SURFING

NSW BIOLOGY 5&6

Module 5 Heredity
Module 6 Genetic Change

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Module 6 Genetic Change

Introduction

This book covers the Biology content specified in the NSW Biology Stage 6 Syllabus. Sample data has been included for suggested experiments to give you practice to reinforce practical work in class.

Each book in the *Surfing* series contains a summary, with occasional more detailed sections, of all the mandatory parts of the syllabus, along with questions and answers.

All types of questions – multiple choice, short response, structured response and free response – are provided. Questions are written in exam style so that you will become familiar with the concepts of the topic and answering questions in the required way.

Answers to all questions are included.

A topic test at the end of the book contains an extensive set of summary questions. These cover every aspect of the topic, and are useful for revision and exam practice.

Words To Watch

account, account for State reasons for, report on, give an account of, narrate a series of events or transactions.

analyse Interpret data to reach conclusions.

annotate Add brief notes to a diagram or graph.

apply Put to use in a particular situation.

assess Make a judgement about the value of something.

calculate Find a numerical answer.

clarify Make clear or plain.

classify Arrange into classes, groups or categories.

comment Give a judgement based on a given statement or result of a calculation.

compare Estimate, measure or note how things are similar or different.

construct Represent or develop in graphical form.

contrast Show how things are different or opposite.

create Originate or bring into existence.

deduce Reach a conclusion from given information.

define Give the precise meaning of a word, phrase or physical quantity.

demonstrate Show by example.

derive Manipulate a mathematical relationship(s) to give a new equation or relationship.

describe Give a detailed account.

design Produce a plan, simulation or model.

determine Find the only possible answer.

discuss Talk or write about a topic, taking into account different issues or ideas.

distinguish Give differences between two or more different items.

draw Represent by means of pencil lines.

estimate Find an approximate value for an unknown quantity.

evaluate Assess the implications and limitations.

examine Inquire into.

explain Make something clear or easy to understand.

extract Choose relevant and/or appropriate details.

extrapolate Infer from what is known.

hypothesise Suggest an explanation for a group of facts or phenomena.

identify Recognise and name.

interpret Draw meaning from.

investigate Plan, inquire into and draw conclusions about.

justify Support an argument or conclusion.

label Add labels to a diagram.

list Give a sequence of names or other brief answers.

measure Find a value for a quantity.

outline Give a brief account or summary.

plan Use strategies to develop a series of steps or processes.

predict Give an expected result.

propose Put forward a plan or suggestion for consideration or action.

recall Present remembered ideas, facts or experiences.

relate Tell or report about happenings, events or circumstances.

represent Use words, images or symbols to convey meaning.

select Choose in preference to another or others.

sequence Arrange in order.

show Give the steps in a calculation or derivation.

sketch Make a quick, rough drawing of something.

solve Work out the answer to a problem.

state Give a specific name, value or other brief answer.

suggest Put forward an idea for consideration.

summarise Give a brief statement of the main points.

synthesise Combine various elements to make a whole.

SURFING

NSW BIOLOGY 5&6

Module 5

HEREDITY

CONTENT FOCUS

In this module you will:

- Understand that life continues through the processes of reproduction and heredity.
- Expand your knowledge of evolution by exploring the cellular processes involved in increasing genetic diversity.
- Investigate reproduction and inheritance patterns in both plants and animals.
- Examine the role of DNA in polypeptide synthesis and the uses of technologies in the study of inheritance patterns.
- Learn about contemporary research and the work of geneticists across a variety of industries, including medical applications and agriculture.
- Explore the effects of genetic research on society and the environment.
- Engage with all the Working Scientifically skills for practical investigations involving the focus content to collect, process and analyse data and identify trends, patterns and relationships related to heredity.

1 Assumed Knowledge Module 5

QUESTIONS

1. Define mitosis.
2. The diagram shows the last division of meiosis in the anther of a flower.
   (a) What is meiosis?
   (b) What would be produced, in this diagram?

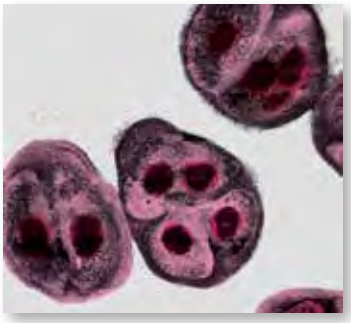

Figure 1.1 Meiosis in an anther.

3. The diagram shows two body systems.

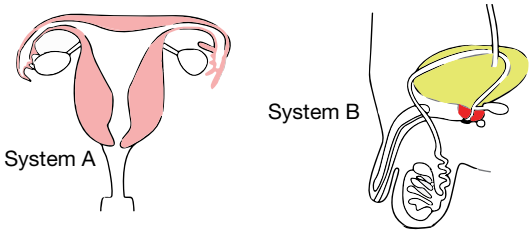

Figure 1.2 Two body systems.

Identify system A and system B.

4. The diagram shows different stages of pregnancy.

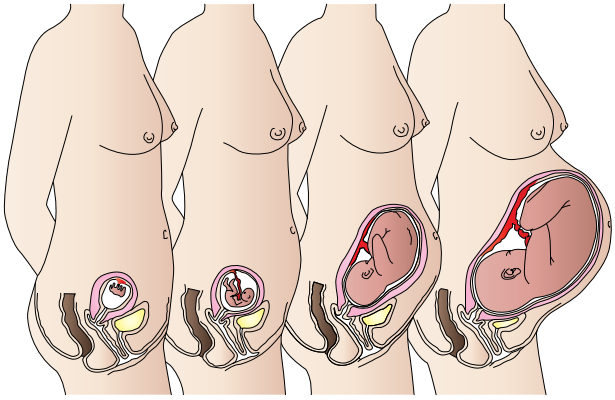

Figure 1.3 Different stages of pregnancy.

