fundisa for change

Teaching
Life and Living

Natural Sciences and Technology
Grades 4–6

Cynthia Slattery & Chris Reddy

This is a teacher education text. Its purpose is to expand educators' knowledge of environmental topics to support the teaching thereof in the curriculum. Teachers and teacher educators should consult CAPS documents and textbooks for specific curriculum content, as these units are not a textbook, but rather a resource for teacher education.

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Orientation

This resource works in combination with the *We Care* book of activities which was originally published in 2004 to support the teaching of environmental education in the Intermediate phase.

Introduction

What is Life and Living?

Life and Living:

Our prime concern is what is life? What does life look like? Where do we find life? How do we study life? And how do we ensure the survival of life?

The science of nature: We can understand life by studying it at many levels, starting with the **atoms and molecules** that make up life and then moving onto the **interactions of organisms with their environment**. The scientific study of life is called Biology. Biology is one of the many ways that we humans try to make sense of the world around us (Starr, Taggart, Evers & Starr, 2013).

Life's unity: All living things must have **constant inputs of energy and raw materials**; all sense and respond to change; and all have DNA that guides their development and functioning (Starr et al., 2013).

Life's diversity: Observable characteristics vary tremendously between organisms. Various **classification systems** help us keep track of the differences (Starr et al., 2013).

How we study life: We study life by using carefully designed experiments that help researchers to understand cause and effect **relationships** in complex natural systems.

Learning about the structure and function of atoms and molecules will begin your understanding of how living cells work. Learning about the processes that keep a single cell alive can help you understand how multicellular organisms survive. **Knowing what it takes for organisms to survive can help you see why and how they interact with one another and with their environment** (Starr et al., 2013). When we study the biodiversity of life we try to understand where we fit in.

The levels of life's organisation: (Starr et al., 2013)

(SMALLEST) Atom ➔ molecule ➔ cell ➔ tissue ➔ organ ➔ organ system ➔ multi-celled organism ➔ Population ➔ community ➔ ecosystem ➔ biosphere (LARGEST)

*Teaching ecology to children is easy. All children have a fascination with other creatures. To teach children ecology we need to give them the **opportunity to explore the plants and animals within their local environments**. This enhances their awareness and appreciation of other organisms. Learning how to conduct experiments using these organisms teaches them how the scientific method is employed in the science of ecology.*

(Herzig, 29 July 2013)

Why is Life and Living important?

The 'Life and Living' part of Natural Sciences forms part of the discipline of ecology where we study the relationships between living things and their physical environment (or how organisms interact with their environments).

Ecology provides the foundation for the much broader discipline of **environmental studies**, which includes both social and scientific issues related to the environment.

Ecology education need not be limited to areas that are relatively pristine, but can include the study of organisms in areas that are heavily influenced by humans, like cities and towns. There are many interesting natural history observations to be made within an urban environment. For example, birds during migration can form dense and diverse aggregations in city parks. Insects and spiders are everywhere. Lichens can grow on bare rock. (Herzig, 29 July 2013)

Through Life and Living we want learners to become curious and develop skills in exploring, experimenting, inquiring, describing relationships between social and scientific issues (e.g. ecological issues), describing how we are part of a global system, identifying our impacts on the local environment and taking action to improve situations where there is conflict between humans and their environment.

We want learners to develop values linked to awareness, appreciation, care, respect, empathy and hope.

Remember to use your school gardens as a site for ecological studies too! There are for example, small plants such as weeds that can be classified, and insects and spiders to study. The study of ecology in urban settings shows the important lesson that humans are interacting members of a much larger global system. Care and respect for the environment is fostered by an understanding of one's personal impact on the local environment.

(Herzig, 29 July 2013)

How do these units support teaching about Life and Living?

These units aim to give teachers a starting point for planning lessons within the CAPS syllabus. There are suggested activities and assessments that can be used from the *We Care* book. You will find ideas to teach many of the Life and Living themes in a holistic way.

These Life and Living units and the CAPS

The following diagrams show the knowledge progression that needs to take place when teaching Life and Living in the Intermediate phase. The overriding themes are biological in nature. Ecology is also particularly strong in all three grades. Discovering and understanding the natural world around us and how it impacts on our life are important broad issues to include in lessons.

Grade 3s will have some knowledge (from Life Skills) of insects and life cycles of plants and animals.They will have explored pollution and recycling. They will have some knowledge about healthy and sustainable living, having studied healthy eating and health protection.

There are three units in this Fundisa for Change resource. Each unit will cover a particular grade, thus Unit 1 covers Life and Living in Grade 4, Unit 2 covers Grade 5 and Unit 3 covers Grade 6. The following diagrams summarise the Life and Living topics covered in each unit for Grades 4, 5 and 6.

Unit 1 (Grade 4)

The Grade 4 Natural Science syllabus expands the idea of what life is and what aspects of the environment are non-living and then looks at the survival needs of plants and animals.

Grade 4 Topics – Term 1: 10 weeks	
1	Living and non-living things
2	The structure of plants and animals
3	What plants need to grow
4	Habitats of animals
5	Structures for animal shelters

Unit 2 (Grade 5)

In Grade 5 the idea of interdependence of the parts of an ecological system is introduced. The concept of biodiversity is also introduced. The concept of animals having specific body support mechanisms is explored. Teachers need a basic understanding of plant and animal classification in order to show the scope of the diversity of species on Earth and how this diversity is related to the physical environment in which the plants and animals are found.

Grade 5 Topics – Term 1: 10 weeks	
1	Plants and animals on Earth (Biodiversity)
2	Animal skeletons
3	Skeletons as structures
4	Food chains
5	Life cycles

Unit 3 (Grade 6)

In Grade 6 the ecological themes are taken further. Our natural environment provides the means of using the sun's energy, in green plants, to make carbohydrates during the bio-chemical process of photosynthesis. These carbohydrates are part of the nutritional needs of humans and other organisms. The concept of a food web is introduced and also the idea of ecosystems: systems in a particular setting that have a particular set of producers and consumers. How humans preserve food is also discussed.

Grade 6 Topics – Term 1: 10 Weeks	
1	Photosynthesis
2	Nutrients in food
3	Nutrition
4	Food processing
5	Ecosystems and food webs

Key concepts for teaching these Life and Living units

Teachers will need to familiarise themselves with basic ecological principles and the classification of plants and animals, in order to provide a conceptual framework for the teaching of the topics in the syllabus. The topics cannot be taught in isolation. The big picture is very important.

Definitions and concepts

Biology – the scientific study of life.

Ecology – the study of the inter-relationships, between organisms, and all living (biotic), and non-living (abiotic) components of their environment.

Anatomy – the study of the physical structure of a plant or an animal.

Physiology – the study of the functioning of living things.

Botany – the study of the structure and functioning of plants.

Zoology – the study of the structure and functioning of animals.

Biochemistry – the study of the chemical basis of life / chemical reactions in living organisms.

Conservation biology – the branch of **biology** that deals with the effects of humans on the environment and with the **conservation** of **biological** diversity. (www.thefreedictionary.com, 29 July 2013)

Conservation – the management and sustainable use of the natural environment and natural resources for ethical reasons and the benefit of humanity. (Fiedler & Jain 1992) (freecourseware.uwc.ac.za, 29 July 2013)

Photosynthesis – the process used by most autotrophs (organisms that produce their own food) to convert light energy, water and carbon dioxide into sugars (Starr et al., 2013). It occurs in green plants that contain chlorophyll in the cells of their leaves and stems.

Cellular respiration – an intracellular (within cells) process, in which food is chemically changed (oxidised) with the release of energy. The complete breakdown of sugar or other organic compounds to carbon dioxide and water is termed aerobic respiration (Ravin, Evert & Curtis, 1981). This process is the reverse of photosynthesis.

Breathing (gaseous exchange) – a mechanical process which has two parts: inhalation (the drawing in of air into the lungs) and exhalation (the act of expelling air from the lungs). (Marieb, 2012)

Organic compounds – consist mostly of carbon and hydrogen atoms. (Starr et al., 2013)

Inorganic compounds – compounds that lack carbon e.g. water, sodium. The exception is carbon dioxide which is an inorganic molecule. (Marieb, 2013)

Ecology: basic definitions (A level biology notes, 2013)

Ecosystem – a unit made up of biotic and abiotic components interacting and functioning together including all the living organisms of all types in a given area, and all the abiotic physical and chemical factors in their environment, linked together by energy flow and cycling of nutrients. Ecosystems may vary in size but always form a functional entity, e.g. a decomposing log, a pond, a field, a sea shore, a forest, or the entire biosphere.

Habitat – the particular location and type of local environment occupied by a population or organism characterised by its physical features or by its dominant producers (e.g. rocky shore or sugar cane field).

Niche – the functional role or place of a species of organism within an ecosystem including interactions with other organisms (e.g. feeding interactions), habitat, life-cycle and location, adding up to a description of the specific environmental features to which the species is well adapted.

Population – *all of the organisms of one particular species* within a specified area at a particular time, sharing the same gene pool and more or less isolated from other populations of the same species.

Community – *all of the populations of all of the different species* within a specified area at a particular time.

Producers – autotrophic organisms (produce their own food), at the first trophic level in food-chains, that can use simple inorganic compounds (e.g. carbon dioxide and inorganic nitrogen) plus energy from light (photosynthesis) or oxidation of inorganic chemicals (chemosynthesis) to manufacture energy-rich organic compounds.

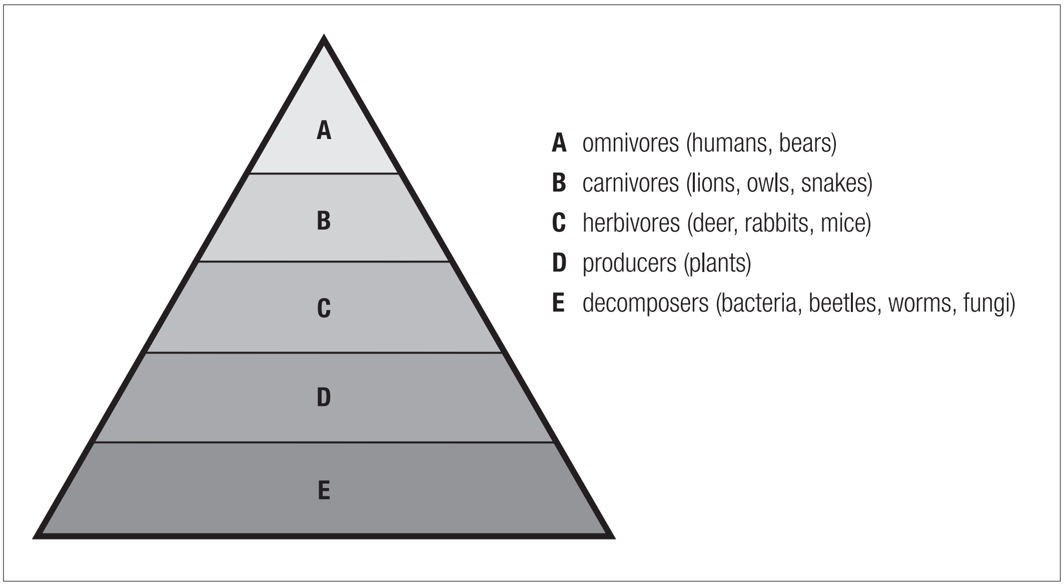
Consumers – heterotrophic organisms (cannot produce food) that obtain energy-rich organic compounds by eating or decomposing other organisms, at the second (e.g. herbivore) or higher (e.g. carnivore) trophic levels in food chains.

Decomposers – saprotrophic organisms that feed on dead organisms and organic waste (e.g. dead leaves, faeces), releasing nutrients for re-use and so playing an important role in the carbon and nitrogen cycle.

Trophic level – a position in a food chain, indicating the numbers of energy-transfer steps to that level, where producers are at trophic level 1, herbivores are at trophic level 2 and so on up to trophic level 5 (some big, fierce predators such as the polar bear).

Biomass – The total dry weight of all organisms in a particular habitat or area (Ravin et al., 1981).

Figure 1: The trophic structure of an ecosystem



Source: ocw.nd.esu

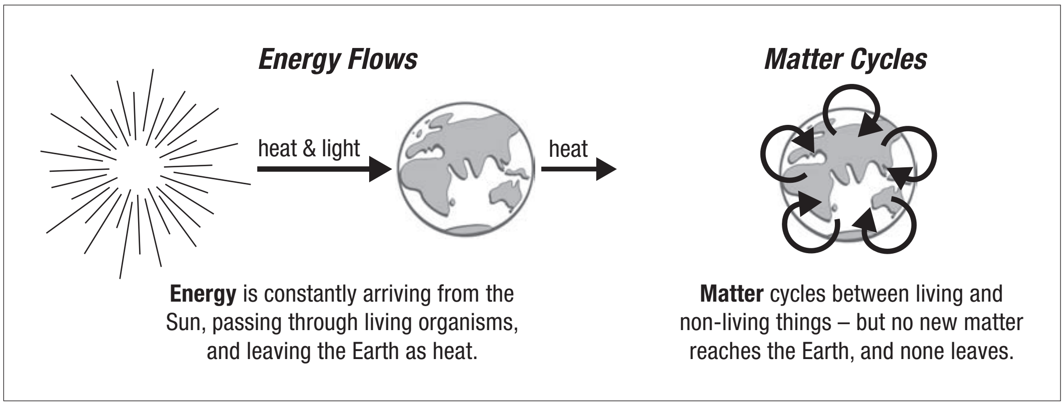
Ecology: basic concepts

When studying ecosystems in any detail, it is important to understand the difference between energy and matter. Energy and matter are quite different things and cannot be inter-converted. (A level biology notes, 2013)

Energy comes in many different forms (such as heat, light, chemical, potential, kinetic, etc.) which can be inter-converted, but energy can never be created, destroyed or used up. If we talk about energy being "lost", we usually mean as heat, which is radiated out into space. Energy is constantly arriving on Earth from the sun, and is constantly leaving the Earth as heat, but the total amount of energy on the Earth is constant.

Matter comes in three states (solid, liquid and gas) and again, cannot be created or destroyed. The total amount of matter on the Earth is constant. Matter (and especially the bio-chemicals found in living organisms) can contain stored chemical energy, so a cow contains biomass (matter) as well as chemical energy stored in its biomass.

Figure 2: Energy and matter



All living organisms need energy and matter from their environment. Matter (nutrients from food) is needed to make new cells (growth) and to create new organisms (reproduction), while energy is needed to drive all the chemical and physical processes of life, such as biosynthesis (making cell components), active transport (of molecules between cells) and movement.

