Unit 3:
Interaction and coordination

1. Interaction function

2. Interaction in animals
- 2.1. Receptors
- 2.2. Coordination systems
- 2.3. Effector organs

3.Interaction in plants

Think and answer

a. Chameleons can change their colour. Why they do it?

b. How does the chameleon know that its prey is nearby?

c. Why do animals need to obtain information from their surroundings?

d. How can plant react? Put some examples.

UNIT OBJECTIVES

In this unit you will learn:

- To describe the elements of the interaction process in animals.
- To compare the interaction process in animals and plants.
- To distinguish the endocrine and nervous coordination.
- To identify the receptor and effector organs.
- To identify the responses in animals and plants.

1. Interaction function

Living beings have to *interact* with their environment and with other living beings to survive.

Interaction involves a group of processes, which allow living beings:

- To obtain information from their environment (other living beings and their surroundings) in order to act properly.
- To perceive what is happening in the inside of the organism itself, in order to assure the correct functioning of the organism.

The property of living beings to react properly to a stimulus is called **sensitivity**. Sensitivity increases the probability of survival of the organism and the species.

a) Stimuli

These are detectable changes in the internal or external environment that are able to provoke a reaction. Stimuli can be:

- Physical (e.g. light, temperature, pressure, sound, etc)
- Chemical (e. g. presence or absence of a determinate chemical substance)

b) Responses

These are the actions that living being executes as a reaction to a stimulus.
There are two types of responses:

- Motor responses: They are movements.
- Secretory responses: They are secretions.

The joint of the responses of a living being is called **behaviour**. Plant and animals have different ways of receiving and responding to stimuli, that is to say they have different behaviour.

- In **plants** responses are slow and they are related with growth (stem or leaves) or maturing of seeds, fruits and flowers.
- In **animals** responses can be slow or fast, simple or very complex and related to:
  - **Feeding**, like hunting prey.
  - **Reproduction**, like mating, courtship or caring for offspring.
  - **Defence**, like fleeing from a predator or protecting their own territory.

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
Remember: you must make complete sentences.

1.1. Identify the stimulus and the response in each case:

a. An earthworm avoids light and looks for humidity by burying itself in moist soil.

b. An anemone folds in its tentacles when detects a dangerous concentration of salt in water.

c. A male peacock displays its beautiful tail in front of a female peacock.

1.2. What function is this behaviour related to?

a. A tree producing new shoots in spring……

b. A cat running to hunt a mouse……..

c. A female duck incubating its eggs……

d. Two male deers fighting during mating season…….……..

e. A lion forcing to flee to another lion from its territory……

2. Interaction in animals

In the process that goes from the reception to the stimulus to the elaboration of the response, several elements intervene:

- Receptors
They are the structures that *capture* the stimuli.
In animals these receptors are the **sense organs**.

- Coordinators
These organs *process* the information captured by receptors and *elaborate* proper responses.
In animals there are two coordination systems: nervous system and endocrine system.

- Effectors
These structures *execute* the response.
In animals they are **muscles** (motor responses) and **glands** (secretory responses)

1. Perception of the stimulus
E.g. A gazelle hear a cheeta aproaching

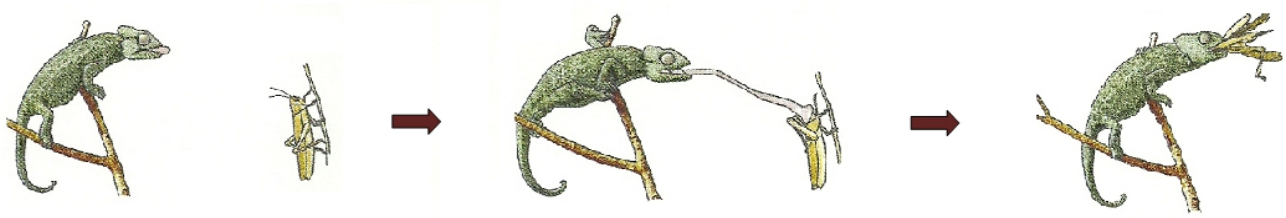
2. Processing of information
E.g. The nervous system of the gazelle elaborates a response: run away

3. Execution of the response
E.g. The gazelle's locomotor system execute the response.

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
Remember: you must make complete sentences.