How long is human gestation?

5. What is parturition?
6. The diagram shows a type of human cell. What is the name of this cell and what is its function?

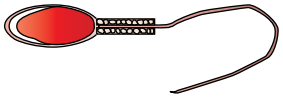

Figure 1.4 Type of human cell.

7. Distinguish between an embryo and a foetus.
8. Define genome.
9. What is a chromosome?
10. What is meant by genotype?
11. Define fertilisation.
12. Why is it important for gametes to have half the number of chromosomes of the species?
13. The diagram shows the structure of a female reproductive system.

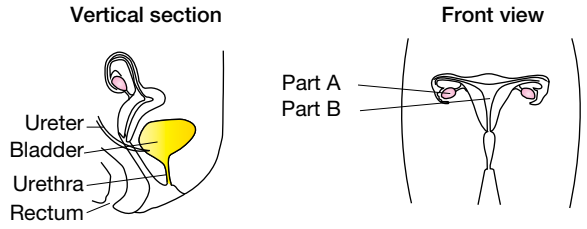

Figure 1.5 Female reproductive system.

State the function of part A and part B.

14. How is information transferred when cells reproduce themselves?
15. What does DNA stand for?
16. Name the basic unit of DNA.
17. Where is DNA located in cells?
18. Outline the structure of the DNA molecule.
19. What is the relationship between genes and DNA?

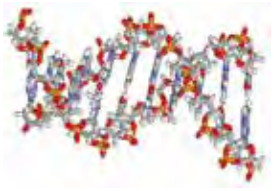

Figure 1.6 DNA.

20. Explain the advantages of DNA replicating exactly.
21. Why is Gregor Mendel often referred to as the 'father of genetics'?
22. Identify the factors that determine the features of an organism.
23. Use an example to show how environment influences the appearance of an organism.
24. Use an example to show how genes determine the features of an organism.
25. What is the 'Watson-Crick' model of DNA?
26. The diagram shows the structure of a buttercup.

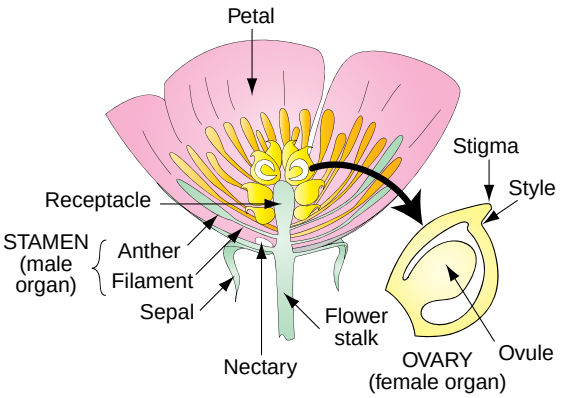

Figure 1.7 Half flower of buttercup.

Identify the male part of the flower and the female part of the flower.

2 The Animal Kingdom and Reproduction

Animals are eukaryotes, heterotrophic and multicellular with tissues that develop from embryonic layers. **Diploblastic animals** develop from two germ layers (ectoderm and endoderm), e.g. cnidarians while **triploblastic animals** develop from three germ layers (ectoderm, mesoderm, endoderm), e.g. all bilateral animals. Most animals reproduce sexually with the diploid stage dominating the life cycle.

Sexual reproduction involves the production of **gametes** (sex cells) which fuse in **fertilisation** to form a **zygote** which will grow into a new individual with features similar but not identical to its parents.

Asexual reproduction does *not* involve the fusion of gametes. The parent cell or body can divide by fission into two or more individuals or cells or segments of the parent may break off with offspring identical to the parent.

Porifera

Porifera are the sponges which have a very simple body structure covered in small holes that allow water to flow through internal channels trapping food particles in suspension feeding. They are sessile and aquatic. They reproduce sexually with many being hermaphrodites producing eggs and sperm at different times. Many can reproduce asexually with buds or gemmules (packets of several cells).

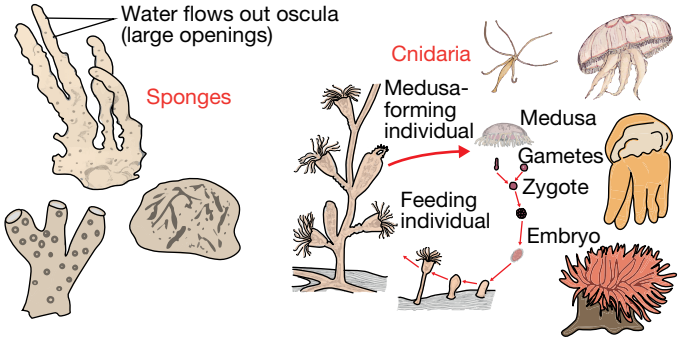

Figure 2.1 Porifera and Cnidaria.

Cnidaria

Cnidarians include the jellyfish, corals and hydras with a body as an attached polyp or floating bell-like medusa. They have radial symmetry, stinging cells on tentacles and a gastrovascular cavity with single opening that is both mouth and anus. Many have a complex life cycle with both polyp and medusa stages. Polyps mainly reproduce asexually by budding while medusa produce eggs and sperm. Hermaphrodites produce both types of gametes and a polyp can develop into medusa by asexual strobilation.

Platyhelminths

Platyhelminths are the flatworms and include the liverflukes, tapeworms and planarians. They have a flattened body, bilateral symmetry, several organs, muscles, a single opening for the digestive system, an osmoregulatory system, gonads and a central nervous system that collects information from sensory structures, e.g. eyes. Asexual reproduction occurs by budding, parthenogenesis or transverse or longitudinal fission. Some are **hermaphrodites** and can self-fertilise or copulating mates can cross-fertilise each other. Being a hermaphrodite is beneficial as it can be possible for an individual to produce fertilised eggs, however this leads to reduced genetic diversity in the offspring.