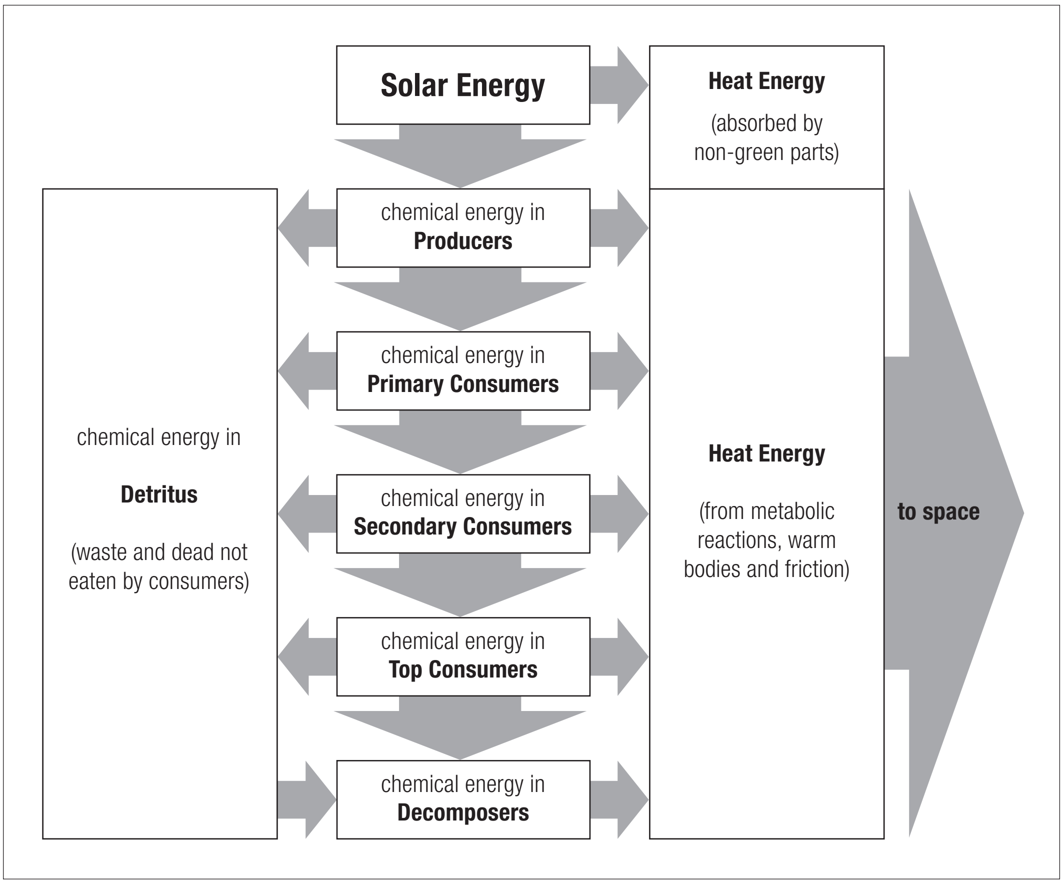
Energy flow in ecosystems

Three things can happen to the energy taken in by the organisms in a **trophic level**:

1. It can be passed on to the **biomass** of the next trophic level in the **food chain** when the organism is eaten.
2. It can become stored in **detritus** (dead organic matter). This energy is passed on to **decomposers** when the detritus decays.
3. It can be converted to heat energy by inefficient chemical reactions, radiated by warm bodies, or in friction due to movement. The heat energy is lost to the surroundings, and cannot be regained by living organisms.

These three alternatives are shown in the energy flow diagram in Figure 3.

Figure 3: Energy flow diagram

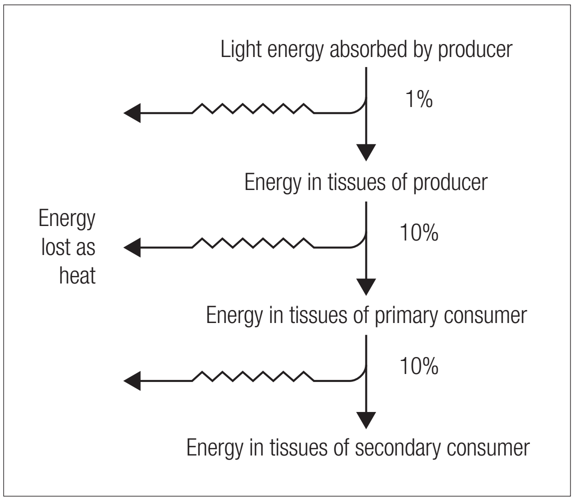


Eventually *all* the energy that enters the ecosystem will be converted to heat, which is lost to space.

Energy transfer

The idea of the transfer of energy allows us to consider the efficiency with which light energy is transferred to energy in producers, as well as the efficiency with which energy in the producers is then transferred from trophic level to trophic level.

Figure 4: The efficiency with which energy is transferred within an ecosystem



Transfer of sunlight energy to energy in plant tissues

Not all the light energy falling on a plant is used to make new tissues. In most ecosystems plants convert less than 3% of this sunlight to chemical energy. This inefficiency is due to the following reasons:

1. Some sunlight missing leaves entirely, and falling onto the ground or other non-photosynthesising surfaces.
2. Only certain wavelengths of light being absorbed by chlorophyll.
3. Some fails to strike a chlorophyll molecule.
4. Some will be reflected from the plant surface.
5. Energy losses, as energy absorbed by chlorophyll is transferred to carbohydrates during photosynthesis.
6. Other factors such as soil nutrients or carbon dioxide concentration may be in short supply. This will limit the rate of formation of new tissue.

The **chemical potential energy**, now in the plant tissue, is contained in various organic molecules, especially **carbohydrates, lipids and proteins.** It is from these molecules that the primary consumers in the ecosystem obtain their energy supply – from the food they eat. However, in most plants, almost half of the chemical potential energy stored by plants is used by the plants themselves. They release the energy by cellular respiration. During these processes, much energy is lost to the environment as heat.

What is left is then available for other organisms (consumers), who feed on the plants**.** Once again, losses occur between the plants and the primary consumers. The reasons for these losses include:

1. Not all of the parts of the plants being available to be eaten, such as woody tissues and some roots;
2. Not all the parts of the plants eaten being digestible, so that not all the molecules can be absorbed and used by the primary consumer;
3. Energy losses, as heat within the consumer's digestive system, as food is digested.

As a result of the loss of energy during cellular respiration in the plants, and the three reasons given above, the overall efficiency of transfer of energy from producer to primary consumer is rarely greater than 10%.

Similar losses occur at each **trophic level.** So, as energy is passed along a **food chain**, less and less energy is available at each successive trophic level. Food chains rarely have more than four or five links in them because there simply would not be sufficient energy left to support animals so far removed from the original energy input to the producers.

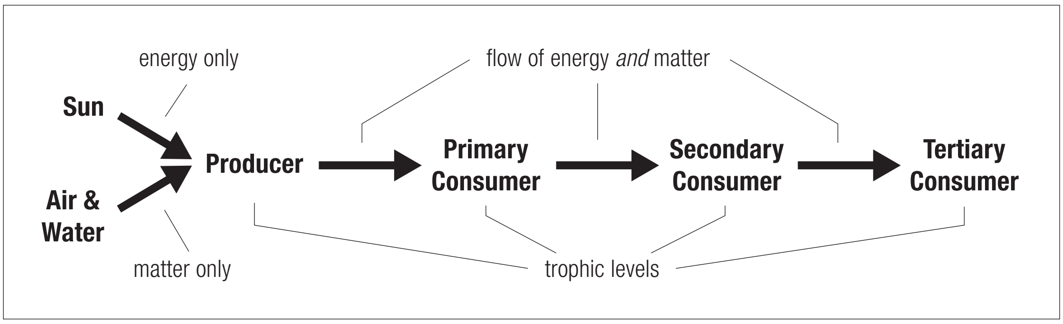
In the diagram, the efficiency of energy transfer was given as 10%, but it is very variable. Some of the factors which result in this variation include the following:

1. **Carnivores** are more efficient than **herbivores** at converting energy in food into energy in body tissues. This is partly because plants contain much more indigestible material than animals.
2. Poikilothermic animals (cold blooded), such as fish, are much more efficient at transferring energy in food into energy in body tissues than homoiothermic animals (warm blooded), such as pigs and chickens. This is because a homoiothermic animal maintains a high body temperature. It does this by producing heat by metabolic processes. A lot of the food that a homoiotherm eats goes into heat production.
3. A small mammal has a larger surface area compared with its volume than a large mammal has. It therefore loses more body heat. Since this heat comes from its metabolic processes, it follows that a lot more of the energy in the food that a small mammal eats is lost as heat and does not go into making new tissues.

Food chains and webs

The many relationships between the members of a **community** in an ecosystem can be described by *food chains* (Figure 5) and *webs*. Each stage in a food chain is called a *trophic level*, and the arrows represent the flow of energy and matter through the food chain. Food chains always start with photosynthetic *producers* (plants, algae, plankton and photosynthetic bacteria) because, uniquely, producers are able to extract both energy and matter from the abiotic environment (energy from the sun, and 98% of their matter from **carbon dioxide** in the air, with the remaining 2% from **water and minerals in soil**). All other living organisms get both their energy and matter by eating other organisms.

Figure 5: A simple food chain



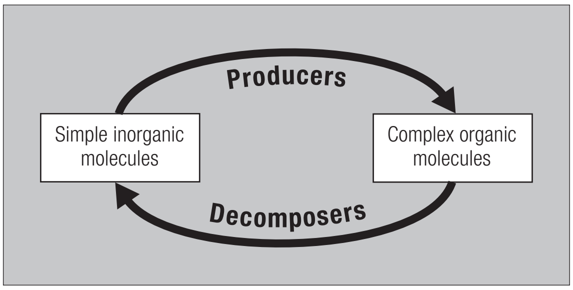
Although this represents a “typical” food chain, with producers being eaten by animal consumers, different organisms use a large range of feeding strategies (other than consuming), leading to a range of different types of food chain, which in reality make up food webs. So food chains need not end with a consumer, and need not even start with a producer, e.g.

Producer ➔ Primary Consumer ➔ Top Consumer ➔ Scavenger

Material cycles in ecosystems

Matter cycles (moves) between the biotic environment and in the abiotic environment. Simple inorganic molecules (such as CO_2, N_2 and H_2O) are *assimilated* (or *fixed*) (used up) from the abiotic environment by producers and microbes, and built into complex organic molecules (such as carbohydrates, proteins and lipids). These organic molecules are passed through food chains and eventually returned to the abiotic environment again as simple inorganic molecules by decomposers. Without either producers or decomposers there would be no nutrient cycling and no life.

Figure 6: The cycling of nutrients



Simple inorganic molecules are often referred to as *nutrients*. Nutrients can be grouped as: *major nutrients* (molecules containing the elements C, H and O, comprising >99% of biomass); *macronutrients* (molecules containing elements such as N, S, P, K, Ca and Mg, comprising 0.5% of biomass) – (required in large amounts); and *micronutrients* (small amounts required) or *trace elements* (0.1% of biomass). Macronutrients and micronutrients are collectively called *minerals*. While the major nutrients are obviously needed in the largest amounts, the growth of producers is usually limited by the availability of minerals such as nitrate and phosphate.

There are two groups of decomposers:

1. **Detrivores** are animals that eat detritus (such as earthworms and woodlice). They digest much of the material, but like all animals are unable to digest the cellulose and lignin in plant cell walls. They break such plant tissue into much smaller pieces with a larger surface area making it more accessible to the saprophytes. They also assist saprophytes by excreting useful minerals such as urea, and by aerating the soil.

2. **Saprophytes** (or decomposers) are microbes (fungi and bacteria) that live on detritus. They digest it by extracellular digestion, and then absorb the soluble nutrients. Given time, they can completely break down any organic matter (including cellulose and lignin) to inorganic matter such as carbon dioxide, water and mineral ions.

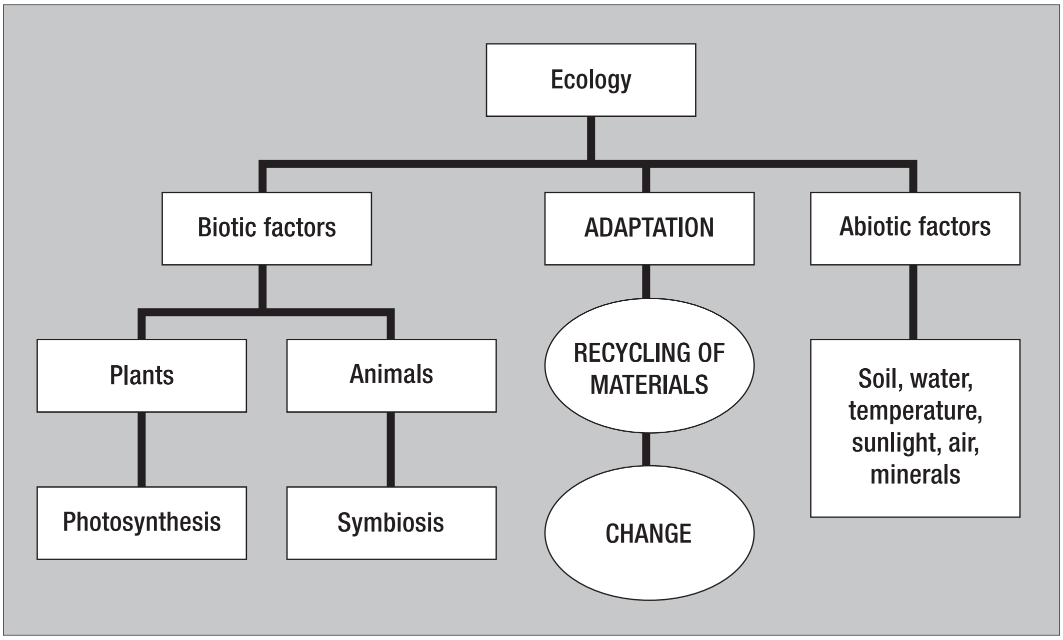
Detailed material cycles can be constructed for elements such as carbon, nitrogen, oxygen or sulphur, or for compounds such as water, but they all have the same basic pattern as the diagram in Figure 6.

Ecology basically then is the study of interactions between living organisms with other living organisms as well as between living organisms and the non-living environments in which they occur.

These interactions are trophic (involving food and energy transfer) as well as interactions that are mutualistic and involve interactions that are almost incidental – birds nesting in trees etc.

Figure 7 summarises the classification of biotic and abiotic and also mentions some important processes occurring in nature – all these interactions are involved in creating conditions that make the Earth a living planet – one on which living organisms can survive

Figure 7: Summary diagram for ecology



and live biologically. It is important that these pathways and interactions happen and are not interrupted by human activities as this would seriously threaten biological life as we know it and therefore threaten human existence.

It is therefore important for young children to understand natural interactions and the "ecological services" they provide and to play their role in maintaining these processes for the future and for sustainable living and lifestyles.

