

8.3 Patterns in Nature

Contextual Outline

Detailed examination of one or two species of living things does not provide an overview of the general features of living things. By looking across the range of commonly occurring living organisms, patterns in structure and function can be identified. These patterns reflect the fundamental inputs and outputs of living things – the absorption of necessary chemicals and the release of wastes.

At a microscopic level, there are patterns in the structure and function of cells. The fundamental structural similarities exist because the biochemical processes are similar. Some important differences between plant and animal cells reflect the fundamental differences between plants and animals – the process of photosynthesis in plants.

Many living things have evolved complex and efficient systems with large surface areas to facilitate the intake and removal of wastes. Transport systems allow distribution and collection of nutrients and wastes. The processes of sexual reproduction also follow similar patterns in living things – these processes reflect the purpose of sexual reproduction as well as a common evolutionary origin for multicellular plants and animals.

This module increases students' understanding of the history, applications and uses of biology.

Assumed Knowledge

Domain: knowledge and understanding

Refer to the *Science Years 7–10 Syllabus* for the following:

- 5.7.3c) construct word equations from observations and written descriptions of a range of chemical reactions
- 5.8.1a) explain that systems in multicellular organisms serve the needs of cells
- 5.8.1b) identify the role of cell division in growth, repair and reproduction in multicellular organisms
- 5.8.2c) identify that information is transferred as DNA on chromosomes when cells reproduce themselves
- 5.8.2d) identify that genes are part of DNA.

	<i>Students learn to:</i>	<i>Students:</i>
1. Organisms are made of cells that have similar structural characteristics	<ul style="list-style-type: none"> outline the historical development of the cell theory, in particular, the contributions of Robert Hooke and Robert Brown describe evidence to support the cell theory discuss the significance of technological advances to developments in the cell theory identify cell organelles seen with current light and electron microscopes describe the relationship between the structure of cell organelles and their function 	<ul style="list-style-type: none"> use available evidence to assess the impact of technology, including the development of the microscope on the development of the cell theory perform a first-hand investigation to gather first-hand information using a light microscope to observe cells in plants and animals and identify nucleus, cytoplasm, cell wall, chloroplast and vacuoles process information from secondary sources to analyse electron micrographs of cells and identify mitochondria, chloroplasts, Golgi bodies, lysosomes, endoplasmic reticulum, ribosomes, nucleus, nucleolus and cell membranes
2. Membranes around cells provide separation from and links with the external environment	<ul style="list-style-type: none"> identify the major groups of substances found in living cells and their uses in cell activities identify that there is movement of molecules into and out of cells describe the current model of membrane structure and explain how it accounts for the movement of some substances into and out of cells compare the processes of diffusion and osmosis explain how the surface area to volume ratio affects the rate of movement of substances into and out of cells 	<ul style="list-style-type: none"> plan, choose equipment or resources and perform a first-hand investigation to gather information and use available evidence to identify the following substances in tissues: <ul style="list-style-type: none"> glucose starch lipids proteins chloride ions lignin perform a first-hand investigation to model the selectively permeable nature of a cell membrane perform a first-hand investigation to demonstrate the difference between osmosis and diffusion perform a first-hand investigation to demonstrate the effect of surface area to volume ratio on rate of diffusion

Students learn to:

3. Plants and animals have specialised structures to obtain nutrients from their environment

- identify some examples that demonstrate the structural and functional relationships between cells, tissues, organs and organ systems in multicellular organisms
- distinguish between autotrophs and heterotrophs in terms of nutrient requirements
- identify the materials required for photosynthesis and its role in ecosystems
- identify the general word equation for photosynthesis and outline this as a summary of a chain of biochemical reactions
- explain the relationship between the organisation of the structures used to obtain water and minerals in a range of plants and the need to increase the surface area available for absorption
- explain the relationship between the shape of leaves, the distribution of tissues in them and their role
- describe the role of teeth in increasing the surface area of complex foods for exposure to digestive chemicals
- explain the relationship between the length and overall complexity of digestive systems of a vertebrate herbivore and a vertebrate carnivore with respect to:
 - the chemical composition of their diet
 - the functions of the structures involved

Students:

- plan, choose equipment or resources and perform first-hand investigations to gather information and use available evidence to demonstrate the need for chlorophyll and light in photosynthesis
- perform a first-hand investigation to demonstrate the relationship between surface area and rate of reaction
- identify data sources, gather, process, analyse and present information from secondary sources and use available evidence to compare the digestive systems of mammals, including a grazing herbivore, carnivore and a predominantly nectar feeding animal

	<i>Students learn to:</i>	<i>Students:</i>
4. Gaseous exchange and transport systems transfer chemicals through the internal and between the external environments of plants and animals	<ul style="list-style-type: none">▪ compare the roles of respiratory, circulatory and excretory systems▪ identify and compare the gaseous exchange surfaces in an insect, a fish, a frog and a mammal▪ explain the relationship between the requirements of cells and the need for transport systems in multicellular organisms▪ outline the transport system in plants, including:<ul style="list-style-type: none">– root hair cells– xylem– phloem– stomates and lenticels▪ compare open and closed circulatory systems using one vertebrate and one invertebrate as examples	<ul style="list-style-type: none">▪ use available evidence to perform a first-hand investigation and gather first-hand data to identify and describe factors that affect the rate of transpiration▪ perform a first-hand investigation of the movement of materials in xylem or phloem▪ use available evidence to discuss, using examples, the role of technologies, such as the use of radioisotopes in tracing the path of elements through living plants and animals
5. Maintenance of organisms requires growth and repair	<ul style="list-style-type: none">▪ identify mitosis as a process of nuclear division and explain its role▪ identify the sites of mitosis in plants, insects and mammals▪ explain the need for cytokinesis in cell division▪ identify that nuclei, mitochondria and chloroplasts contain DNA	<ul style="list-style-type: none">▪ perform a first-hand investigation using a microscope to gather information from prepared slides to describe the sequence of changes in the nucleus of plant or animal cells undergoing mitosis