2.1. The following sequence of pictures represents the process of interaction in chameleon hunting. Can you identify the elements that intervene?



2.1. Receptors

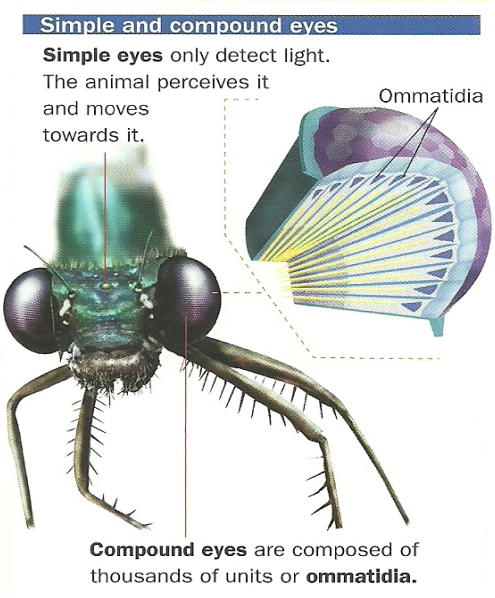
In Animals there are some specialized organs to detect stimuli. They are the **sense organs**. These organs contain **receptor cells** that are specialized in capture a determinate type of stimulus (light, vibration, etc) and send a signal to the coordination systems, which interpret them as a sensation (an image, a sound, a smell, etc)

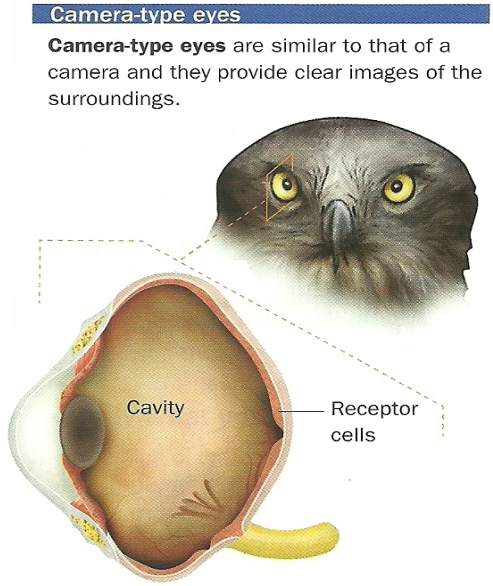
These receptor cells can be classified according to the *type of stimuli* they receive:

a) Photoreceptors

They detect *light* stimuli and are necessary for vision.
The photoreceptor organs of animals are the **eyes.** Eyes are usually located on the head.
Depending on their complexity they can be:

- *Simple eyes* (many invertebrates)
- *Compound eyes* (*Arthropods*)
- *Camera-type eyes* (*Cephalopods* and Vertebrates)

