VITAL FUNCTIONS

1. INTRODUCTION

There is a huge diversity of life on our planet. In fact there are over two million known species. There is life in the coldest of places, on the tops of the highest mountains and the depths of the deepest oceans, from a depth of 10,000 metres below sea level to a height of 10,000 metres above sea level. Wherever we look, we can find evidence of living things that have adapted themselves to their environments.

A.1. a) Write down differences between livings things, for example a lion, and an inert matter, such as a stone.

b) Do you think all living things do the same things? Do they have the same functions? Make a list of general functions performed by **all living things**.

Vital functions in living things

Living things perform three vital functions:

- **Nutrition: living things take substances they need to stay alive. These substances are oxygen, water and food. There are two types of living things according to their nutrition:**
  - **Autotrophous: they produce their own food, like plants.**
  - **Heterotrophous: they eat other living things, like animals.**

- **Interaction: living things receive information from the environment and from their own bodies. And then they react to changes.**

- **Reproduction: living things reproduce other living things. So they ensure the survival of their species. Living things can reproduce in two different ways:**
  - **Asexual reproduction: in this type of reproduction only one individual participates in the reproductive function. For example, bacteria or starfish (in some circumstances).**
  - **Sexual reproduction: in this type of reproduction two individuals are involved. The union of special cells from each individual produces a new living thing.**

A.2. Write the vital function involved in each case:

- A bacteria goes to its food.
- Cows eating grass in a field.
- Germination of a seed.
- The fertilization of the ovules.
- Lions eating other animals.
- Rabbits escaping from wolves.

A.3. Visit the following link and answer these questions:

a) What does it mean when all living things have their functions in common?

b) What does it mean when all living things have their organization in common?

2. WHAT DO ANIMALS FEED FOR?

A.4. a) If we suppose a person eats 3 times and breathes 30,000 times a day, how many breaths will he take in 80 years? How many meals will he eat?

b) Why do we need to eat and breathe throughout all our life?

c) Why do we need to do it frequently?

d) What is the main difference between feeding in animals and feeding in plants?

Feeding and breathing are two of the most important activities carried out by living organisms. An organism needs food for three main reasons:

For growth so that it can increase in size and complexity.
For health because an organism needs to maintain its body functioning.
For energy to provide fuel for all the living processes, such as movement, sensitivity and reproduction.

Respiration is like combustion. When we burn wood, oil or coal we need oxygen. Burning wood produces carbon dioxide gas and water vapour as well as heat and light energy. When we 'burn' sugar in our bodies by respiration, the energy that is released is used to move or keep warm.

The carbon dioxide that we produce by respiration must be breathed out through our lungs. We can reuse some of the water which is also made during respiration (our bodies are mostly made of water).

Not all the food that we eat is consumed in respiration. A large amount of the protein in the meat and vegetables that we eat is used for growth. Also the sugars, oils and fats are stored in our bodies for use at an other time.

The food that animals eat can be used in three different ways:

Respiration	Growth, health and Stored Food	Not used
Energy is released to stay alive. Finally excreted as carbon dioxide and water.	**The food becomes part of the animal's body (organic matter).**	**This food passes right through the digestive system and it is therefore lost.**

Not all animals use their food in the same way. Some animals have diets which are difficult to digest, so a lot of food is wasted. In general, herbivores have to eat more food and to digest it for longer than carnivores.

Green plants make their own food by photosynthesis. Herbivores feed upon the leaves, roots and other parts that the plant grows. Carnivores feed upon the muscles and blood that the herbivore grows.

Text adapted from this link

Heterotrophous nutrition

Heterotrophic beings, like animals, fungus and some bacteria, have to take their food from their environment. This food may be plants or other animals.

Organic matter and internal energy

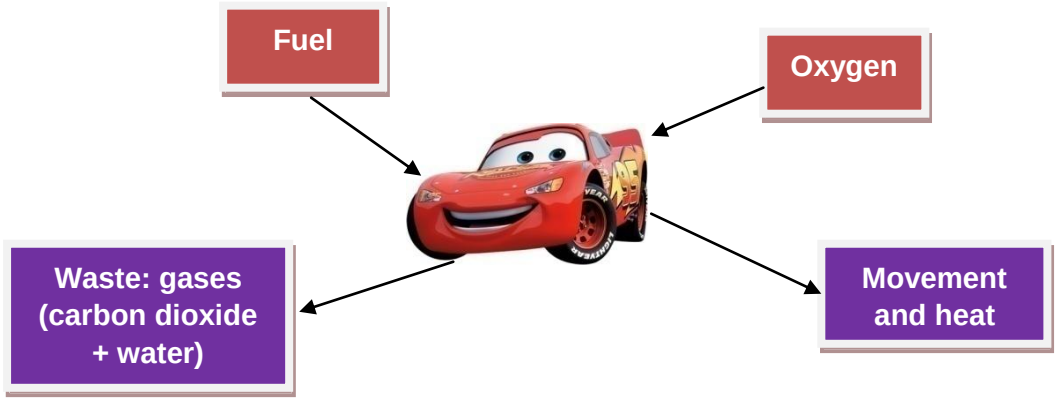
We know that any machine or engine needs energy to work, whether it is electrical, chemical or solar energy.

A vehicle, such as a car, obtains its energy from a substance which it stores in a tank. This substance is called fuel. When the fuel enters the engine, changes occur and it ends up joining with oxygen via combustion and this reaction produces many gases which move the different parts of the engine and make the wheels go round.