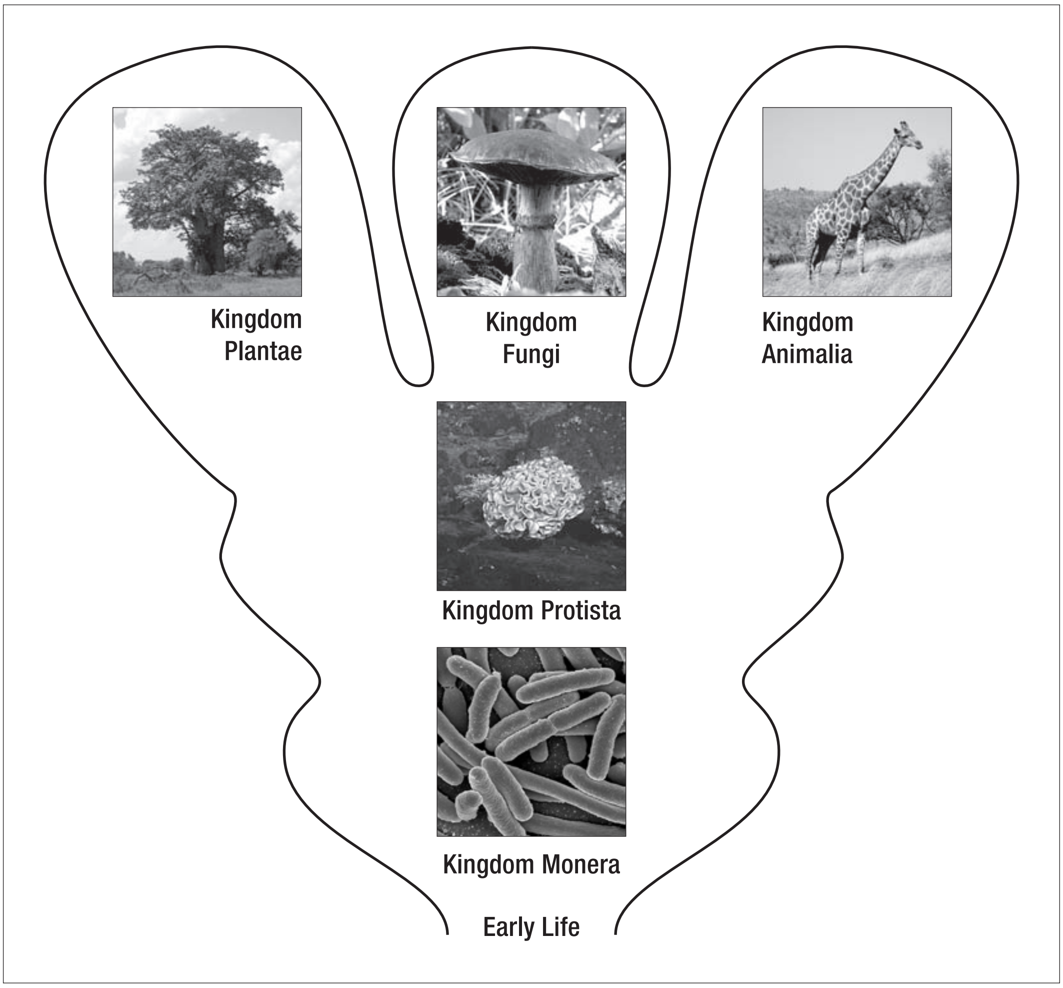
Classification

As there are thought to be about 10 million living species on the Earth today, any study of biology requires that some order and method of grouping is established. This area of study in natural science or biology is called taxonomy or classification. It has a history dating back centuries and the pioneer of this area of enquiry is Carolus Linnaeus, a Swedish botanist. All organisms are at this time usually grouped into five kingdoms (classic Linnaean classification), although new discoveries lead to new ideas and this grouping may change in the future. Viruses are not included in this system as many biologists do not consider them to be living organisms (A level biology notes, 2013).

These five kingdoms (Figure 8) are:

- Kingdom **Prokaryotae (Monera)**
- Kingdom **Protista**
- Kingdom **Fungi**
- Kingdom **Plantae**
- Kingdom **Animalia**

Figure 8: The five kingdom classification of living organisms



Because science is constantly expanding our knowledge of living things, the precise details of how organisms are classified in the Linnaean system are frequently in flux. This is not due to confusion but rather to the evolution of our understanding brought about by new discoveries.

For instance, as a result of the discovery of a dramatically new form of life known as archaeo bacteria, a growing number of researchers now use a classification level above kingdoms referred to as a domain. They define three domains of living things:

- *Archaeo* (simple bacteria-like organisms that live in extremely harsh anaerobic environments – these are the archaeobacteria)
- *Bacteria* (all other bacteria, blue-green algae, and spirochetes)
- *Eukarya* (organisms with distinct nuclei in their cells) protozoans, fungi, plants, and animals. (Reference: http://anthro.palomar.edu/animal/animal_3.htm 29 July 2013)

To identify animals and learn more about them, it helps to become familiar with the way they are classified. Biologists arrange animals into groups on the basis of traits (characteristics) which they share with other animals and their genetic relationships with each other. This orderly way of classifying animals forms the basis of the field of study called **taxonomy.** Modern scientific taxonomy is based on physical characteristics (such as teeth, skin, fur, feather, or scale patterns, size, or the structure of body parts) and on **genetic**

Where do fungi fit in?

Fungi are a large group of organisms that were once classified as plants but are now allocated to a kingdom in their own right. Examples includes: Pin moulds, e.g. Mucor (bread mould); Penecillium moulds and yeasts, e.g. Saccharomyces; mushrooms and toadstools, e.g. Agaricus.

The distinguishing features of Fungi are:

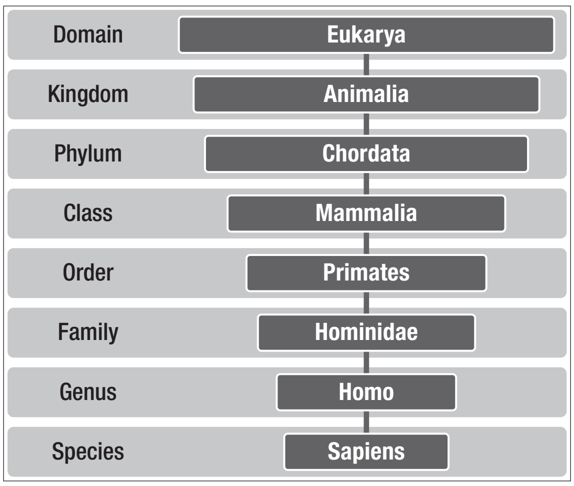
1. eukaryotic organisms
2. bodies usually multicellular except yeast which is unicellular
3. absence of chlorophyll and therefore do not photosynthesise but feed as saprobionts or parasites
4. feed heterotrophically by absorbing their food
5. cell walls made of chitin rather than cellulose
6. usually made up of thread-like hyphae that collectively form a mycelium
7. reproduce sexually and asexually by means of spores that lack a flagellum.

characteristics. Some key characteristics are basic to taxonomic descriptions. Others are not part of the basic description, but correspond to evolutionary relationships upon which taxonomic classifications are based.

The most important categories in this hierarchical system, from higher and more inclusive to lower and more specific, are **domain, kingdom, phylum, class, order, family, genus, and species**. A kingdom is one of the highest primary divisions into which all objects are placed. All animals are part of the Animal Kingdom. Each kingdom is divided into smaller units called **phyla** (the plural form of phylum). For example, animals that have a nerve cord are classified as members of the **Phylum Chordata.** The chordates are further divided into **classes** such as **Mammalia, Aves, Reptilia, and Amphibia**.

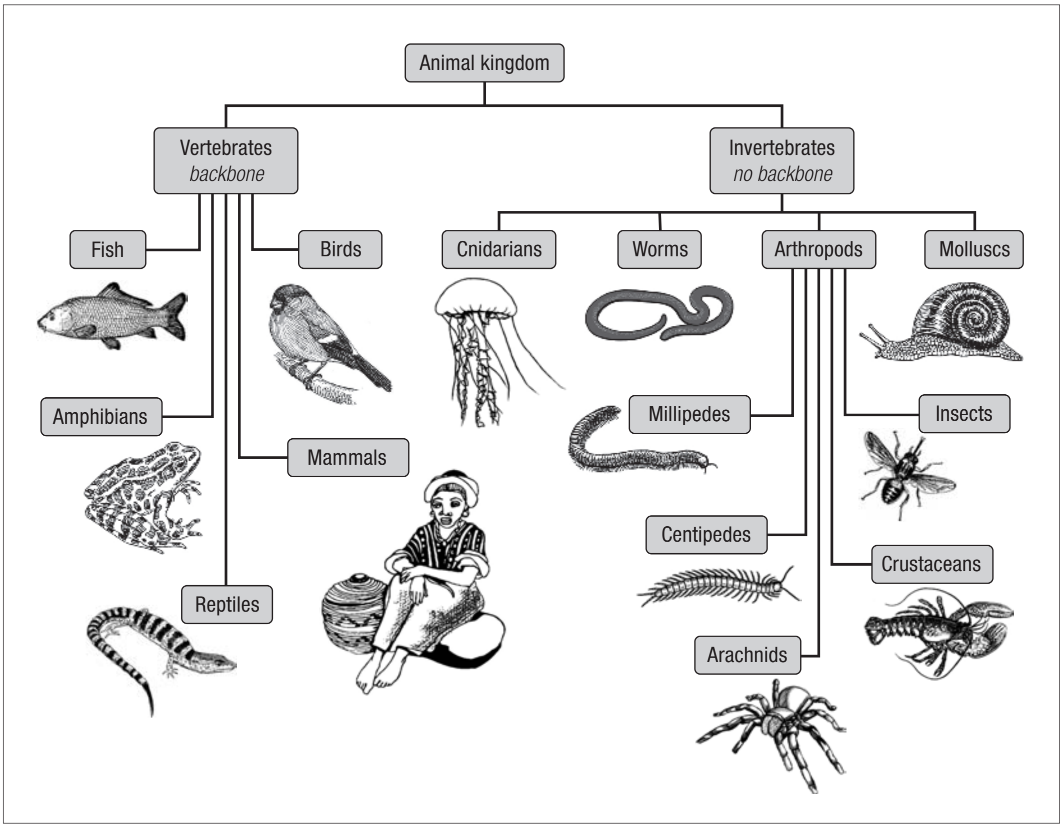
Members of each class have characteristics which they share with other members of their class, but which generally are not found in members of the other classes. Classes are divided into **families**. Families are subdivided into **genera** (the plural form of genus); and genera are subdivided into **species.** A family usually contains more than one **genus,** and each genus usually includes more than one species. Animals that share the same genus are very similar and probably evolved from a common ancestor. The **species** is the most fundamental unit and contains a single type of animal. The classification of a human being is shown in Figure 9.

Figure 9: The classification of a human



Source: microvirology.blogspot.com

Figure 10: A simplified classification of animals



Developing your Teaching Practice

In teaching natural science there is a variety of knowledge and skills that form part of the learning area or subject. Scientific knowledge is largely based on evidence and scientific exploration is co-operative in nature. A large part of science teaching thus involves the teaching of "science process skills" and the provision of opportunities to develop and exercise such skills. The CAPS document suggests that activities need to sustain enjoyment and curiosity about the world and natural phenomena. The skills below, developed through the We Care activities, link to this the teaching of science as discussed in CAPS. Major processes mentioned include investigative and logical processes, planning investigations, conducting investigations and collecting data, evaluating data and communicating findings and analysis and creation of theories.

In short, a list of skills developed in these *Life and Living* units includes:

- Observing: finding information, observing detail or oddity through close observation;
- Classifying: sorting and arranging objects according to similarities and differences;
- Inferring: making judgments after obtaining as much evidence as is possible to gather; and
- Hypothesising: this is seen as a reasonable guess to explain a particular event or observation.

Assessment

Assessment is the process of gathering valid and reliable information using different context appropriate approaches to determine what learners' actual level of performance is in relation to what they ought to attain eventually through the different teaching and learning processes outlined in the CAPS guidelines.

Learners require timely, constructive feedback to support their learning. In guiding learners to close the gap between their actual level of achievement and their possible level of achievement, teachers use informal and formal assessment to scaffold (support) and improve learning. They use multiple sources of information as part of ongoing assessment to determine where learners are along their zones of proximal development and what the next learning step(s) should be to close the gap.

Apart from the fact that the insights gained by the teacher from learner assessment should inform their own teaching, they are also ultimately responsible, both legally and professionally, for reporting learner progress to all relevant stakeholders. In most instances, the assessment should reflect the objectives of the curriculum and the learner's ability to learn.

For science teaching this is largely linked to the process skills listed above but also includes content knowledge links to these skills. Various assessment processes are listed and presented in the CAPS document and some suggestions are provided in the *We Care* activities suggested as teaching practices for Natural Sciences in these units. These include:

- Informal assessment: checking learners' classwork and practical reports and oral questions with feedback.
- Formal assessment: assessment tasks, tests and practical projects
    - Use a variety of assessment tasks (see We Care suggestions in listed and recommended activities); and
    - Ensure that major skills suggested are included and assessed by a variety of approaches; also ensure content knowledge is done.

Assessing practical work

Practical work or activities provides opportunities for learners to demonstrate that they have acquired or developed various skills over time. One skill or a variety of skills can be assessed in the time period. Practical work provides opportunities skills to be assessed in the process of doing and not only at the end or conclusion of the activities. The following are some important skills that learners need to demonstrate and which can be assessed as part of practical work:

1. Following instructions;
2. Handling apparatus and materials;
3. Observation skills (gross features and fine detail);
4. Measuring skills (reading instruments or measuring changes in size);
5. Recording data (tables, graphs, texts);
6. Interpreting results (observing trends);
7. Formulating hypotheses.

The exercises provided give opportunities for all the above to be assessed and recorded as part of the teaching and learning processes. These in turn link up with the assessment requirements for CAPS.

The We Care activities provide suggestions for assessment in the section for teachers. Use these as suggestions and link to content as well as skills that need to be assessed. These suggestions provide the flexibility for teachers to adapt the assessment to suit both their particular contexts and learners' abilities.

Unit 1

Life and Living in Grade 4

This unit will explore five topics within Life and Living in Grade 4. These are listed in the table below.

Grade 4 Topics – Term 1: 10 weeks	
1	Living and non-living things
2	The structure of plants and animals
3	What plants need to grow
4	Habitats of animals
5	Structures for animal shelters

Grade 4 – Topic 1: Living and non-living things

Key words:

biotic, abiotic, life, atom, cell, tissue, organ, organism, nutrient, energy, adaptation

Subject content knowledge

What are living and non-living things?

Biology is the scientific study of life. What is life? All elements on Earth are made up of atoms. Atoms join to form molecules. Molecules join together to form cells. Cells are the smallest unit of life. Cells come together in tissue systems and tissue systems come together in organ systems, and a group of organ systems comes together to form an organism.

How do living things differ from non-living things?

All things, living or not, consist of the same building blocks: atoms. Atoms join to make molecules. The unique properties of life emerge as certain kinds of molecules become organised into cells. Higher levels of life's organisation include multi-celled organisms, populations, communities, ecosystems and the biosphere. (Starr et al., 2013)

Why is it important to discuss living and non-living things?

All living organisms share a set of key features. All require ongoing **inputs of energy** and **raw materials;** all **sense** and **respond to change;** and **all have DNA** (genetic material) that guides their functioning. Not all living things eat, but all living things require energy and nutrients. A **nutrient** is a substance that an organism needs for growth and survival but cannot make for itself.

An organism cannot live for very long in a changing environment unless it **adapts** to changes. So every living thing has the ***ability to sense and respond*** to conditions both inside and outside of its body. For example, after you eat, the sugars from your meal enter your bloodstream. The added sugars set in motion a series of events that causes cells throughout the body to take up sugar faster, so the sugar level in your blood quickly falls. This response keeps your blood sugar levels within a certain range, which in turn helps keep your cells alive and your body functioning.

Non-living things are not able to move (without help), breathe, feed, grow, reproduce, excrete or sense the environment.

LIVING THINGS CAN:	EXPLANATION
1 Move	Movement by means of muscles using chemical energy obtained from food
2 Breathe	Take in oxygen through cells membranes or lungs in higher animals
3 Feed	Eat food to build more cells
4 Grow	Get bigger and develop into an adult organism
5 Reproduce	Mate and produce offspring
6 Excrete	Get rid of waste products from the body
7 Sense their environment	In the case of humans – see, hear, touch, taste, smell

Expanding knowledge

Teach about atoms, elements, molecules, cells, and organ systems and the hierarchy of life with simple everyday examples.

Teaching practice ideas from *We Care*

ACTIVITY	METHOD	LINKS TO CAPS	CORE KNOWLEDGE
Activity 1.4 **Exploring soil**	Investigation Measuring	Living and non-living things	Some parts of soil are living and others are not! The interaction between living and non-living parts of soil is important for the growth of plants.
Activity 1.5 **The water cycle**	Experiment		Water is non-living but vital to life!
Activity 1.6 **How much water**	Experiment Record & Observe		Water is an abiotic factor.
Activity 1.7 **The air around us**	Group work Writing a report		Oxygen is found in air and is a gas (abiotic) vital for life on Earth.
Activity 2.2 **Getting to know a plant**	Research Report writing Worksheet		Get to know a living thing and find out what makes it different from water and the physical parts of soil.
Activity 2.4 **Getting to know an animal**	Research Report writing Worksheet		Attributes of animals that make them living things.