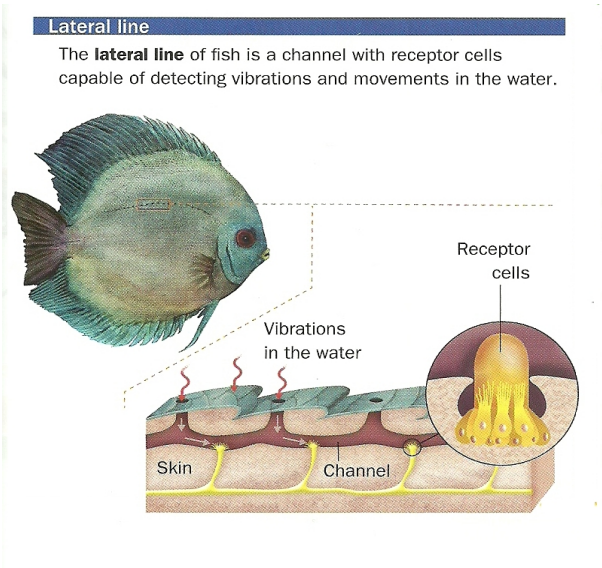


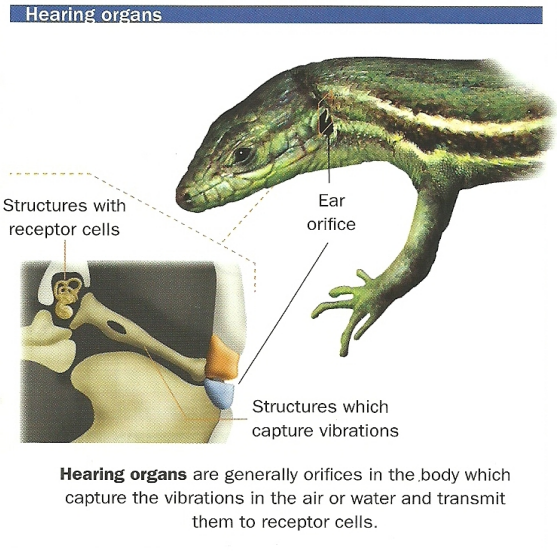


b) Mechanoreceptor organs

They are stimulated by changes in movement, like *pressure*, *contact* or *sound waves*.
These include several types of sense organs:

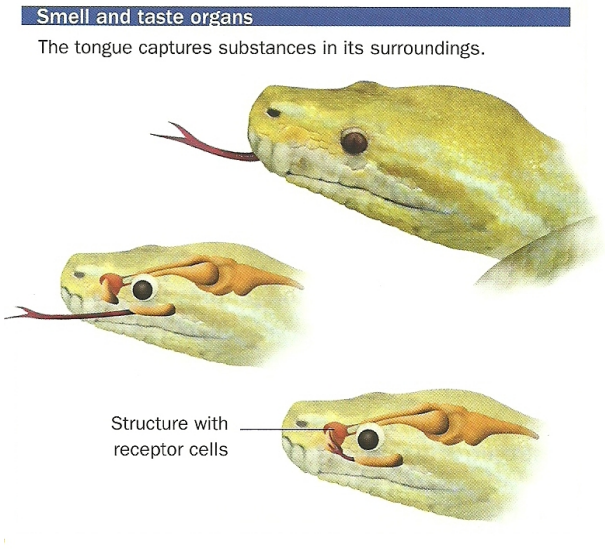
- Hearing organs
- Balance organs
- Skin
- Lateral line (*Fish*)
- Echolocation organs (*Cetaceans* and *Chiropters*)

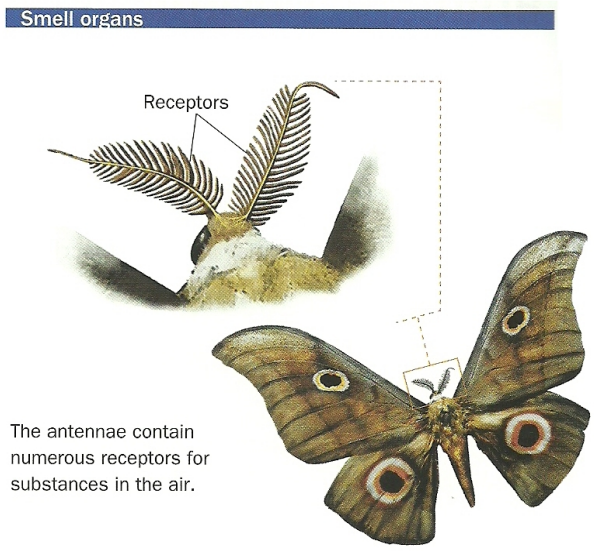




c) Chemoreceptor organs

They pick up information from *chemical substances*. These include taste and smell receptors. These organs are usually on the head near the mouth. In Arthropods they are in antennae and in vertebrates they are in nostrils and the tongue (taste buds).





d) Thermoreceptors

They detect changes in *temperature*. These include some skin receptors and the pits of snakes.

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
Remember: you must make complete sentences.