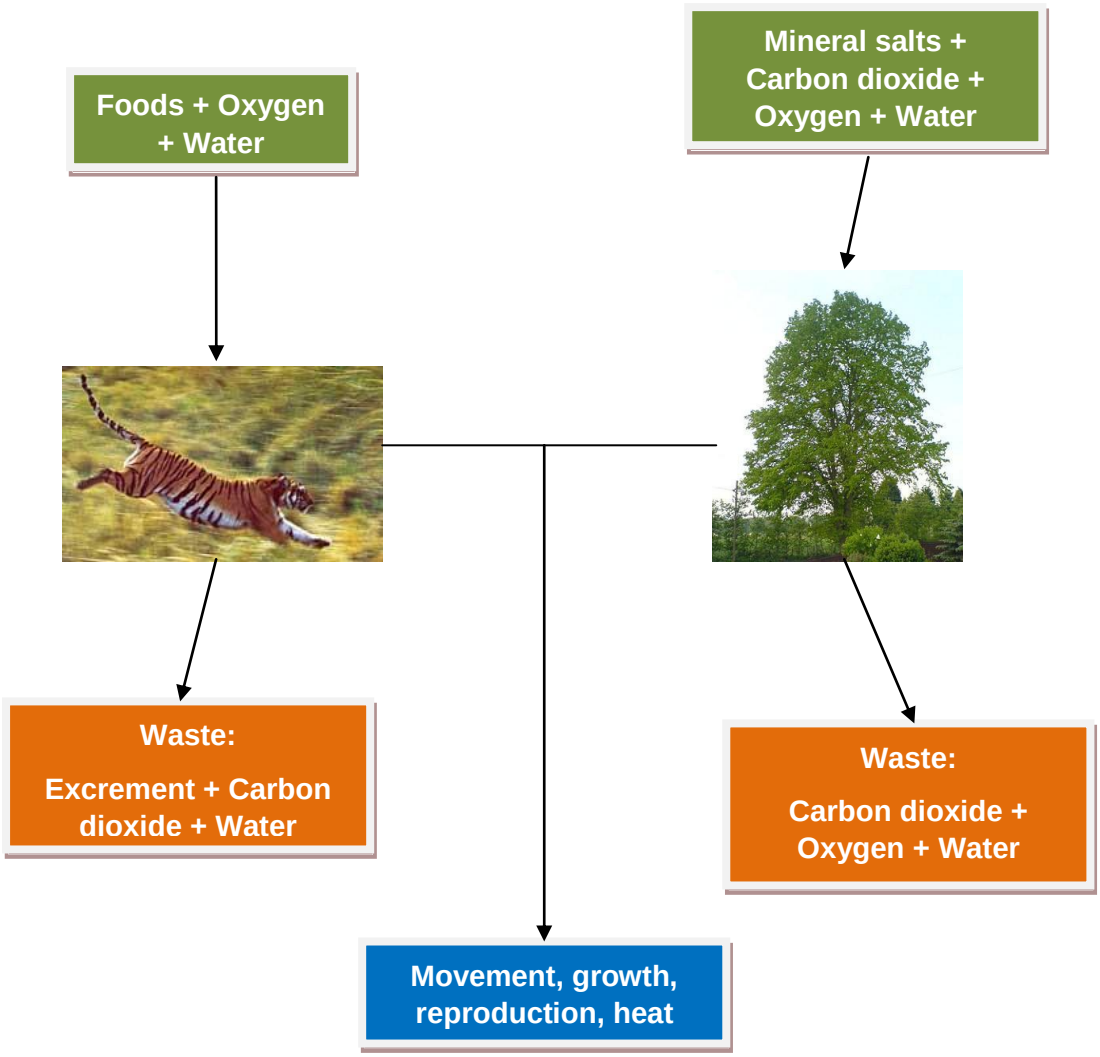
Living things require various substances. They require oxygen and food. They transform food into energy by using a chemical reaction.

But despite the fact that machines and living things seem similar in their use of energy, they are very different. Machines only produce movement and give off heat, they don´t grow and they don´t reproduce.

Living things are very complex if we compare them with inert matter and they can function in a complicated way in different situations.



A.5. What differences can you see in the use of energy between a machine and living things?



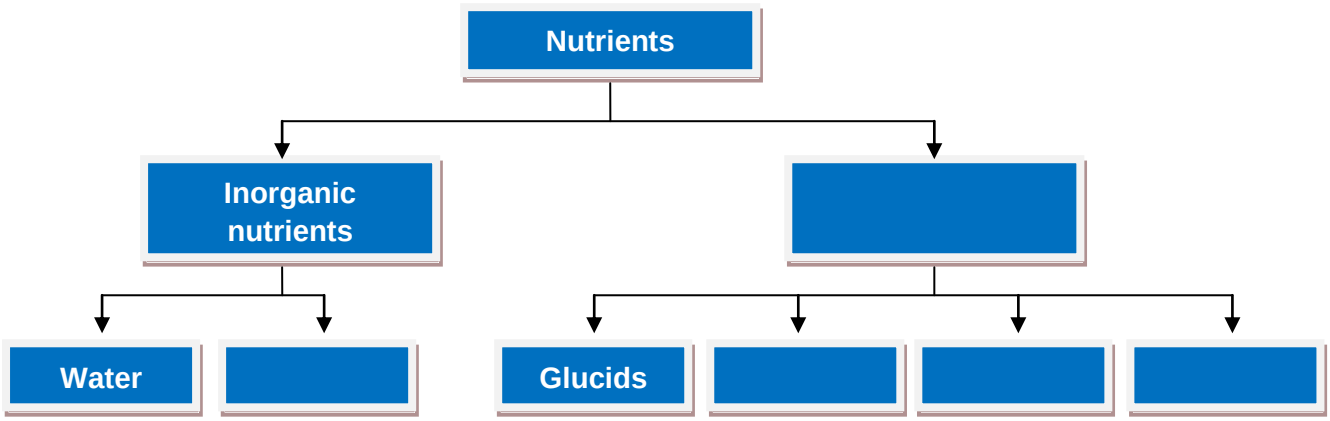
A.6. What´s the difference between food and nutrition?

