

LEARNING AREA

NATURAL SCIENCES

GRADE

7

MOULTON

1

LIFE AND WAY OF LIVING

MODULE FRAMEWORK AND ASSESSMENT SHEET

LEARNING OUTCOMES (LOs)	ASSESSMENT STANDARDS (ASs)	FORMATIVE ASSESSMENT		SUMMATIVE ASSESSMENT		
		ASs Pages	(mark out of 4)	ASs Pages	Tasks or tests (%)	ASs Pages
<p style="text-align: center;">LO 1</p> <p>SCIENTIFIC INVESTIGATIONS The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.</p>	<p><i>We know this when the learner:</i></p> <p>1.1 plans investigations;</p> <p>1.2 conducts investigations and collects data;</p> <p>1.3 evaluates data and communicates findings.</p>	<p>16, 37, 31</p> <p>5, 16, 27, 31</p> <p>23, 27, 31</p>				
<p style="text-align: center;">LO 2</p> <p>CONSTRUCTING SCIENCE KNOWLEDGE The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.</p>	<p><i>We know this when the learner:</i></p> <p>2.1 recalls meaningful information (at least definitions and complex facts);</p> <p>2.2 categorises information (can compare the properties of categories of organisms);</p> <p>2.3 interprets information;</p> <p>2.4 applies knowledge in a variation of a known situation.</p>	<p>1, 5, 13, 14, 30</p> <p>5, 7, 8</p> <p>1, 3, 5, 14, 16, 23, 27, 31, 35</p> <p>5, 16, 23, 31, 35</p>				

LEARNING UNIT 1

Activity 1.1

TO BRUSH UP YOUR KNOWLEDGE OF ECOSYSTEMS

LO 2.1

LO 2.3

THE ECOSYSTEM

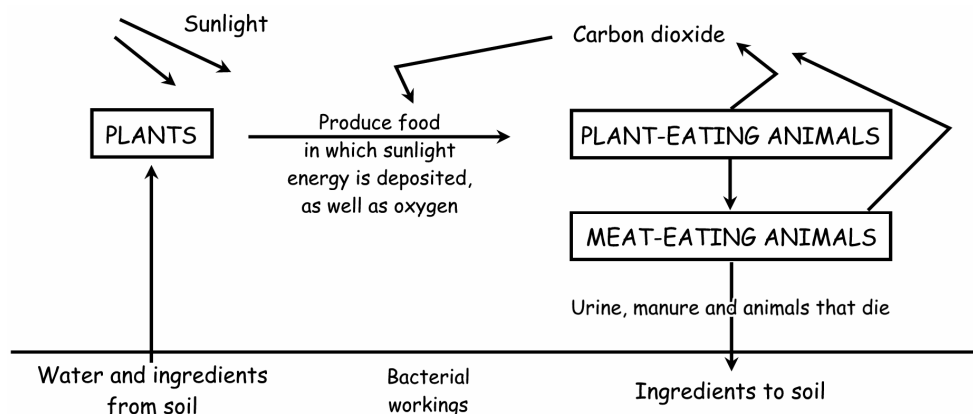
Test your knowledge

You were introduced to the concept of the ecosystem in Grade 6. Let us see how much you can remember:

1. Complete: An ecosystem is all the living that live in a specific as well as all the factors that determine the nature of the environment.
2. In an ecosystem, the plants are the while the animals are the Animals can be divided into three groups on the basis of their manner of feeding, namely , and
3. The non-living factors which determine conditions in the ecosystems are , , and

Cycles and balance within an ecosystem

An ecosystem can be represented diagrammatically as follows:



Try to answer the following questions that deal with the diagram:

1. Why is the ecosystem represented as a cycle?

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2. Name three substances/compounds that are circulated in an ecosystem according to the diagram, and give a brief description of each cycle:

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3. Why is it important for the substances to be circulated?

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2. Try to determine what types of animals you possibly might find in the following places in the ecosystem (consult books or investigate the ecosystem that you have chosen):

In the trees and shrubs above the soil:

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On top of the soil:

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In the layer of dead plant material on top of the soil:

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In the soil:

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In the water:

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3. Why is there such a variety of plants and animals?
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Activity 1.3**TO STUDY ROOT SYSTEMS OF PLANTS**

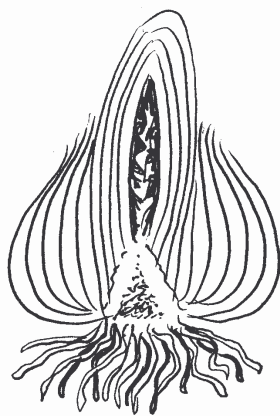
LO 1.2	
LO 2.1	
LO 2.2	
LO 2.3	
LO 2.4	

PLANT DIVERSITY

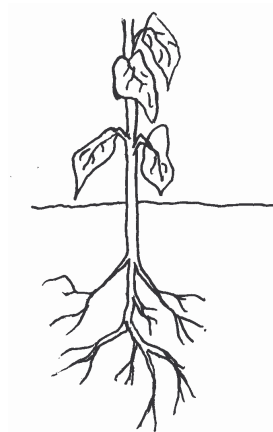
In Grade 6, you learned that plants could have leaves with different shapes because they are adapted to specific environmental conditions, and that the plants can be divided into groups on the basis of their leaves.

Let us now take a look at the **roots** of plants.

Study the representations of the two types of roots below (you will make the teacher very happy if you can bring real examples of plants with the two types of roots to class).



An adventitious root system



A tap-root system

1. Try to complete the table by writing yes or no in each block:

	Tap-root system	Adventitious root system
All the roots are equally thick		
All the roots are equally long		
There is a main root that is longer and thicker than the others		
The roots branch (smaller roots grow from the larger roots)		

2. Which of the plants in the sketch of an ecosystem (page 3) do you think will have adventitious roots and which do you think will have taproots? Also say why you think so:

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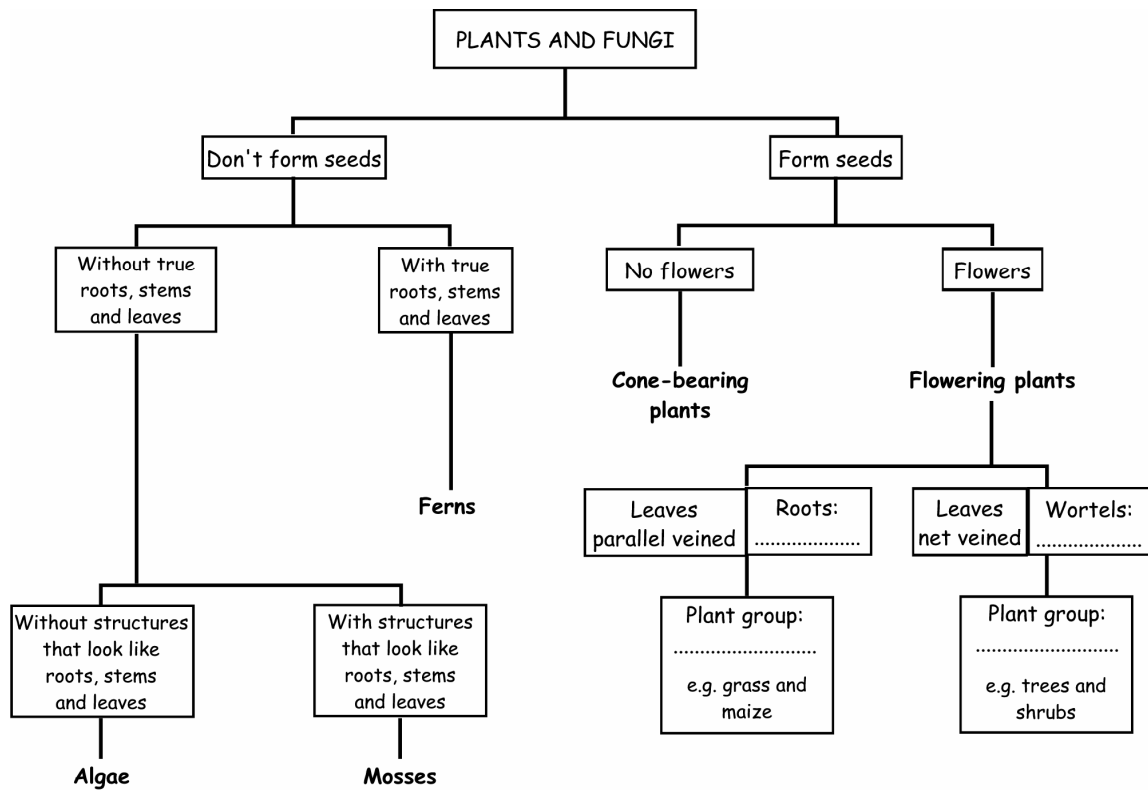
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Do you still remember the division of plants that you did in Grade 6 that is shown below? Use what you have just learned about root systems to add to the division by writing the missing information in the open blocks (ask your teacher to help you):



The division of plants according to their external characteristics

THE DEVELOPMENT OF A KEY WITH WHICH TO CLASSIFY PLANTS

You have now been introduced to various characteristics of plants and have learned that we can group the plants in terms of their characteristics. A lot of work has already been done in this regard by biologists and all the plants that are known to people have already been divided into groups. New plants that are discovered can also be placed into a group immediately.

The advantage of this is that we can identify any plant that we see, find out its name and discuss it with other people. For example, we can determine whether a plant is indigenous or exotic, whether it is a harmful weed, what we can do with it, etc.

To be able to identify a plant we can make use of a *key*. We will now use our knowledge about plant characteristics and plant groups to compile our own key.

The easiest way is to pretend that you have seen a particularly interesting plant and want to go to a plant expert (botanist) to ask him/her to which group the plant belongs. Try to think what type of questions you would ask such a person in order to find out the answer.

The person most probably will ask questions to which you can answer yes or no. In this manner, it is possible to use each question to eliminate one possibility and thereby to move in the direction of the answer.

Let us try. Use the diagrammatic division of plants on the previous page and work through it from top to bottom on the basis of the questions that follow:

1. Does the plant form seeds?

Yes Proceed to 2

No Algae or mosses (proceed to 4)

2. Does the plant bear flowers?

Yes Proceed to 3

No Coniferous plants, e.g. fir tree (Proceed to 12)

3. Does the plant have vein-like leaves or does it have an adventitious root?

Yes Dicotyledonous plants e.g. proteas (Proceed to 20)

No Monocotyledonous plants, e.g. grasses (Proceed to 40)

Assignment 1

Describe in your own words what a key for the identification of plants or animals is and how it is used.

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Activity 1.5

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**TO CATEGORISE INVERTEBRATES ON
THE BASIS OF THEIR SIMILARITIES AND
DISSIMILARITIES**

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LO 2.2

ANIMAL DIVERSITY

Can you still remember what you learned about the division of animals in Grade 6? You learned that animals can be divided into two main groups, namely the

..... and

You also learned that vertebrates could be divided into five groups:

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Let us now take a look at the invertebrates.

We will study a number of examples of invertebrates. You will realise that they all share specific characteristics, but that, on the other hand, they also differ greatly from one another. We will use two methods to try to make it easy to understand and remember the similarities and the differences: firstly, we will determine how the animals are adapted for survival (this causes differences between different animals), and then we will classify the animals on the basis of the similarities and differences. If you classify things, it means that you group those with the same properties or characteristics together.

Biologists have already identified more than 2 million different types of living organisms and new types are still being discovered. There is a strict international code according to which living organisms are named, sorted and classified. It is based on the work of *Linnaeus*, who suggested that every organism should be given two names. Today, all living organisms have two scientific Greek or Latin names:

- & The genus name (genus/genera), which is always written with a capital letter, e.g. *Panthera* for the large cats.
- & The species name, which is written with a small letter, e.g. *leo* for the lion.

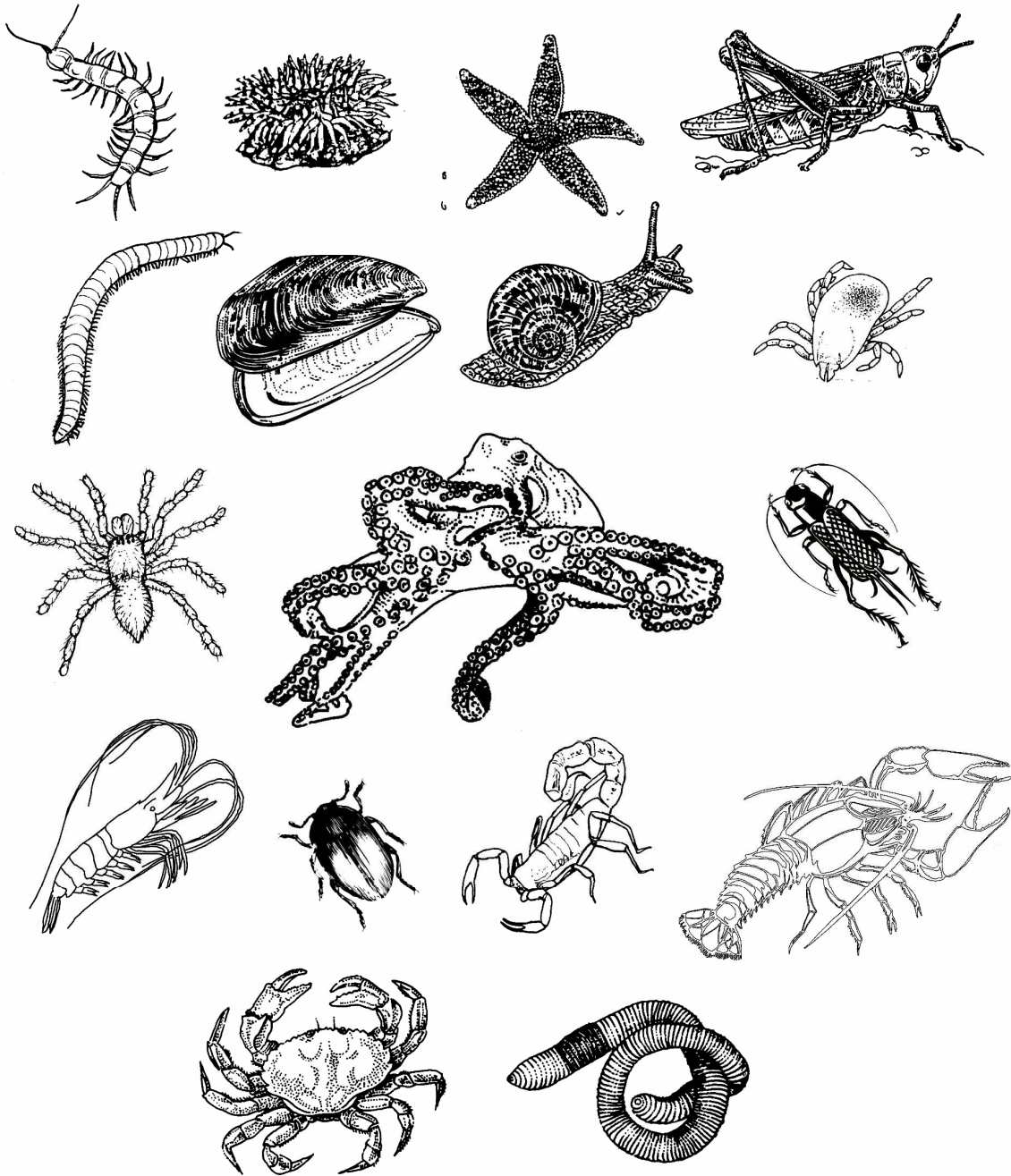
The complete name of the lion therefore is *Panthera leo*, while that of the leopard is *Panthera pardus*. The same is applicable to the invertebrates.