2.2. Classify the following organs according to the type of stimulus they perceive:

a. Simple eyes of spiders……

b. Antennae of Insects……

c. Lateral line of fish……

d. Hears of birds……

e. Pits of snakes……

f. Taste buds of Mammals……

2.3. List the sense organs we can find in the following animals:

A 

B 

C 

D 

2.4. Answer these questions about special sense organs:

a. Snakes can detect the presence of birds or mammals from the heat they emit. Why can they not detect the presence of other reptiles?

b. How can the lateral line in fish be useful for their survival?

c. What advantage do echolocation organs give to whales and bats?

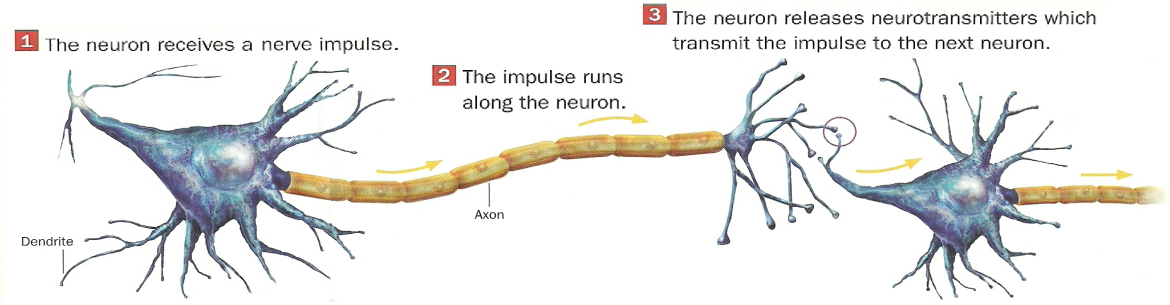
2.2. Coordination systems

Living beings perform at the same time a huge amount of varied functions, such as grow, breath, feed, etc. To make this possible they need **coordination systems** that assure that all this tasks are carried out correctly and in the proper moment.

Animals have two coordination systems that interact and work together. They regulate and coordinate the vital functions of the organism: the **nervous system** and the **endocrine system**.

a) Nervous system

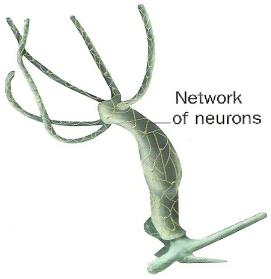
The **nervous system** regulates and coordinates the body's activities by means of specialized cells called **neurons**. These cells transmit information in the form of **nerve impulse**, a little electrical current.



Nerve impulse effects are short in time and in general are related with functions which require rapid and brief responses such as locomotion.

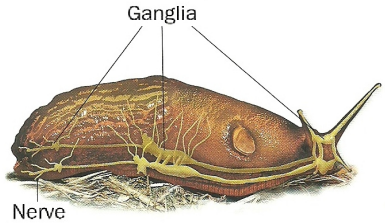
The nervous system functions are:
- It receives information from the receptor organs.
- It interprets this information and elaborates an appropriate response.
- It transmits this response to the effector organs.

Invertebrates have simple nervous systems. The main models are:



- Nerve net system.
It is typical of *Cnidarians* (jellyfish, corals and anemones).
It is formed by a net of neurons extended throughout the body.
There are not complex nerve organs, such as a brain.

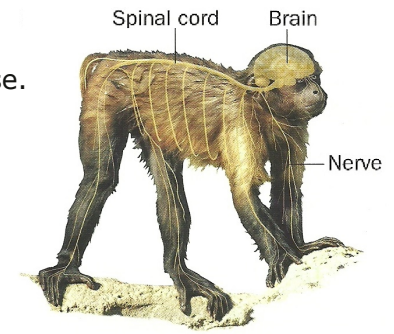
- Ganglia systems
It is typical of *Arthropods* (insects, etc), *Annelids* (earthworms, etc) and *Molluscs* (snails, etc)
It is formed by **ganglia** and **nerve cords**.



- Ganglia are groups of neurons that are distributed throughout the body.
  The main ones are together in the head and form the brain.
- Nerve cords connect the ganglia.

In vertebrates, the nervous system is divided into:

- The Central nervous System (CNS).
It consists of the nerve centers, which are the **brain** (encephalon) and the **spinal cord**.
Its function is analyses information and decides on a suitable response.