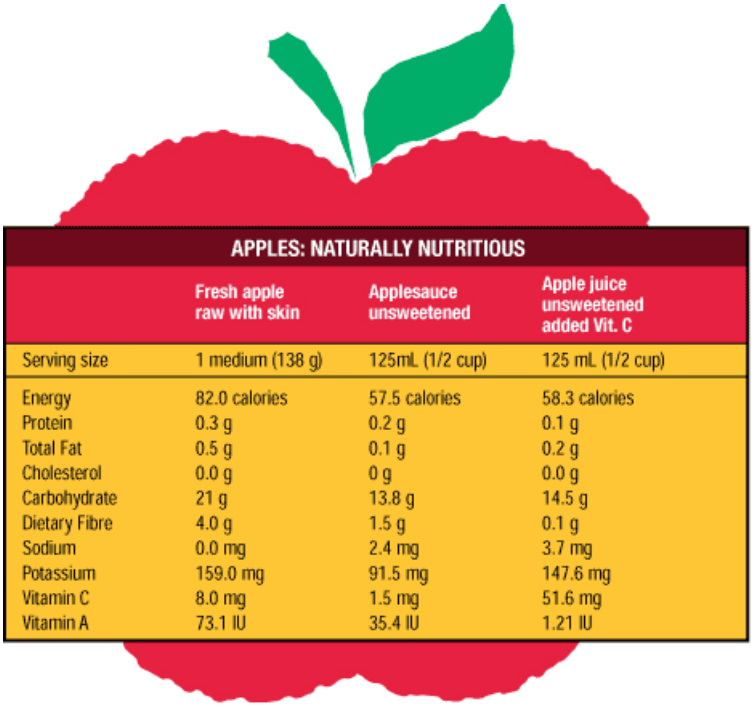
Food and nutrition

Food is about the animal and vegetal products that we eat. Feeding is about food in general, but this food has different substances which are useful for our body: oxygen, water, mineral salts, glucids, lipids, proteins, nucleic acids, amino acids, vitamins. These substances are called nutrients. Grapes or a pork steak are types of food but the glucids of a grape or the proteins of pork are nutrients.

You can know all types of nutrients visiting the next presentation.

A.7. Complete the scheme about the different types of nutrients.





APPLES: NATURALLY NUTRITIOUS

	Fresh apple raw with skin	Applesauce unsweetened	Apple juice unsweetened added Vit. C
Serving size	1 medium (138 g)	125mL (1/2 cup)	125 mL (1/2 cup)
Energy	82.0 calories	57.5 calories	58.3 calories
Protein	0.3 g	0.2 g	0.1 g
Total Fat	0.5 g	0.1 g	0.2 g
Cholesterol	0.0 g	0 g	0.0 g
Carbohydrate	21 g	13.8 g	14.5 g
Dietary Fibre	4.0 g	1.5 g	0.1 g
Sodium	0.0 mg	2.4 mg	3.7 mg
Potassium	159.0 mg	91.5 mg	147.6 mg
Vitamin C	8.0 mg	1.5 mg	51.6 mg
Vitamin A	73.1 IU	35.4 IU	1.21 IU

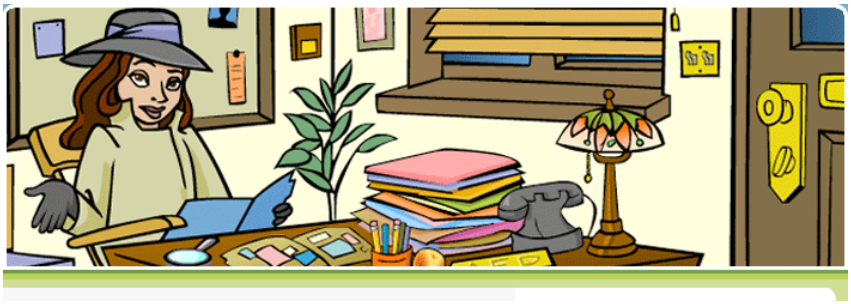
In the next link you can consult the amount of all types of nutrients we have in a cow milk glass.

A. 8. a) Classify the following products as nutrients or foods: milk, cellulose, water, vitamin A, sugar, oil, orange, saccharin, glucose, salt (NaCl), oxygen and meat.

b) Classify the following substances into glucids, lipids, proteins, vitamins or mineral salts: starch, triglyceride, glucose, A, fructose, fatty acids, casein, E, cellulose, hemoglobin, sodium chloride, cholesterol, albumin, fibre.

A. 9. Can a person eat a lot of foods and not be healthy? Why?

In the next link you can be an important “Food Detective” and you can learn to improve unhealthy habits in a funny way.



In the next link you can find a questionnaire (on page number 33), in which you can be conscious of the quality of your feeding habits.

Nutrition in animals

Nutrition is a very complex function. First we need to obtain nutrients from food. This occurs in the digestive apparatus (mouth, esophagus, stomach and intestines). Nutrients are taken by the blood around your body. In your small intestine, nutrients pass into your blood. Your blood carries these nutrients to all your body´s cells. This work is made by the circulatory apparatus.

In cells we also need oxygen because this substance is necessary to obtain energy. Oxygen is carried from the lungs to the blood by the respiratory apparatus.

Finally chemical activity in the cells produces wastes that we have to expel. Carbon dioxide is expelled by the respiratory apparatus. The other cells' wastes are expelled by the excretory apparatus.

Be careful with the terminology used: in Spanish we speak of digestive, respiratory, circulatory or excretory apparatuses, while in English we speak about the digestive, respiratory, circulatory or excretory systems.

Here we use the Spanish convention.

A. 10. Visit the following link about the digestive apparatus and draw a picture including the names of the organs involved in its operation.

A. 11. Visit the following links (1 y 2) about the respiratory apparatus and draw a picture including the names of the organs involved in its operation.

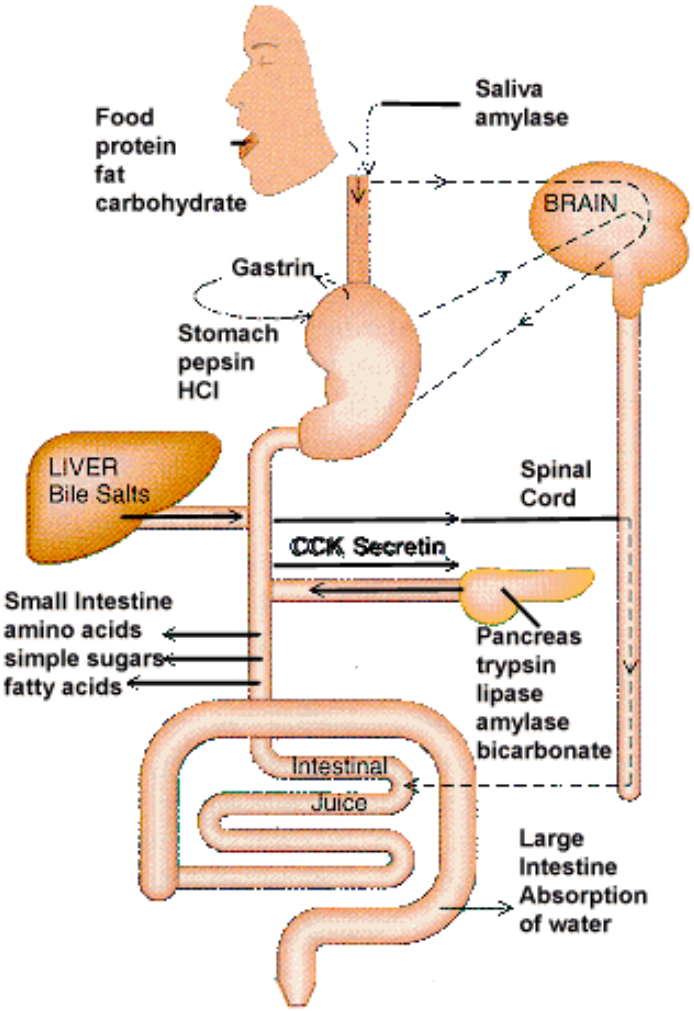
A. 12. Visit the following link about the circulatory apparatus and draw a picture including the names of the organs involved in its operation.

