HOMEOSTASIS

Inquiry question: How is an organism's internal environment maintained in response to a changing external environment?

Homeostasis is a process by which an organism maintains a constant internal environment, despite fluctuating external environment conditions. The process of homeostasis involves:

- Detecting changes from the stable state
- Counteracting changes from the stable state in a **negative feedback loop**.

KEY TERMS:

- Homeostasis
- Stimulus
- Response
- Optimal Metabolic Efficiency

Feedback refers to the bodies efforts to detect change, put in pace an action to adjust the change then to send a message (feedback) about the change. Once the feedback tells the body about the change, further actions will be initiated to maintain homeostasis. This is a continuous process.

The **'internal environment'** refers to the conditions within the body, such as temperature, blood pressure, blood sugar level, and acid–base balance. Homeostasis mechanisms keep the internal environment in a consistent state, which is necessary for the correct functioning of the body's tissues and organs.

Four things that cells do to **maintain homeostasis** include acquiring energy, reproducing new cells, exchanging materials, and eliminating wastes.

A **'constant environment'** means that all factors inside the organism's body are kept within a 'normal' range.) By maintaining a constant internal environment, enzymes can work and carry out their functions efficiently. Examples of homeostasis include thermoregulation, blood glucose regulation and baroreflex in blood pressure.

'Optimal metabolic efficiency' is achieved when enzymes can work at their most efficient rate. The conditions under which enzymes work best are known as 'optimal conditions'. Each enzyme has optimal pH and temperature at which they work best.

STIMULUS: change is detected (body detects change from stable state). The variable that is being regulated. In general, the stimulus indicates that the variable's value has deviated from the set point or has moved outside of its typical range.

RESPONSE: change is counteracted.

PROCESS:

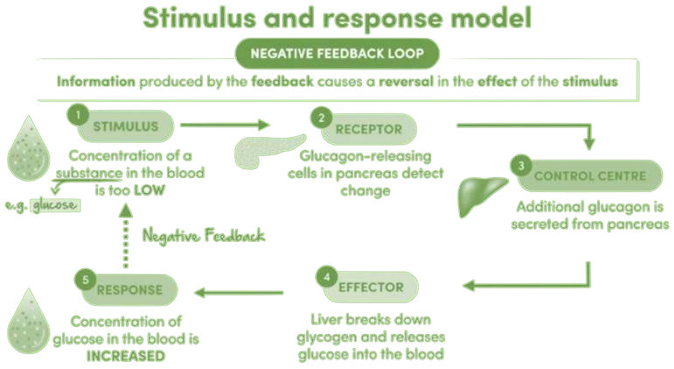
(1) the stimulus

(2) the receptor

(3) the control centres

(4) the effector

(5) the response



Stimulus (change) → **receptors** (detect change and convert into impulse) → **control centre** (brain/spinal cord) → messenger (communicates message from CNS to effector) → **effector** (receives message and causes response) → **response** (change in body).

In words, the **stimulus** is received, detected by a **receptor**, and then sent to the central nervous system. The **control centres** then release a neural or hormonal messenger to activate an **effector** and **respond** to the stimulus.

SUMMARY of 8.1

Homeostasis	a self-regulating mechanism that allows biological systems to maintain stability while adapting to changing external situations.
Process	1.Stimulus (change)→ 2. Receptors→ 3. Control centre→ 4. Effector → 5. Response
Example	Thermoregulation- a mechanism by which mammals maintain body temperature with tightly controlled self-regulation independent of external temperatures

8.1.2a-

investigate the various mechanisms used by organisms to maintain their internal environment within tolerance limits, including:

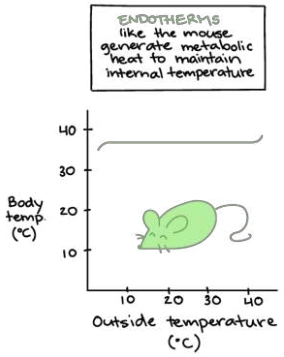
- *trends and patterns in behavioural, structural, and physiological adaptations in endotherms that assist in maintaining homeostasis*

KEY TERMS:

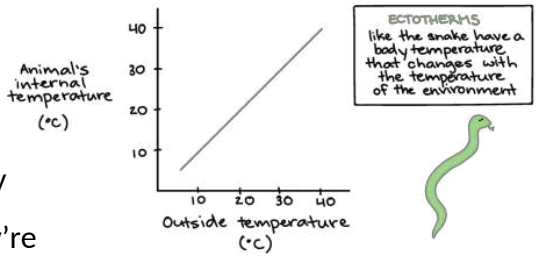
- Trends
- Patterns
- Endotherms
- Ectotherms
- Adaptations
- homeostasis

Trends are the general direction of lines of best fit in data. A trend can be increasing, decreasing or stable (plateau). They show whether a correlation exists in the data. To describe a trend, describe the behaviour of the dependent variable as the independent variable changes.

Patterns are recognizable forms found in data. Analysts look at data and distinguish ideas, draw conclusions, and make predictions.



Animals are either ectothermic (poikilothermic) or endothermic (homoiothermic). **Endotherms** are 'warm-blooded' creatures, which means they can keep their internal body temperature constant regardless of the surrounding environment. Humans, like most birds and mammals, are endotherms. Endotherms, which burn chemical fuel to maintain a consistent temperature range, require a lot of energy from meals. Endotherms can remain active in variable environmental temperatures due to their constant body temperature and have thus effectively conquered a wider range of ecosystems on Earth. 2



Ectotherms are 'cold blooded' organisms, which means their internal temperature varies with the outside temperature. They become more active as the surrounding temperature rises, and they become sluggish and lethargic as the temperature drops. Since they're dependent of environmental temperatures, ectotherms are limited in the habitats they may inhabit.

Adaptations are features of organisms that increase its chances of survival and reproduction in an environment.