We will first do an overview of the invertebrates so that you can get to know the group with its smaller groupings. For this purpose, we will look at the similarities and differences between the animals.

Then we will study a few examples in greater detail so that you can discover how the animals are adapted to the conditions in their ecosystems.

CLASSIFICATION OF THE INVERTEBRATES

A number of different invertebrates are represented below.



Can you still remember what characteristic(s) is/are applicable to all these animals?

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Now try to divide them into approximately eight groups on the basis of their characteristics. In the following table, one or two characteristics of each group are provided to make it easier for you.

GROUP	CHARACTERISTIC	ANIMALS
1	No head, only one opening in the body, with 'arms' around the mouth	
2	Soft body, large muscular foot, sometimes arms, often with a shell	
3	Large round body that consists of ring-shaped segments	
4	Hard or tough body with six articulated legs	
5	Hard or tough body with eight articulated legs	
6	Hard or tough body with ten articulated legs	

Now try to group the six groups in the table together to form two main groups:

Group 1 consists of groups.....

Group 2 consists of groups.....

Explain why you grouped them as you did:

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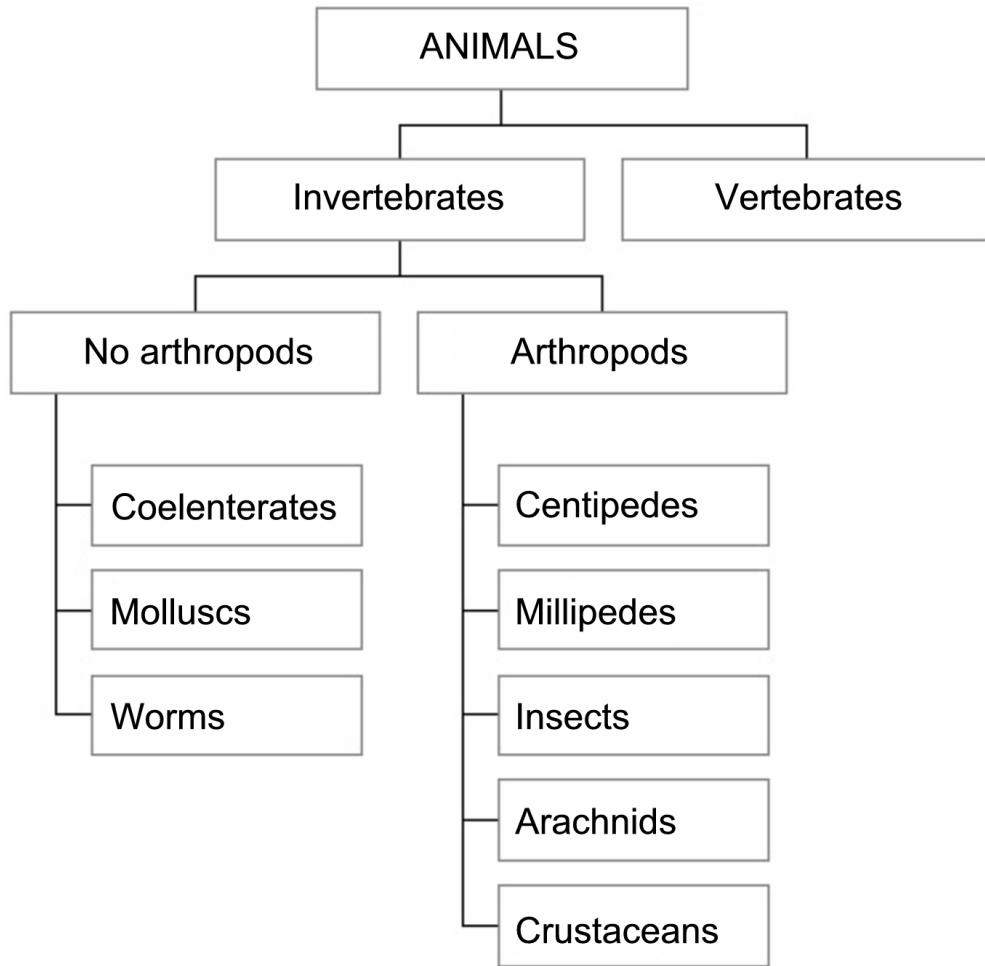
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Compare your division with the following diagram:



Assignment 2

Compile a key that will lead someone who has caught a strange insect to the answer that it is an insect.

TO DISTINGUISH LIVING ORGANISMS
FROM NON-LIVING THINGS

A STUDY OF A FEW INVERTEBRATES

We will now look at a few examples of the invertebrates in greater detail.

Remember that we will look particularly at the manner in which they are adapted to be able to survive in their environment (the ecosystem).

Can you remember what characteristics of living organisms distinguish them from non-living things?