Grade 4 – Topic 2:
The structure of plants and animals

Key words:

shoot, flowering plant, cone bearing plant, stamen, ovary, seed, flower, roots

Subject content knowledge

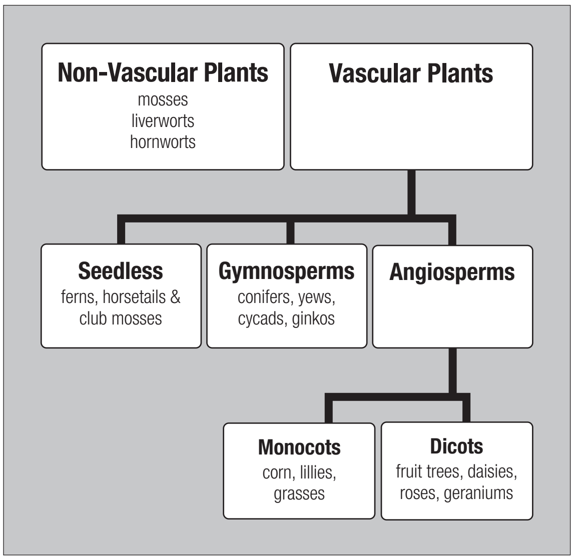
The structure of plants

Plants are defined as multi-celled, photosynthetic organisms that have adapted to life on land. (Starr et al., 2013)

All angiosperms (flowering plants) and gymnosperms (cone bearing plants) have roots, stems, leaves, and fruit (containing seeds). They are called **vascular plants** as they have a proper system of vessels to transport water and organic food. Only angiosperms have flowers.

Mosses are seedless and reproduce with spores. They do not have flowers and proper vascular tissue so they are called **non-vascular** plants. Ferns also reproduce with spores and have no flowers but do have the start of a vascular system. Gymnosperms include plants such as cycads, pine trees and welwitchias.

Figure 11: Plant classification

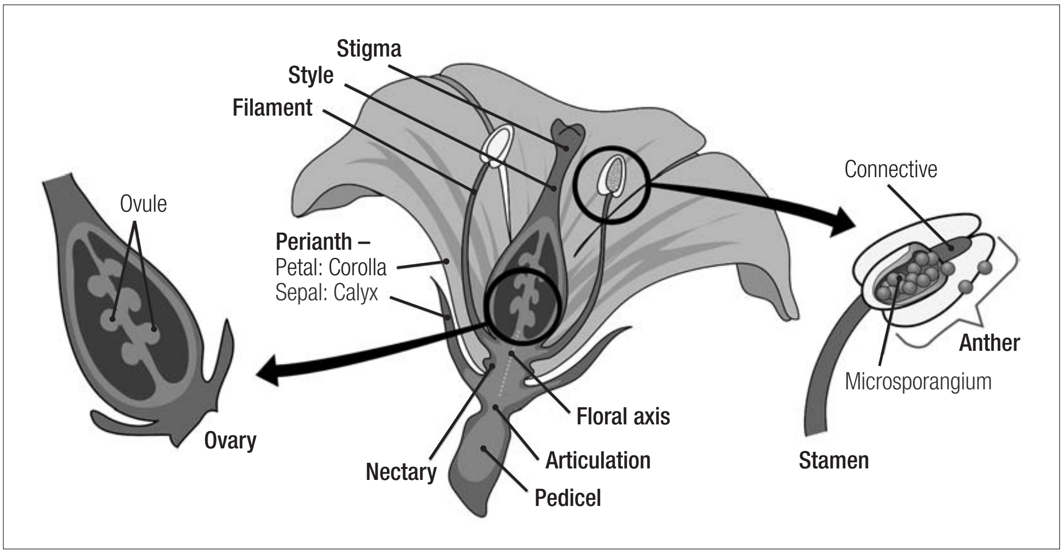


Source: ournestof3.blogspot.com

A **flower** is a specialised reproductive shoot that consists of modified leaves arranged in whorls (circles). A flower contains **male parts called stamens** and a **female part called an ovary containing ovules.** Stamens produce pollen in anthers and the ovary contains ovules that will become eggs. After fertilisation an ovule matures into a seed and the ovary becomes the fruit. (Starr et al., 2013)

Angiosperms are divided into two groups – **monocots** (parallel veins, one seed leaf) such as grasses, wheat, orchids, palms and **dicots** (net veins, two seed leaves) such as daisies, sweet peas, tomatoes, roses, trees, cabbages.

Figure 12: Parts of a flowering plant



Source: Wikimedia

The structure of animals

Animals are multi-celled heterotrophs that move about. Animals are divided into two groups:

Invertebrates have no spinal cord and often have an exoskeleton, made of chitin – which is very strong and which keeps the animals relatively small. Invertebrates include animals like sea sponges, tapeworms, earthworms, molluscs e.g. snails; insects e.g. grasshopper, ant, bee, crustaceans e.g. crayfish and crabs; arachnids e.g. spiders and scorpions.

Vertebrates have a spinal cord and can grow larger than invertebrates. Vertebrates include animals like fish, amphibians (e.g. frogs), birds, reptiles (e.g. lizards and snakes) and mammals. Animals have heads, body, limbs; some have tails and sense organs.

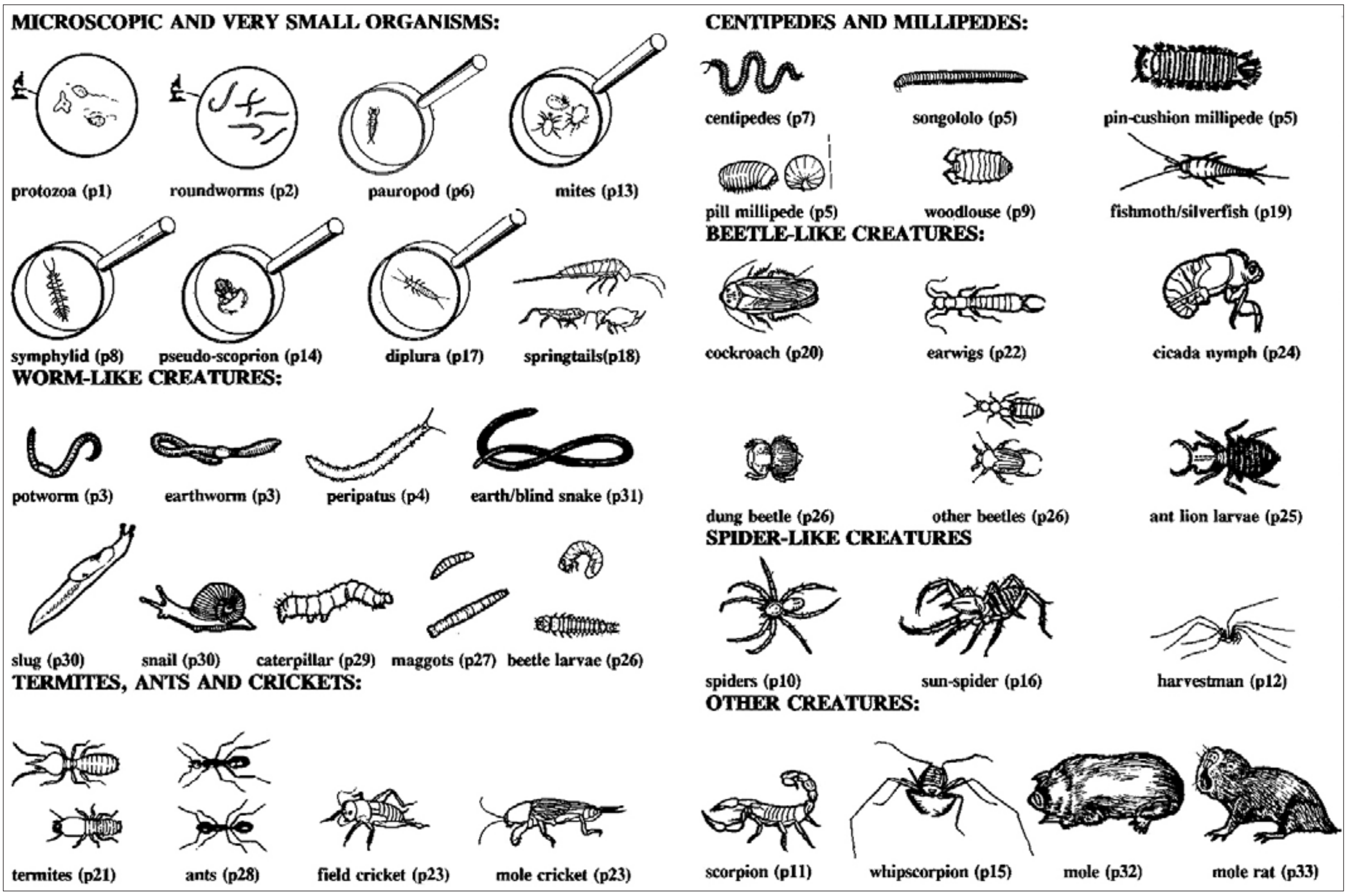
Expanding knowledge

- Teach about how plants and animals are classified. Do simple classification exercises using everyday items.
- Compare vertebrates to invertebrates in a table.

Teaching practice ideas from *We Care*

ACTIVITY	METHOD	LINKS TO CAPS	CORE KNOWLEDGE
Activity 1.4 **Exploring soil**	Investigate the small animals (mini beasts) that live in soil; use picture reference sheet below.	The structure of animals	Need to know the attributes of insects and spiders.
Activity 2.1 **Interview a tree**		The structure of plants	Need to know parts of a flowering plant
Activity 2.2 **Getting to know a plant**		The structure of plants	Need to know parts of a plant
Activity 2.4 **Getting to know an animal**		The structure of animals	Parts of an animal
Activity 2.5 **See the birds around us**	Monitor the birds in your school grounds. List the types found.	The structure and behaviour of birds.	

Exploring soil using a reference sheet



Source: Share-Net, *Hands-On Soil and Compost Life*

Grade 4 – Topic 3: What plants need to grow

Key words:
growth, transpiration, photosynthesis, nutrients, water, temperature

Subject content knowledge

What is growth?

Growth is enlarging in size and developing.

Plants need **light** from the sun for photosynthesis, as well as **water** and **carbon dioxide** and chlorophyll. Plants need **oxygen** for cellular respiration (to produce energy to grow) and **good soil**, as well as a moderate temperature**.**

Plants need good soil (loam) in order to get the nutrients that they need. The roots of the plant absorb water and nutrients from the soil. Water moves up the plant from the roots through continuous pipelines called **xylem.** Food made in the leaves moves to other parts of the plant through cells called **phloem.**

Where do plants get the nutrients they need?

Plants need macronutrients e.g. nitrogen, potassium, phosphorus, carbon, hydrogen and oxygen, and micronutrients (e.g. iron and manganese) that they are able to get from water, soil and air.

What is transpiration?

Transpiration is the loss of water from the aerial parts of plants. This water goes back into the water cycle.

What is the best temperature to germinate seeds at?

25-30 degrees Celsius is best.

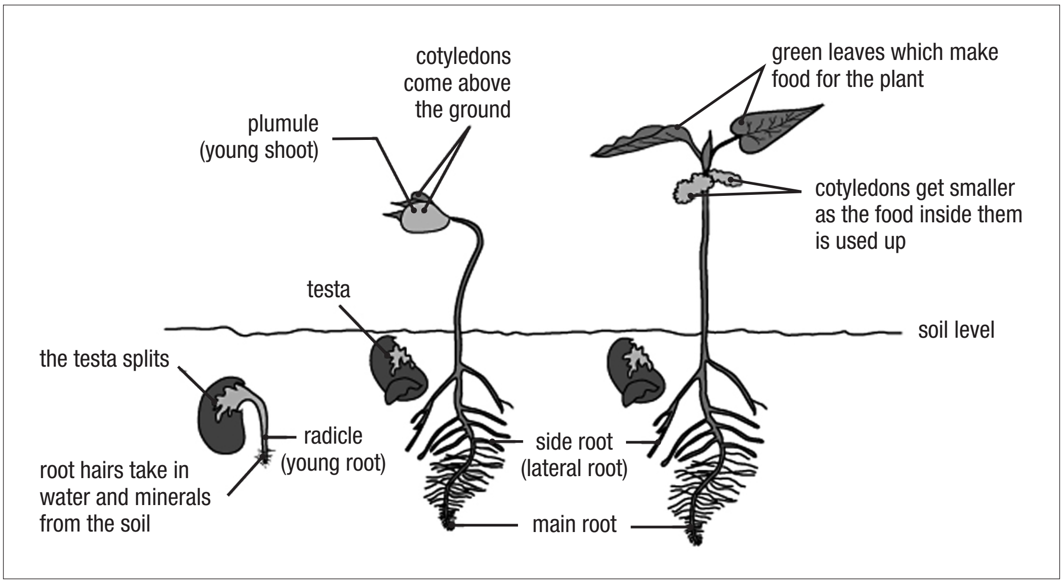
What minerals are needed by plants for growth?

MINERAL ELEMENT	WHAT PLANTS USES IT FOR
Nitrogen	Making leaves
Potassium	Making flowers and fruit
Phosphorus	Making roots
Magnesium	Making chlorophyll for photosynthesis
Oxygen, hydrogen and carbon	For making carbohydrates (sugars) in the leaves of green plants.

Source: Adapted from Target Science Biology foundation tier, D. Coppock, 2001, Oxford, Oxford University press)

How do seeds grow into new plants?

Figure 13: A bean seed growing into a new plant



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How do plant leaf cuttings grow into new plants?

Name of plant	Part that can be used for taking cuttings
Pelargoniums	Stems
Streptocarpus	Leaves
Plectranthus	Stems
Roses	Stems
African violets	Leaves

Figure 14: Taking a leaf cutting of an African violet plant and rooting it in water

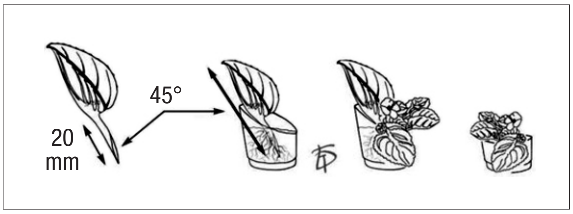


Illustration by Francine Pilon, author of the book *Saintpaulia*, http://www.saintpaulia2010.org/english/

Expanding knowledge

Research how to take specific stem and root cuttings and see which method gives the quickest results. Discuss problems that you had rooting your cuttings.

Teaching practice ideas from *We Care*

Activity 1.4 **Exploring soil**	Plants need good soil to grow in. What does this mean? What is soil made of? What different types of soil do we get? Which type of soil do most plants grow well in?
Activity 1.5 **The water cycle**	Plants need water to grow. Where does water come from? The importance of plants in the water cycle – Theme 1 p.41 – two experiments to do.
Activity 1.6 **How much water?**	p.46: An experiment to establish how much water seeds need to germinate. Water wise and indigenous gardening information.

Grade 4 –Topic 4: The habitats of animals

Key words:

habitat, shelter, species, biome, adaptation, ecosystem

Subject content knowledge

Why do animals need shelter?

Animals need places to sleep, rest, and care for their young, store their food and hide from predators. A **habitat** is a type of environment in which a species (an animal or a plant!) typically lives (Starr et al., 2013). Habitats contain different animals and plants (Coppock, 2001). We find many different habitats in an ecosystem.