- **Structural adaptation-** physical features, 'STRUCTURAL RESPONSE'.
- **Behavioural adaptation-** instinctual behaviours which allow organisms to survive in their

Behavioural Adaptation for Thermoregulation:

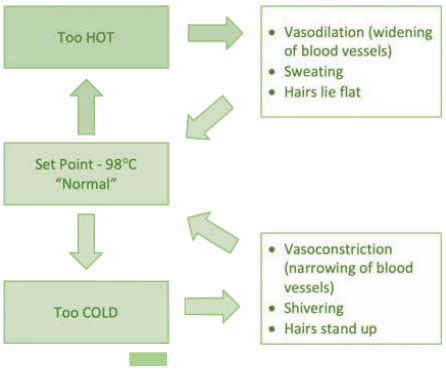
Behavioural Adaptations are an organism's actions that allow it to survive in its surroundings (e.g., bears hibernate in winter to escape the cold temperatures and preserve energy).

The preservation of homoeostasis in mammals depends heavily on **thermoregulation**.

- Organisms try to reduce the energy costs when returning to **normothermia** (A condition of normal body temperature) and their capacity for thermoregulation is closely tied to energy balance.

environment,

ture results in higher rates of energy use.
can alter their behaviour to lessen work
e energy expenditure of thermoregulatory



rategies used by various mammal species
o changes in ambient temperature, both
Furthermore, as the brain, metabolic, energetic, and endocrine systems all have a role in controlling thermoregulation, variables like the time of day, the season, the sex of the organism, or their age may have an impact on how the body regulates its temperature.

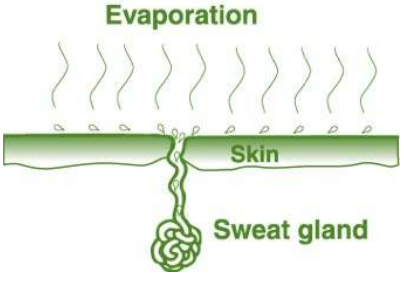
Some specific examples of learned behaviours include:

- ⇒ Behavioural changes include swimming, drinking cold water, sitting in a shade etc. Endotherms also have specific behaviours in response to temperature change. For example, elephants spray themselves with water in the heat to cool down.
- ⇒ In the cold, animals can sunbake to allow the heat from solar radiation to soak into their skin. Sunbaking can also increase SA: V ratio in order for heat absorption.
- ⇒ Some animals, like birds, migrate depending on the time of the year. During the colder seasons, birds will migrate toward the equator to stay warm, and they will migrate toward the tropics once the warmer seasons arrive.
- ⇒ Animals also lick themselves in order for move heat to be evaporated by the saliva.
- ⇒ Animals will also deliberately use their muscles, by running or jumping, will contract the muscles and generate additional heat energy to keep the organism warm.

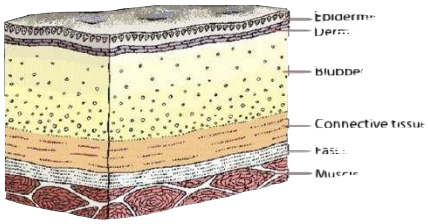
Structural Adaptation for Thermoregulation:

Structural Adaptations are physical characteristics of an organism that allow it to survive in its environment (e.g., a penguin has blubber to protect itself from freezing temperatures). Animals use different insulating mediums, such as hair or feathers, to reduce the heat transfer to the environment.

Sweat glands are coiled tubular structures vital for regulating human body temperature. These sweat glands help in cooling down excessive body temperature. The liquid has one main purpose: as it evaporates, it helps to cool the body. Sweating is regulated by the autonomic, or sympathetic, nervous system.



The hairs on the skin aid to regulate an organism's body temperature. They lie flat when we are warm and rise when we are cold. The hairs trap a layer of air above the skin, which helps to insulate the skin against heat loss. Fur does the same thing as hair, as it keeps us warm in an insulated layer and protects us from solar radiation. An animal's fur will trap a layer of heat between the skin and the fur, keeping the animal warm. Humans do not have enough body hair to keep them warm during the winters, therefore, clothes come in handy as they act as a layer of insulation.



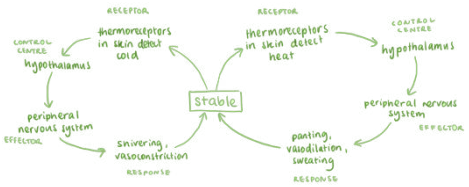
Marine mammals have blubber to keep them warm in the cool temperatures. Blubber is a thick layer of fatty tissue directly under the skin that stores energy, insulates heat, and increases buoyancy. For example, whales and penguins use this method to keep them warm during winter.
Birds which have adapted to cold-climates put on weight in the late summer and autumn to prepare for the cold winter, but feathers also key factors in keeping birds warm. All birds stay warm by trapping pockets of air around their bodies and they maintain these layers of air by staying clean, dry and having healthy feathers.

SA: V Ratios:
Small objects have a large Surface Area: Volume ratio. As the SA: V increases, the heat exchange from the organism to the environment also increases.

- This means that the larger the animal and the smaller the SA: V ratio, the more protected against the extreme temperatures these animals are.
- This would typically mean that larger animals can survive in the colder, extreme temperatures and the smaller animals live in temperate, warmer climates.
- Some animals have larger body parts to release or conserve heat. E.g., little foxes with large ears utilise their ears to release heat into their environment.

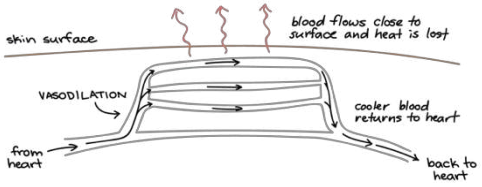
Physiological Adaptation for Thermoregulation:

Physiological adaptations are internal and/or cellular characteristics of an organism that allow it to survive in its surroundings (e.g., snakes produce poisonous venom to ward off predators and to capture prey).



⇒ In case of cold weather to avoid the body from losing heat to the environment, shrinking the diameter of blood vessels in a process known as vasoconstriction, reduces blood flow and helps retain heat.