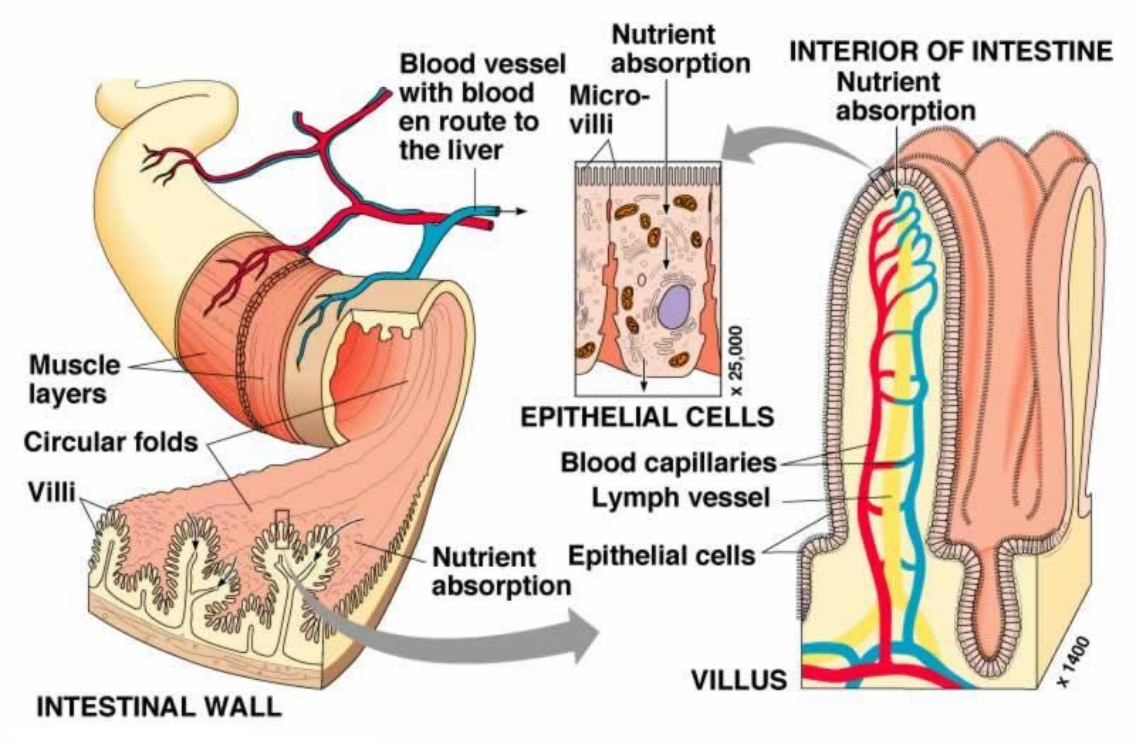
A. 13. Visit the following links (1 y 2) about the excretory apparatus and draw a picture including the names of the organs involved in its operation.

A. 14. a) What is the function of the digestive apparatus in nutrition? What about the functions of the respiratory and the circulatory apparatus?

b) Is excretion a nutrition function? What apparatus is responsible for this?

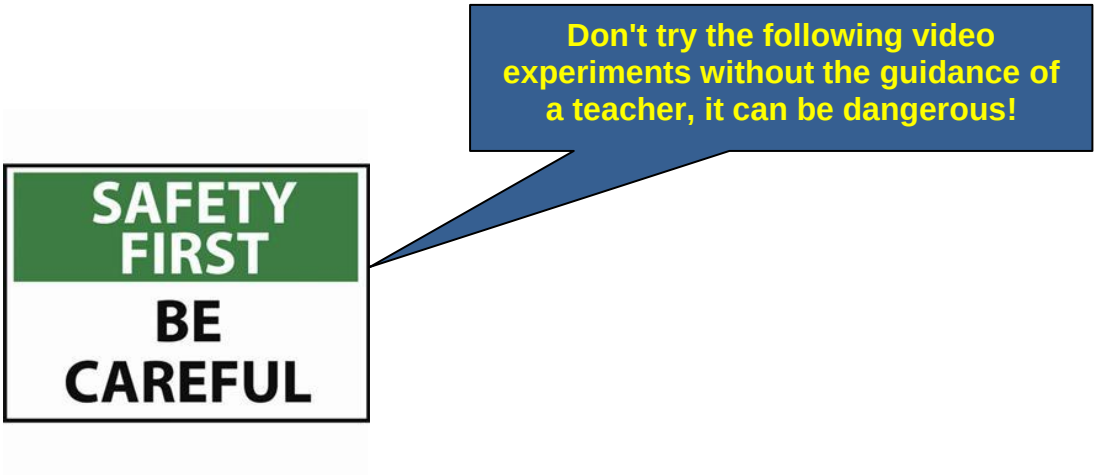
Nutrients: from the mouth to the cells in two diagrams





A. 15. a) Is digestion only a physical process? Explain your answer.

b) Where does the chemical reaction of nutrients with oxygen happen?



A. 16. In the following video you can see different experiments about Biology. The first two demonstrations (about 7 minutes long) are related to the digestive apparatus. Watch the video and try to answer the following questions:

a) What´s the aim of the first experiment?

b) What´s the aim of the second experiment?

