Republic of Iraq
Ministry of Education
General Directorate
of Curricula

BIOLOGY

2

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5th Edition

2023 – 1445

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قسم التحضير الطباعي

PREFACE

Biology is a rapidly developing branch of science. The major advances being made continuously affect our life on earth. Some of these important advances are included here. The results of a recent survey on the attitudes towards existing literature available to high school students showed that many were unhappy with the material used in teaching and learning. Those questioned identified a lack of the following: accompanying supplementary material to main text books, current information on new developments, clear figures and diagrams.

This book aims to improve the level of understanding of modern biology by inclusion of the following: main texts, figures and illustrations, extensive questions, articles and experiments. It is the intention and hope of the authors that the contents of this book will help to bridge the current gap in the field of biology at this level.

This book has been carefully reviewed and the language is considered suitable for students for whom English is a second language.

To the students

Being curious students, you may have wondered why you resemble your parents or why you need to breathe. In this book, I try to summarize some major subjects of biology. These are the most promising and perhaps the most complicated subjects of modern biology.

Group work will greatly enhance your learning abilities as well as give you an opportunity to share your knowledge and experience with your friends. I hope that, being assiduous students, you will work hard throughout this academic year and do your best to satisfy your scientific curiosity and, of course, to pass all of your exams successfully.

The authors

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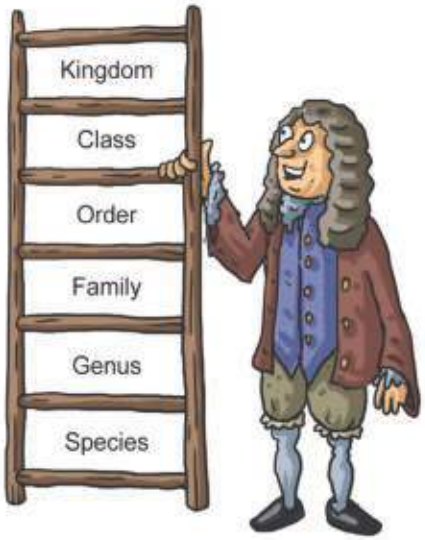
CHAPTER 1
CLSSIFICATION OF LIVING THINGS & VIRUSES

Carolus Linnaeus
(1707- 1778)



CLASSIFICATION OF LIVING THINGS

What is Classification?

Classification is dividing the living things into many groups according to their similarities and differences. Classification is studied by taxonomy, which is a branch of biology. Biologists estimate that there are about two million kinds of organisms live today on our planet and new species are continuously being discovered.

The classification of organisms provides an advantage in investigating and observing them.

The History of Classification

Before biologists have used observation to classify living things. The Greek philosopher Aristotle (350 B.C.) was the first man who made some attempts on grouping of organisms. He knew only a few kinds of plants and animals. He classified plants as herbs, shrubs and trees. He grouped animals according to where they lived: water, land or air.

The modern classification system was discovered by a Swedish biologist Carolus Linnaeus or Karl Von Linne (1707-1778). He developed principles of the modern taxonomy.

Linne used two latin names for each organism in his system which is known as **binominal nomenclature**. These are genus and species names. For example; Homo sapiens is the biological name of human beings.

First name (Homo) is the genus name and second name (sapiens) is the species name of human beings.

What is species?

Species is a group of living things which have many common properties. Organisms which belong to the same species can mate and produce fertile organisms. (they can reproduce too).