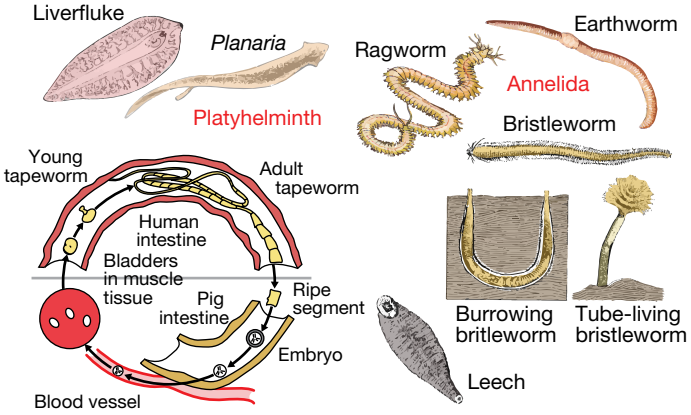

Figure 2.2 Platyhelminths and Annelids.

Annelids

Annelids are cylindrical segmented worms and can be divided into two main groups – the **polychaete worms** with many hairs per segment and well developed head, e.g. bristleworms, ragworms, sandworms and oligochaetes with few chaete per segment and a reduced head, e.g. earthworms, leeches. Annelids have bilateral symmetry, a tube-like digestive system with two openings and appendages are not jointed or absent (no legs). They reproduce sexually with some being hermaphrodites that can cross-fertilise. Some can reproduce asexually by fragmentation followed by regeneration, e.g. some earthworms.

Molluscs

The molluscs are a diverse kingdom of soft-bodied animals that include the snails, slugs, clams, squids and octopus. They have an unsegmented body, a muscular foot, a visceral mass containing internal organs and the gonads, a mantle that can secrete a shell (if present), a tube like digestive system with two openings and the mouth has rasp-like radula. Molluscs reproduce sexually with most having separate sexes that produce either eggs or sperm though many snails are hermaphrodites.

Some hermaphrodites have separate male and female phases, e.g. *Helix* spp (garden snails) start the breeding season as males and during mating exchange sperm and later switch to the female phase with egg production and using the stored sperm from their 'partner' to fertilise their eggs.

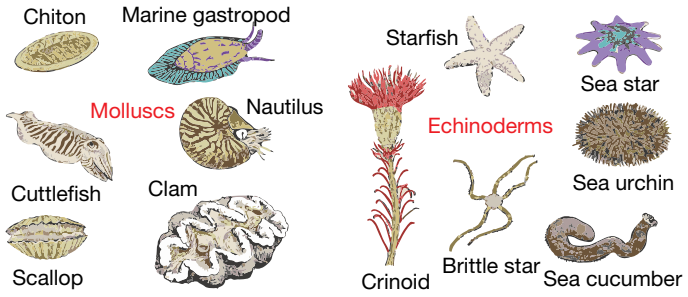

Figure 2.3 Molluscs and echinoderms.

Echinoderms

Echinoderms include the sea stars, sea urchins and crinoids (sea lilies). They are aquatic and most adults have radial symmetry, tube feet, a tube-like digestive system with two openings and a network of internal canals to pump water to different parts of their body. They can reproduce both sexually with separate sexes and asexually by regeneration. Many sea stars can regrow a missing arm and some can grow a complete body from a single arm.

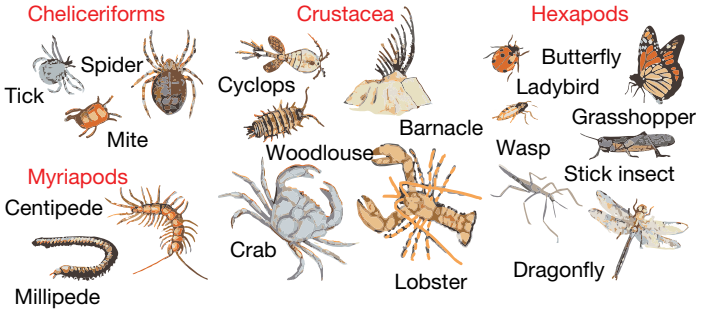

Figure 2.4 Arthropods.

Arthropods

Arthropods are diverse and numerous and include the insects, crustacean, arachnids, centipedes and millipedes. They have a hard segmented exoskeleton made of chitin, jointed legs, tube-like digestive system with two openings. at least three pairs of jointed legs and an open circulatory system. Most reproduce sexually with the male transferring sperm to the female.

Chordates

Most chordates are vertebrates with a backbone but they also include the tunicates (e.g. sea squirts), lancelets and hagfishes. Chordates are bilaterally symmetrical, have a notochord, a dorsal hollow nerve cord, pharyngeal slits and a post-anal tail.

Most chordates reproduce sexually with separate sexes though some are hermaphrodites, some, e.g. tunicates can reproduce by budding and some can reproduce by parthenogenesis (e.g. fish and reptiles). Fertilisation can be internal, e.g. mammals or external, e.g. fish.

