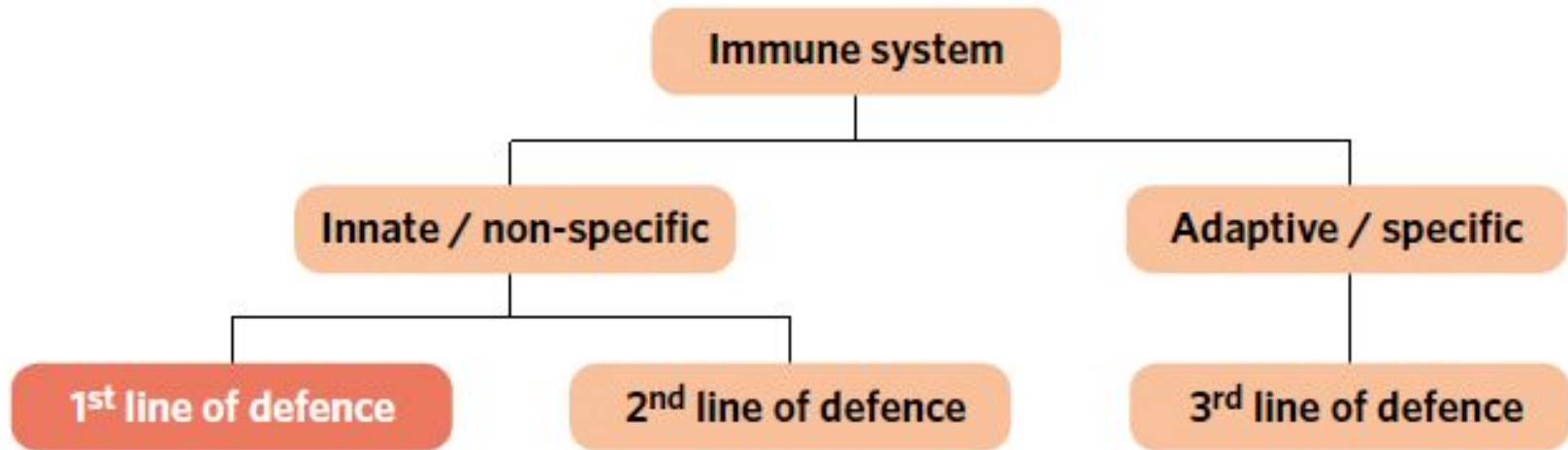


Figure 1 Breakdown of the immune system

Innate Immune system

The innate immune system is composed of two different defences:

1. **The first line of defence:** a component of the innate immune system characterised by the presence of physical, chemical, and microbiological barriers to keep pathogens out of the host organism
2. **Second lines of defence:** Component of the innate immune system characterised by the nonspecific response to injury and/or pathogens by a variety of cells and molecules.

Both of these mechanisms involve a non-specific response to foreign antigens, responding the same way regardless of the type of pathogen or antigen present. These two mechanisms respond to injury and antigens extremely quickly and limit the spread of infection and stimulate local changes at the site of injury.

