

Heredity

Reproduction

How does reproduction ensure the continuity of a species?

Explain the mechanisms of reproduction that ensure the continuity of a species by analysing sexual and asexual methods of reproduction in a variety of organisms:

Reproduction:

- Is a biological process by which an organism produces offspring which are biologically similar to the parent organism.
- It enables and ensures the continuity of species, generation after generation.

Two Types of Reproduction

1. Asexual Reproduction
2. Sexual Reproduction

Asexual reproduction:

- It does not involve the fusion of gametes.
- The offspring produced are genetically identical to the parent.
- The organisms produced by asexual reproduction are less diverse, so there is less genetic variation within that species.
- This type of reproduction is common in unicellular organisms.
- It is usually rapid and requires no mate
- The lack of genetic diversity makes the species more susceptible to environmental change

Sexual reproduction:

- Male and female gametes form & fuse to produce offspring.
- These gametes are either formed by the same individual or by different individuals of the opposite sex.
- This process is usually slow and complex compared to asexual reproduction.
- The organisms produced are genetically diverse.
- These species are more robust and can often evolve along with the changing climatic conditions.
- Humans and many multicellular organisms exhibit a sexual mode of reproduction.

Animals

Advantages of external and internal fertilisation

A process involving two processes:

1. Transcription (copying)
2. Translation (reading)

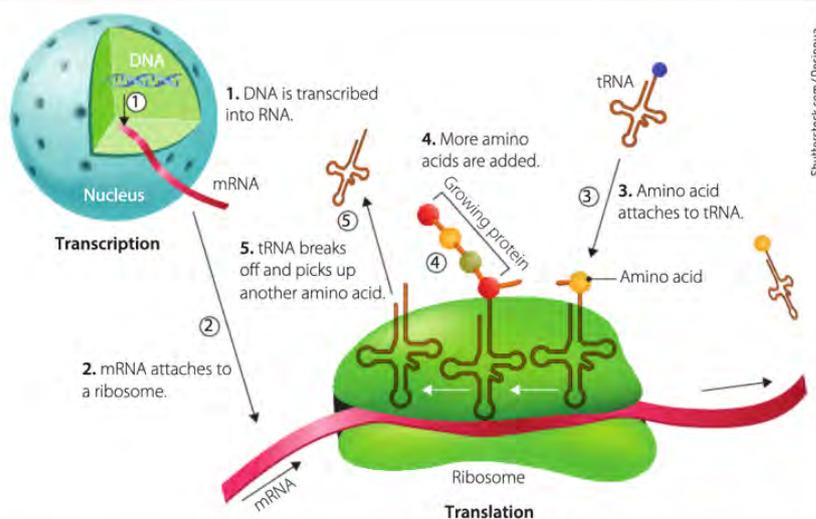
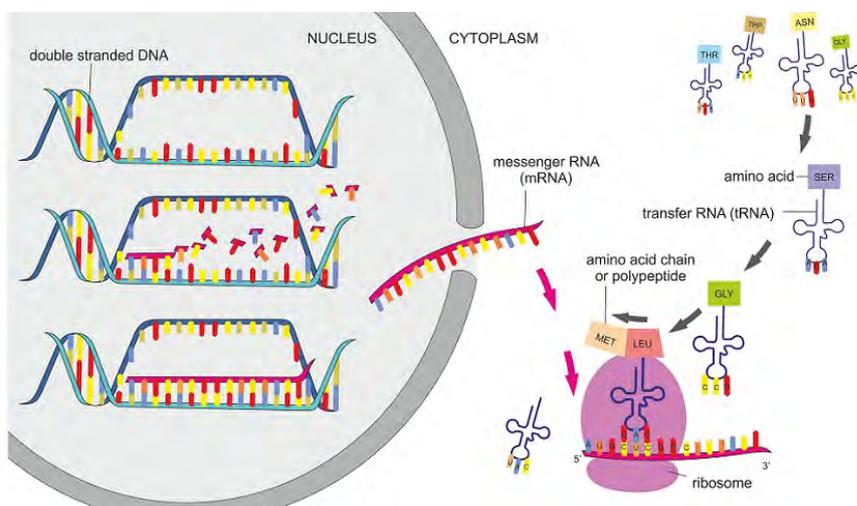


FIGURE 4.11 Gene expression involves the information in DNA being decoded during transcription into RNA (1) and subsequently translated into a product such as a protein (2–4).