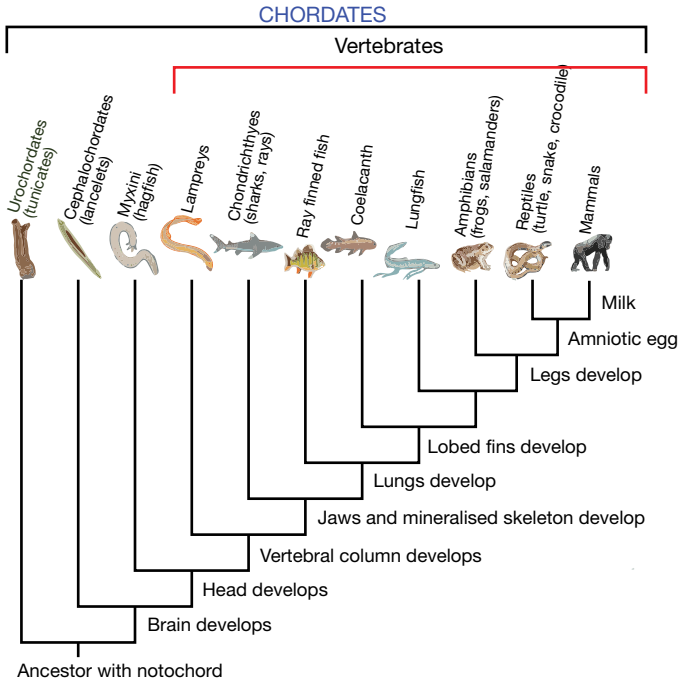

Figure 2.5 Chordate development.

QUESTIONS

1. Distinguish between diploblastic and triploblastic animals.
2. Construct a table to summarise the main differences between sexual reproduction and asexual reproduction.
3. Construct a table to summarise the main reproductive methods of at least six phyla in the animal kingdom.
4. Many animals have a breeding season that is triggered by seasonal variation in daylength. Suggest an adaptive reason for this response?
5. The diagram shows the internal structures of a female arachnid.

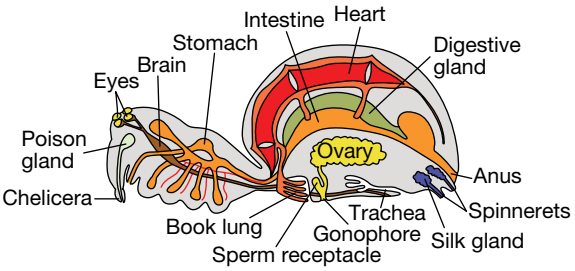

Figure 2.6 Arachnid features.

(a) To which phylum do arachnids belong?
(b) Outline the advantage of a sperm receptacle and gonophore in the female arachnid.

3 Asexual Reproduction In Animals

Many animals, especially the invertebrates have the ability to reproduce asexually. Asexual reproduction only involves one parent. Since the Australian environment is particularly arid, asexual reproduction is a means of using less energy to produce offspring.

Sponges

Sponges are very simple animals that are basically a colony of cells with very little division of labour between the cells. They do not have any type of nervous system. Australia has 25 species of freshwater sponges. Sponges can reproduce both sexually and asexually. They can reproduce asexually in several ways. Adult sponges produce 'buds' which are clones of the parent. The buds break off and grow into new sponges. Sponges can also regenerate from fragments that have been broken off. When rivers dry up during droughts, the sponges form gemmules which are drought-resistant buds. These remain dormant until immersed in water again when they will return to life.

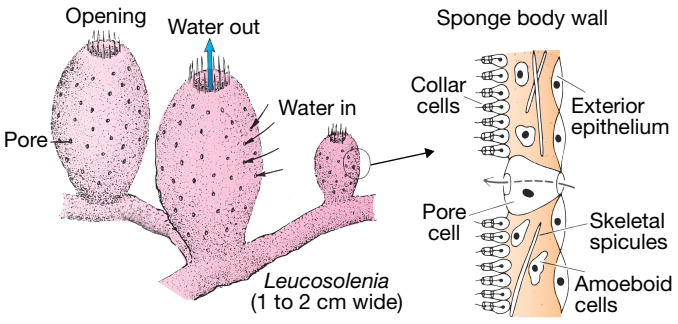

Figure 3.1 The calcareous sponge *Leucosolenia* looks like curved vases.

Cnidarians and budding

Cnidarians are aquatic animals with a simple body plan with one opening for the digestive system. Their body is basically a hollow container that is a polyp and vase shaped or a medusa and bowl shaped. The polyp is usually sessile and the medusa is usually motile.

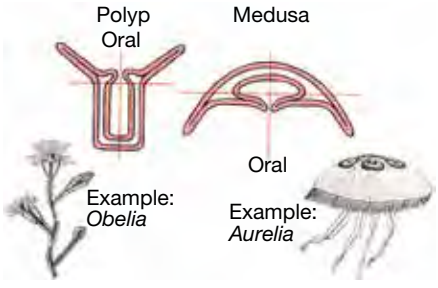

Figure 3.2 Cnidarian body shape and examples.

Cnidarian polyps typically reproduce asexually by **budding** where a new animal is formed as an outgrowth of the parent polyp and the division of the animal into two is unequal. Medusa always reproduce sexually.

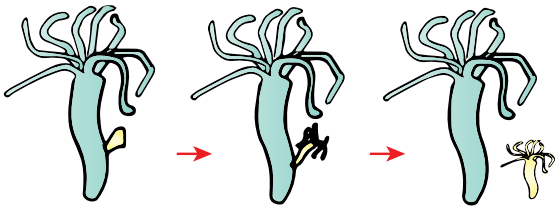

Figure 3.3 *Hydra* asexually reproducing by budding.

In ideal conditions more than one bud may develop at a time until the bud is pinched off at the base to form an independent organism.

Regeneration

Regeneration occurs when a parent organism splits and the parts of the organism develop into mature, fully grown individuals. The fragments regenerate into new complete individuals by mitosis and differentiation.