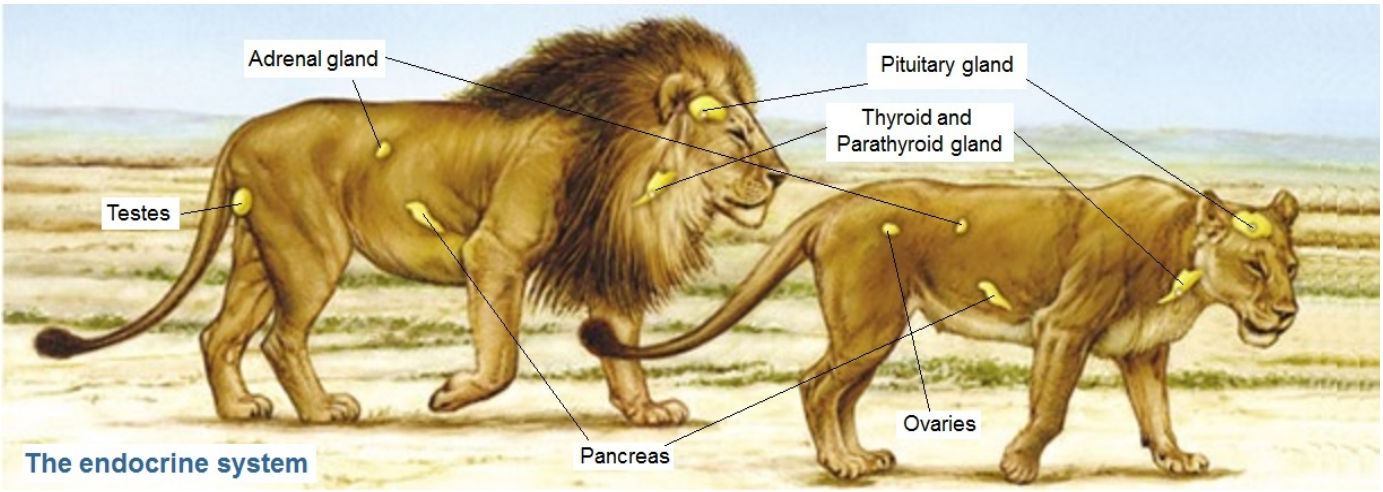
- The Peripheral Nervous System (PNS)
It consists of **nerves**, which originate in the brain and spinal cord.
They carry nerves impulses from the nerve centers to all other parts of the body, and from the sense organs to the nerve centers.

b) Endocrine system

The **endocrine** or **hormonal system** regulates and coordinates the body functions by means of **hormones**.

Hormones are chemical substances produced by **endocrine glands** that are released to the blood that distributed them throughout the body and act over a specific organ.

Hormones effects are long in time and in general are related with functions which require maintained responses such as growth and development, moulting, metamorphosis, metabolism and reproduction.



READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
Remember: you must make complete sentences.

2.5. Complete the following chart:

	Nervous system	Endocrine system
Transmission by		
Means of transmission		
Speed of response		
Duration of response		
Functions that it regulates		

2.6. Indicate what coordination system, nervous (N) or endocrine (E) is acting in each situation:

a. You take your hand away quickly after you put it close to a flame..... ☐
b. Maintaining an adequate level of sugar in the blood..... ☐
c. A hare runs away when it see a wolf..... ☐
d. You stop when you see a car coming before crossing the street..... ☐
e. A female dog is pregnant..... ☐
f. A tadpole undergoes metamorphosis..... ☐

2.7. Why are called the hormones chemical messengers?

2.3. Effector organs

Living beings can have two different types of responses to stimuli:

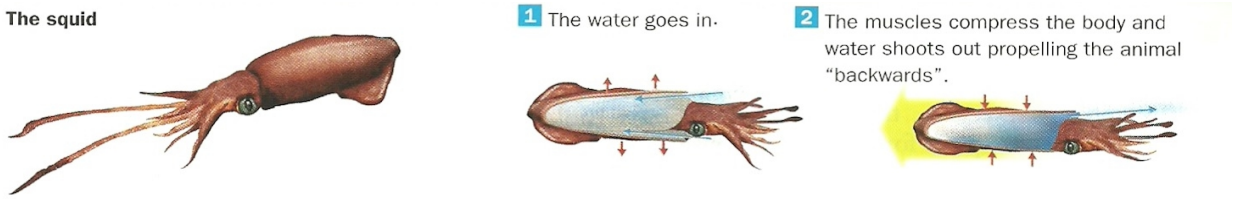
- **Motor responses**: the response is a **movement.**
- **Glandular responses**: the response is a **secretion**.

a) Motor responses

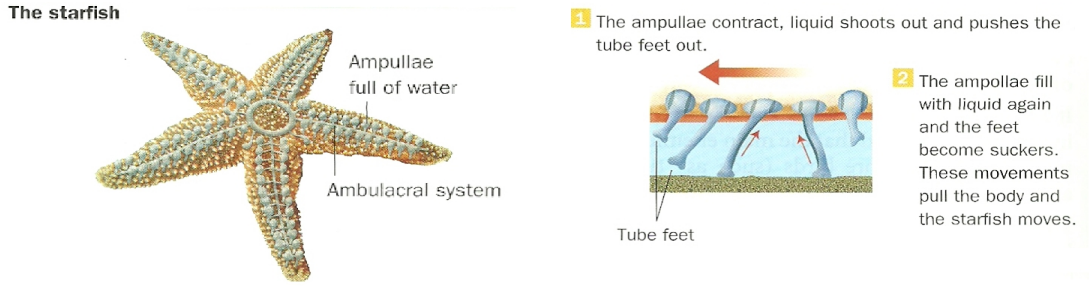
The responsive organs or effectors are the **muscles**. They are the active part of the **locomotor system**, formed by the muscular system and the skeletal system. Muscles contract or relax when they receive the order from the coordination systems, enabling the movement.

- Invertebrates without exoskeleton

In *Cnidarians*, *Annelids* and *Molluscs*, the muscles form part of the walls of the body. By contracting them the animal's shape changes and they can move. For example, the squid propels itself compressing its body and pumping the water out.

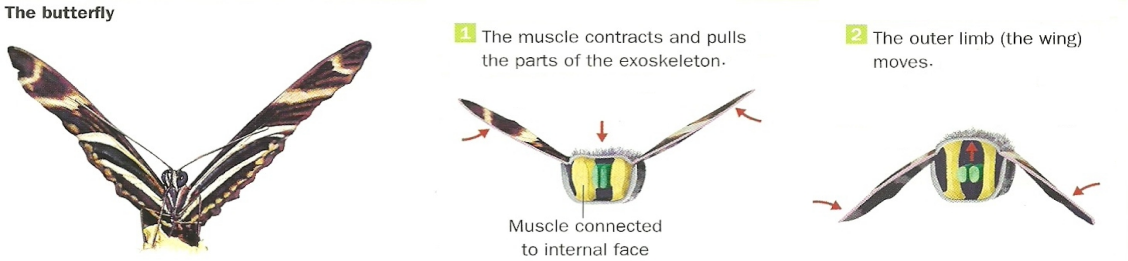


In *Echinoderms*, the muscles are associated with a system of tubules and sacs (ampullae) full of water (the ambulacral system). The pressure on the sacs pushes mobile appendices (the tube feet) out of the animal's body, making the animal move.