First Line of Defence in plants

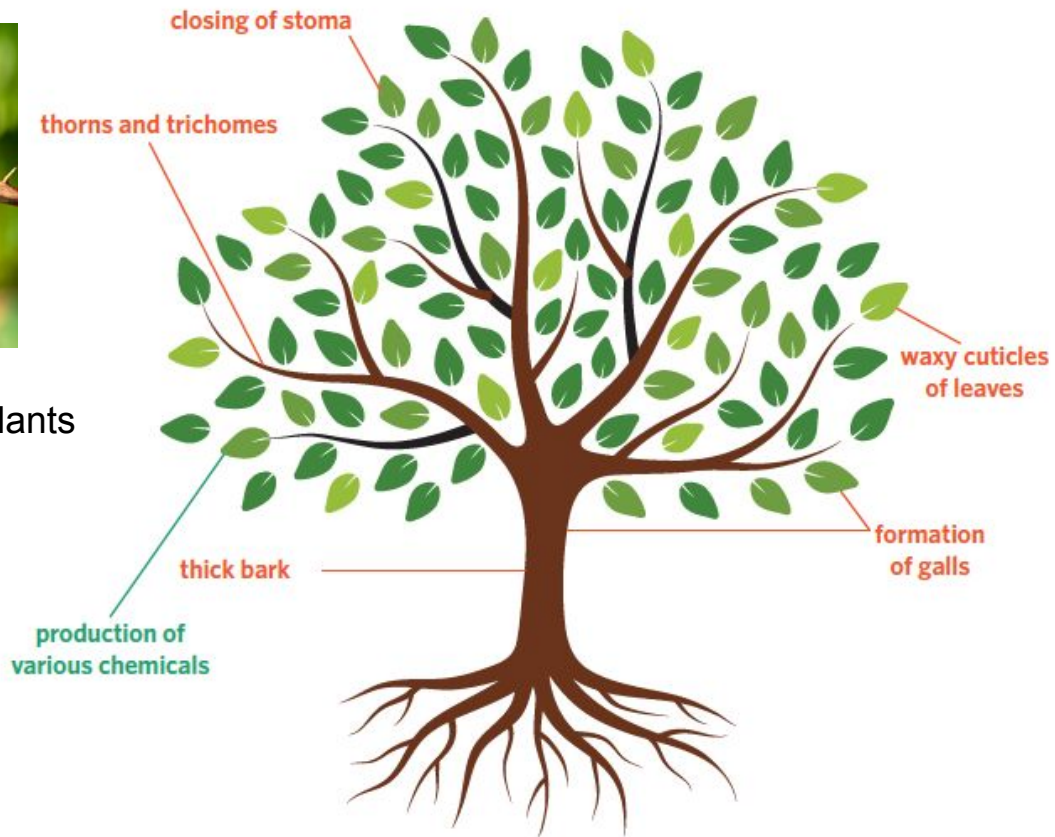
There are two types of barriers present in the first line of defence of plants – physical and chemical barriers.

Table 1 First line of defence in plants

Barrier type	Description	Examples
Physical	Barriers that prevent pathogens from physically entering the organism	<ul style="list-style-type: none">• Thick bark• Waxy cuticles of leaves• Formation of galls to prevent the spread of infection• Presence of thorns and trichomes to deter insects and grazers• Closing of stomata to prevent pathogen invasion during carbon dioxide uptake
Chemical	Barriers that involve the production of chemicals (e.g. toxins) which are harmful to the pathogen and/or enzymes that affect the functioning or development of the pathogen. Some chemicals can also act to repel insects or animals that may damage the plant	<ul style="list-style-type: none">• Chitinases - enzymes that occur in a number of different plants and have antifungal properties• Phenols - secreted by wounded plants, repelling or killing invading microorganisms• Defensins - small peptides that are toxic to microbes and fungi• Saponins - disrupt the cell membranes of various fungi• Oxalic acid - a substance that can be toxic if ingested• Glucanases - defend plants against fungi



Thorns and trichomes in plants



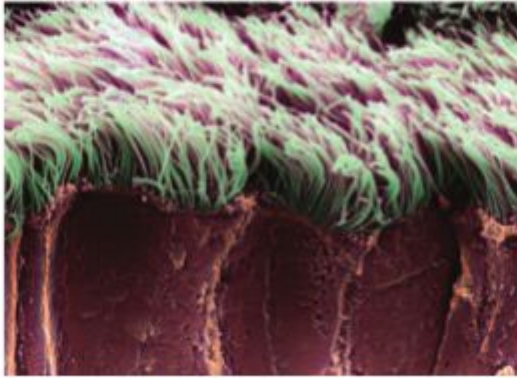
Galls in plants

First Line of Defence in animals

Animals have a number of first line defences against pathogens, including physical, chemical, and microbiological barriers.

Table 2 First line of defence in animals

Barrier type	Description	Examples
Physical	Barriers that block or hinder pathogens from entering the organism	<ul style="list-style-type: none">• Intact skin and surfaces between external and internal environments (e.g. integumentary, respiratory, gastrointestinal, and genitourinary tracts)• Mucous secretions and/or hairs in the respiratory tract that trap organisms, and cilia that sweep them away from the airways and into the throat where they are swallowed and destroyed by the gastrointestinal tract
Chemical	Barriers that work by producing chemical substances that make an environment unlivable for a pathogen	<ul style="list-style-type: none">• Presence of lysozyme enzymes in tears and saliva that destroy bacterial cell walls• Acidic sweat that destroys pathogens growing on the surface of the body• Stomach acid that destroys pathogens that have been eaten/swallowed• Antibacterial compounds in earwax• Antibacterial proteins in semen• Low pH in the vagina
Microbiological	The presence of non-pathogenic bacteria (known as normal flora) in the body can prevent the growth of pathogenic bacteria as they compete for space and resources	<ul style="list-style-type: none">• Presence of bacteria on the skin, in the lower gastrointestinal tract, and the vagina