Cellular respiration

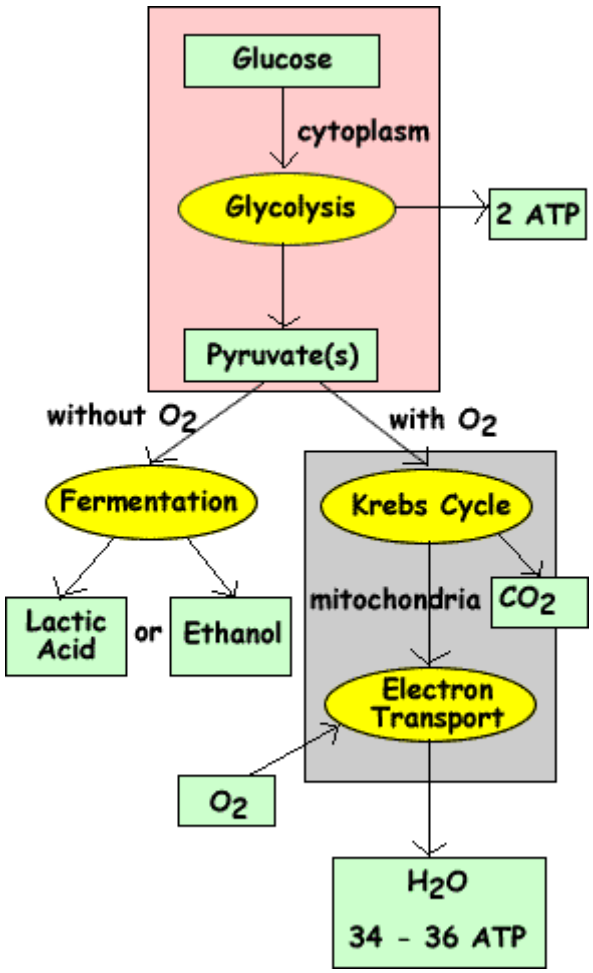
Normally when we speak about respiration we think of lungs but the real respiration consists of a cell process. A chemical reaction occurs in the cells:

$$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + \text{Internal energy}$$

Nutrient: glucose	Oxygen	Carbon dioxide	Water	ATP

Summarizing: we take in oxygen from air and nutrients like glucose from food. Both substances react in cells and produce energy.

In the next diagram you can see the cellular respiration in detail. Now it isn't very important to understand and study the name of every process involved, but you can find every reactant and product of the chemical reaction written above. Internal energy is stored in ATP (adenosine triphosphate) molecules. For example, we can use these molecules to produce movement or thoughts.



A. 17. a) Who needs more food, a person who works in an office or an athlete? Why?

b) What happens when somebody eats more food than he needs?

c) Why does our heart go faster if we run a lot? Why do we take in air faster if we run a lot?

3. WHAT DO PLANTS FEED FOR?

3.1. Water and mineral salts

A. 18. If a tree grows, what is the origin of its matter? Can you make some hypothesis about this problem?

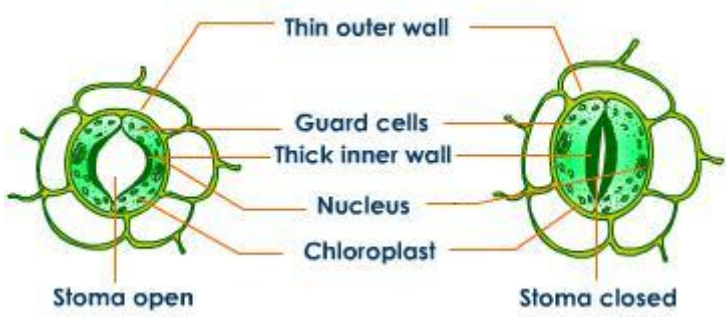
Autotrophus nutrition

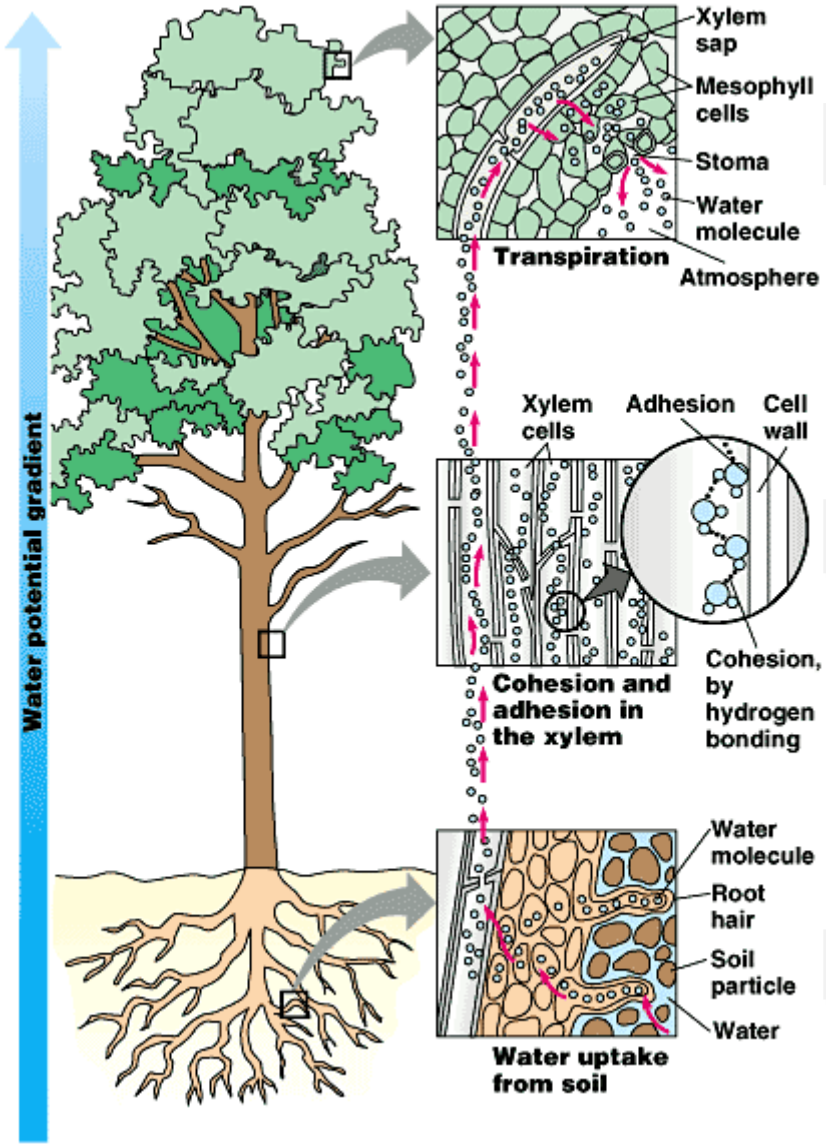
Autotrophous beings, like plants, have to take their energy directly from the sun. Also they need mineral salts and water from the soil.