⇒ In case of warm weather to expel heat from the body, these blood vessels get wider, or dilate. This process is called vasodilation. Vasodilation increases blood flow to the skin and help the animal lose some of its extra heat to the environment.



⇒ Moist surfaces lose heat quicker than dry surfaces through evaporative cooling. Sweating, licking and panting is seen in endotherms, especially in areas with clumped blood vessels, maximising efficiency for heat loss. To reduce the excess heat from the organism, animals' begin to breathe swiftly and shallowly with their mouth open, referred to as panting. This process of panting allows evaporation through the mouth of the animal, therefore cooling down the body temperature.

⇒ **Hibernation** is another tactic. It allows animals to conserve energy to survive adverse weather conditions or lack of food. It involves a physiological change in the organism, such as the reduction in body temperature and slowed metabolism. Hibernation is an extended form of torpor which occurs when an animal lowers its heart and respiratory rate down to a point that saves energy.

Hibernation vs Torpor

Hibernation	*Torpor*
Hibernation is when an organism spends the winter in a state of dormancy; it is long-term multiday torpor for survival of cold conditions.	Torpor involves physiological changes related especially to body temperature, metabolism, and water balance.

SUMMARY of 8.1.2a

Endotherm	Organisms that maintain a constant body temperature independent of the environment.
Ectotherm	Any animal whose regulation of body temperature depends on external sources
Adaptations	Features of organisms that increase its chances of survival and reproduction

	in an environment.
Structural Adaptation	Physical characteristics o Sweating to cool down body temperature o Fur, feathers and blubber are structural adaptions to allow for thermoregulation o SA: V ratios
Behavioural Adaptations	Organism's actions o Finding shade to remove solar radiation from their bodies o Finding water to cool body temperature
Physiological Adaptations	Internal characteristics o Shrinking of blood vessels in the cold (vasoconstriction) o Dilation of blood vessels in the heat (vasodilation) o Hibernation and torpor

8.1.2b-

investigate the various mechanisms used by organisms to maintain their internal environment within tolerance limits, including:

- *internal coordination systems that allow homeostasis to be maintained, including hormones and neural pathways*

KEY TERMS:
- Internal environment
- Tolerance limit
- Homeostasis
- Hormones
- Neural pathways

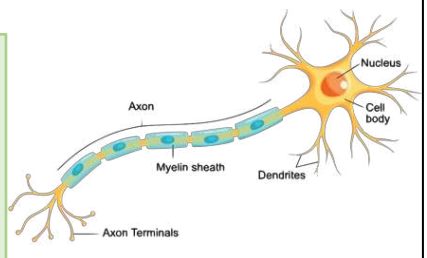
Internal Coordination Systems for maintaining Homeostasis

When deviations in the external environment cause deviations in the internal environment, the hormonal and endocrine and nervous systems restore stability.

A neural pathway is the connection allowing a signal to be conveyed from one part of the nervous system to another. The neural pathways carry nerve impulses along nerve cells, called neurons. Electricity travels between neurons to deliver information and signals.

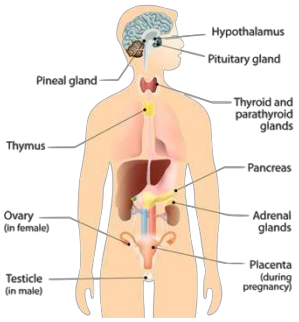
NEURONS

The main cell type is a neuron- neurons have a unique shape and function as they conduct electrochemical messages quickly round the body. They transfer information between different parts of the brain and between the



Endocrine System:

The word endocrine comes from 'endo' meaning 'from within' and 'krine' meaning 'to secrete'.

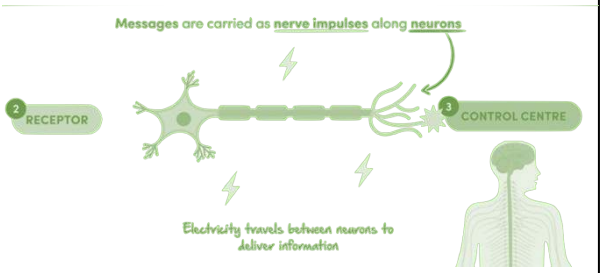


The endocrine system regulates processes such as metabolism and growth rate in the body by secreting hormones into the bloodstream and directing them to other organs. It is a complex network of glands and organs which coordinate the body's metabolism, energy levels and respond to injury or stress. The endocrine system maintains homoeostasis while also ensuring that the composition of the body fluids bathing the constituent cells remains consistent.

The control and maintenance of blood sugar levels is a key example of bodily regulation by the endocrine system. Hormones are transported by the bloodstream to target cells containing receptors for the hormone. The hormones cause the cells to change their activity in a way that will maintain homeostasis, e.g., influencing activity or concentration of enzymes.

- E.g., endocrine system sustaining homeostasis: Blood sugar is maintained by two hormones secreted by the pancreas: insulin and glucagon (hormones)

The Nervous System:



The nervous system allows all the body's parts to communicate with one another. It reacts to external and internal changes. The nervous system utilises both electrical and chemical methods to send its signals through the body. The nervous system is made up of two main parts: the central nervous system and the peripheral nervous system. It is mostly made up of nerve tissue and connective tissue. The brain, spinal cord, and nerves are the main organs.

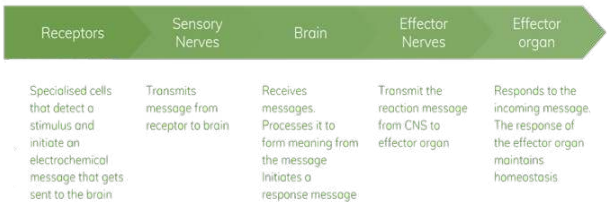
Central nervous system: The brain and spinal cord are the major components to the central nervous system (CNS). It's one of the two components of the nervous system. The peripheral nervous system, which is made up of nerves that connect the brain and spinal cord to the rest of the body, is the other component. The body's processing centre is the central nervous system.