Mucous membrane (or bronchial epithelium) that lines the major airways of the lung

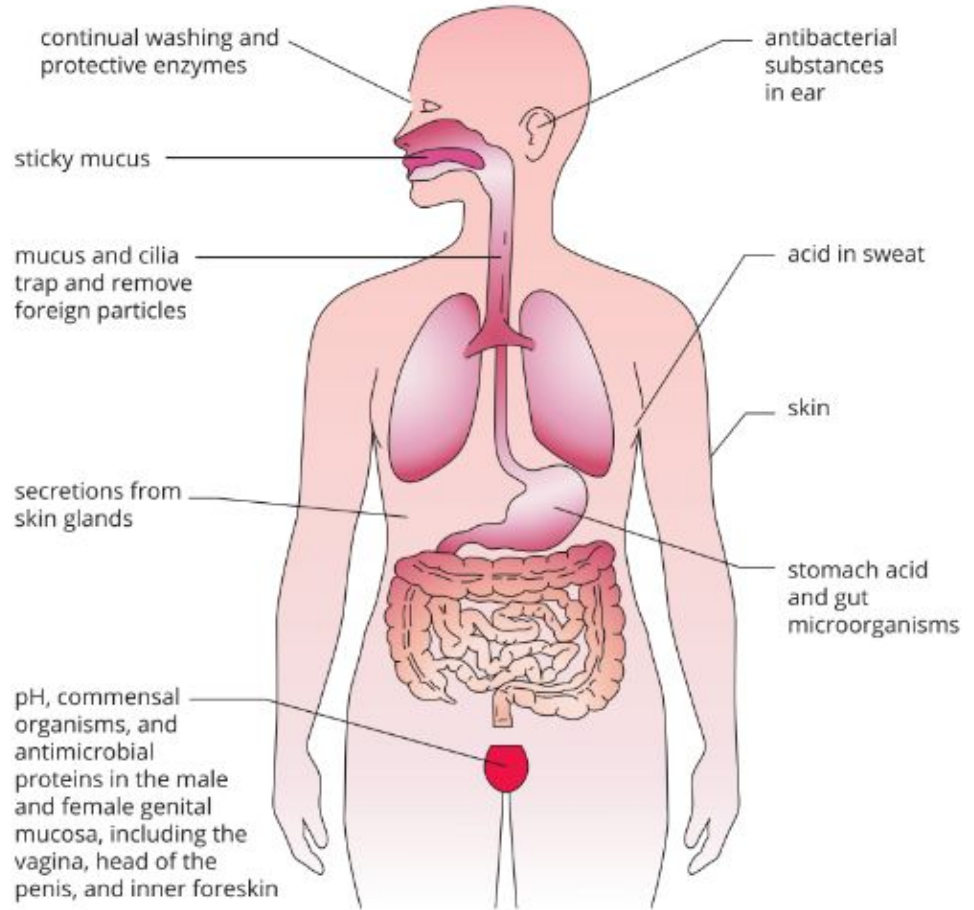


FIGURE 8.2.4 Some of the physical and chemical defence mechanisms that prevent foreign organisms from gaining access to the human body

Worked Example

Describe the features of an innate immune system.

An innate immune system includes physical, chemical and biological barriers. In animals, physical barriers include skin, the exoskeleton and mechanisms to remove pathogens such as vomiting and other secretions. In plants, physical barriers include waxy cuticles, thick bark, thorns and spines. Chemical barriers include enzymes, fatty acids, stomach acid, acidic secretions and thick mucus in animals, and deadly odours, a bitter taste, chemical messengers, toxic molecules and the sealing of infected cells in plants. Animals also have a biological barrier in the form of their microbiota

Summary

- Barriers that provide innate resistance include physical, chemical and biological barriers in both plants and animals.
- Physical barriers in animals include intact skin and mucous membranes.
- Chemical barriers include various secretions. Secretions that contribute to preventing entry include mucus, tears, saliva and urine.
- The so-called ‘normal flora’ that are the non-pathogenic bacterial residents of regions of the body act as a microbiological barrier to pathogenic bacteria.
- Plants have physical and chemical barriers to stop pathogenic invasion. They do not have a second or third line of defence, so they rely on preventing pathogenic entry.

Reflection

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