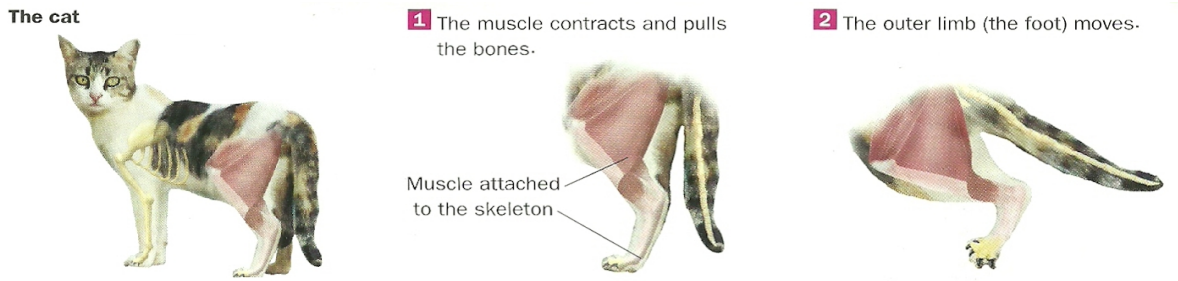
- Invertebrates with exoskeleton

In *Arthropods* (*Insects, Myriapods, Crustaceans* and *Aracnids*), the muscles are attached to the internal face of the articulated exoskeleton. When they contract, they pull on parts of the exoskeleton (legs and wings) and move them.



- Vertebrates

The muscles are attached to the pieces of the internal skeleton (bones and cartilages). They pull these pieces and provoke the movement of extremities.



b) Glandular responses.

The responsive organs or effectors are the **glands**. They produce a substance when they receive the order from the coordination systems.

- **Endocrine glands**. They form the endocrine system. They produce **hormones** that are released to the internal medium.
- **Secretion glands.** They are very varied. The main secretions of animals are **sweat**, **digestive juices**, **milk**, **poison**, **mucus**, etc.

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
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2.8. Indicate what type of response glandular (G) or motor (M) is each one:

a. You cry when something comes into your eye..... ☐
b. Adrenaline is produce in the adrenal capsules of a rabbit when it sees a wolf..... ☐
c. A snail retracts its tentacles when you touch them..... ☐
d. A chameleon changes its colour to become similar to the surroundings..... ☐
e. Your stomach starts to move to make the digestion..... ☐

2.9. Skunks are well known for spraying a harmless liquid with a foul smell when feeling threatened.

a. If it is not a poisonous substance, why do you think they secrete it?
b. Do you know other any animal that secretes a harmless substance as a response of a stimulus?

2.10. Why should we be cautious when we see jellyfish in the sea?

3. Interaction in Plants

Interaction in plants is not easy to observe, as their reactions are often very slow and subtle. Despite this, we can see that plants react, in a coordinated way to stimuli such as light, humidity or temperature.

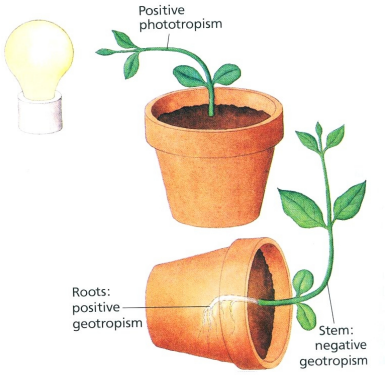
When a stimulus reaches a plant, some of its cells sense it and react or send a signal to other cells (for example, they produce a substance which is distributed around the organism) leading to a joint, coordinated response of part, or all of the plant.

The most frequent reactions of plants are tropisms, nastic movements and changes in their vital processes.

a) Tropisms

Tropisms are plant responses which consist of directing their growth towards, or away from stimulus.

- **Phototropism** is a response to **light**.
  For example, the shoots of a plant grow towards the light.
- **Geotropism** is a response to **gravity**.
  For example, roots grow towards the earth.
- **Hydrotropism** is a response to the presence of **water**.
  The roots grow towards water in the soil.
- **Thigmotropism** is a response to **contact**.
  It occurs in the shoots of creepers, which grow around the objects they touch.