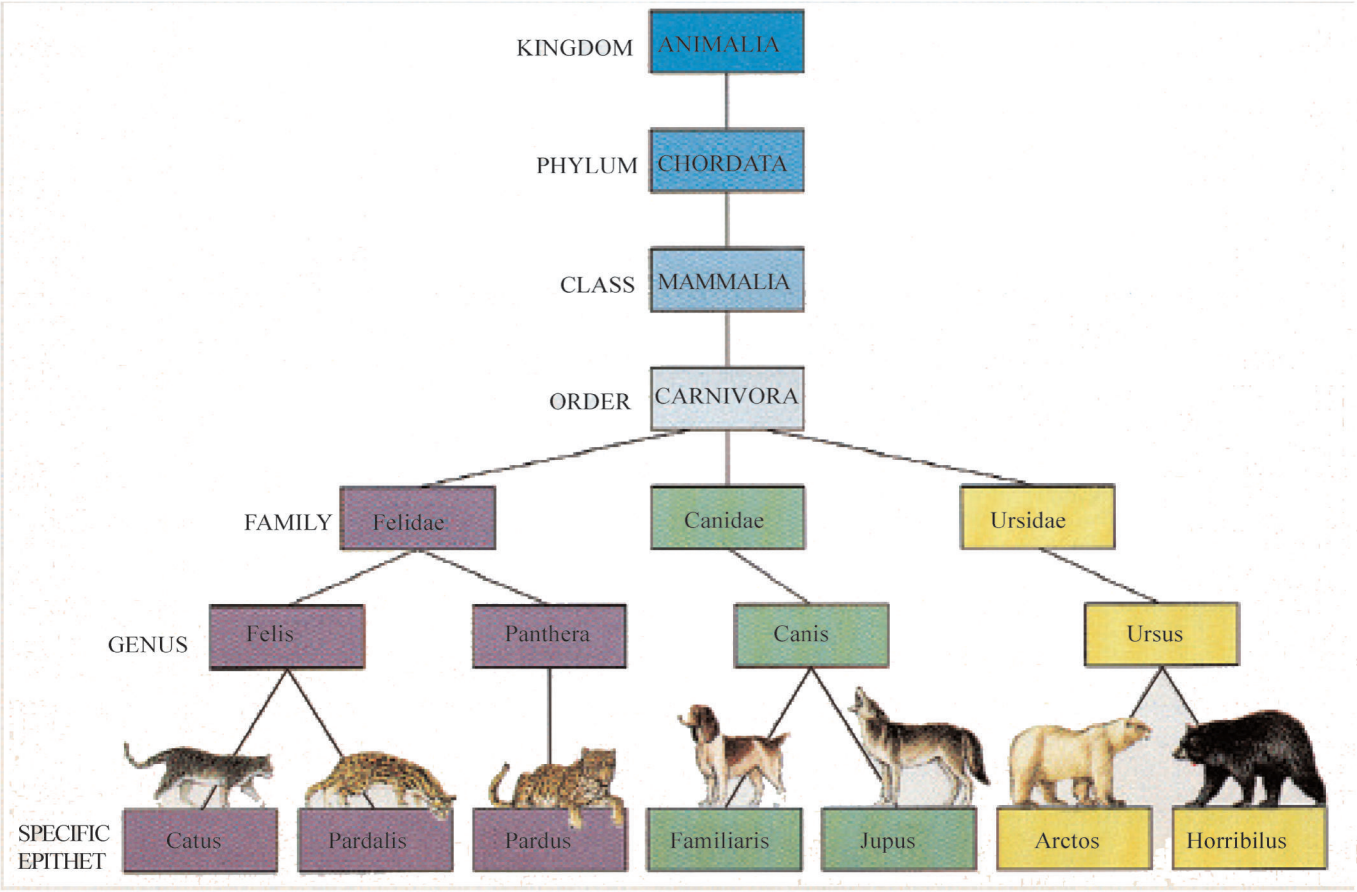
What is genus?

A genus consists of one or more species that show many similarities. So a house cat (Felis domestica) is a species which belongs to genus of Felis. Other species of the genus Felis is a lion (Felis leo). The genus name is spelled with capital letter, while the species name begins at a small letter. Such as:

Pinus nigra, Populus alba, Rosa canina.