Peripheral nervous system: The peripheral nervous system (PNS) is one of two parts that make up a bilateral animal's nervous system; the other is the central nervous system (CNS). Other than the major parts, such as the brain and spinal cord, the PNS is composed of nerves and ganglia.

Providing the correct chemical environment for biological activities to occur is essential in homeostasis. Sense organs monitor any changes in the internal environment, such as chemoreceptors that detect oxygen partial pressure in the arterial blood, mechanoreceptors that detect blood pressure, and chemoreceptors within the central nervous system that detect hydrogen ion concentration or various hormones. To counteract the disruption, information from the sense organs is supplied to the central nervous system, which processes it and sends appropriate outputs to the effectors, such as striated, smooth, and cardiac muscle, and glands.

The Brain:

The human brain is the most complicated organ in the body. The brain is three pounds worth of knowledge as it is a sense decoder, a movement instigator, and a behaviour manager. The hypothalamus serves as your body's intelligent control and coordination centre. Its major job is to keep your body in a state of homoeostasis, or balance. It accomplishes this via altering your autonomic nervous system or by controlling hormones. The hypothalamus serves as a link between the endocrine and neurological systems, relaying instructions from the brain to the pituitary gland, which controls the activity of the endocrine glands and regulates body temperature, appetite, and thirst.



- The brain is the main control centre of the body
- The hypothalamus is the control centre for the regulation of many activities or the body that maintains homeostasis.
- It is the link between the nervous system and the endocrine system- responsible for hormone secretions

hypothalamus

How do Neural Pathways Coordinate Homeostasis?

The sensory nerves take messages from receptors:

- Photoreceptors detect light
- Thermoreceptors detect heat
- Osmoreceptors detect water levels
- Olfactory receptors detect small
- Nociceptors detect pain

The brain then decides the appropriate response to the information and sends messages to effectors to respond to the stimuli via effector nerves.

SUMMARY of 8.1.2b

Neural Pathways	A neural pathway is the connection allowing a signal to be conveyed from one part of the nervous system to another. The neural pathways carry nerve impulses along nerve cells, called neurons. Electricity travels between neurons to deliver information and signals.
The Endocrine System	By secreting hormones into the bloodstream and directing them to other organs, the endocrine system regulates activities such as metabolism and growth rate in the body.
The Nervous System	The nervous system allows all the body's parts to communicate with one another. CNS: The brain and spinal cord PNS: Outside of the brain and spinal cord
The Brain and Hypothalamus	The hypothalamus serves as a link between the endocrine and neurological systems.
Systems in Homeostasis-	Endocrine: controls blood sugar levels by releasing hormones such as insulin and glycogen. Nervous: regulates core body temperature Brain: regulates body temperature, appetite, thirst

8.1.2c-

investigate the various mechanisms used by organisms to maintain their internal environment within tolerance limits, including:

- *mechanisms in plants that allow water balance to be maintained*

KEY TERMS:

- Internal environment
- Homeostasis
- Water Balance
- Stomata
- Transpiration

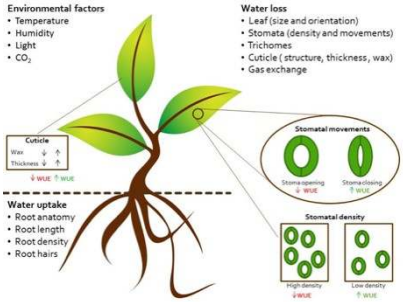
Australia is one of the driest continents in the world and the plants in this country must cope with little water in hot, dry conditions. When plants can't maintain water balance:

Plasmolysis: The cell membrane is sucked inwards, pulling away from the cell wall (rigid and cannot change shape). Eventually, the cell cannot exchange anything with its external environment and dies.

Xerophytes are plants which have adapted to live in dry, warm conditions- these plants have features that minimise their water loss from transpiration. The vegetation of Australia is largely dominated by xerophytes a subclass of xerophytes - the sclerophytes - which are hard-leaved plants (although they have several other associated traits) adapted to both low or variable availability of water and low nutrient levels, especially low phosphorus soils.

Transpiration is the mechanism through which plants lose water vapour through their stomata. When the temperature is hot, the loss of water vapour from the plant cools it down. Water from the stem and roots flows upwards and is released into the leaves.

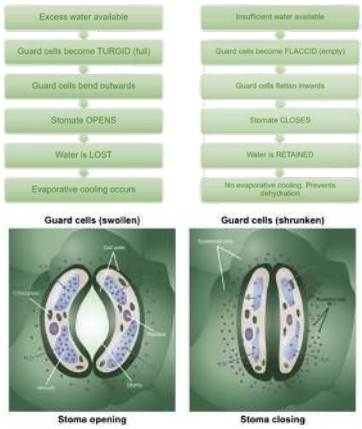
Plants are in **water balance** when they have the correct amount of water to carry out life processes like photosynthesis. Plants collect water from the soil through their roots (if they have roots), utilise it to maintain homoeostasis, and the rest evaporates through the plant's epidermis through the open stomata.



Stomata:

Stomata are defined as any of the minute pores in the epidermis of a plant's leaf or stem that form a variable-width slit that allows gases to flow in and out of intercellular spaces. The function of the stomata is the most important mechanism of plants that maintain water balance. They must carefully balance the plant's needs to stay cool and also conserve water.

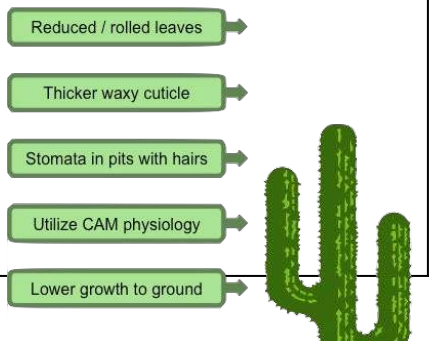
- Guard cells become turgid during times of excess water, thus opening the stomata to allow increased transpiration and evaporative cooling.
- In comparison, they became flaccid during dry spells, thus closing the stomata and conserving water but reducing the capacity for evaporative cooling
- Plants in hot environments may have sunken stomates to reduce water loss.