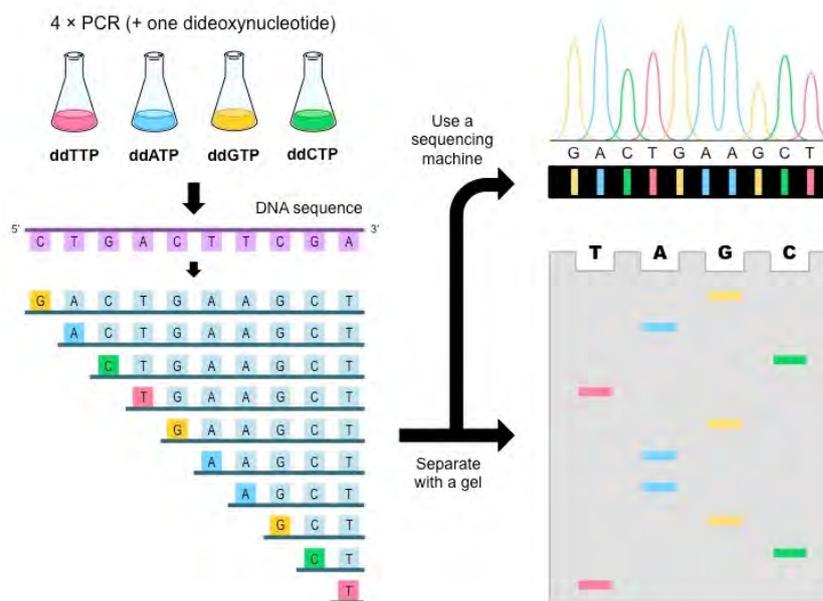
The process of polypeptide synthesis:

DNA never leaves the nucleus- the molecules are too large to pass through the pores in the nuclear membrane.

- Next generation technologies

Sanger Method Steps:

- Isolate the DNA from the cells of organism.
- DNA is isolated and replicated by PCR technology
- Double-stranded DNA is separated into single strands by heating (96°C)
- Mixture is then cooled (50°C), this enables the DNA primers to bind to plasmid DNA
- Mixture is then heated to 60°C which allows the DNA polymerase to bind to the primer DNA
- Heated again to 96°C to separate the new strand from the original strand and the process continues over and over again by heating and cooling
- Gel electrophoresis (gel & electric current) is used to separate and group the DNA strands into groups based on their length, longer strands move through the gel more slowly.
- As the strands move through the gel, they pass through a laser beam which causes the terminator base with the tag to light up, the colour of this is read by a computer and the sequence of bases on the original DNA strand is read and recorded as a chromatogram.



Next generation technologies

A range of next-generation or latest sequencing technologies are faster, cheaper, use shorter DNA lengths and can sequence many fragments at the same time, for example:

- Nanopore sequencing - process involves propelling a DNA molecules using a motor protein through a nanopore to read the base sequence quickly.

- In-farm biosecurity
- Ensuring all staff adhere to hygiene practices

Case: Panama Disease

Background:

- 1st discovered in Australia NT in 1997 where it was quarantined
- Panama TR4 can't be eradicated and can survive in the soil for decades

Cause:

- Fungus that lives in the soil and easily spread by movement of infected bananas/ plants, materials and contaminated soils and water

Effect:

Fungus travels up the stem, blocks the tissues that carry water and nutrients (xylem and phloem)

Impact:

- effective chemical control/ no resistance
- Loss of \$138 mill / year

Animal diseases

- Typically, viruses and bacteria

Case: Foot and Mouth disease

- Highly contagious disease of hoofed animals
- Australia is free of the disease due to strict quarantine measures

Cause:

- Foot and mouth disease virus (FMDV)

Impact:

Its purpose is to waterproof and lubricate the skin. The pH of skin is normally around 5.5, because of the presence of lactic acid, amino acids and fatty acids in sweat and sebum. Lysosome is secreted in perspiration and lyses or breaks down bacterial cell walls.

Saliva

It is a mixture of water, mucus, electrolytes, enzymes such as amylase and antimicrobial substances such as lysozymes and immunoglobulin A (IgA).

Saliva has a flushing action against microbes as well as chemical activity against them due to antimicrobial molecules contained within it.