Classification Categories

Taxonomists have added several categories to the classification system. The biggest category is a **kingdom** and the smallest category is a **species**. Each kingdom is divided into lower categories as follows:



LEARN EASILY

- ☐ **King (Kingdom) 5 kingdoms**
- ☐ **Phillip (Phylum)**
- ☐ **Came (Class)**
- ☐ **Over (Order)**
- ☐ **For (Family)**
- ☐ **Good (Genus)**
- ☐ **Spaghetti (Species)**

Do not forget these rules

From kingdom to species, the following trends are observed:

1 - Number of groups decreases.
2 - Similarities in organisms increase.
3 - Number of members decreases

Human	*Homo sapiens*
Cat	*Felis domesticus*
Lion	*Panthera leo*
Leopard	*Panthera pardus*
Dog	*Canis familiaris*
Wolf	*Canis lupus*
Coyote	*Canis latrans*
Housefly	*Musca domesticus*
Yoghurt making bacteria	*Lactobacillus bulgarius*
Dandelion	*Taraxacum officinale*

How Living Things are Classified?

According to modern taxonomic system all living things are classified into five kingdoms. They are Monera, Protista , Fungi, Plantae and Animalia. Kingdom is the biggest category of classification in the modern taxonomy.

These five kingdoms are classified according to their cell properties and structures. We use an identification key to detect a kingdom of organisms.

VIRUSES

Viruses are tiny strands of nucleic acids that are not assigned to any of the five kingdoms.

Here are some characteristics of viruses:

1. Viruses are not true living organisms.

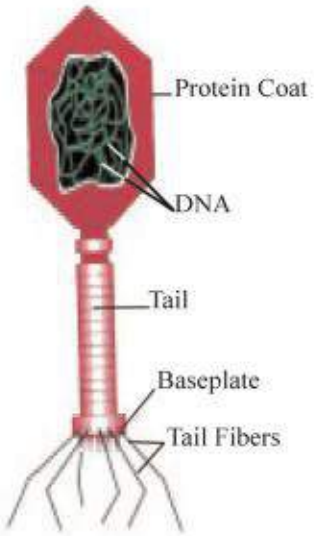
2. Viruses are non-cellular structures that crystallize.

3. Viruses are classified initially on the basis of the host they infect, such as animal viruses, plant viruses, and bacterial viruses (often called **bacteriophages**).

4. The virus genome consists of either **DNA** or **RNA**, but not both.

5. Some viruses (a large number of animal viruses) have an outer membranous envelope containing lipids, proteins and traces of metals.

6. Virus means poison in latin and they cause different diseases in living organisms.



(a)

Structure of Bacteriophage

Structure of Viruses

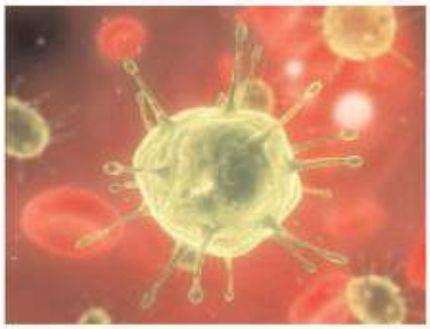
Viruses are consist of genetic material which is DNA or RNA but not both and a protein coat. Viruses don't have nucleus neither organelles nor cytoplasm. They can reproduce only in a host. They have projections on surface to attach the host. The figure above shows a bacteriophage which is virus that attack bacteria.

Some Important Viral Disases :