Species: Unique type of organism; two names genus and species – e.g. *Homo* (genus) *sapiens* (species). (Starr et al., 2013)

Biome: A group of regions that may be separated but share a characteristic climate and dominant vegetation (Starr et al., 2013). For example desert, grassland, mountains. A biome contains a variety of ecosystems that contain a variety of habitats.

Ecosystem: A community interacting with its environment through a one-way flow of energy and cycling of materials. (Starr et al., 2013)

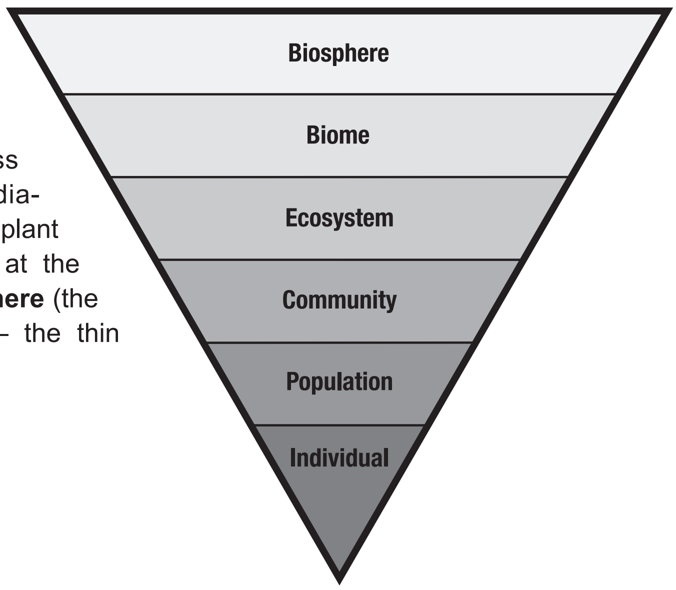
Population: Individuals of the same species living together. (Coppock, 2001)

Community: Made up of a number of different plants and animals, e.g. a small forest.

A hierarchy of complexity

Living things can be studied at six different levels (Eyewitness science-Ecology, 1993). The diagram starts with an **individual** plant or animal (smallest unit here) at the bottom and moves to the **biosphere** (the highest level of organisation) – the thin layer of earth that supports life.

Figure 15: The hierarchy of complexity in ecology



Where do animals live? – Types of habitats

HABITAT	EXAMPLES OF ANIMALS THAT LIVE IN THIS HABITAT	TYPE OF SHELTERS
Grasslands: A biome with mostly grasses and non-woody plants that can withstand fire and grazing (Starr et al, 2013)	Zebras, buck, rhino Small mammals e.g. bat-eared foxes, Insects e.g. termites	Burrows in the ground Termite mounds Porcupines in burrows Earthworms under the ground
River	Birds such as kingfishers, herons	Nests
Pond / Wetland	Dragonflies, water creatures, frogs, bees, wasps	Wasps – mud nests Bees – bee hives
Forest (evergreen or deciduous)	Birds , snakes, insects	Birds' nests
Sea	Large fish, birds, shellfish , seals, penguins	Penguins – nests on the ground
School grounds	Birds, insects, lizards, snails,	Insects in holes in the ground

Expanding knowledge

Take learners on a field trip to investigate particular habitats in their local environment and write a report on a particular plant or animal found there.

Teaching Practice ideas from *We Care*

Particular species discussed:

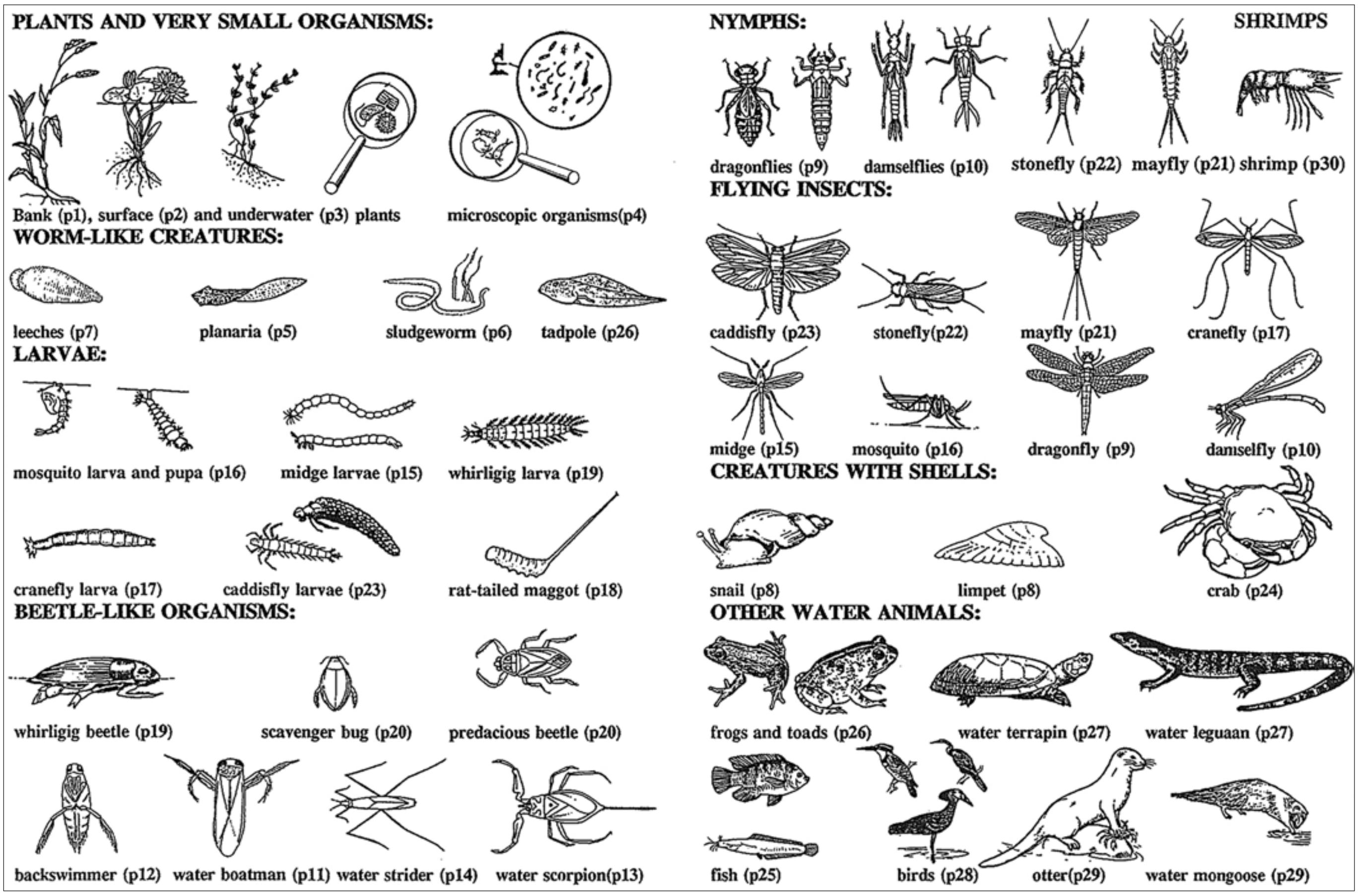
- Habitat of a penguin (Theme 3, p.115);
- Habitat of a Cape Mountain Zebra (Theme 3, p.116);
- Habitat of a Geometric tortoise (Theme 3, p.117).

Other examples in *We Care* that could be used: black rhino, Cape vulture, Cape hunting dog, riverine rabbit, Southern right whale, wattled crane, loggerhead turtle. These are all endangered species too, so you could discuss threats to their habitats as well.

Activity 2.6 **Habitat watch**	Find a habitat to study in your school grounds.
Activity 3.20 **Pond Project**	A water habitat (p.168) Theme 3 Survey of a pond animal activity – You can use someone else's pond if you do not want to build your own). Use the water organisms' reference sheet below to identify plants and animals.
Activity 2.8 **Adapt to survive**	Adaptations to living in a particular place.
Activity 2.9 **Invent a species**	Invent a plant or animal that can live in your school garden.

Activity 2.11 **A nature trail**	Take a walk around your school gardens and see where animals live.
Activity 3.15 **Adopt an endangered species**	Use the species in this activity as examples and find out what habitats they live in.

Exploring water using a reference sheet



Source: Share-Net, *Hands-On Stream and Pond Life*

Grade 4 – Topic 5: Structures for animal shelters

Key words:

mound, hive, burrow, nests, webs, camouflage, predator

Subject content knowledge

Many **structures are built by animals** other than humans, such as termite mounds, wasp and beehives, burrow complexes of rodents, nests of birds, and webs of spiders.

These structures often have features such as ventilation, temperature regulation, structural strength, multiple escape routes, traps, bait, and special-purpose chambers. They may be created by individuals or complex societies of social animals with different forms carrying out specialised roles. (adapted from Wikipedia, 22 July 2013)

Building behaviour is common in many mammals, birds, insects and arachnids. It is also seen in some fish, reptiles, amphibians, mollusks, urochordates, crustaceans, annelids and some other arthropods. It is virtually absent from all the other animal phyla.

Animals create structures mainly for three reasons:

- To create **protected habitats**, i.e. homes;
- To **catch prey** and for foraging, i.e. traps;
- For **communication** between members of the species, i.e. display.

Animals mainly build habitats for protection from extreme temperatures and from **predation. Temperature extremes** harm animals irrespective of whether they are warm or cold blooded.

Constructed structures raise physical problems which need to be resolved, such as humidity control or ventilation, which increases the complexity of the structure. Over time, through evolution, animals use shelters for other purposes such as reproduction, food storage.

Predators are attracted to animal-built structures either by the prey or its offspring, or the stored caches of food. Structures built by animals may provide protection from predators through avoiding detection, by means such as ***camouflage and concealment***, or through prevention of invasion, once predators have located the hideout or prey, or a combination of both. As a last resort, structures may provide means of escape.

Animals use the techniques of camouflage, concealment, and mimicry, for avoiding detection. ***Camouflage*** works by blending the structure with its background. The use of lichen flakes as an outer covering of nests by birds, as in the case of the Paradise Flycatcher (*Terpsiphone paradisei*) is an example of disruptive camouflage, where the lichen flakes are thought to resemble small patches of light. Ground-nesting birds which rely on camouflage for concealment have nests made from local materials which blend in with the background, the eggs and young too are camouflaged.

Materials used by animals in building structures need to be suitable for the kind of structure to be built and also need to be able to be manipulated by the animals. These materials may be organic in nature or mineral. They may be "***collected material***" (found by the animal) or "***self-secreted material***" (made by the animal). Some animals collect materials with plastic properties which are used to construct and shape the nest. These include resin collected by stingless bees, mud collected by swallows and silk collected by hummingbirds.

Certain materials in nature act as **readymade "building blocks"** to the animals in question, such as feathers and leaf stalks for some birds and animal hair for other kinds of bird. Other materials need to be **"processed"**. Bagworms cut and shape thorns or twigs to form their case. Some wasps collect mud and blend them with water to construct free standing nests of mud. Paper wasp queens build with paper pulp which they prepare by rasping wood with their jaws and mixing with saliva, a case of collecting, processing and blending raw materials.

Birds form the majority of the group of animals which **collect building material of animal origin.** They collect animal fur, and feathers of other species of birds to line their nests. Some birds use spider silk in their nests.

Flowering plants provide a variety of materials – twigs, leaves, leaf stalks, roots, flowers and seeds. Fungi, lichens, mosses and ferns also find use in structures built by animals. The leaves of grasses and palms being elongate and parallel-veined are very commonly used for building. **Wooden twigs** form the greater proportion of materials used in the nests of large birds. Plants and trees not only provide materials but also places for building structures. Branches provide support in the form of beams while leaves and green twigs provide flexible but strong supports.

Most of the **self-secreted materials** are produced by insects. For example, the scale wax, produced on the bodies of honey bees, is gathered and blended with saliva, to form comb wax, the building material. (adapted from Wikipedia, 22 July 2013)

Expanding knowledge

Search your local environment for examples of what is listed above. Get learners to draw or photograph the animal homes and write a short paragraph.

Teaching Practice ideas from *We Care*

Activity 3.18 **Permaculture**	p.149 (Theme 3)
	Get the class to make a chicken tractor – a structure to keep chickens in. If they can't make the real thing, get them to make a model of the structure. Or they could make a model of a structure that houses a pet that they have.
	Learners can label and colour in enlarged diagrams of the paper wasp and the honey bee and discuss and draw their homes.

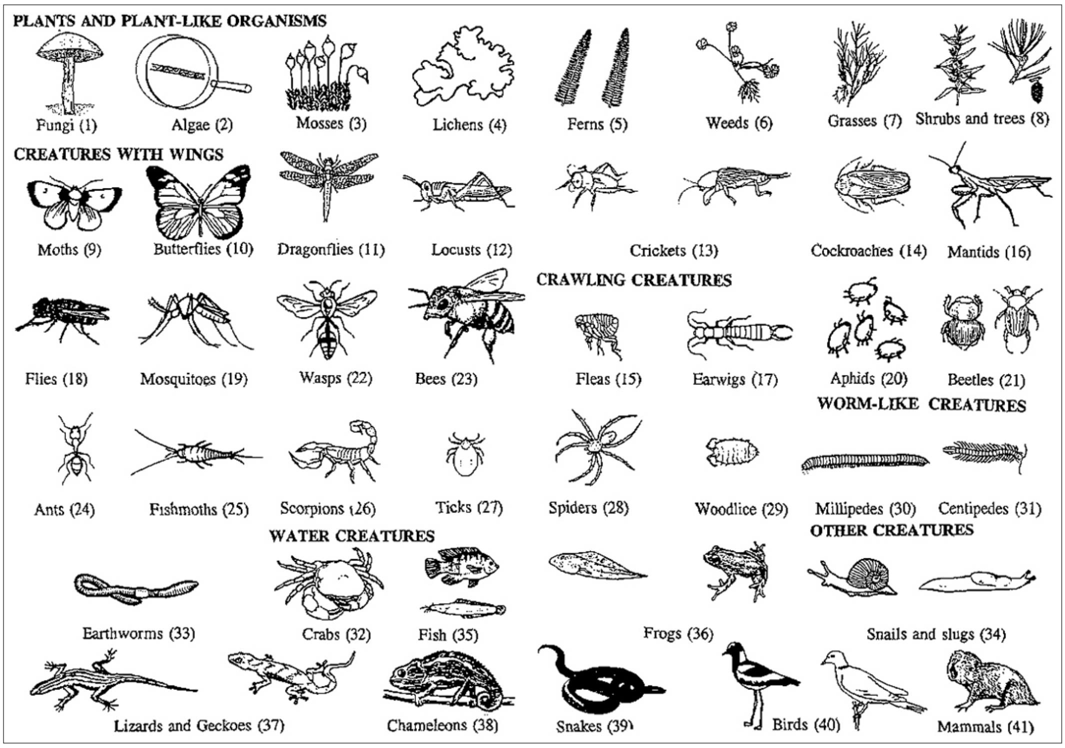
Unit 2

Life and Living in Grade 5

Several topics are covered in the first term of Grade 5 within the subject of Life and Living. These are listed below.