A. 19. We know by experiments that the growth of a plant produces a lot of matter but the soil loses only a little matter. What´s your conclusion about this fact?

A. 20. We know by experiments that a plant absorbs more water than its increase in weight? What is your conclusion about this fact?

A. 21. Where do you think plants lose water from?





Stomas are very small holes in plants; there are plenty of them in leaves. Transpiration consists of evaporation of water through the stomas.

A. 22. The leaves of some plants which live in deserts are very small, sometimes like prickles. However, in humid places like rainforests leaves are very large. How do you explain this fact? What would happen if the situation was the reverse?

A. 23. Are there fertile and unfertile soils for plants? What is the difference between these soils? How would you show that plants take in something more than water from soil?

Mineral salts

Plants absorb water and mineral salts from the soil. These nutrients do not give energy to the plants but they are very important in some processes like photosynthesis.

A. 24. a) Why does the farmer need fertilizer on the fields?

b) Why don't forests need fertilizers?

3.2. Air gases

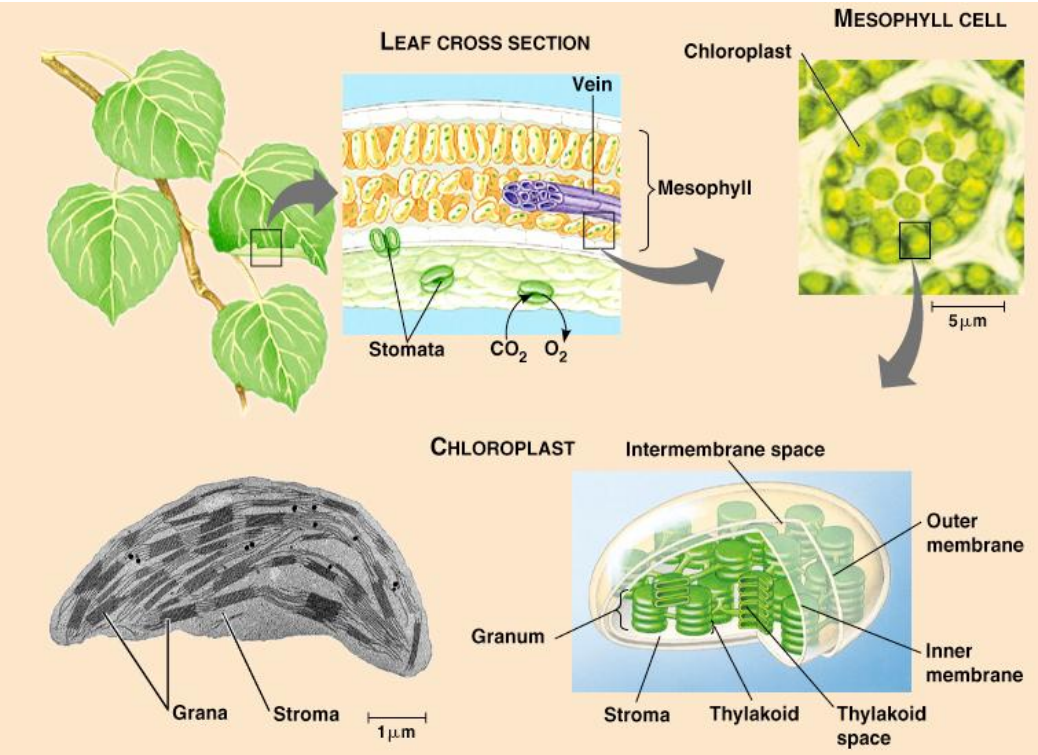
A. 25. Plants contain a lot of carbon but it doesn´t come from the soil. We have to think this carbon comes from the air.

a) What substance from the air contains carbon?

b) Where do you think this substance comes into the plant?

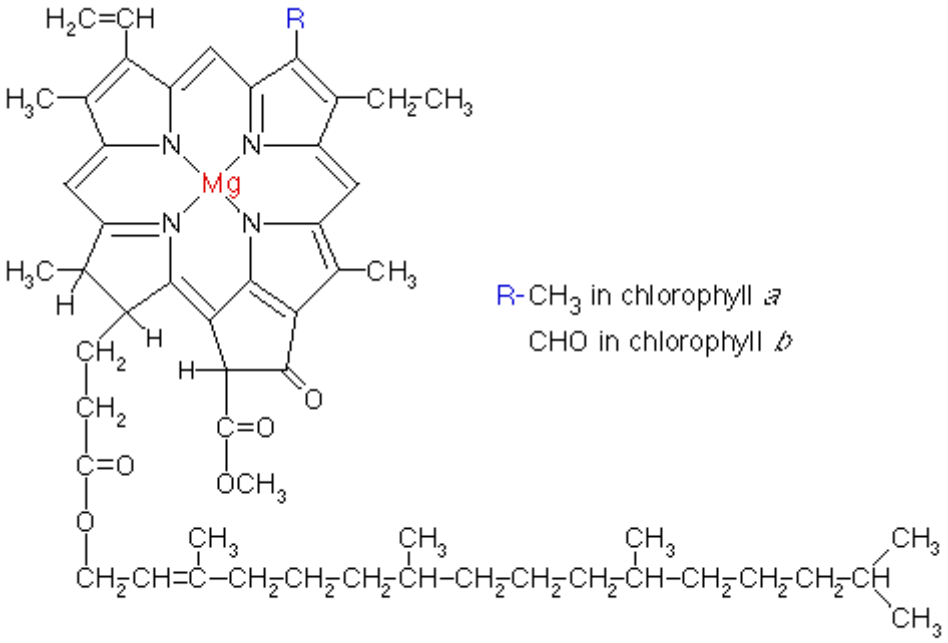
A. 26. Draw a picture which shows how exchanges of gases take place in leaves, as we have learnt up to now.