Tears

The glands along the eyelid edges secrete sebum-like substances that contribute to the tears and have antimicrobial properties. Lacrimation (production of tears) produces a tear film that covers the cornea and conjunctiva. This film contains antimicrobial properties such as:

- lysozyme
- AMPs
- Complement
- IgA
- Mucins

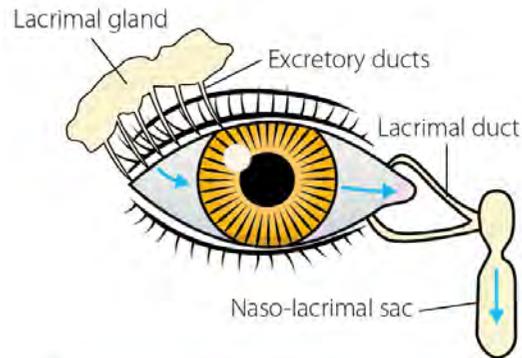


FIGURE 11.25 Anatomy of lacrimation: tears are produced by the lacrimal gland, and drain via the lacrimal duct into the nasal cavity.

Gastric secretions

- The parietal cell lining in the stomach wall secretes hydrochloric acid. This creates a highly acidic environment which discourages the growth and survival of microbes.

involved in limiting local regional and global spread of a named infectious disease

- Major factors that influence the spread of disease include sanitation, especially how waste and sewage are disposed of.
- Animal husbandry practices
- Local cultural and spiritual beliefs may influence attitudes to medical advice, burial rituals and suspicion towards Western medical practices

Regional factors

- A region may characterise by mountains, deserts, rainforests or grasslands and these geographical factors determine whether a population in that region is highly mobile or relatively isolated.
- Local seasonal variations in temperature and precipitation patterns may influence the availability of vectors.

Global factors

- The increased movement of people around the globe due to travel and work and migration of refugee population also introduces difficulties in limiting the spread of infectious disease.
- Misuse of antibiotics and other antimicrobial medications has led to a rise in resistant bacteria- many strains of Tuberculosis are now resistant to the antibiotics traditionally used to treat the disease.
The ease of communication of up-to-date data on disease outbreaks through the internet.

Factors involved in disease transmission

Pathogen factors

- The virulence of the pathogen
- Some pathogens form natural reservoirs in food, water and the environment.
- The incubations period
- Environment resistance

Host factors

- Concurrent illness in the host may reduce the effectiveness of the immune system

Environmental and geographic factors

- Wherever a pathogen is able to build up a large reservoir in the environment, there is a greater risk of outbreak
- Environmental conditions may favour pathogen preservation

Other societal factors

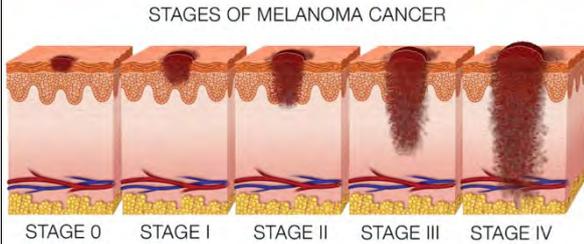
- A genetic predisposition
- Mutations due to carcinogenic chemicals or radiation
- Failure in apoptosis
- An oncovirus

Treatment, management and future directions- Melanoma:

The stage at which melanoma is diagnosed determines the best treatment option. Treatment options for melanoma include:

- Surgery
- Radiation
- Chemotherapy
- targeted therapies
- immunotherapy.

The type of treatment will also depend on the person's age and health.



Treatment options:

There are many treatment options available depending on the stage of melanoma. The most common treatment for localised (early stage) melanoma is surgery, and in the majority of cases, this is the only treatment required.

More advanced cases of melanoma where the cancer has spread to other parts of the body may require treatments such as chemotherapy, radiotherapy, immunotherapy or targeted molecular therapy.

evaluate the method used in an example of an epidemiological study

There are three major types of epidemiological studies:

- descriptive
- analytical
- interventional

descriptive and analytical studies are observational studies, which help us to understand the causes of disease.