Grade 5 Topics – Term 1: 10 weeks	
1	Plants and animals on Earth (Biodiversity)
2	Animal skeletons
3	Skeletons as structures
4	Food chains
5	Life cycles

Figure 16: Organisms that can be found in most school grounds



Source: Share-Net, *Hands-On Schoolyard Life*

Grade 5 – Topic 1:
Plants and animals on Earth

Key words:

biodiversity, classification, invertebrate, vertebrate, habitat, interdependence, bone, skeleton, trait, taxonomy, symbiosis, indigenous, heterotroph

Subject content knowledge

Classification of animals

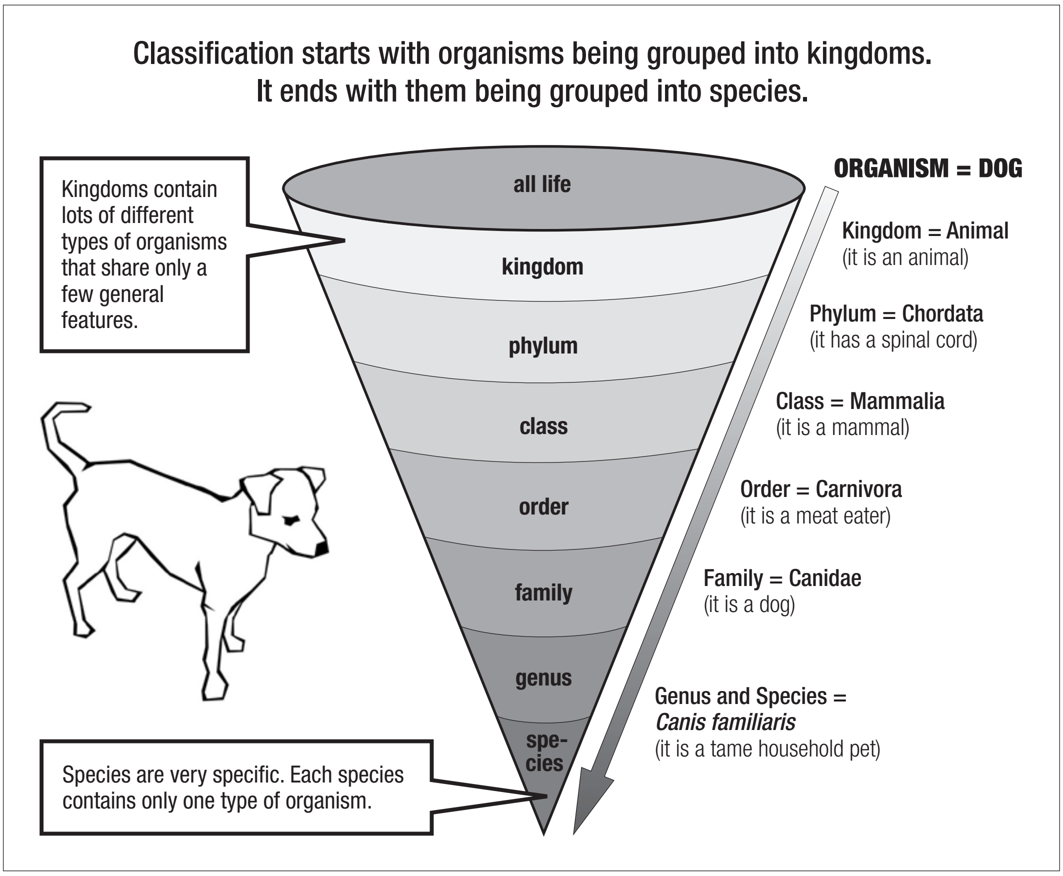
Animals are multicellular heterotrophs that are motile during part or all of their life cycle (Starr et al., 2013).

To identify animals and learn more about them, it helps to become familiar with the way they are classified. Biologists arrange animals into groups on the basis of traits (characteristics) which they share with other animals and their genetic relationships with each other. This orderly way of classifying animals forms the basis of the field of study called **taxonomy.** Modern scientific taxonomy is based on physical characteristics (such as teeth, skin, fur, feather, or scale patterns, size, or the structure of body parts) and on genetic characteristics. Some key characteristics are basic to taxonomic descriptions. Others are not part of the basic description, but correspond to evolutionary relationships upon which taxonomic classifications are based.

The most important categories in this hierarchical system, from higher and more inclusive to lower and more specific are **domain, kingdom, phylum, class, order, family, genus,** and **species**. A kingdom is one of the highest primary divisions into which all objects are placed. All animals are part of the Animal Kingdom. Each kingdom is divided into smaller units called **phyla** (the plural form of phylum). For example, animals that have a nerve cord are classified as members of the **Phylum Chordata.** The chordates are further divided into **classes** such as **Mammalia, Aves, Reptilia, and Amphibia.** Members of each class have characteristics which they share with other members of their class, but which generally are not found in members of the other classes. Classes are divided into **families**. Families are subdivided into **genera** (the plural form of genus); and genera are subdivided into **species.** A family usually contains more than one genus, and each genus usually includes more than one species. Animals that share the same genus are very similar and probably evolved from a common ancestor. The species is the most fundamental unit and contains a single type of animal.

For an example of how this works, consider the **taxonomy of the domestic dog.** Dogs are classified as members of the Class Mammalia, Order Carnivore, Family Canidae, Genus Canis and Species familiaris. Usually when we ask for the name of a "species" we really mean we want to know the genus and species of that animal's scientific name. (http://naturalhistory.uga.edu/~GMNH/gawildlife/index.php?page=information/classification – 12 July 2013)

Figure 17: The classification of a domestic dog



Source: Adapted from https://wikis.engrade.com/year7/classification

Animals show the greatest diversity of form of any of the kingdoms. Much of this diversity is a result of their ability to move from place to place, which has led *to* the evolution of a wide range of different methods of locomotion. (A level biology notes, 2013)

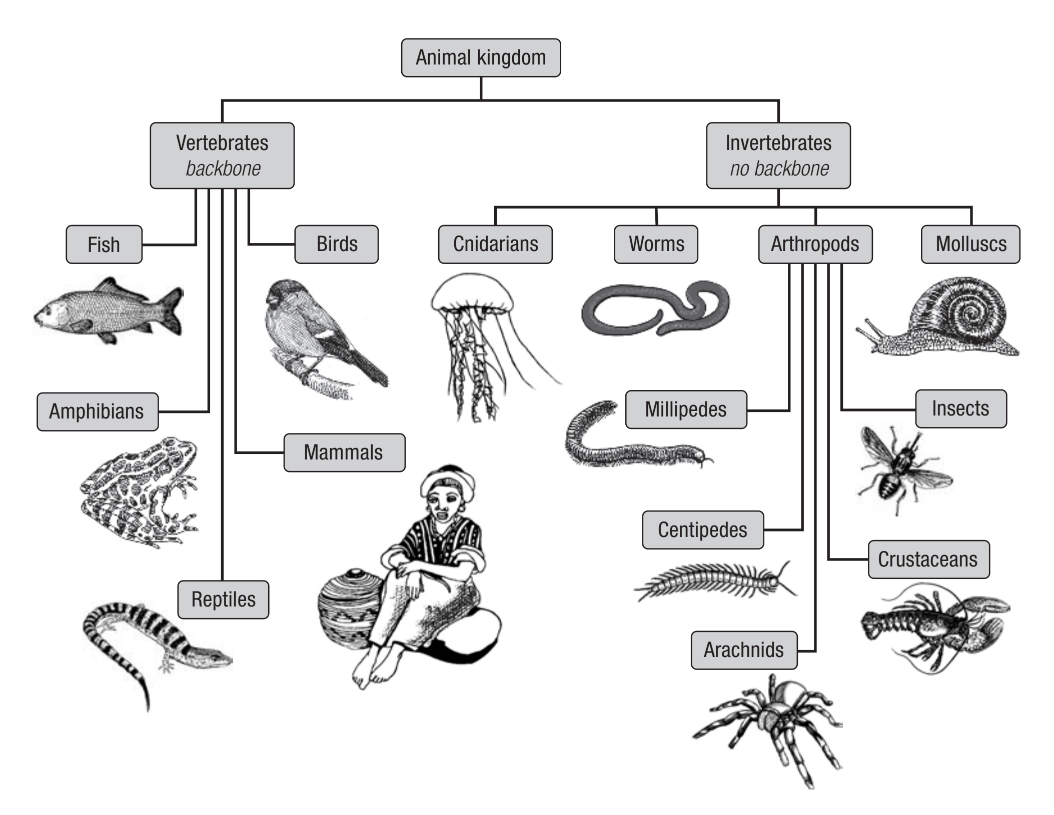
The group includes:

- **Cnidaria** – jellyfish and sea anemones, e.g. *Actinia* (sea anemone)
- **Nematoda** – roundworms, e.g. *Ascaris* (roundworm)
- **Platyhelminthes** – flatworms, e.g. *Fasciola* (liver fluke), tape worms
- **Annelida** – segmented worms, e.g. *Lumbricus* (earthworm)
- **Mollusca** – limpets, mussels, and snails, e.g. *Helix* (snail)
- **Arthropoda** – crabs, spiders and insects, e.g. *Pieris* (cabbage white butterfly)
- **Echinodermata** – sea urchins and starfish, e.g. *Asterias* (starfish)
- **Chordata** – fish, amphibia, reptiles, birds and mammals, e.g. *Rattus* (rat).

The distinguishing features of the Animalia are:

- eukaryotic organisms (all organisms have a membrane-bound nucleus in their cells);
- multicellular organisms that do not have chlorophyll and therefore feed heterotrophically;
- do not have cell walls;
- have a nervous system that allows them to display nervous coordination.

Figure 18. A simplified classification of animals



Source: Wikis.engrade.com

Animal types: vertebrates and invertebrates

Vertebrates are animals that have a backbone and invertebrates are animals that do not have a backbone. The kinds of invertebrates are:

- **Sponges** (marine mammals without any tissues or organs)
- **Cnidarians**, e.g. Sea anemones, jellyfish and corals
- **Flatworms**, e.g. tapeworms
- **Annelids** (segmented worms), e.g. earthworms
- **Mollusks**, e.g. snails, clams, octopus.
- **Roundworms**
- **Arthropods**, e.g. insects and crustaceans (e.g. crayfish)
- **Chelicerates**, e.g. spiders

Biodiversity

Biodiversity is the wide assortment of life on Earth. It is the **genetic diversity** within each species, the richness or **total number of species** on the planet, and the **web of ecosystems** (Freeman, 2007).

Causes of extinction and decline in biodiversity

Extinction, according to Chiras (2007), results from many factors. Two important ones are **habitat alteration,** and commercial hunting and harvesting. Other factors can be the introduction of alien and domesticated species; pest and predator control; collection of animals for pets and research; pollution; ecological factors and loss of keystone species.

Physical alteration of habitat

Human activities tend to fragment the habitat of plants and animals. Human settlements become islands of human activity in the natural environment. And as expansion occurs all that is left are a few islands of natural habitat in a human landscape. Nowhere is the loss of habitat more pronounced than in the tropical rainforest. Tropical rainforests have at least half the Earth's species.

Commercial harvesting and hunting

Sports hunting is mostly well regulated and may aid wild populations by helping to control numbers. **Subsistence hunting** is killing animals to provide food for indigenous people. **Commercial hunting** is, for example, whale hunting or hunting for rhino horns. When this is illegal it's called poaching. This is usually a large scale activity and has almost led to the extinction of some whale species.

Introduction of foreign species

Such species experience no natural predators in their new areas and so populations may increase. This leads to the foreign species outcompeting and eliminating indigenous species.

Expanding knowledge

How do plants and animals depend on each other?

For example, explain the relationship between flowers and bees and between penguins and fish.

Find local examples of the different forms of symbiosis listed below. Draw them, describe them, photograph and explain the relationship depicted.

Symbiosis

Symbiosis is a close ecological relationship between the individuals of two (or more) different species.

Mutualism: Two organisms of different species which live in close contact for their mutual benefit (e.g. a fungus and an algae in a lichen).

Commensalism: A relationship between two different species in which one benefits and the other suffers no harm (e.g. birds and their nests in trees).

Parasitism: The interaction through which an organism obtains food from the living tissues of another organism (e.g. ticks and fleas on dogs).

Teaching Practice ideas from *We Care*

Activity 3.15 **Adopt an endangered species**	Classify these animals as vertebrates or not
Activity 1.8 **The tin can game**	Interrelationships
Activity 2.10 **Food pyramid game**	Interrelationships
Activity 2.9 **Invent a species**	Biodiversity
Activity 2.11 **A nature trail**	Biodiversity

Grade 5 – Topic 2:
Animal skeletons

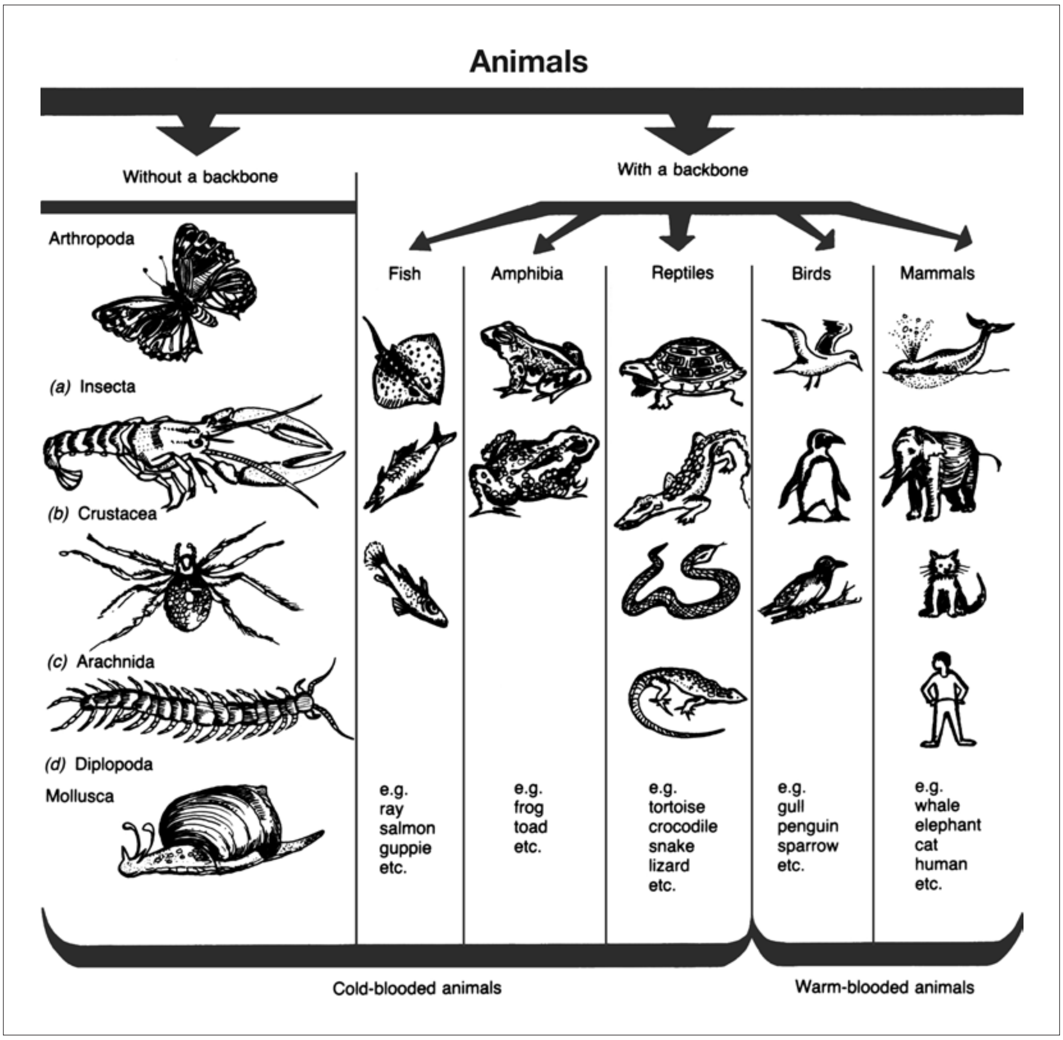
Key words:

vertebrate, skeleton, joint, bone, skull, backbone, ribs, shoulder blades, hip bone

Subject content knowledge

Animals with backbones are classified as vertebrates. They include fish, amphibians, reptiles, birds and mammals. Animals without backbones are called invertebrates.