Write them down below:

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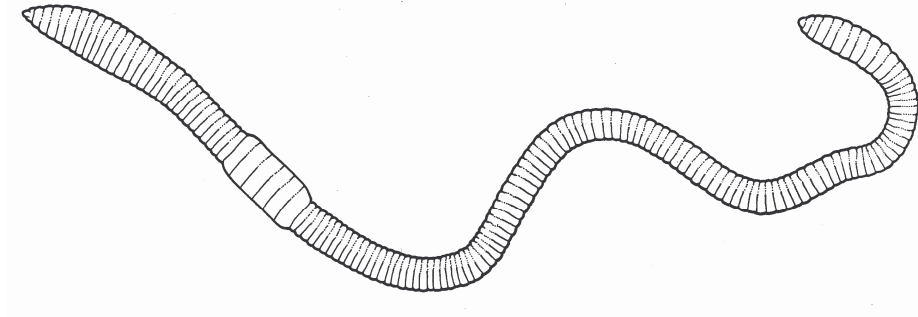
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You will agree that if we want to study an animal in its habitat (in the ecosystem), we will have to look at these characteristics in particular.

THE EARTHWORM

The earthworm is part of a group that is known as *segmented worms*.



It is important that you get to know the earthworm, as this small animal plays a very important role in the ecosystem.

Let us look at how its body is adapted to its way of life.

Build

The earthworm is approximately 150 mm long and the whole body consists of ring-shaped segments, each approximately 1 mm thick.

At the front tip there is a mouth with a small lip with which food is pushed into the mouth. At the back tip is the *anus*, where the remains of the food leave the body.

On all the segments, except the first and the last, there are hairs that help the worm to move through the soil.

Movement

The earthworm moves by means of muscles in the segments that contract and relax, causing the body to become long and thin, and then short and thick. The hairs on the segments press against the soil and the worm then moves forward.

Feeding

The earthworm comes out of the ground at night and pulls rotting plant material into its tunnel with the help of the lip in front of its mouth. It also eats the soil as it tunnels through the ground.

Respiration

The earthworm breathes through its moist skin. It therefore is important that the skin remains moist, as the worm is dependent on a moist environment.

Maintaining a water balance

The earthworm has a complex system of tubes in its body with openings to the outside by which it controls the quantity of water that its body absorbs and excretes so that the correct balance is maintained.

Reproduction

Two earthworms lie next to one another and exchange sexual cells. A slime cocoon forms around their bodies and the sexual cells remain in the cocoon when it slips off the bodies. The young hatch in the cocoon and immediately look just like their parents.

In summary: the earthworm in the ecosystem

Complete the following sentences:

1. The earthworm plays an important role in the ecosystem because it ... (give two reasons)

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2. The earthworm is dependent on a moist environment because

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3. If we use poison to combat pests, it can be disadvantageous to the soil because

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Activity 1.8

TO INVESTIGATE AND DESCRIBE THE GRASSHOPPER'S ABILITY TO SURVIVE

LO 1.1	
LO 1.2	
LO 2.3	
LO 2.4	

THE GRASSHOPPER

The grasshopper belongs to the largest group in the animal kingdom, namely the insects.

What do you already know about this group?

Spinal column: yes or no?

Legs: articulated or not?

Number of legs:

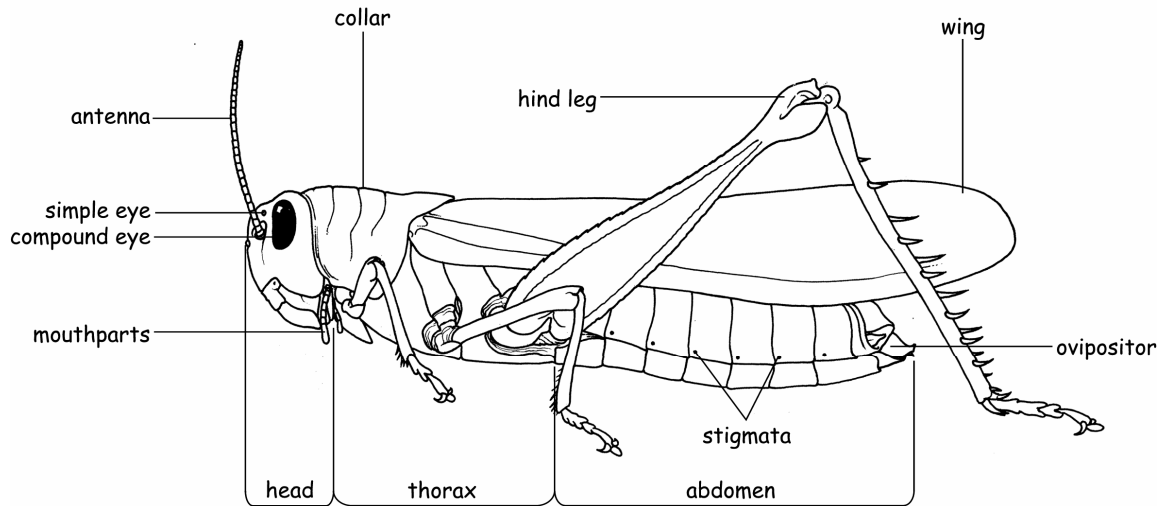
Investigation: Catch a few different types of insects and bring them to class. Form groups of two or three and study the insect in the group of which the body parts can be distinguished easily. A grasshopper or a cricket works well. Answer the following questions (try your best to give a good answer so that you can get a good mark):








1. An insect has large as well as small eyes.
How many eyes can you count? Large:
Small:
2. In how many main parts would you divide the body?
3. How many wings does the insect have? If the wings are folded against the body, lift them up and look carefully.
4. Are all the wings the same?..... Describe.
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5. What does the insect's skin covering feel like?
6. What does the insect feel with?

7. Does the insect have a nose with which to breathe? Describe.....
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8. Does the insect have a mouth? Describe.
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9. How do you know that it is an insect that you are busy studying?
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10. Are all the legs developed equally strongly? What do you observe?
.....
11. Do the tips of the abdomen look the same in all the insects of the same type?
..... Describe.
.....
12. Insects are particularly well adapted to be able to survive under different
circumstances. Describe (refer to protection, need of water, movement, ability
to look for food).
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13. Make a drawing of the insect as seen from the side.

We will now look at the grasshopper as an example of an insect in greater detail. Study the information and mark your answers to questions 1 to 12 above.