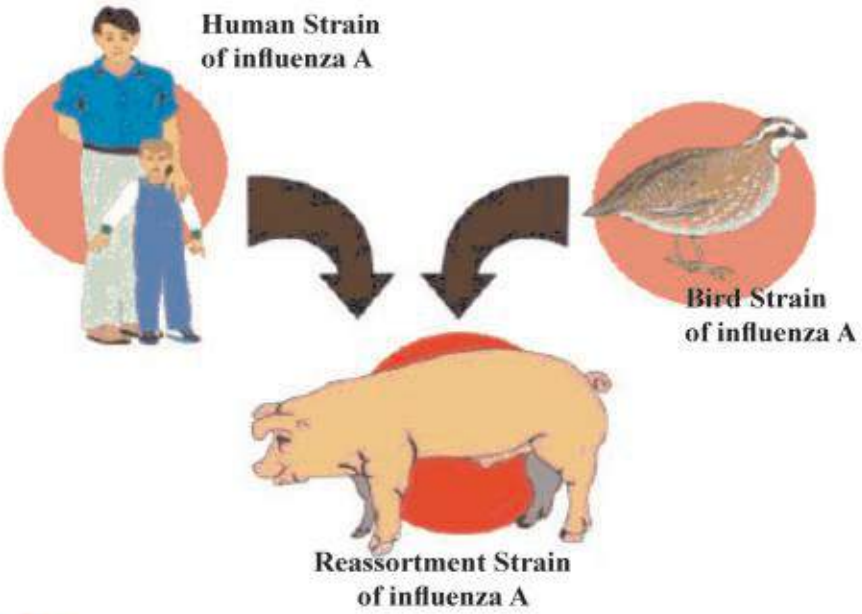
1- AIDS(Acquired Immune Deficiency Syndrome

The immunity deficiency is a final stage of infection with virus which causes this disease. The incubation period of AIDS may be ten years; the infected person may look healthy for many years. During this period patient has ability to transfer the infection to other people. This disease starts by action of virus which causes this disease; it attacks and destroys the body cells which are responsible for defense against the diseases. So, it leads to the weakening of the natural immune system of the body. Because of this effect, this disease is called **Acquired Immune Deficiency Syndrome.**

2 - Swine Flu



Influenza occur when a new strain of the influenza virus is transmitted to humans from another animal species. Species that are thought to be important in the emergence of new human strains are pigs, chickens and ducks. These novel strains are unaffected by any immunity people may have to older strains of human influenza and can therefore spread extremely rapidly and infect very large numbers of people. Influenza viruses can occasionally be transmitted from wild birds to other species causing outbreaks in domestic poultry and may give rise to human influenza pandemics. The propagation of influenza viruses throughout the world is thought in part to be by bird migrations, though commercial shipments of living bird products might also be implicated, as well as human travel patterns.

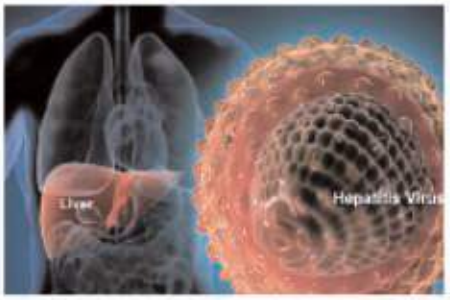


3 - Bird Flu

"Bird flu" is a phrase similar to "swine flu," "dog flu," "horse flu," or "human flu" in that it refers to an illness caused by any of many different strains of influenza viruses that have adapted to a specific host. All known viruses that cause influenza in birds belong to the species influenza A virus. Strains of influenza viruses are adapted to multiple species, though may be preferential towards a particular host.

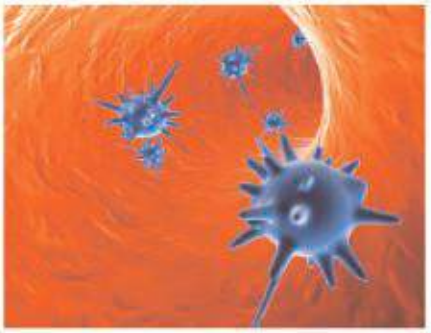
4 - Hepatitis

Hepatitis is a medical condition defined by the inflammation of the liver and characterized by the presence of inflammatory cells in the tissue of the organ. Hepatitis may occur with limited or no symptoms. Hepatitis is acute when it lasts less than six months and chronic when it persists longer. A group of viruses known as the hepatitis viruses cause most cases of hepatitis worldwide.