Types of leaves:

Needle leaves: reduce surface area and water loss

Hanging leaves: sclerophyll leaves hang vertically rather than being held horizontal to the ground--> reduces sun exposure, especially at midday.



Waxy, reflective cuticle: reduce water loss as a thick cuticle prevents evaporation reflects infrared radiation from sun, reducing heat gain

Leaf curling: reduces SA from which transpiration can occur, traps a humid layer of air around the stomates which reduces water loss by transpiration.

Woody fruit: less water loss than in fleshy fruits (also fire resistant)

Sunken stomata: reduce water loss in the stomates

Hard fruit: less water requirements from the fruit

Loss of leaves during dry periods: less water requirements from the leaves, less leaves = less solar radiation.

SUMMARY of 8.1.2c

Water loss	Plants lose water vapour through their stomata through a process known as transpiration. When the weather is very hot, the plant loses water vapour, and water from the stem and roots flows upwards or is pulled into the leaves, cooling the plant.
Stomata	any of the minute holes that form a variable-width gap in the epidermis of a plant's leaf or stem and allow gases to move in and out of intercellular spaces.
Leaves reducing transpiration	o Smaller SA: V ratio o Reducing solar radiation o Waxy, reflective cuticle reducing evaporation from the sun o Reducing water usage and loss

CAUSES AND EFFECTS

Inquiry question: Do non-infectious diseases cause more deaths than infectious diseases?

Non-Infectious Diseases:

Non-infectious diseases are caused by heredity, malnutrition, the environment, lifestyle, etc., meaning these types of diseases aren't caused by pathogens, they can't be passed from one person to the next. Cancer, Alzheimer's disease, and epilepsy are examples of non-infectious diseases.

8.2.1a-

KEY TERMS:

- Non-infectious diseases
- Genetic diseases
- Genome
- Hereditary
- mutations

investigate the causes and effects of non-infectious diseases in humans, including but not limited to:

- *genetic diseases*

Genetic Diseases:

Genetic diseases are disorders resulting from an altered or incorrect expression of a gene or a change to a whole chromosome. The faulty gene may be hereditary, meaning the gene is inherited from one or both parents. The altered gene causes a production of a faulty protein, with too much or too little protein being produced. Some types of genetic disorders result from changes within the genes that are present in many cells across the body. Unfortunately, this means that many disorders often affect multiple bodily systems or major organs, and most cannot be prevented or cured. However, approaches may be available to treat or manage some of the associated signs and symptoms.

- Caused due to abnormalities in genome.
- Usually rare
- Can be hereditary

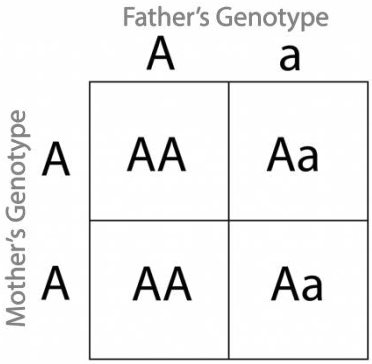
Examples of genetic diseases include:

⇒ *Cystic fibrosis:* A genetic condition that affects the lungs, digestive system, and other body organs severely. Caused by mutations in genes or hereditary.

⇒ *Down syndrome:* Down syndrome, also known as trisomy 21, is a genetic disease characterised by the presence of a third copy of chromosome 21 in all or part of a person. Caused by chromosomal changes.

⇒ *Sickle cell anaemia:* A series of diseases that cause red blood cells to break down and become malformed. A gene defect causes sickle cell disease, which is an inherited condition.

A Punnett square is a graph utilised to calculating the expected percentage or chance of different genotypes and phenotypes presenting in the offspring of two parents. It is utilised to calculate the chances of dominant and recessive genes presenting within children A Punnett Square is a helpful tool that helps to predict the variations and probabilities that can come from cross breeding. This includes predicting crossing plants, animals, even humans with each other.



Genetic Diseases can be classified into four types:

1. **Single-gene inheritance diseases:** Single gene disorders are caused by mutations in a single gene, and their inheritance patterns are frequently predictable.
2. **Multifactorial genetic inheritance disorders:** When more than one element causes a trait or health concern, such as a birth defect or persistent sickness.
3. **Chromosome abnormalities:** A chromosomal anomaly is an alteration in a kid's genetic material or DNA that affects the development of the child before birth.
4. **Mitochondrial genetic inheritance disorders**: chronic (long-term), genetic, often inherited disorders that occur when mitochondria fail to produce enough energy for the body to function properly.

Causes:

- One of the most common causes of genetic illnesses is mutation. Variable genetic illnesses are caused by deviations in the normal functioning of genes caused by various physical and chemical entities.
- Changes in chromosomal number and shape can lead to hereditary disorders.
- Genetic recombination has been linked to the development of genetic disorders.
- They are passed down through the generations through reproduction (hereditary)
- They can range from basic issues like myopia to more serious issues like haemophilia. E.g., Down Syndrome is a hereditary disease which is caused by the inheritance of an extra chromosome called trisomy 21.