Build



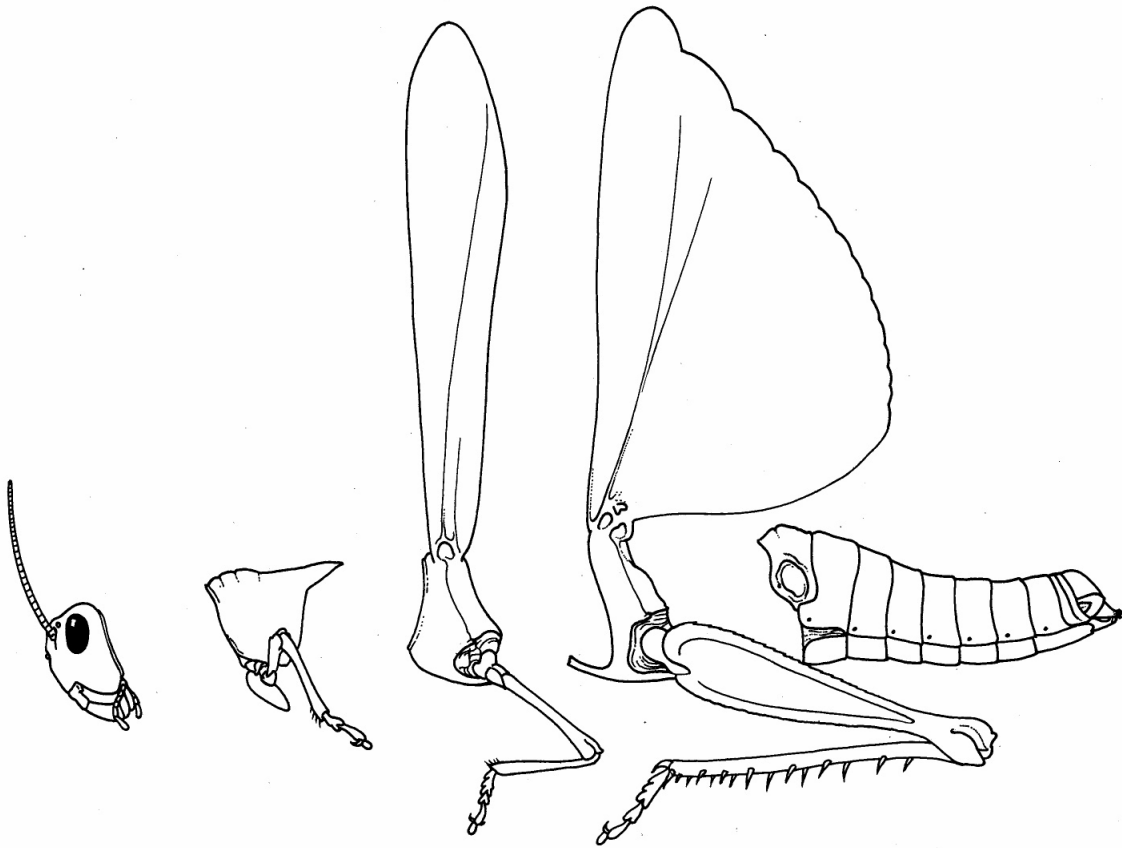
-  The body consists of three main parts: the head, the thorax and the abdomen.
-  The insect has an exoskeleton that consists of a strong leathery material called *chitin*.
-  The three pairs of articulated legs are attached to the thorax.
-  Two pairs of wings are also attached to the thorax: the front ones are leathery and lie flat against the body; the hind ones are soft and fold underneath the front ones like fans.
-  The head bears:
 - two antennae (feelers) with which the insect feels;
 - three small eyes that are called simple eyes;
 - two large or compound eyes; and
 - mouth parts.
-  The abdomen has no attachments, except for small sexual organs at the tip that differ in the case of the male and the female.
-  There is a small spiracle (breathing opening) on each segment of the abdomen.

Movement

Insects are very mobile. Just think about the agility of a fly and the distance that swarms of grasshoppers can fly.

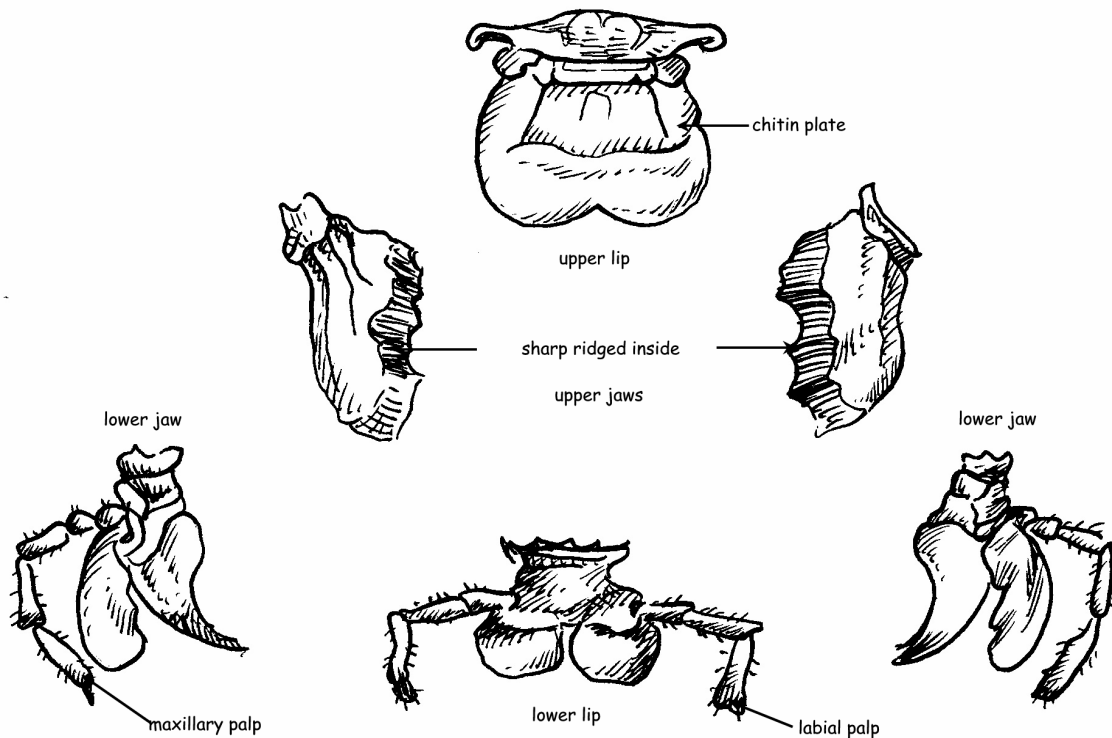
The legs are articulated. The hind legs of the grasshopper are developed more strongly so that it can jump.

The front wings fold open diagonally and balance the insect during flight (like the wings of an aeroplane), while the soft hind wings fold open like fans and do the actual flying.



Feeding

The grasshopper is a herbivore with mouthparts that are very well adapted for this purpose. Amongst others, there are two small feelers with which it can feel the food so that it can push the food into its mouth. There are also two jaws with cutting edges that finely cut up the plant material. The grasshopper therefore has biting mouthparts.



Other insects have the same mouthparts as the grasshopper, although the shape can differ greatly to adapt to other ways of eating. For example, they can be licking (the fly), sucking (some moths) or biting (the mosquito).