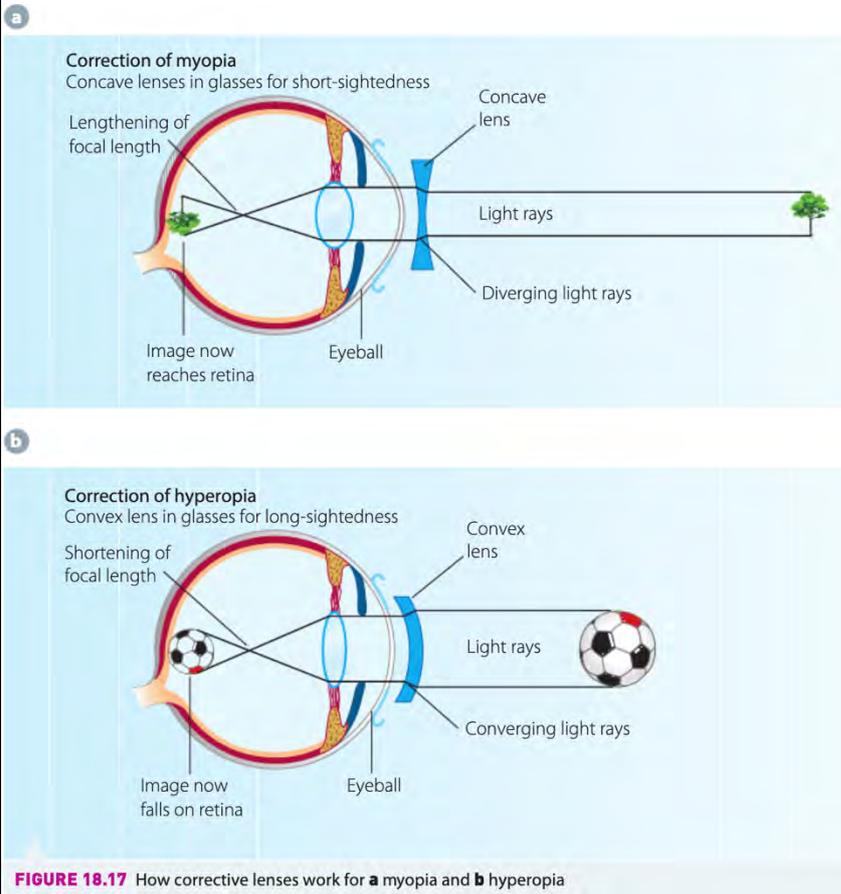
The three main types of epidemiological studies include: descriptive; analytical; interventional

evaluate, using examples, the benefits of engaging in an epidemiological study

There are a number of qualities that are common to all three:

- contain large sample size (thousands)
- collect a range of data through the use of surveys
- collect data on incidence, prevalence and mortality
- analysed to determine common factors between groups

Spectacles



Myopia can be corrected by wearing spectacles with concave lenses, which are thicker towards the outside and thinner towards the centre. These lenses bend the light rays outwards, causing them to diverge before they reach the eye. This extends the focal length of the light rays, allowing the focused image of a distant object to fall on the retina instead of in front of it

Hyperopia can be remedied by wearing spectacles with convex lenses, which are thicker towards the centre and thinner towards the edges. This type of lens bends incoming light rays inwards, causing them to begin converging before they reach the eye, shortening the focal length and allowing the focused image of a near object to fall on the retina rather than behind it

Contact lenses:

Contact lenses are an alternative for those who don't want to wear spectacles all the time and either don't want to undergo or are not suitable candidates for laser surgery. Contact lenses are based on similar technology to spectacles in terms of the shape of the lens and the refraction of light. Although the basic lens structure is convex or concave in shape, it is shaped to fit the curvature of the eyeball.

Cataract surgery:

Intraocular lens implantation (IOL) corrects cataracts. The cloudy lens is removed from the lens capsule and an artificial lens is inserted. To do this, the surgeon makes a very small incision in the eye and inserts a device that delivers high-frequency sound that breaks up the cloudy lens. The small lens particles are suctioned out and then an artificial lens is inserted into the lens capsule. An emerging technology is the use of laser cataract surgery, in which a laser is used to break up the lens and to more accurately place the artificial lens in the lens capsule.

The bionic eye:

Bionic Vision Technologies is developing a bionic eye to restore vision to people with retinitis pigmentosa (a disease where the rods and cone cells degenerate gradually) and age-related macular degeneration. The bionic eye consists of a camera attached to a pair of glasses, which transmits high-frequency radio