Effects:

- Normal development and growth of people who are diagnosed with genetic diseases are hampered.
- Makes a person more prone to non-genetic diseases.
- Can affect intellectual ability
- Developmental delays
- Fatigue and weakness

SUMMARY of 8.1.2a

Genetic diseases	Genetic diseases are disorders resulting from an altered or incorrect expression of a gene or a change to a whole chromosome. There are four types of genetic diseases: 1. Single-gene inheritance diseases

	2. Multifactorial genetic inheritance disorders 3. Chromosome abnormalities 4. Mitochondrial genetic inheritance disorders
Causes	- Caused due to abnormalities in genome. - Usually rare - Can be hereditary
Effects	o can affect development and growth o can make a person more prone to non-genetic diseases. o Weakness o Developmental delays
Examples	⇒ Sickle cell anaemia ⇒ Down syndrome ⇒ Cystic fibrosis

8.2.1b-

investigate the causes and effects of non-infectious diseases in humans, including but not limited to:

- *diseases caused by environmental exposure*

KEY TERMS:

- Non-infectious diseases
- Environmental exposure by

Diseases Caused by Environmental Exposure:

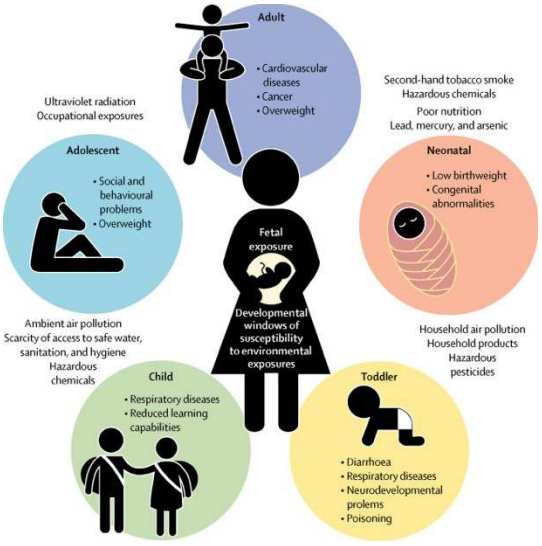
Diseases caused by environmental exposure are a direct outcome of contact to toxins or substances in the environment that make organisms sick.

Causes:

- Exposure to toxins
- Different types of radiations
- Overexposure to chemicals used in personal healthcare products

Effects:

- Evokes adverse immune reactions.



Examples of Early Life environmental exposures

- Can lead to different water borne diseases which can be fatal for humans such as diarrhoea and cholera.
- Leads to respiratory disorder and diseases such as asthma, bronchitis and in extreme cases, tuberculosis.
- At times, toxic substances get mixed with agricultural produce which can slowly cause harm to human health when taken in dietary form.
- Radiations can induce mutation that may result in genetic diseases.
- Both radiations and chemicals in personal healthcare products can cause skin diseases such as eczema, rashes, skin lesions and sometimes, skin cancer.

Examples of diseases caused by the environment include:

- ⇒ **Allergies:** sensitivity of the immune system in response to the specific antigens and toxins within the environment
- ⇒ **Asthma:** A condition in which a person's airways become inflamed, constrict, and bulge, as well as create excessive mucus, making breathing difficult. Pollen, dust mites, mould spores and cockroach waste particles are examples of airborne allergens.
- ⇒ **Allergic Rhinitis:** When the immune system overreacts to allergens in the air, it causes inflammation in the nose.

SUMMARY of 8.2.1b

Diseases from environmental exposure	Caused due to a variety of environmental factors
Causes	- Exposure to dangerous toxins - Radiations - Exposure to chemicals
Effects	o Immune reactions o Respiratory diseases o Gene mutations o Skin diseases o Water borne diseases o Can be fatal
Examples	⇒ Allergies

	⇒ Asthma ⇒ Allergic rhinitis

8.2.1c-

investigate the causes and effects of non-infectious diseases in humans, including but not limited to:

- *nutritional diseases*

KEY TERMS:
- Non-infectious diseases
- Nutritional diseases

Nutritional Diseases:

Nutritional diseases occur due to poor or excess in diet or a change in intake of specific dietary elements.

Causes:

- Body not getting adequate amount of nutrients from dietary intake.
- Inability to absorb nutrients from the dietary intake due to some other form of health disorder.
- Body unable to eliminate unnecessary components of the dietary intake.

Chronic undernutrition is the most serious nutrition related disease, affecting over 925 million people worldwide

Effects:

Can affect a number of diseases in different parts of the body such as:

- ⇒ *Cardiovascular Disease*: Excessive fat intake can cause blockage in arteries causing heart diseases.
- ⇒ *Obesity:* fat accumulation resulting into overweight and in severe cases, obesity.
- ⇒ *Diabetes mellitus:* Lack of insulin to convert this excess amount of glucose into glycogen causes the glucose to accumulate in the bloodstream causing high levels of blood sugar.
- ⇒ *Scurvy:* causes swelling of body parts and teeth start to fall out.
- ⇒ *Iron deficiency:* may cause fatigue, shortness of breath, dizziness, increased heart rate
- ⇒ *Rickets:* causes weak bones, bone deformities, skull abnormalities, cramping, muscle weakness.

SUMMARY of 8.1.2c

Nutritional diseases	Changes in nutritional intake
Causes	- inadequate nutrient levels

	- inability to absorb nutrients - poor diet - changes in dietary elements.
Effects	o Can cause excess fat to block vital organs, such as the heart (cardiovascular disease) o Can cause bodily swelling (scurvy) o Glucose accumulation in bloodstream (Diabetes Mellitus) o Weakness in bones or muscle
Examples	⇒ *Scurvy:* causes swelling of body parts and teeth start to fall out. ⇒ *Iron deficiency:* may cause fatigue, shortness of breath, dizziness, increased heart rate ⇒ *Rickets:* causes weak bones, bone deformities, skull abnormalities, cramping, muscle weakness.

8.2.1d

KEY TERMS:
- Non-infectious diseases
- Cancer

investigate the causes and effects of non-infectious diseases in humans, including but not limited to:

- *cancer*

Cancer:

Cancer is a non-infectious disease which occurs when certain cells in the body spread uncontrollably around the body. Cancer can start basically anywhere within the body in the masses of cells.

In 2020, there was an estimated 18.1 million cancer cases around the world. Of these cases, over half of them were found in men.