Respiration

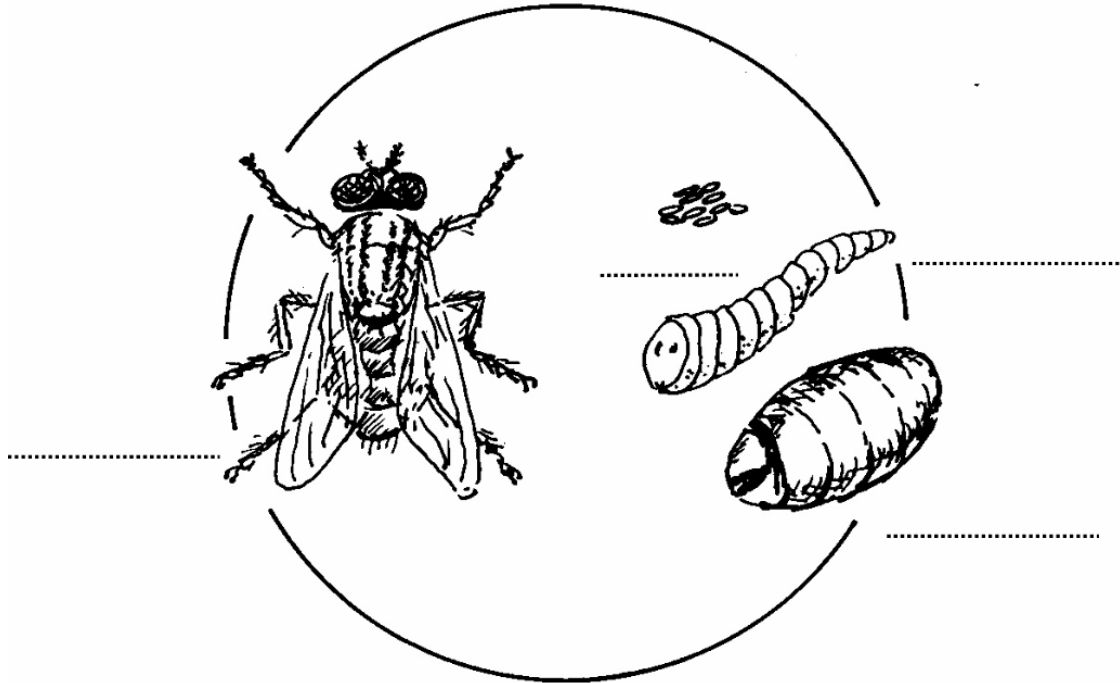
On either side of each of the first eight abdominal segments is a spiracle. These openings lead to a network of tubes (trachea) that branch throughout the whole body and transport air.

Maintaining a water balance

The exoskeleton of the grasshopper forms a watertight skin covering. This means that the body does not lose moisture and therefore can survive in dry conditions. The plant material eaten by the grasshopper contains sufficient water.

Reproduction

In Grade 6 you learned that a fruit fly undergoes a complete change of form, or metamorphosis, from the time the egg hatches until an adult fly has developed. Can you still remember the stages? Fill them in on the illustration below.



The grasshopper does not undergo a complete metamorphosis. After the male and female have mated, the female lays eggs in the ground with her ovipositor. The small grasshoppers that hatch look just like the adults. They moult a few times as they grow. We therefore speak of incomplete metamorphosis.

The grasshopper and other insects in the ecosystem

Assignment 3

Explain why the grasshopper and other insects are adapted to their environment particularly well.

- ▶ Dependence on water:

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Obtaining food (distinguish between the grasshopper and other insects that undergo a complete metamorphosis).

- ▶ Grasshopper:

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- ▶ Insects that undergo complete metamorphosis:

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- ▶ **Respiration** (Tip: why are insects not as dependent on a moist environment as the earthworm is?):

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- ▶ **Senses and communication** (Tip: research whether grasshoppers can hear and make sounds)

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THE SPIDER

The spider belongs to the group of *arachnids* or *Arachnida*. Some arachnids can spin webs, such as the spider, while others, such as ticks and scorpions, do not spin webs.

Can you still remember the characteristics of all arachnids?

They all have..... legs.

Can you still remember what characteristic the arachnids share with the insects?

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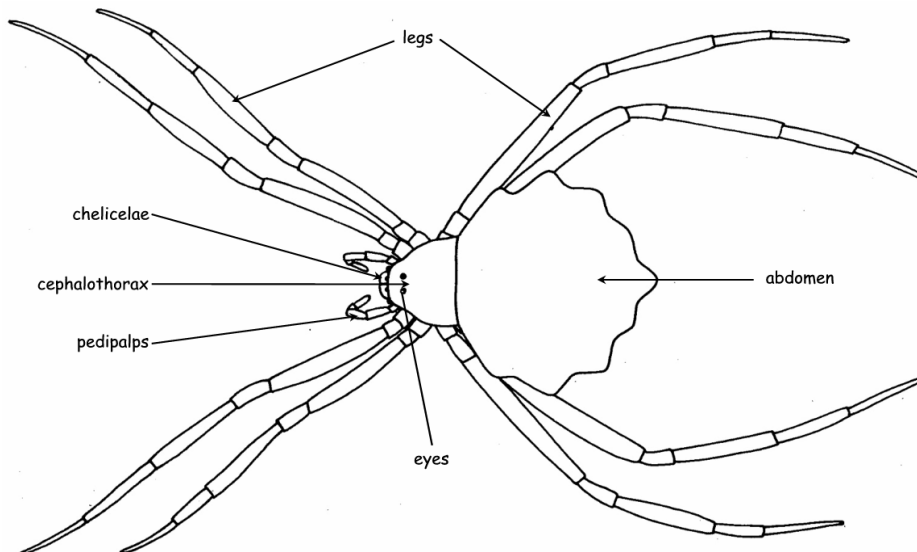
If your teacher has a dead spider or scorpion, look at its build and try to answer the following questions:

Can you distinguish a head, thorax and abdomen as in the case of the grasshopper?

Why does it look as if there are ten legs?.....
.....

To which part of the body are the legs attached?

Can you see small and large eyes as in the case of the grasshopper?.....



Build

The body of the spider consists of only two parts, namely a cephalothorax and an abdomen. There are eight simple eyes on the cephalothorax (the spider does not have compound eyes like other insects), as well as two palps or feelers. The spider has two conspicuously large pedipalps with which it catches its prey.

There are spinnerets at the tip of the abdomen with which the spider builds cobwebs in which to catch prey.

The skin covering (exoskeleton) is leathery and hairy.

Movement

Spiders are particularly agile, particularly those that do not catch their prey in a web, e.g. the large hunting-spider.

Feeding

Spiders are meat eaters (carnivorous) and paralyse their prey with poison that is stored in their pedipalps. The palps handle the prey while it is being eaten. In South Africa, there are only a few spiders that are harmful to people, e.g. the button-spider (black with distinct markings on the underside; the body excluding the legs is approximately the size of a peanut). However, spider bites can become infected as a result of the germs that are found around their mouthparts.

Respiration

The spider has spiracles on the underside of the abdomen that lead to internal *book-lungs*.

Maintaining a water balance

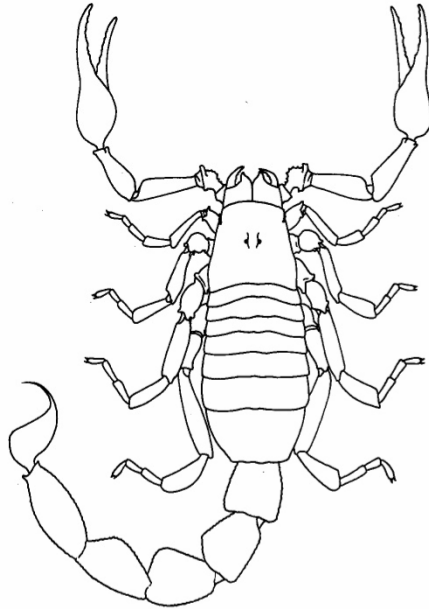
As in the case of the grasshopper, spiders obtain the little water that they need from their food.