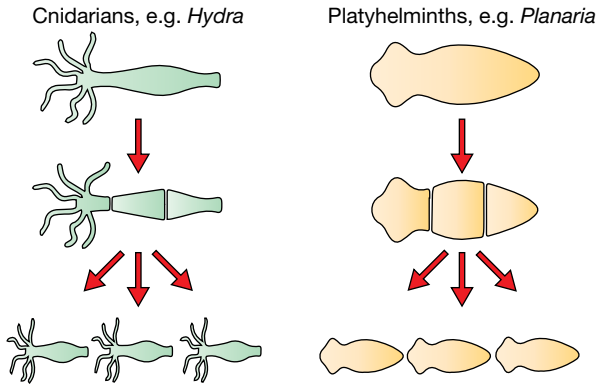

Figure 3.4 Regeneration after being cut into three pieces.

Parthenogenesis

Parthenogenesis is the development of unfertilised eggs into adults, e.g. in ants, wasps and bees. In honey bees every egg laid by the queen will develop whether or not they are fertilised. Most of the eggs are fertilised eggs and develop into sterile worker females, while the few eggs which are not fertilised develop parthenogenetically into male drones. The males are involved in mating and do not help in the nest. In parthenogenesis the offspring are identical to the parent, which is an evolutionary disadvantage in a changing environment, but it allows the build-up of a large population in a short time without the need to find a mate. For example, aphids can produce several generations of female young when conditions are favourable in summer. A newly hatched female can produce new females within days and thus millions of aphids can be produced in a very short time frame.

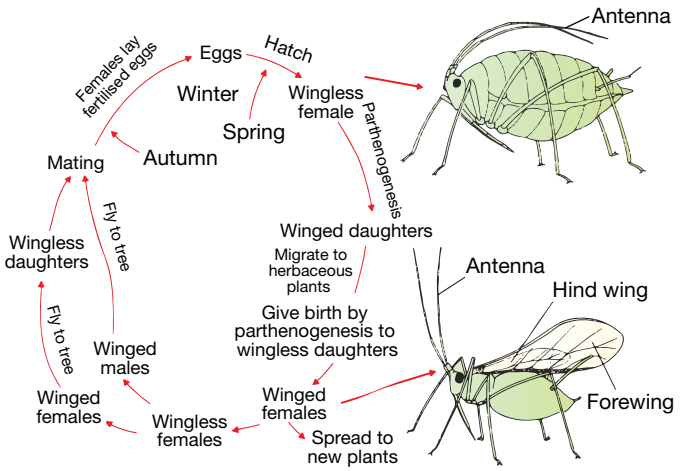

Figure 3.5 Parthenogenesis in aphids.

Although parthenogenesis is more common in insects than vertebrates, some species of lizard have been found to reproduce asexually. Bynoe's gecko (*Heteronotia binoei*) is one of the most widespread lizards in Australia found everywhere except the dampest areas in the south-east and south-west. In Central and Western Australia several populations that only consist of females have been found existing next to populations that contain both sexes. Parthenogenesis has been artificially induced in laboratory experiments using the unfertilised eggs of several different species.

QUESTIONS

1. Describe three ways in which Australian freshwater sponges can reproduce asexually and explain why this is suited to the Australian environment.
2. The diagram shows the development of a sponge.

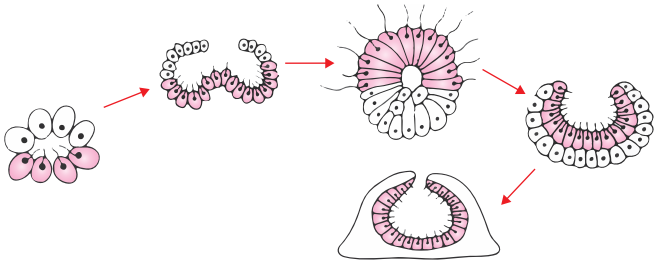

Figure 3.6 Stages in sponge development.

   If the body of a living sponge is pushed through a sieve to separate into individual cells and small clumps of cells within a short time, e.g. 30 minutes for some species, the isolated sponge cells will start to aggregate to form the recognisable form of a sponge with an outer surface of epithelial cells, pores and channels and flagellated chambers. Explain why scientific research into this feature of sponges could help solve issues in the treatment of human diseases and injuries.
3. What is budding?
4. Outline what happens in regeneration.
5. Define parthenogenesis and give an example.
6. Outline an advantage and a disadvantage of parthenogenesis.
7. Aphids show facultative parthenogenesis, that is, they can reproduce by either parthenogenesis or sexually. Explain why agriculturalists study the life cycle and reproductive features of aphids.
8. Discuss why the reproduction of Bynoe's gecko is interesting for a vertebrate.
9. All individuals in populations of the mourning gecko (*Lepidodactylus lugubris*) are female. Each female usually lays two soft, sticky eggs which hatch and grow into adult females.

Figure 3.7 Mourning gecko.

   What type of reproduction must occur in the mourning gecko?
   (A) Sexual reproduction.
   (B) Budding.
   (C) Regeneration.
   (D) Parthenogenesis.
10. In laboratory experiments it has been found that the unfertilised eggs of frogs and the unfertilised eggs of rabbits can be made to develop into adults by giving them a mild electric shock or by pricking them with a needle dipped in blood or by changing the osmotic pressure by changing the salt concentration. What would be the sex of the adults produced in this manner?
    (A) Male.
    (B) Female.
    (C) 50% chance either male or female.
    (D) Sex cannot be predicted.
11. Compared with European honey bees Australian honey bees are smaller and have no sting. Which of the following shows a type of reproduction in honey bees?
    (A) Males produced parthenogenetically.
    (B) Females produced parthenogenetically.
    (C) Males produced from fertilised eggs.
    (D) Queens produced asexually.
12. What process involves the formation of a new individual with a smaller 'daughter' individual breaking from the larger 'mother' individual?
    (A) Sexual reproduction.
    (B) Budding.
    (C) Regeneration.
    (D) Parthenogenesis.