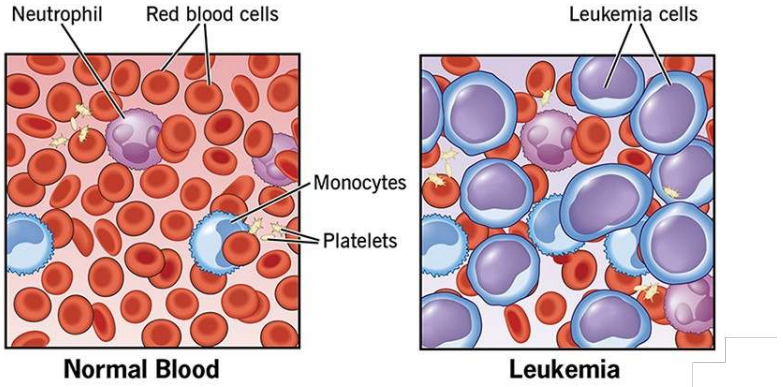
Causes:

- Exposure to chemical or toxic compound such as asbestos, tobacco or cigarette smoke (contains at least 66 known potential carcinogenic chemicals and toxins.
- Exposure to ionizing radiations such as ultraviolet rays from sunlight, radiation from alpha, beta, gamma, and X-ray-emitting sources.
- Invasion of pathogens such as Human papillomavirus (HPV), EBV or Epstein-Barr virus, hepatitis viruses B and C

- A number of specific cancers have been linked to human genes and are as follows: breast, ovarian, colorectal, prostate, skin and melanoma.

Effects:

- Hair loss
- Fatigue
- Skin changes, including rashes and burns
- Swelling
- Decreased physical skills, including athletic abilities, balance, and agility
- Weight loss or gain
- Infertility, or the inability to conceive a child



Examples of prevalent cancer diseases include:

⇒ *Leukaemia:* Leukaemia is a blood-forming tissue cancer that affects the bone marrow and lymphatic system. Leukaemia is caused by an unknown combination of genetic and environmental factors, which can cause mutations in the cells that make up the bone marrow.

⇒ *Melanoma:* Melanoma is a type of skin cancer that starts in the pigment-producing cells, called melanocytes, and malignant cancers form in these cells. This cancer is mostly found on the exterior of the body, such as the skin, but can also develop in the eyes and, in rare cases, inside the body, such as the nose or throat.

SUMMARY

Cancer	Cancer is a disease in which some of the body's cells grow rapidly and migrate to other places.
Causes	o Exposure to dangerous toxins or chemicals, such as tobacco smoke o Exposure to radiation o Specific genes
Effects	- Hair loss - Weight gain/weight loss - Weakness and loss of agility and stamina

	- Infertility - Hair loss and skin changes
Examples	*Leukemia:* a blood-forming tissue cancer that affects the bone marrow and lymphatic system. *Melanoma:* a type of skin cancer that starts in the pigment-producing cells, called melanocytes, and malignant cancers form in these cells

PREVENTION

Inquiry question: How can non-infectious diseases be prevented?

8.4.1a-

use secondary sources to evaluate the effectiveness of current disease-prevention methods and develop strategies for the prevention of a non-infectious disease, including but not limited to:

- *educational programs and campaigns*

KEY TERMS:

- Disease prevention
- Non-infectious diseases
- Educational programs
- Campaigns

Educational programs are any programs utilised to engage in the provision of education, including programs which teach the general public about ideas, concerns, etc.
Health educational initiatives are important for a myriad of reasons such as raising disease awareness among the general public, enhance knowledge on the issue, influencing people's values and attitudes, encouraging people to help, donate or educate, etc.

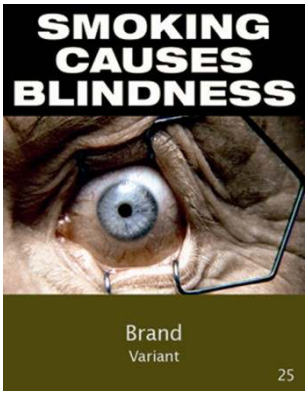
Educational Initiatives may include:

- Social media is a broad platform that can be used to notify the wider public about the dangers of specific diseases and how they can be evaded.
- Educational documentaries can be established to portray how a person's actions make them susceptible to diseases.
- On specific national days devoted to the awareness and informing of certain diseases, such as Diabetes Day, World Heart Day, etc., events can be held where people can learn about diseases and how to prevent them.

A key example of a health initiative to prevent the spread of a disease is the labels on smoking packet.

Cigarette Packet Labels:

Cigarette smoke contains harmful chemicals that, overtime, damage our DNA. The chemicals in cigarettes make it more difficult for cells to repair DNA damage and harm the sections of our DNA that guard us against cancer. Cancer is caused by the accumulation of DNA damage in a single cell over time, and through continuous smoking, about 90% of Australian lung cancer cases in males and 65% in females are estimated to be a result of tobacco smoking.



In 2011, Australia's Parliament became the first in the world to impose new plain, uniform cigarette packaging with huge graphic warning labels on the health risks of smoking. These labels and infographics were specially chosen to warn and educate the public, specifically smokers, about the risks of smoking. Tobacco packaging can effectively communicate messages about the dangers of smoking and, according to research, improves the general knowledge about the risks connected with smoking and can impact future smoking decisions. Cigarettes packets in Australia have legal regulations over the graphics and statements covering the packet. For example, the front of cigarette packs must include a message and graphic that covers at least 75% of the surface area, cover at least 90% of the back of the card with a statement, graphic, or explanatory message. Government research has found that the packaging was responsible for roughly 25% of the decrease in smoking rates in Australia between 2012 and 2015. After three years of full implementation, an estimated 100,000 Australians had quit smoking. Through the use of this educational campaign, the labels on the cigarette packets have successfully reduced the number of Australian smokers, and, therefore, reduced the future risk of lung cancer for a population.