Reproduction

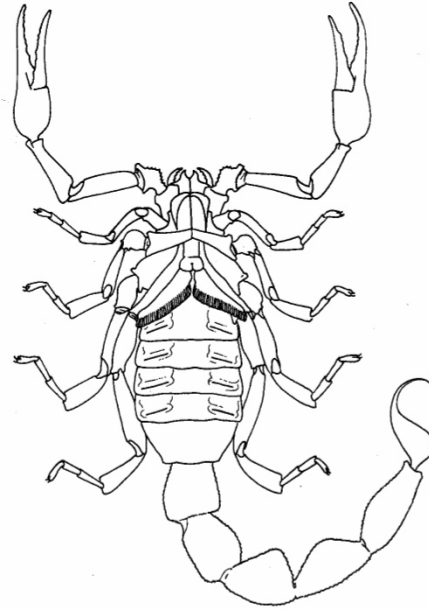
Small spiders look like the adults.

The spider and other arachnids in the ecosystem

Insects are adapted very well to their environment, as is the case with the spiders, scorpions and ticks; they can survive extremely dry conditions. They feed on other animals that are also hunters (not the tick, though, which is a parasite) and therefore play an important role in maintaining a balance in the ecosystem. Spiders therefore should preferably not be killed. The same is valid for scorpions, but care should be taken in the case of those with thick tails – they are poisonous to humans.



View from above



View from below

Assignment 4

Study the following and answer the questions that follow:

The owner of a garden sprays poison on the plants in his garden to get rid of caterpillars. The gardener is unhappy about this and decides to have a look at how the poison affects other animals in the garden. Every day he counts how many spiders and flies, amongst others, he can find in the garden. He does not want to identify Animal X in the table. He notes down the numbers of creatures.

Number of animals that can be found in the garden within one hour on the indicated dates.

	2 January	9 January	16 January	23 January
Spiders	20	10	7	2
Flies	2	12	24	38
Animal X	5	4	2	0

1. Explain what happened in the garden from 2 January until 23 January by referring to the numbers.

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2. What animal could Animal X possibly be? Explain why you think so.

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3. What should the owner learn from this situation?

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**Activity
1.10**

**TO STUDY THE CRAB AND COMPARE
VARIOUS INVERTEBRATES**

LO 1.1	
LO 1.2	
LO 1.3	
LO 2.3	

THE CRAB

Crabs belong to the group of *crustaceans* (shell-fish) or *Crustacea*, which also includes lobsters, shrimps, prawns and mussels. Most members of the group are marine animals.

Can you still remember how the crustaceans differ from the insects and the arachnids?

They have legs.

Try to get hold of a crab and look at its external characteristics.

Can you distinguish between a head, a thorax and an abdomen? (Tip: the abdomen of a crab is folded underneath its body)

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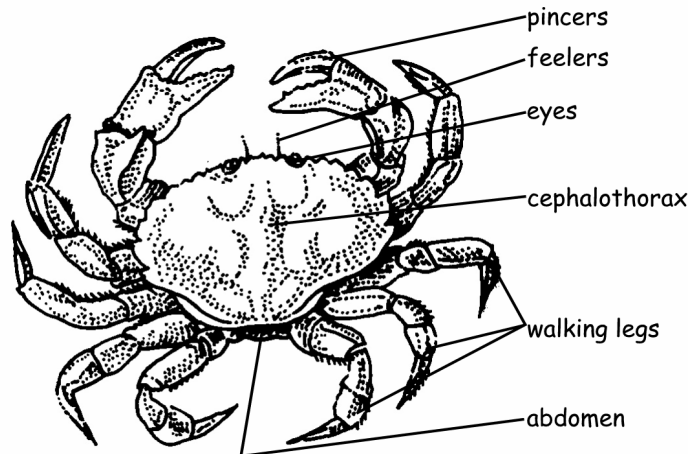
What does the skin-covering feel like?

What does the front pair of legs look like?

Describe

 the eyes:

 the mouthparts:



Build

The body of the crab consists of a cephalothorax and an abdomen. The abdomen is small and is folded underneath the cephalothorax. The following are found on the cephalothorax:



Five legs, of which the front pair has pincers;



Two eyes on stalks;



Two feelers; and



Mouthparts.

The skin covering (exoskeleton) is hard and like plastic. It consists of chitin that is strengthened with calcium.

Movement

Crabs move sideways and are very agile. Have you ever tried to catch one on the beach? It should not be very difficult for them to catch their prey!

Feeding

Crabs are meat eaters (carnivores) and catch their prey with their pincers, with which they hold the food while eating it.

Respiration

Crabs breathe with their gills and therefore are dependent on water. However, the gills are situated in gill-chambers that are filled with water all the time. Crabs therefore can also breathe on land.

Research assignment

Determine what is meant by the term respiration. Refer specifically to gas exchange and the gases involved. Then compare the earthworm, grasshopper, spider and crab with regard to their breathing. Make use of simple illustrations. Do the assignment on a loose sheet of paper that can be placed in your portfolio. Explain which of the animals will be able to survive under the greatest variety of conditions.

Maintaining a water balance

The exoskeleton of the crab prevents excessive water from moving into the body (when they are in water) or out of the body (when they are on land).

Reproduction

The crab lays eggs that hatch in the space between the abdomen and the cephalothorax. The young look just like the adults when they hatch.

The crab and other crustaceans in the ecosystem

Crabs and other crustaceans are meat eaters and form an important link in the food chain. They are adapted to live in water, but land crabs can survive out of the water for long periods.

Test your knowledge:

The crab



has legs;



breathes with that are found in
that are filled with



has an that is strengthened by
that occurs in the chitin;

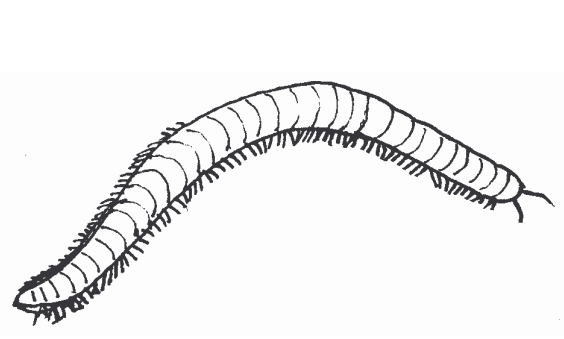


has the following in common with spiders but not with insects:

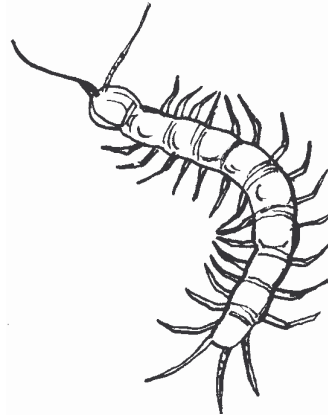
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MILLIPEDES AND CENTIPEDES

We will not study examples of these animals in great detail. However, it is important to remember that they play an important role in the ecosystem. Let us compare them:



Millipede



Centipede

	Millipedes	Centipedes
Build	Many segments, round	Many segments, flat
Number of legs	4 on each segment	2 on each segment
Food	Rotting plant material	Insects, earthworms and snails
Where they live	Amongst dead plant material on the ground	Under old tree stumps and amongst dead leaves on the ground
When they are active	In the day	At night

Activity
1.12

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**TO STUDY THE GARDEN SNAIL AND TO
COMPARE THE ADAPTION OF A FEW
INVERTEBRATES WITH REGARD TO
SURVIVAL**
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LO 1.1	
LO 1.2	
LO 1.3	
LO 2.3	
LO 2.4	

THE GARDEN SNAIL

The snail belongs to the group of *molluscs* or *Mollusca*. Can you still remember which other animals belong to this group?