A. 27. Leaves are always green but roots are not green. What do you think about this fact?



Chlorophyll and light

Plants are green because a substance called **chlorophyll** is green. This substance absorbs light from the sun. Chlorophyll is contained in the **chloroplast**, a cell organelle. **Photosynthesis** occurs in chloroplast. This process needs chlorophyll.



The structure of chlorophyll

Photosynthesis in plants

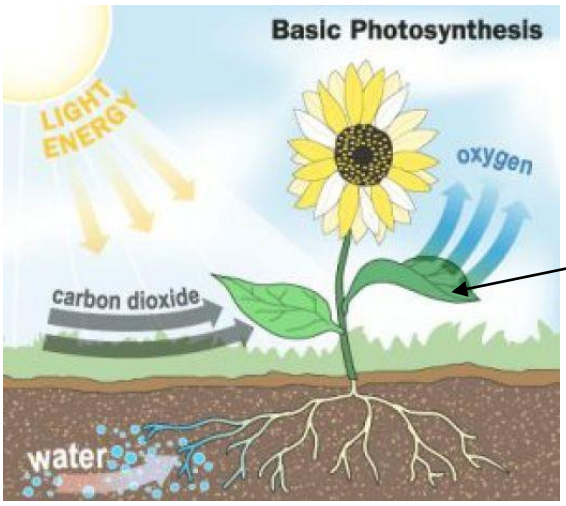
You know plants are green because chlorophyll is green and this substance is necessary in the photosynthesis process. Plants synthesize chlorophyll when they receive light. Photosynthesis takes advantage of the sun´s energy through a chemical reaction:

$$CO_2 + H_2O + \text{Sun energy} \rightarrow C_6H_{12}O_6 + O_2$$

Carbon dioxide — Water — Glucose — Oxygen

Glucose is an organic matter that gives energy to living things. Plants make glucose (autotrophous beings) but animals have to eat plants to get this substance and energy (heterotrophous beings).

The other product from photosynthesis is oxygen. This gas is very important in respiration in living things.



A. 28. The following table shows the amount of plants that grew with different carbon dioxide concentration in the air. All plants had the same light:

Amount of tomatoes (kg/m^2)	2.0	3.7	5.0	6.6	7.5	8.1	8.2	8.2	8.2
Carbon dioxide concentration (ppm)	50	150	250	430	600	790	1000	1200	1400

a) Draw a graph that represents the amount of tomatoes versus the carbon dioxide concentration.

b) What do you think about the relationship between both variables?

c) Looking at the table, what kind of relationship does it show?

d) If you increase the carbon dioxide concentration, do you think it always increases the amount of tomatoes?

e) What other variables influence the productivity of plants?

Respiration of plants

A. 29. a) Do plants need energy?

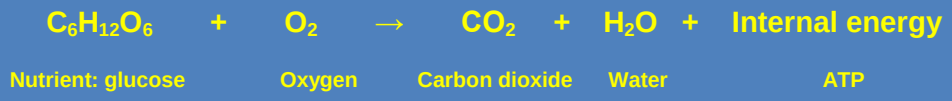
b) What substance provides plants with energy?

c) How do you think plants obtain energy from glucose?

d) How do you think animals obtain energy from glucose?

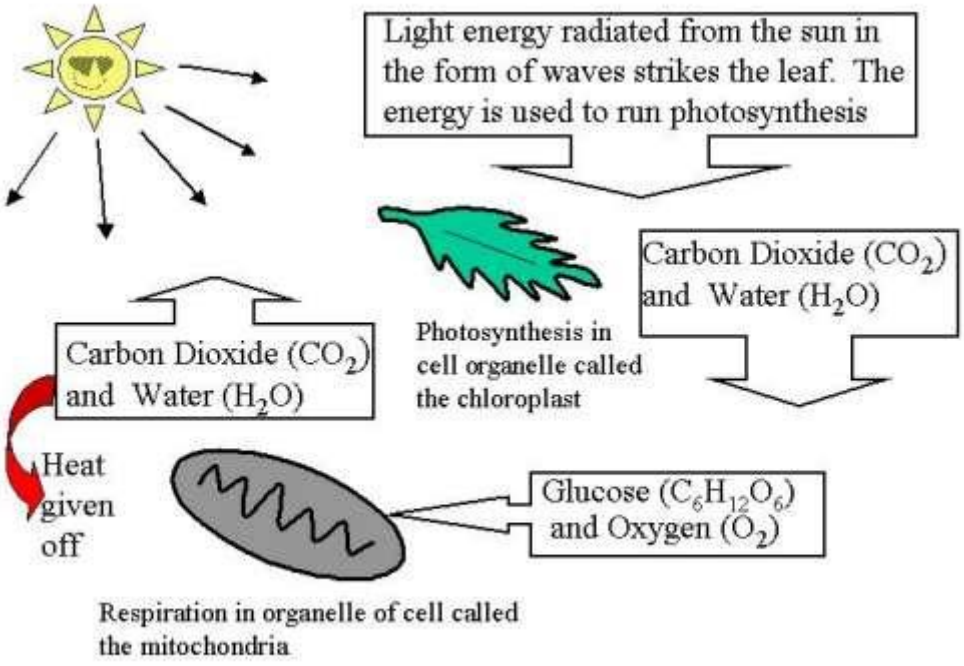
e) Is it the same or a different process?

Photosynthesis produces glucose from water, carbon dioxide and sun energy. This substance stores energy but we need another process to use this energy. This process, called respiration, consists of a chemical reaction:



And it is exactly the same process that animals perform inside their cells.

Oxygen and carbon dioxide are exchanged by stomas.



A. 30. According to the above diagram, photosynthesis and cellular respiration are reverse processes in plants. Which one do you think is produced in more extension? Why?

A. 31. Imagine you are sleeping in your room and there are some plants inside it.

a) Do you think we would have problems with the plants?

b) Write down what process is happening in both the person and the plant.

A. 32. Summarise what processes happen in a plant when:

a) There is light in its environment.

b) There is darkness in its environment.

4. INTERACTION IN LIVING THINGS

A. 33. a) Can a prey escape from its predator without interacting with the environment?

b) Can you survive an illness if you don´t feel bad?

c) Can a sunflower survive without interacting with light?

d) Can you write down other examples like the above ones about the interaction function?