SUMMARY of 8.4.1a

Educational programs	any programs utilised to engage in the provision of education, including programs which teach the general public about ideas, concerns, etc.
Example of initiative	Cigarette packaging in Australia: o Australia became the first parliament to create uniform cigarette packaging with huge health warnings and labels all over the packaging.
Effect of initiative	⇒ After 3 full years of implementing the cigarette packaging initiative, 100,000 Australians had successfully quit smoking.

	⇒ Educates public on health risks of smoking ⇒ Provides graphic images and large warnings

8.4.1b-

use secondary sources to evaluate the effectiveness of current disease-prevention methods and develop strategies for the prevention of a non-infectious disease, including but not limited to:

- *genetic engineering*

KEY TERMS:

- Disease prevention
- Non-infectious diseases
- Genetic engineering
- Gene therapy

Genetic engineering, (also known as genetic modification) is a technique for altering an organism's DNA composition using laboratory-based technologies. A single base pair (A-T or C-G) can be changed, an area of DNA can be deleted, or a new piece of DNA can be added. GE has aided in the mass manufacture of hormones and enzymes that can aid in the cure of diseases and the reduction of their deadly effects.

Gene therapy is the insertion of healthy genes into cells in the place of missing or defective genes in order to cure genetic abnormalities. Gene therapy is predicted to be able to prevent diseases from forming even in the embryonic stage of an organism's life span. This technique is still undergoing intensive research, but could be a good illness prevention approach, albeit it will take a lot of effort.

The difference between gene therapy and genetic engineering is the purpose of which the technique is being utilised for. Gene therapy aims to correct genetic abnormalities and thereby prevent or treat hereditary disorders by modifying genes. Genetic engineering tries to tweak genes to improve an organism's capabilities beyond what is normal.

SUMMARY of 8.4.1b

Genetic engineering	- tweaks genes to improve organisms capabilities - hormones and enzymes which can aid in the prevention of diseases or reduce the effects.
Gene therapy	⇒ corrects gene abnormalities, thereby preventing or treating the disorder by modifying the genes

GLOSSARY:

8.1-

Homeostasis: a self-regulating mechanism that allows biological systems to maintain stability while adapting to changing external situations.

Stimulus: A measurable change (physical or chemical) in an organism's environment that causes some functional activity.

Response: a change in the organism as a result of detecting a stimulus.

Internal environment: a multicellular organism's interior environment. A multicellular organism's cells must manage their surroundings in order to maintain a somewhat steady internal environment.

External environment: The physical, chemical, biological, and social conditions that surround the organism are referred to as the organism's environment. In contrast to the organism's internal environment, the external environment is exploited.

Thermoregulation: a process in mammals that allows them to regulate their body temperature independently of environmental temperatures.

Constant environment: natural selection will keep a population stable and essentially maintain the status quo.

Optimal Metabolic Efficiency: The amount of energy expended by an animal over a specific period of time.

8.1.2a-

Trends: a general direction in which something is developing or changing.

Patterns: regular and intelligible forms or sequences that can be found throughout nature.

Adaptations: organisms' biological process for adapting to new settings or changes in their current environment.

Behavioural Adaptation: the actions organisms do to survive.

Structural Adaptation: physical features of an organism

Physiological Adaptations: an internal body process to regulate and maintain homeostasis for an organism to survive in the environment in which it exists

Endotherms: organisms that maintain a constant body temperature independent of the environment.

Ectotherms: any animal whose regulation of body temperature depends on external sources.

Normothermia: A condition of normal body temperature.

Thermoregulation: a mechanism by which mammals maintain body temperature with tightly controlled self-regulation independent of external temperatures.

8.1.2b-

Tolerance limit: the upper and lower limits of a particular environmental condition which allows a certain species to survive.

Water Balance: the ratio between the water assimilated into a system and that lost from the system.

Stomata: cell structures in the epidermis of tree leaves and needles that are involved in the exchange of carbon dioxide and water between plants and the atmosphere.

Plasmolysis: the process of contraction or shrinkage of the protoplasm of a plant cell and is caused due to the loss of water in the cell.

Transpiration: the physiological loss of water in the form of water vapor, mainly from the stomata in leaves, but also through evaporation from the surfaces of leaves, flowers, and stems.

Evaporation: a type of vaporization that occurs on the surface of a liquid as it changes into the gas phase.

Evapotranspiration: the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.

Turgid: cells or tissues that are swollen from water uptake.

Flaccid: Describing plant tissue that has become soft and less rigid than normal because the cytoplasm within its cells has shrunk and contracted away from the cell walls through loss of water.

Xerophytes: plants which have adapted to live in dry, warm conditions. These plants have features that minimise their water loss from transpiration.

8.2.1a + b + c-

Non-infectious diseases: diseases that are not caused by pathogens and therefore cannot be spread from one person to another

Pathogen: an organism causing disease to its host, with the severity of the disease symptoms referred to as virulence

Genetic diseases: occur when a mutation (a harmful change to a gene, also known as a pathogenic variant) affects your genes or when you have the wrong amount of genetic material.

Genome: the complete set of genetic information in an organism.

Hereditary: the sum of all biological processes by which characteristics are transmitted from parents to their offspring.

Mutations: a change in the DNA sequence of an organism.

Environmental exposure by diseases: diseases that can be directly attributed to environmental factors.

Nutritional diseases: any of the nutrient-related diseases and conditions that cause illness in humans.

Cancer: a disease in which some of the body's cells grow and mutate uncontrollably and spread to other parts of the body.

Incidence: a measure of disease that allows us to determine a person's probability of being diagnosed with a disease during a given period of time.

Prevalence: the proportion of a population who have a specific characteristic in a given time period.

Mortality: The death rate. The ratio of the total number of deaths to the total population

8.4.1a + b-

Disease prevention: a procedure through which individuals, particularly those with risk factors for a disease, are treated in order to prevent a disease from occurring.

Educational programs: any program principally engaged in the provision of education, including programs which teach the public about diseases.

Campaigns: a planned sequence of activities and processes which promote an individual product, service, or resources.

Genetic engineering: a process that uses laboratory-based technologies to alter the DNA makeup of an organism.

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