5 - Polio

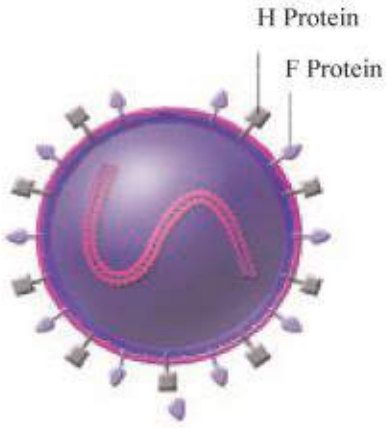
Polio or infantile paralysis, is an acute, viral, infectious disease spread from person to person, primarily via the fecal-oral route. Although approximately 90% of polio infections cause no symptoms at all, affected individuals can exhibit a range of symptoms if the virus enters the blood stream. In about 1% of cases, the virus enters the central nervous system, preferentially infecting and destroying motor neurons, leading to muscle weakness and acute flaccid paralysis. Different types of paralysis may occur, depending on the nerves involved. Spinal polio is the most common form, characterized by asymmetric paralysis that most often involves the legs.



Polio virus

6 - Measles

Measles is an infection of the respiratory system caused by a virus.Measles is spread through respiration (contact with fluids from an infected person's nose and mouth, either directly or through aerosol transmission), and is highly contagious—90% of people without immunity sharing living space with an infected person will catch it. There is no specific treatment for measles. Most patients with uncomplicated measles will recover with rest and supportive treatment.



Measles Virus

7 - Common Influenza

The common cold is a viral infectious disease of the upper respiratory tract which affects primarily the nose. Symptoms include coughing, sore throat, runny nose, sneezing, and fever which usually resolve in seven to ten days, with some symptoms lasting up to three weeks.

SELF CHECK
CLASSIFICATION & VIRUSES

A. Key Terms

Classification
Genus
Host
Species
Bacteriophage
Measles

B. Review Questions

1. Give two examples for viral diseases?
2. List the categories of classification in order?
3. How did Carl Von Linne classified organisms?
4. List the charactheristics of viruses?
5. Draw the structure of bacteriophage?

C. Fill in the blanks

1. The five kingdoms are _____, _____, _____, _____ and _____.
2. Virus genome consist of _____ or _____.
3. The biggest category of living organisms is _____
4. Hepatitis is the inflamation of _____.

D. True or False

1. Measles is a viral disease.
2. Viruses are completely living things.
3. From kingdom to species number of members increase.
4. Horse and monkey are same species.
5. Viruses are one of the kingdoms of living organisms.