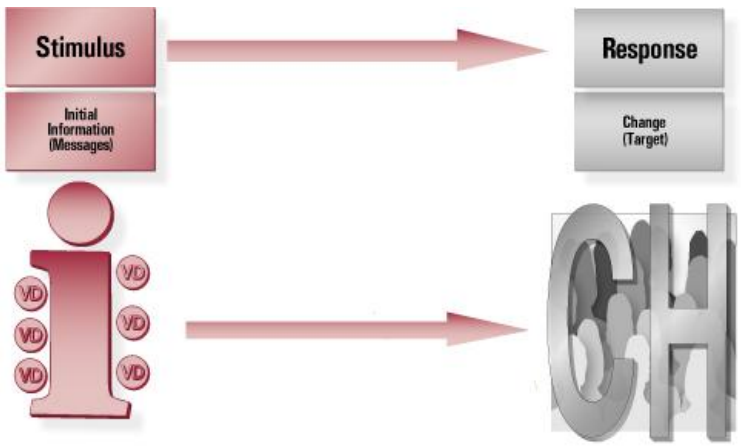
Interaction function

All living things need to interact with their environment and with all other living things.

The interaction among living things is very diverse such as looking for and finding food, protection from danger or the courting of females in the species. This interaction requires the use of special organs in order to:

- **Obtain information from the external or internal environment through the sensory organs (the receptive organs).**
- **Process the information that is obtained and decide on a response. This is only in animals because they have the organs of the nervous system.**
- **Respond to the information that is received with responsive organs like muscles, bones, tendons or glands.**

The information that a living thing receives is called the stimulus, which causes a response.



TYPES OF STIMULI AND RESPONSES		
Stimuli	**Produced by…**	**Receptive organs**
visual	light	eyes
auditory	sound	ears
balance	changes in position	ears
smell	gaseous substances	nasal passage
taste	liquid substances	tongue
touch	contact, pressure	skin
thermal	temperature	skin
painful	pain	skin
Responses	**Nature**	**Responsive organs**
motor	movement	muscles, bones
secretor	secretions	glands

We can see in this chart that there are many different stimuli and a huge number of responses. Let´s look more closely at an example: imagine a gazelle hears a lion roaring and reacts by running in the opposite direction. The lion´s roar acts as the stimulus, the gazelle´s brain identifies the roar as danger and its response is to run away in order to escape from the lion.

A. 34. Give five more examples about stimulus-response chains.

5. REPRODUCTION IN LIVING THINGS

A.35. In the past, scientists thought that living things like worms or fungi and so on, appeared spontaneously without parents.

a) How do you explain that worms appear in a piece of meat after a period of time?

b) How do you explain that fungi appear on a piece of bread, vegetable or fruit after a period of time?

c) What would you do to avoid worms and fungi in the cases above?

The purpose of reproduction

Living things are able to multiply and generate new individuals. The function of reproduction perpetuates life. It maintains the species on the Earth for longer than the life of an individual.

The function of reproduction is not a question of increasing the number of beings of a species, but rather of replacing those which die, so as to keep the balance between the different species which inhabit the Earth.

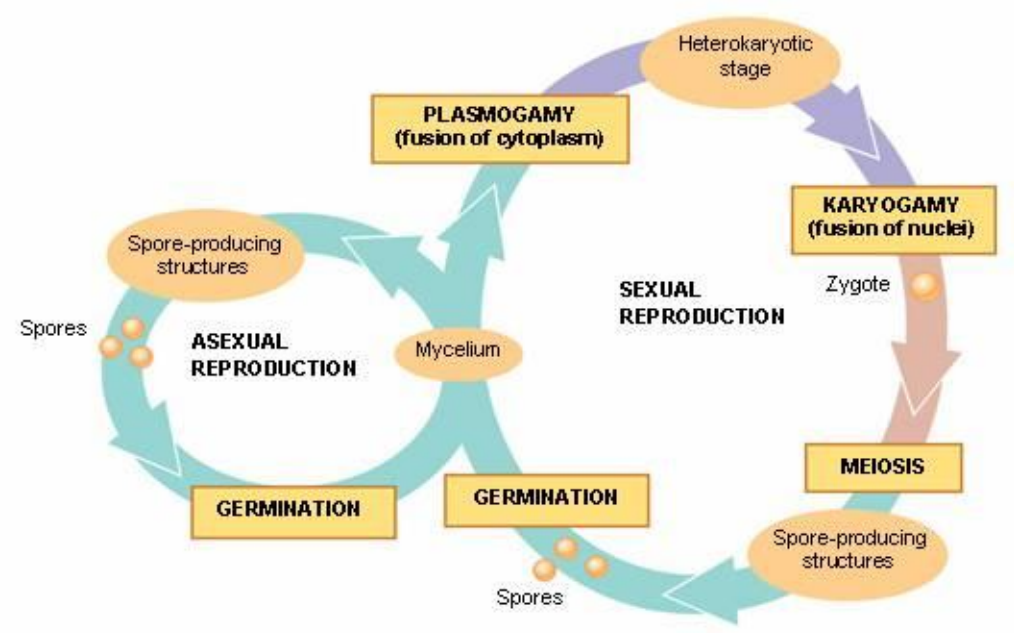
At the same time, genetic information is transmitted from parents to children to develop and keep the species alive and to conserve the characteristics of the species in the future.

Asexual and sexual reproduction

There are basically two kinds of reproduction: asexual and sexual.

- **Asexual reproduction: a single individual is able to separate a part of its body and this develops into a new being. This happens in plants and in some animals.**
- **Sexual reproduction: two individuals of the opposite sex are necessary, a male and a female. Each one of them makes special cells, the gametes, which join together and become a single cell, a zygote, by means of fertilization. This happens in plants and in most animals.**

Gametes are cells which are only used for reproduction. Each gamete contains half of the genetic information of the individual. Female gametes are known as oospheres (in plants) or ovules (in animals) and the male gametes are known as endosperm (in plants) or sperm cells (in animals).



6. SUMMARY

A. 36. Try to make a mind map that summarizes the entire previous unit.

7. EDUCATIONAL RESOURCES ON THE INTERNET

- Photosynthesis animation (medium level).
- Photosynthesis animation (high level).
- Cell respiration animation (high level).
- Stimulus-Response Mini-quiz (medium level).
- Stimulus-Response video explanation (high level).

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APPENDIX 1: GENERAL VOCABULARY OF THE UNIT

APPENDIX 2: SPECIFIC VOCABULARY OF THE UNIT