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It will not be difficult to find a garden snail. Look at its external build and try to answer the following questions:

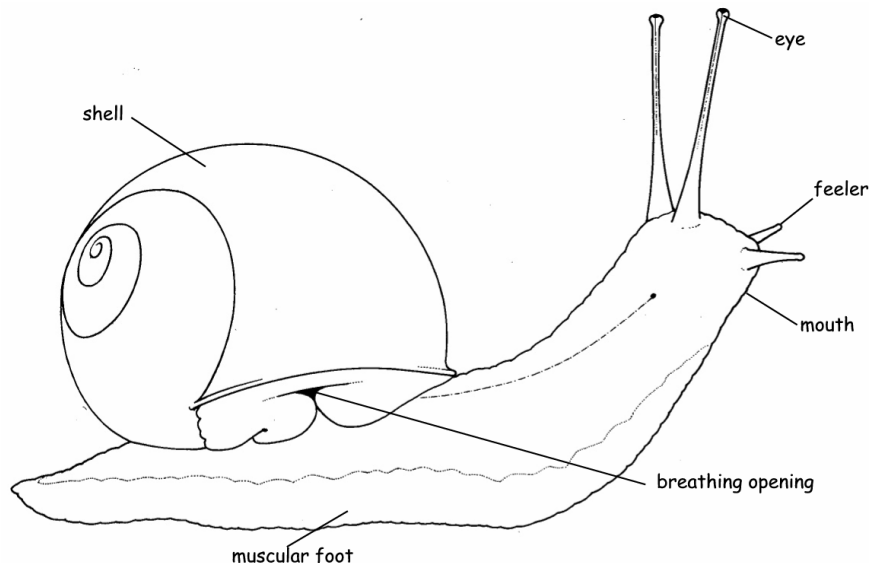
The largest part of the body consists of a..... foot. On the head are two and two

Place the snail on a glass plate and when it begins to move, look through the glass from below and describe what you see (how it moves).

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Can you see its mouth? Describe.

Lift the snail and try to look into the shell next to the body. Can you see an opening? This is the breathing opening.



Build

The body of the snail consists of a head, a foot and a hump. The hump contains the organs (for reproduction, digestion, etc.) and is covered by a shell. There is a spiracle under the shell on the right-hand side. Four tentacles are found on the head. Two have eyes while the other two serve as feelers. There is a T-shaped mouth underneath the head.

Movement

The snail moves by means of wavelike motions in the muscle foot. Slime is secreted, making the surface smooth.

Feeding

The snail is plant eating and has a radula with which the plant material is grated fine.

Respiration

Underneath the shell, the snail has a membrane that is rich in blood vessels (the mantle) and is used for breathing. The membrane connects to the air outside via the spiracle and thereby is protected from drying out.

Maintaining a water balance

The snail secretes slime that protects it from drying out. When the muscle foot is pulled into the shell, the only the part of the foot outside the shell is that part against the surface on which the snail is sitting. It therefore cannot dry out.

Reproduction

The snail lays eggs and the young look like the adults. Snails can have both male and female sexual cells and they keep them until conditions are favourable for the survival of the young.

The snail in the ecosystem

Snails eat plants and are an important link in various food chains. They are adapted very well to life on land and can survive dry conditions, although damp periods are essential for at least part of the year.

Assignments

1. Describe what would happen in an ecosystem if people removed all the snails.

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2. Make a summary of the ways in which the invertebrates that we have studied are adapted to survive in their particular environments by completing the table below:

ANIMAL	FEEDING	RESPIRATION	WATER BALANCE
Earthworm			
Grasshopper			
Spider			

Crab			
Snail			

3. **Research assignment:** Describe how you would develop a corner of 100 square metres in a zoo into a self-sustaining zoo for invertebrates (in other words, the animals do not need to be fed). Your teacher will evaluate your project in terms of the following:

-  planning of the project (which invertebrates, what information is needed, etc.);
-  gathering of information, e.g. on the conditions that need to be created for the animals to be able to live;
-  design of the zoo; and
-  evaluation of the design.

Activity
1.13

**TO APPLY CONCEPTUAL KNOWLEDGE,
TO ARRIVE AT CONCLUSIONS AND TO
DARE MAKE PREDICTIONS**

LO 2.3	
LO 2.4	

DIVERSITY AND CHANGE

You now know that a large variety of plants and animals occur in ecosystems. Try to answer the following questions:

1. Why is there a variety (diversity) of plants and animals (why do plants differ from one another and why do animals differ from one another)?

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2. Will the plants and animals that are alive today remain unchanged forever or will they gradually change? Explain your answer.

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3. What causes plants and animals to change?

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4. Name one non-living factor that currently is busy changing and that eventually will cause the nature of ecosystems all over the world to change.

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5. Will all the plants and animals survive the change?

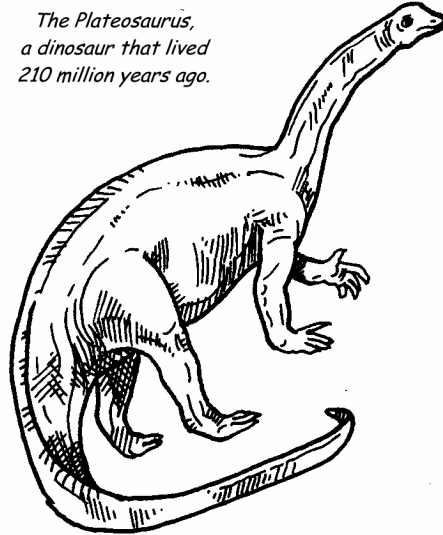
6. What will the plants and animals have to do to survive the change?

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Plants and animals differ from one another because they have adapted to survive under specific conditions. If the conditions change permanently, the plants and animals must adapt to the change. The species that succeed in changing survive the change. Species that cannot change die out.

Dinosaurs are examples of extinct animals.

*The Plateosaurus,
a dinosaur that lived
210 million years ago.*



Try to determine what change caused the dinosaurs to become extinct.

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Can people contribute to a permanent change in conditions on earth?
Describe.

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