4 The Plant Kingdom and Reproduction

The distinguishing features of plants are that they are multicellular, have a cell wall made of cellulose and contain chloroplasts which capture light in photosynthesis to produce organic compounds. The life cycles of all land plants alternates between two different forms in a process called **alternation of generation**. The two different forms are the gametophyte (haploid) and the sporophyte (diploid). The **gametophyte** produces gametes by mitosis. Fertilisation is the union of two gametes to form the zygote. The zygote divides by mitosis to form the sporophyte. The **sporophyte** divides by meiosis to produce spores that grow into the gametophyte.

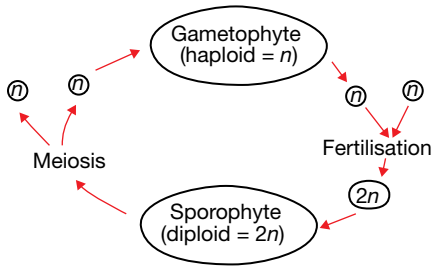

Figure 4.1 Alternation of generation.

Land plants can be divided into two basic groups – vascular plants (have specialised tubes for transport – xylem and phloem) and non-vascular plants (do not have an extensive transport system). The vascular plants can be divided into those with seeds (angiosperms and gymnosperms) and those that are seedless (ferns). The seed contains an embryo with a supply of nutrients inside a protective seed coat. Gymnosperms have a 'naked seed; and angiosperms have a protected seed that develops inside an ovary. Many plants can reproduce both sexually and asesxually.

The **bryophytes** are non-vascular plants which have two generations to their life cycle with the haploid gamete-producing generation being the main plant body.

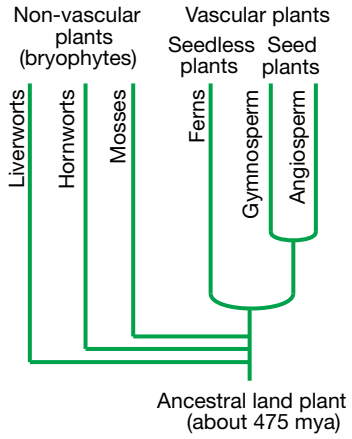

Figure 4.2 Different plant groups.

Fertilisation and land colonisation

If the release of the gametes requires water external to the plant, the plant will be restricted to land habitats that are moist. The gametes of **mosses** are formed in the antheridia (male sperm) and the archegonia (female egg). The sperm require a film of moisture around the antheridia so they can swim to the archegonia and fertilise the egg (see diagram of the life cycle of mosses). Thus the distribution of mosses is limited to specific habitats.

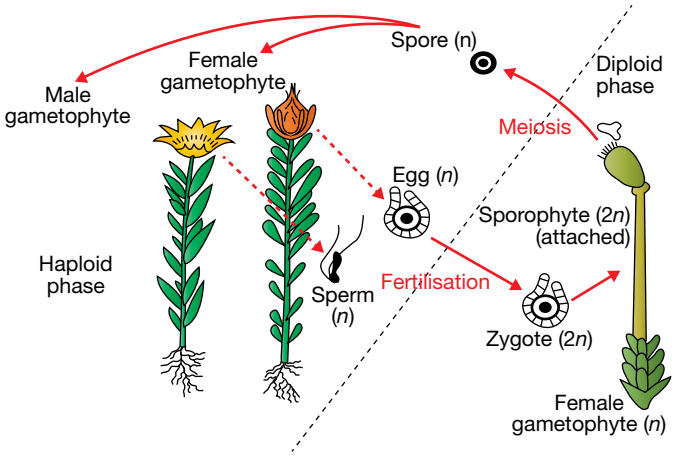

Figure 4.3 Moss life cycle.

Vascular plants

Vascular plants have two types of vascular tissue – xylem and phloem. Xylem conducts water and minerals from the roots to the leaves and phloem translocates sugars and other organic compounds up and down the plant. Vascular plants also have sporophylls – specialised leaves that bear sporangia. The evolution of sporophylls was highly important in aiding land colonisation by plants. **Ferns** are seedless vascular plants that are like mosses in that they are restricted to particular habitats. Fertilisation is internal – inside the archegonium. However, the sperm need to swim to the archegonium from the antheridium and this requires the gametophyte to have a film of surface moisture to prevent desiccation of the sperm (see diagram of fern life cycle.)

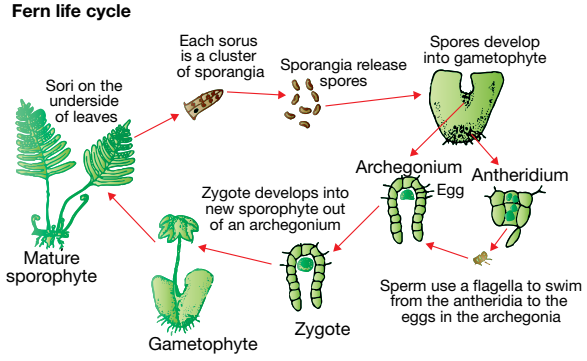

Figure 4.4 Life cycle of ferns.

The life cycle of vascular plants has the sporophyte generation as the dominant generation with the gametophyte retained in sporangia on the parent sporophyte. This is an important evolutionary development as it protects the egg and female gametophyte which is now part of the **ovule**. The male gametophyte is part of the **pollen** grains. This development gave a greater ability to inhabit a wider range of terrestrial environments.