Figure 19: Classification of animals

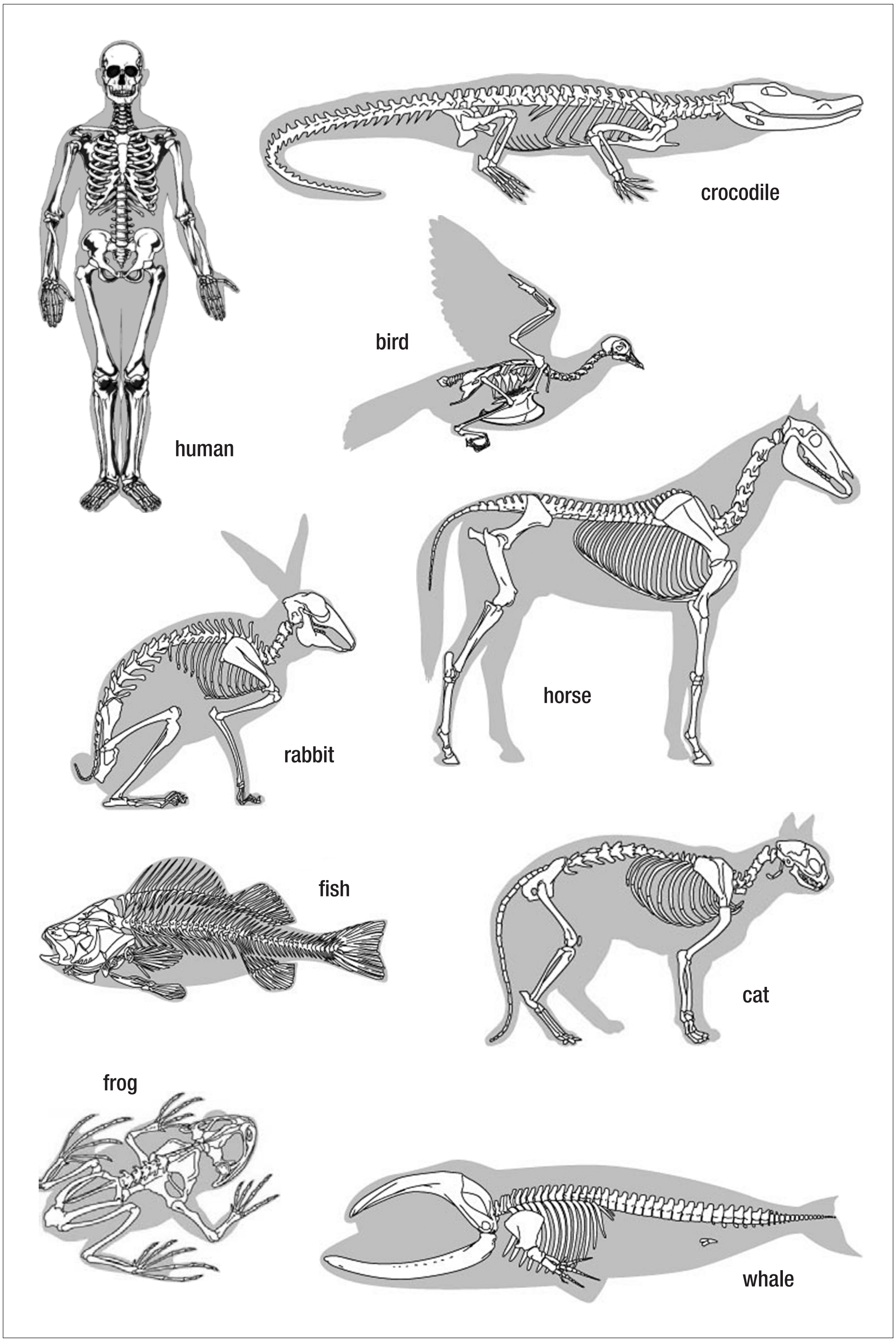


Source: arthursclipart.org

Expanding knowledge

Investigate similarities and differences in the vertebrate skeletons shown in Figure 20.

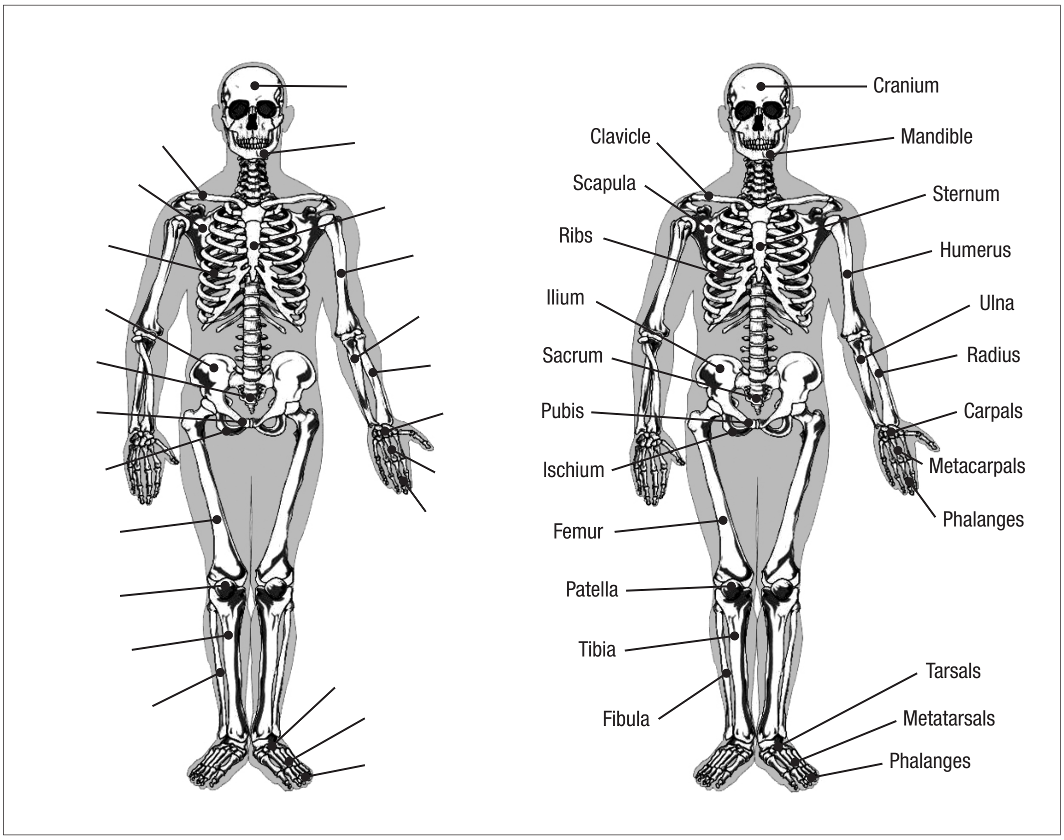
Figure 20: Examples of vertebrates



Source: http://www.ucmp.berkeley.edu/education/lessons/xenosmilus/skeletal_res_manual.html; www.edupics.com

Label the parts of a human skeleton. Use the images in Figure 21.

Figure 21: The human skeleton



Source: www.edupics.com

Teaching Practice ideas from *We Care*

Activity 3.15 **Adopt an endangered species**	Find pictures of the skeletons of these animals. The learners could each research one skeleton and write a short report.

Grade 5 – Topic 3: Skeletons as structures

Keywords:

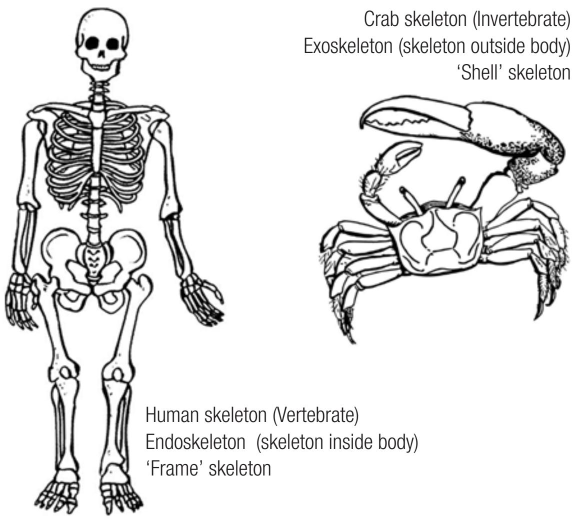
frame, shell, exoskeleton, endoskeleton, different bones and their functions, vertebrate, arthropods, moulting

Subject content knowledge

What is a support structure? (Focus on Life Sciences Grade 11)

If you go camping and put up a tent, the tent poles support the tent and stop it from falling down. *What is the structure that supports your body?* In our bodies these structures are called skeletons. Skeletons give support and also protection to animal bodies. The skeletons can be inside the body, as in humans, and are made of **bone,** which is strong**,** or on the outside, such as in insects (a type of arthropod) and crustaceans, e.g. crayfish, shrimps and crabs, and are made of **chitin.** Arthropods are the largest group of animals on Earth. This group includes crayfish, crabs, spiders, centipedes, bees and house flies. (Kershaw, 1983)

Figure 22: Human and crab skeletons



Source: www.edupics.com

Expanding knowledge

Find examples of invertebrates in your school garden. Draw or photograph them, label and annotate the pictures and make a poster to illustrate the biodiversity of invertebrates at your school.

Teaching Practice ideas from *We Care*

Activity 1.4 **Studying soil**	Find out what arthropods live in the soil in your school garden. Record the information on a record sheet. (See Share-Net booklet on soil)
Activity 2.4 **Getting to know an animal**	Research assignment. Choose one animal to research. Find out if it has a frame or shell skeleton.

Grade 5 – Topic 4: Food chains

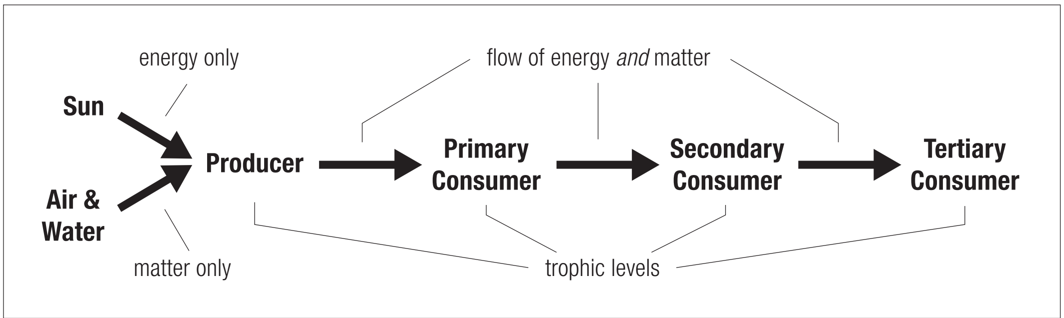
Key words:

food chain, ecosystem, community, population, feeding, photosynthesis, life processes, herbivore, carnivore, omnivore, producers, consumers, transfer of energy, growth, development, death, predator

Subject content knowledge

A **food chain** is the description of who eats who, in one path of energy flow through an ecosystem. A **food web** is a set of cross connecting food chains (Starr et al., 2013). A food chain consists of producers (green plants), primary consumers (herbivores), secondary consumers (who eat herbivores i.e. carnivores) and tertiary consumers who are omnivores. Chemical energy (in the form of the food consumed) is passed from one trophic level to another along the food chain.

Figure 23: Diagram of a food chain



Source: *A Level Biology*, 2013

Expanding knowledge

See http://www.ekapa.ioisa.org.za/module9/relationships.htm for fynbos food chains.

Teaching Practice ideas from *We Care*

Activity 1.8 **The tin can game**	Who eats who
Activity 2.2 **Getting to know a plant**	Who eats your plant?
Activity 2.3 **Visitors to a plant**	Which animals are found on a plant? What are they feeding on?

Activity 2.4 **Getting to know an animal**	p.32 Theme 2 food chain and food web examples
Activity 2.5 **See the birds around us**	What do birds feed on? Who feeds on birds?
Activity 2.10 **Food pyramid game**	Build a food pyramid for a particular ecosystem

Grade 5 – Topic 5: Life cycles

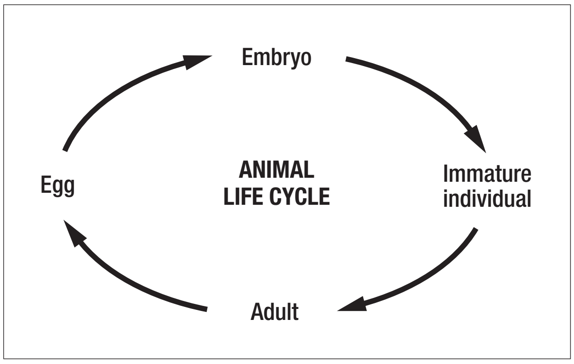
Key words:

life cycle, fertilised egg, embryo, immature individual, adult, vertebrates, invertebrates

Subject content knowledge

All animals generally have a life cycle. The animal life cycle begins with a **fertilised egg.** The fertilised egg develops into an **embryo.** The embryo becomes an **immature individual.** The immature individual becomes an **adult.** This is true in the various classes of vertebrate animals. These include fish, amphibians, reptiles, birds and mammals (Figure 24).

Figure 24: An animal life cycle



Source: http://www.kean.edu/~fosborne/resources/ex6a.htm

Adults produce the fertilised eggs that start the next generation.

Pictures of animals can be used. Birds could be chosen as an example. Some of the pictures should include: bird's nest with eggs, bird's nest with baby birds, adult birds.

Expanding knowledge

Compare different life cycles of plants and animals found in the school grounds.

Teaching Practice ideas from *We Care*

Activity 2.2 **Getting to know a plant**	Choose a specific plant and illustrate its life cycle, and write a few sentences about the life cycle you have chosen.
Activity 2.4 **Getting to know an animal**	Choose a specific animal and illustrate its life cycle. P.31 Use the life cycle of a frog diagram and poem to introduce the idea of a life cycle.
Activity 3.15 **Adopt an endangered species**	Choose a specific endangered species and illustrate its life cycle.
Activity 3.20 **Pond project**	Choose a specific animal or plant that lives in or near a pond and illustrate its life cycle.

Unit 3

Life and Living in Grade 6

This unit covers five Life and Living topics for Grade 6, as listed in the table below.