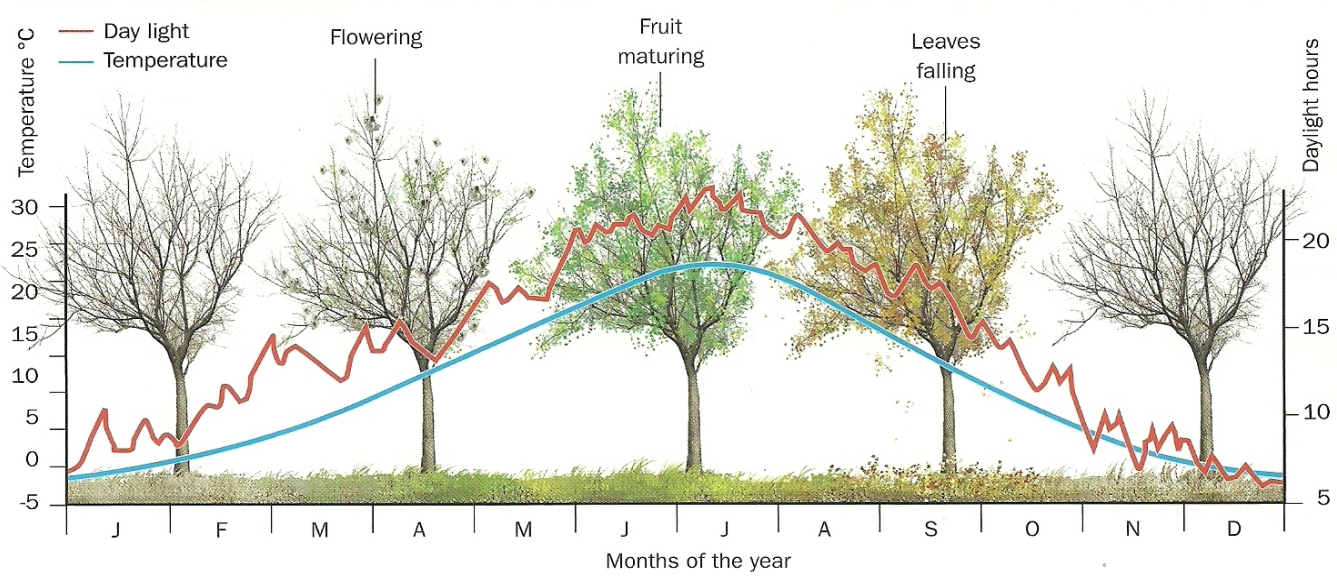
b) Nastic Movements

Nastic movements are plant responses which consist of **rapid** movements of some parts of the plant. They are usually **reversible** and **temporary**. For example:

- **Photonasty** is a response to **light**. Examples are the way leaves or flowers turn, following the sun; or the opening and closing of some flowers depending on whether it is day or night.
- **Thermonarty** is a response to **temperature**. For example, some flower close when temperature drops down too much, or some leaves fold when the temperature is too high.
- **Thigmonasty** is a response to **contact**. For example, the mimosa shrub folds its leaves when touched; the flytrap, a carnivorous plant, snaps its leaves shut when an insect brushes against it.

c) Changes in a plant's vital processes

Some plants react to certain stimuli by modifying some of their vital processes. The most characteristic reactions of this type are the **seasonal changes** of many plants, like responses to temperature, the light or the length of the day and night. For example, flowering in spring, shedding leaves in autumn, fruits maturing in summer.



READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
Remember: you must make complete sentences.

3.1. What is the main difference between *nastic movements* and *tropisms*?

3.2. Vine tendrils (runners) wrap around other stems and nearby objects.

a. What type of response is it?

b. What type of stimulus provokes it?

c. Why is it useful for vines to have tendrils?

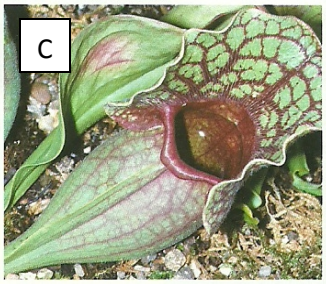
3.3. Answer the questions:

a. What type of plant response is shown in the photographs tropisms or nastic movements? Why?

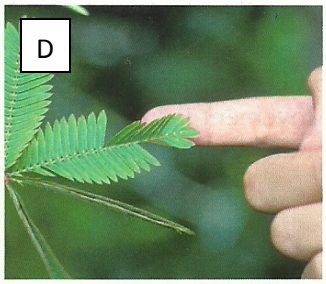
b. Identify the type and the stimulus which act in each case.

These flowers open at dusk and close during the day.

Tulips open and close according to the temperature.



Carnivorous plants close their leaves when an insect lands on them.



Mimosa leaves retract when touched.