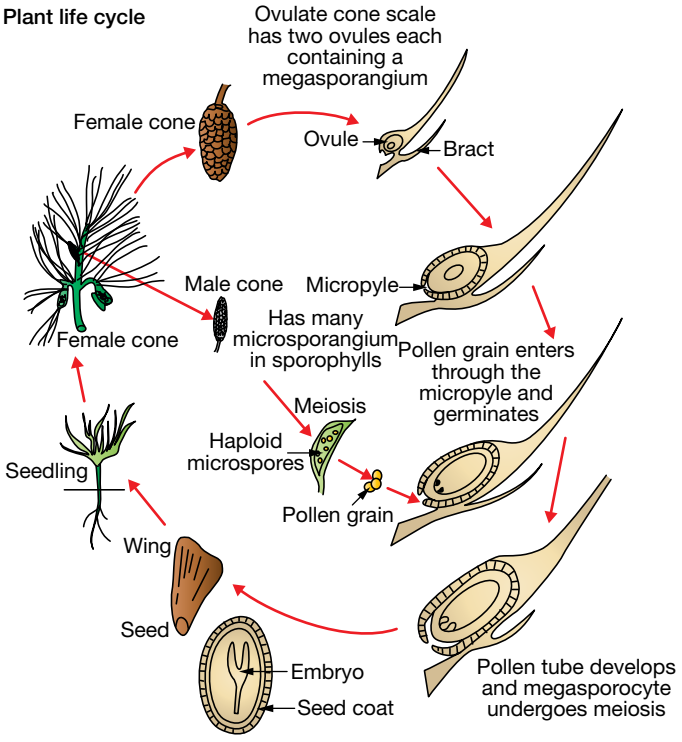

Figure 4.5 Life cycle of pines.

The **gymnosperms**, e.g. conifers and cycads can inhabit more harsh conditions than the ferns. At the beginning of the Permian period when the climate became drier and the poles were colder, the ferns that formed the Carboniferous swamps gave way to the gymnosperms, e.g. forming pine and cypress forests. The main adaptive features that assisted the gymnosperms to inhabit a variety of terrestrial habitats are the dominance of the sporophyte generation, the resistant seed which can be dispersed to other regions and durable pollen that brings the gametes together for internal fertilisation without the need for the sperm to swim to the egg.

The **angiosperm** flower is specially adapted for sexual reproduction. Pollen is highly durable and in many species can be dispersed across great distances and survive harsh conditions. The seed is also resistant and can stay dormant for a long time until conditions are suitable for germination. This has led to angiosperms now dominating terrestrial habitats. Angiosperms are found in all environments, except marine ecosystems.

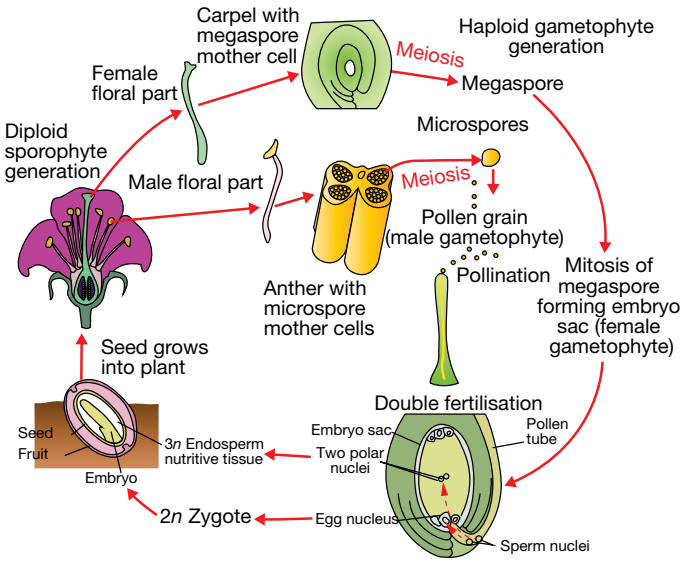

Figure 4.6 Life cycle of angiosperms.

QUESTIONS

1. Identify the distinguishing features of plants.
2. What is alternation of generation?
3. Distinguish between a gametophyte and a sporophyte.
4. What is a vascular plant and give an example.
5. Identify the two main groups of vascular plants and give examples of each.
6. Describe a seed.
7. Distinguish between gymnosperms and angiosperms.
8. Explain why mosses have not been able to inhabit all types of land environments.
9. Describe vascular tissue and its function.
10. What are sporophylls?
11. Why was the evolution of sporophylls important?
12. Where are the sporangia located in ferns?
13. Explain why ferns have not been able to inhabit all types of land environments.
14. Explain why the gymnosperms became the dominant land plant in the Permian period and Mesozoic era.
15. Identify the main features of gymnosperms that helped them to inhabit a wide range of terrestrial environments.
16. When did angiosperms become the dominant terrestrial plant form?
17. Construct a table to summarise how the gametes reach each other and where fertilisation occurs in each of the following groups.
    (a) Mosses (c) Gymnosperms
    (b) Ferns (d) Angiosperms
18. Which plant groups have the sporophyte as the dominant generation?
    (A) Angiosperms only.
    (B) Angiosperms and gymnosperms.
    (C) Angiosperms, gymnosperms and ferns.
    (D) Bryophytes only.