Grade 6 Topics – Term 1: 10 Weeks	
1	Photosynthesis
2	Nutrients in food
3	Nutrition
4	Food processing
5	Ecosystems and food webs

Grade 6 – Topic 1: Photosynthesis

Key words:

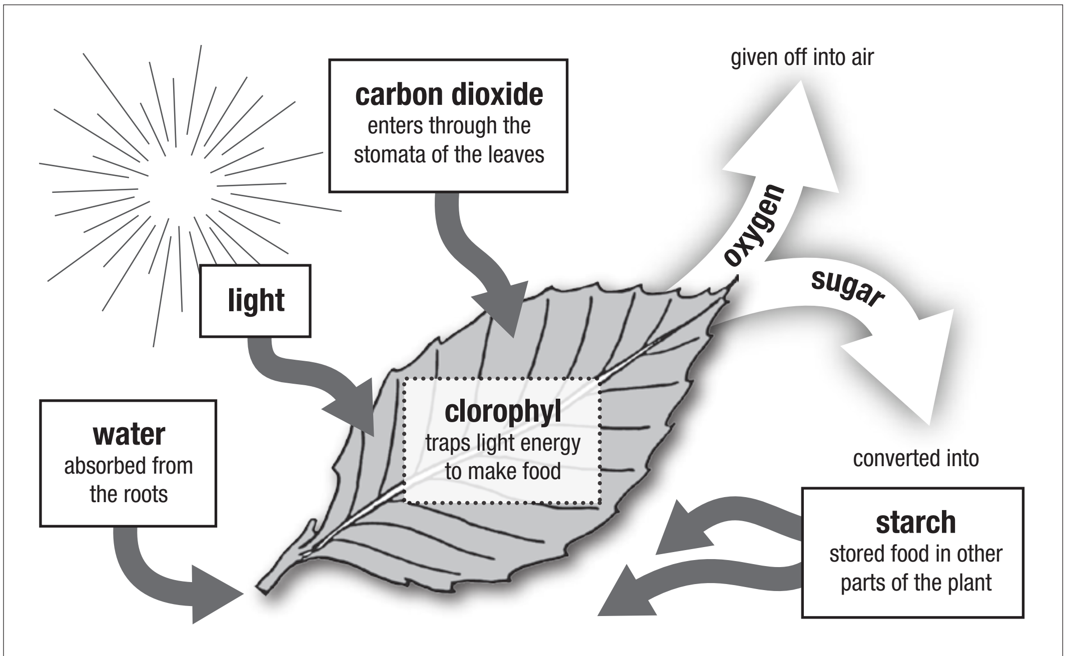
photosynthesis, energy, photon, pigment, light energy to chemical energy, carbon dioxide, water, chlorophyll, glucose, leaf morphology, stomata, autotrophs and heterotrophs

Subject content knowledge

Photosynthesis is the process used by most autotrophs (organisms that produce their own food) to convert light energy, water and carbon dioxide into sugars (Starr et al., 2013). It occurs in green plants that contain chlorophyll in the cells of their leaves and stems.

Leaves are often large and wide to catch a lot of light. Leaves contain cells with special green organelles called chloroplasts. The chloroplasts can capture light energy that comes from the sun.

Figure 25: A summary of the process of photosynthesis



Source: Adapted from www.brighthubeducation.com

Sunlight as an energy source

Energy flow through nearly all ecosystems on Earth starts when photosynthesisers (green plants) capture energy from the sun. Green plants are able to convert light energy to chemical energy, which is used in cells for growth and living. Visible light from the sun makes photosynthesis happen. Light travels in waves, but is also organised in packets of light energy called photons.

Pigments: the rainbow catchers

Photosynthesisers use pigments to capture light. A pigment is an organic molecule that can absorb particular wavelengths of light that plants can use. Green plants use violet and red light. (Starr et al., 2013)

Overview of photosynthesis

> 6 molecules of carbon dioxide + 6 molecules of water in sunlight, and using chlorophyll gives ➔ 1 molecule of glucose + 6 molecules of oxygen.

Chloroplasts in green plants are able to capture light energy and change it to chemical energy in the process called photosynthesis. Photosynthesis occurs in two stages:

- In the **light dependent reaction** of photosynthesis light is captured by the chloroplasts and is turned into chemical energy and some oxygen is given off.
- In the **light independent reaction** of photosynthesis, water and carbon dioxide molecules are broken apart and the molecules are used to make glucose.

Plants therefore need water, carbon dioxide, chlorophyll and light energy to make glucose. Glucose can be stored in fruit, and stems and roots of particular plants in the form of starch (a complex carbohydrate).

How does carbon dioxide get into a leaf?

Stomata on the under surfaces of leaves are little openings that can let gases into and out of the leaves of plants. Carbon dioxide enters in this way.

How does oxygen leave a plant?

Oxygen produced during the process of photosynthesis goes out of the leaves through the stomata.

Expanding knowledge

Explain some of the biochemistry of photosynthesis by using the diagrams in this section.

Investigate the other pigments that plants produce. Find out if these pigments can also capture light energy and use it for photosynthesis.

Teaching Practice ideas from *We Care*

Activity 2.2 **Getting to know a plant**	Use the leaf and fruit sections.
Activity 3.11 **Natural harvest**	“What’s to eat?” theme 3, p.83

Activity 3.12 **"From trees if you please"**	Investigate the types of products that come from particular trees.
Activity 3.14 **"Save the plants that save us"**	Theme 3, p.105

Grade 6 – Topic 2: Nutrients in food

Key words:

nutrient, carbohydrate, fats, proteins, vitamins, minerals

Subject content knowledge

Stored starch in the roots, stems or leaves of plants that has been manufactured during photosynthesis, can become food for humans. Animal parts can also be used as food.

Carbohydrates are molecules that contain mostly carbon, hydrogen and oxygen atoms. Cells use different kinds of carbohydrates as structural materials, for fuel, and for storing and transporting energy. Starch is the energy carbohydrate in plants and glycogen is the energy reservoir in animal cells. Cellulose is the main structural material in plants. (Starr et al., 2013)

Fresh fruits, whole grains and vegetables especially peas and beans provide enough complex carbohydrates. The body breaks the starch in these foods into glucose, a primary source of energy. Most carbohydrates are derived from plants (Marieb, 2012) except milk, sugar and small amounts of glycogen in meats.

Lipids (fats, oils, phospholipids, waxes, steroids) are fatty, oily, or waxy organic compounds. Our bodies use lipids to build cell membranes, as energy stores and as a place to store fat-soluble vitamins (Starr et al., 2013). Most dietary lipids are triglycerides (neutral fats).

Saturated fats are solid at room temperature. We eat saturated fats in meats and full-fat dairy products, and plant products such as coconut. Too much of these can increase the risk of cardiovascular disease.

Poly unsaturated fats are liquid at room temperature. Unsaturated fats are present in seeds, nuts, and most vegetable oils.

There are two types: Omega 3 fatty acids (in oily fish such as sardines; can reduce the risk of cardiovascular disease), and omega 6 fatty acids (e.g. in vegetable oils, nuts and chicken). Monounsaturated fats, such as olive oil, may also help prevent heart disease. An essential fatty acid is one that the body cannot make and must be obtained from food. (Starr et al., 2013)

Triglycerides are the lipids that serve as energy reservoirs in vertebrate animals. Phospholipids are the main lipid component of cell membranes.

Cholesterol is also a lipid and is found in egg yolks, meats and milk products. Cholesterol is important for the functioning of our cell membranes. Too much cholesterol in the body can cause heart disease (Marieb, 2012).

Proteins are the most diverse biological molecules. They have many structural and functional roles. Proteins are made up of chains of amino acids. Your cells can make some amino acids but you must obtain eight essential amino acids from food (Starr et al., 2013). Animal products contain the highest quality proteins. Eggs, milk, fish and most meat proteins are complete proteins. Legumes (beans and peas), nuts, and cereals are also protein rich but are nutritionally incomplete as they are low in one or more of the essential amino acids (Marieb, 2012).

Our digestive system is used to break down our food mechanically e.g. by teeth and chemically e.g. by enzymes in the stomach and small intestine.

A healthy diet provides energy and all the necessary building blocks for assembling essential body components.

Nutrient guidelines are often revised as new research gives us new information. Currently in the USA guidelines suggest that most calories (the energy value of foods) come from complex carbohydrates (e.g. whole grains), rather than simple sugars (e.g. sweets). They also favour fat and protein sources that are low in saturated fats.

The body also needs vitamins and minerals in very small amounts to maintain bodily functions. Fat-soluble vitamins are A (in broccoli, cabbage and Brussels sprouts) D, E, and K. Water-soluble vitamins are B1, B2, B3, B6, Panthothenic acid, foliate, B12, Biotin, C (in broccoli, cabbage and Brussel sprouts).

Table 1: Minerals that our bodies need

MINERAL	COMMON SOURCES	MAIN FUNCTIONS	EFFECTS OF CHRONIC DEFICIENCY
Calcium	Dairy products, dark green vegetables	Bone and tooth formation	Stunted growth; fragile bones
Chloride	Table salt	HCl formation in the stomach for digestion; Neural action	Muscle cramps; impaired growth
Iodine	Marine fish, dairy products	Bone, tooth maintenance	Enlarged thyroid with metabolic disorders.
Iron	Whole grains, green leafy vegetables, legumes, nuts, eggs, dried fruit, lean meat	Formation of haemoglobin in the blood	Iron deficiency anaemia; impaired immune function

Expanding knowledge

Discuss the nutritional content of other food types.

Teaching Practice ideas from *We Care*

Use the list of foods given in Activity 3.10 and classify them as carbohydrates, fats or proteins.

Grade 6 – Topic 3: Nutrition

Key words:

nutrient, carbohydrate, fat, protein, vitamin, mineral

Subject content knowledge

A **nutrient** is a substance in food that is used by the body to promote normal growth, maintenance, and repair. The major nutrients – carbohydrates, lipids (fats) and proteins make up most of what we eat. Minor nutrients – vitamins and minerals are crucial for health and are only required in minute amounts (Marieb, 2012). Water, which accounts for about 60% of the volume of the food that we eat, is also considered to be a major nutrient. Most foods are a combination of nutrients.

What is a balanced diet?

A diet consisting of each of the five groups i.e. grains, fruits, vegetables, meats, and milk products, normally guarantees adequate amounts of all needed nutrients and is considered a balanced diet.

Some diet related illnesses

1. **Obesity:** Obesity is a condition of excessive triglyceride storage (fat) due to over-eating and lack of exercise.

2. **Cardiovascular or heart disease:** While cardiovascular disease can refer to many different types of heart or blood vessel problems, the term is often used to mean damage caused to the heart or blood vessels by atherosclerosis, a build-up of fatty plaques (layers) in the arteries. This is a disease that affects the arteries. Arteries are blood vessels that carry oxygen and nutrients from your heart to the rest of your body. Healthy arteries are flexible and strong. Atherosclerosis is the most common cause of cardiovascular disease, and it is often caused by an unhealthy diet, lack of exercise, being overweight and smoking. All of these are major risk factors for developing atherosclerosis and, in turn, cardiovascular disease. (www.mayoclinic.com, 29 July 2013).

3. **Deficiency diseases**, e.g.

    - **Rickets:** Rickets is caused by a deficiency in vitamin D. Our bodies need vitamin D to absorb calcium and phosphorus from food. Rickets can occur if a child's body doesn't get enough vitamin D or if his or her body has problems using vitamin D properly. We get Vitamin D from sunlight and food such as egg yolks. Because rickets softens the growth plates at the ends of a child's bones, it can cause skeletal deformities such as bowed legs, thickened wrists and ankles and breastbone projection. (www.mayo clinic.com, 29 July 2013)

- **Scurvy:** Scurvy is a disease caused by severe and chronic vitamin C (ascorbic acid) deficiency. Symptoms include feeling generally unwell and bleeding gums. Babies and young children can suffer complications from scurvy including stunted bone growth. Good dietary sources of vitamin C include citrus fruits and green vegetables http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Scurvy (29 July 2013).

4. **Diabetes mellitus:** This is a disease caused by deficient insulin release or inadequate responsiveness to insulin, leading to an inability of body cells to use carbohydrates at a normal rate (Marieb, 2012).

5. **Phenylketonuria (PKU):** This condition occurs when tissue cells are unable to use phenylalanine, an amino acid present in all protein foods. In such cases, brain damage and retardation occur unless a special diet low in phenylalanine is prescribed (Marieb, 2012). Aspartamine, an artificial sweetener found in soft drinks, contains phenylalanine and must therefore be avoided.

6. **Anorexia nervosa:** This is the condition of eating too little, causing a lower than normal body weight. This damages organ systems throughout the body. Starved of essential calcium the body breaks down bone. Inadequate iron intake caused anaemia, and heart muscle weakens. Most anorexia-related deaths occur as a result of cardiac arrest. (Starr et al., 2013)

Expanding knowledge

Find out more about the occurrence of deficiency diseases in South Africa.

Each learner could write a short report about a particular deficiency disease and could tell the class in a short speech.

Teaching Practice ideas from *We Care*

Activity 3.11 **Natural harvest**	Find out which foods contain important nutrients. Find out what diseases and conditions you can get if you lack particular nutrients. Diseases could be tabulated.

Grade 6 – Topic 4: Food processing

Subject content knowledge

Why process food?

We process food in order to make it last longer and to prevent food from losing its nutritional value. The methods in the table below were used in the past before refrigeration, to preserve foods for winter months or when supplies were low.

NAME OF METHOD	TYPE OF FOOD THAT COULD BE USED	EXPLANATION
Pickling	Vegetables, fish	Food preserved in vinegar or brine (Collins Shorter English Dictionary, 1993)
Cooking	e.g. Potatoes	Potatoes are toxic if eaten raw so need to be cooked properly before eating
Freezing	Fish, meat, vegetables , fruit	To prevent spoiling and to keep food for another time
Fermenting	Grapes	A chemical process in which an organic molecule splits into simpler substances; especially the conversion of sugar to ethyl alcohol by yeast
Drying / Dehydrating	Fish, meat, vegetables	e.g. Putting fruit to dry in the sun or in a drying machine (e.g. apples, raisins)
Salting	Fish, meat	Cured and preserved with salt
Preserving in sugar	Fruit	Cured and preserved with sugar
Smoking	Fish, meat	Curing meat by treating with smoke

Expanding knowledge

Try out some of the methods listed above in a class activity. Learners can find out specific methods of preserving food, write out the methods and try them!

Teaching Practice ideas from *We Care*

Activity 3.10 **What's to eat**	Act out the process of getting food on the table, e.g. use peas as an example. Peas can be fresh or preserved in certain ways – for example, tinned, frozen, dehydrated. Use the list of plants supplied in Activity 3.10. Find out which are proteins, carbohydrates or fats and discuss how these foods can lead to a balanced diet. Learners can make a poster in groups to show the process of producing and packaging certain foods so that we can eat them without getting ill.
Activity 3.11 **Natural harvest**	Find out where in South Africa various crops are produced and how they eventually arrive on our plates.

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This list includes both references cited in these units as well as extra useful resources

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Useful websites

- **Fynbos ecology** – http:// www.ekapa.ioisa.org.za

  Module 1: Nature on your doorstep.

  Module 2: Four unique ecosystems.

  Module 5: Rare threatened and extinct.

  Module 9: Local ecology.

  Educators guide for senior phase available for download. http://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Documents/e-Kapa_Educators_Guide-English.pdf

- **Water issues** – http://www.waterwise.co.za/site/water/

  Go to **water info** and then to **water and the environment** for more information on:

  - Water is life
  - Water on Earth
  - Types of water
  - Sources of water
  - The water situation in South Africa
  - Causes of water pollution.

- **Environmental dictionary**

  Smart Living Handbook, City of Cape Town [sections on waste, water & biodiversity]

  https://www.capetown.gov.za/en/EnvironmentalResourceManagement/dictionary/Pages/default.aspx

  The Cape Town government website has a useful *environmental dictionary* in three languages.

- **Environmental education teacher workbook**

  Rosenberg, E. 2009. *Teacher Education Workbook for Environment & Sustainability education.* Rhodes University – Environmental Education and Sustainability Unit Grahamstown. Available at Share-Net or the following websites: www.capeaction.org, www.tessafrica.net, www.ru.ac.za

- **Protea Atlas project** – http://protea.worldonline.co.za

- **UWC botany department** – www.botany.uwc.ac.za

fundisa for change

A partnership programme for environmental learning and teacher education