Answers

1 Assumed Knowledge Module 5

1. Mitosis is a process during cell division in which the cell nucleus divides into two.
2. (a) Meiosis is cell division to produce haploid daughter cells.
   (b) Meiosis produces four daughter cells and in the anther will produce four pollen grains.
3. System A is the female reproductive system and system B is the male reproductive system.
4. Human gestation is on average 266 days (approximately 38 weeks). Since timing is related to the menstrual cycle it is 40 weeks since the start of the last menstrual cycle.
5. Parturition means giving birth to a baby.
6. It is a sperm and it is the male reproductive sex cell (gamete).
7. An embryo is the early stage of development and in humans after 6 to 8 weeks when all the organs have formed the embryo is called a foetus.
8. The genome is the complete genetic information of an organism.
9. A chromosome is a cellular structure that holds genetic information in the coding of the DNA molecule.
10. Genotype is the genetic make-up of an organism, or a set of alleles of an organism.
11. Fertilisation is the union of two gametes.
12. Gametes fuse to form a zygote. It is essential that gametes contain only half the number of chromosomes to maintain the chromosome number of the species. Otherwise the number of chromosomes would double every generation.
13. Part A is the ovary which produces eggs (female gamete) and part B is the uterus which is where the embryo/foetus will grow and develop until birth.
14. Information is transferred as DNA on chromosomes when cells reproduce themselves.
15. DNA stands for deoxyribose nucleic acid.
16. The basic unit of DNA is the nucleotide.
17. Most DNA is located in the nucleus. DNA is also found in mitochondria and in the chloroplasts of green plants.
18. The structure of the DNA molecule is a double helix.
19. A gene is a certain length of DNA that has the code for one characteristic.
20. DNA needs to be able to replicate itself exactly so that cell division can form identical new cells for growth, repair and maintenance of the body of a multicellular organism. Exact replication is also needed to maintain the genetic code for a species and hence keep its integrity as a distinct unit in nature.
21. Gregor Mendel experimented with pea plants and worked out the basic laws of inheritance. His work led to the study of genetics and hence he is often referred to as the 'father of genetics'.
22. Both genes and environmental factors determine the features of an organism.
23. In plants, e.g. pea plants, the environment can have a great influence on the appearance of an organism. If the plant has the genetic code to be tall, but is grown in poor soil which has few nutrients, then the plant will not reach its full height potential and may appear to be a dwarf plant.
24. In pea plants there are two alleles for plant height – tall (T) and dwarf (t). Given that all other environmental factors are the same, a plant with the genetic code TT or Tt will be tall, while a plant with the code tt will be dwarf.
25. Watson and Crick discovered that DNA had a double helix structure.
26. The male part of the flower is the stamen and it consists of the anther and the filament. The female part of the flower is the carpel and it consists of the ovary, with ovules, the style and the stigma.

2 The Animal Kingdom and Reproduction

1. Diploblastic animals develop from two germ layers (ectoderm and endoderm), e.g. cnidarians while triploblastic animals develop from three germ layers (ectoderm, mesoderm, endoderm), e.g. all bilateral animals.
2.

Feature	Asexual reproduction	Sexual reproduction
Parents	One parent	Two parents
Gametes	Not produced	Produced
Fertilisation	Does not occur	Occurs
Genetic diversity	Identical to parent	Similar to parent but not identical

3.

Animal phyla	Type of reproduction
Porifera	Sexual reproduction with many being hermaphrodites producing eggs and sperm at different times. Can reproduce asexually with buds or gemmules (packets of several cells).
Cnidaria	Complex life cycle with both polyp and medusa stages. Polyps mainly reproduce asexually by budding while medusa produce eggs and sperm, some are hermaphrodites and produce both types of gametes. Polyp can develop into medusa by asexual strobilation.
Platyhelminth	Asexual reproduction by budding, parthenogenesis or transverse or longitudinal fission. Some are hermaphrodites and can self-fertilise or copulating mates can cross-fertilise each other.
Annelid	Sexual reproduction with some being hermaphrodites that can cross-fertilise. Some can reproduce asexually by fragmentation followed by regeneration.
Mollusc	Sexual reproduction with most molluscs having separate sexes that produce either eggs or sperm though many snails are hermaphrodite.
Arthropoda	Most reproduce sexually with male transferring sperm to female.
Echinoderm	Reproduce both sexually with separate sexes and asexually by regeneration. Many sea stars can regrow a missing arm and some can grow a complete body from a single arm.
Chordates	Most reproduce sexually with separate sexes though some are hermaphrodites, some, e.g. tunicates can reproduce by budding and some can reproduce by parthenogenesis (e.g. fish and reptiles). Fertilisation can be internal, e.g. mammals or external, e.g. fish.

4. When offspring are produced there needs to be a plentiful supply of food to allow growth and development of the new individuals. Timing the breeding season with changes in day length gives an adaptive advantage to coincide with available, favourable food supplies and environmental conditions.
5. (a) Arachnids are arthropods (phylum Arthropoda).
   (b) Sperm will dessicate when exposed to air which means terrestrial animals, e.g. arachnids will use a form of internal fertilisation. The male arachnid will deposit sperm which will stay in the sperm receptacle until the ovary releases the eggs which will leave the female's body from the gonophore after fertilisation.

3 Asexual Reproduction In Animals

1. Australian freshwater sponges can reproduce asexually by:
   1. Producing buds which break off and grow into new sponges.
   2. Regeneration from fragments that have broken off. 3. Formation of gemmules which are drought resistant buds that remain dormant until immersed in water again when they return to life. These methods are particularly suited to the Australian environment as the gemmules allow sponges to survive drought, regeneration allows them to survive storms, and buds allow them to maximise the production of offspring when conditions are favourable.
2. Sponges are very simple animals with no true tissues or nervous system yet pushing a living sponge through a sieve and the reaggregation of the separate cells into a sponge form shows that sponges show several features of higher organisms, e.g. cell adhesion, cell recognition and differentiation. Understanding how these processes occur in sponges has the potential to aid problems that occur in human prenatal development and the potential use to treat injury and disease.
3. Budding is where a new organism is formed as an outgrowth of the parent and the division of the original is unequal.