E. Multiple choice

1. Which of the following is the largest category of the modern taxonomy?

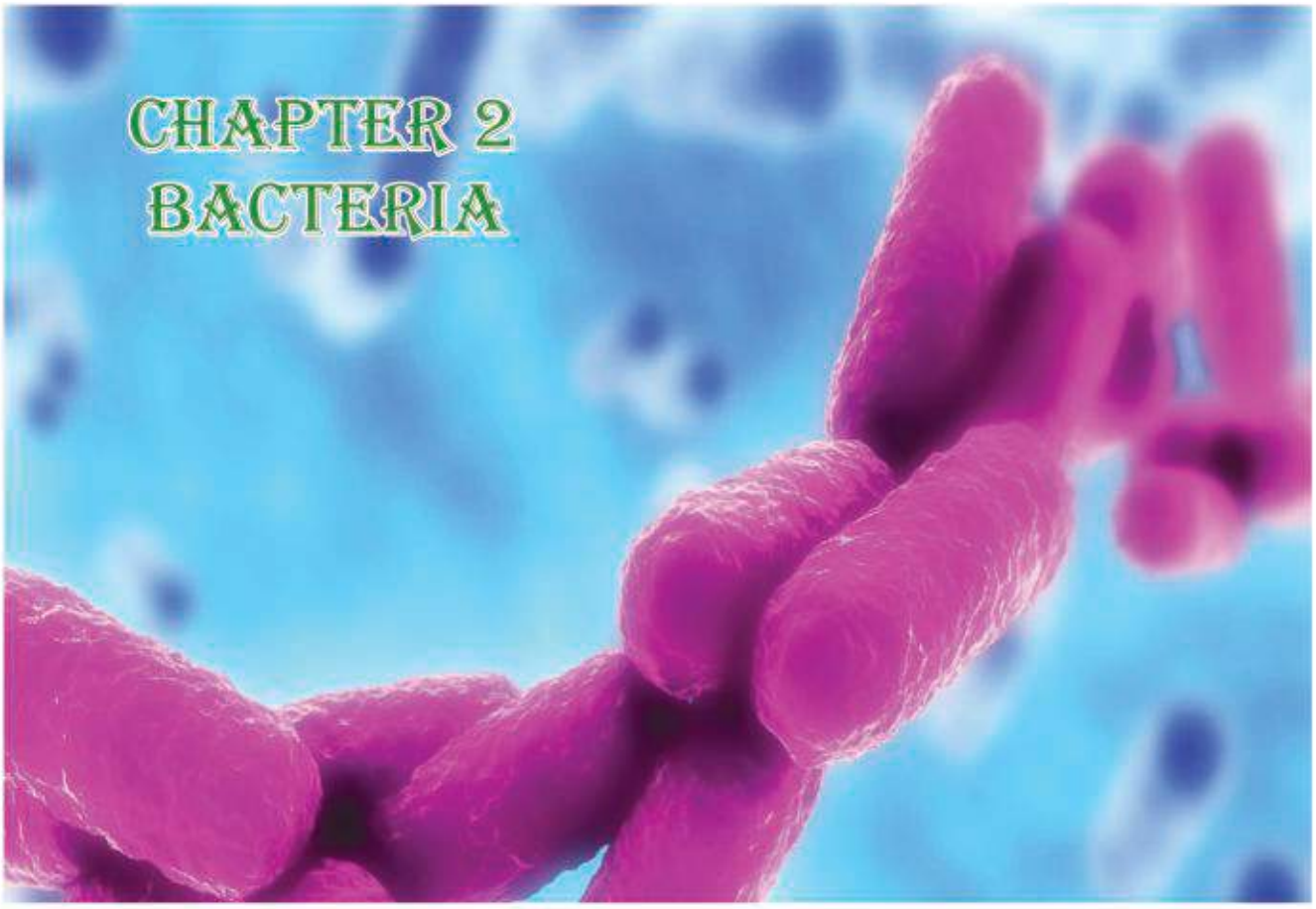
A) Class
B) Species
C) Kingdom
D) Phylum

2. Which of the followings not observed from kingdom to species?

A) Number of groups decreasees
B) Number of organisms increases
C) Similarity in organisms increases
D) Number of members decraeses

3. Which one of the followings is true for viruses?

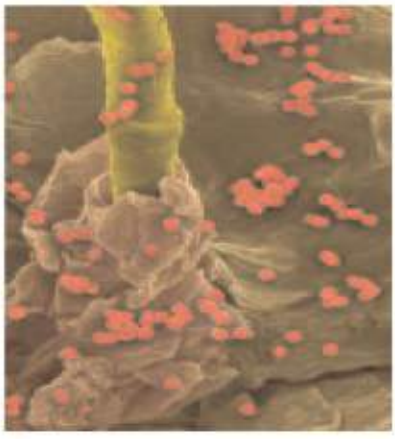
A) Viruses are living organisms
B) They have DNA or RNA
C) Viruses cause diseases in organisms
D) Viruses consist of only one cell



CHAPTER 2
BACTERIA

MONERA

This group is mostly unicellular, but some are multicellular in appearence. They do not have cell organelles such as nuclear membrane, mitochondria, plastids etc. Bacteria and algae are members of this kingdom.



Some bacteria on skin surface

Bacteria

They are mostly useful organisms despite some pathogenic species. Bacteria are the most numerous organisms in the world and found almost everywhere. They can live 5m below ground, in all water kinds and in the body of any living organism.

General Charactheristics of Bacteria

1. They are **prokaryotic** organisms and unicellular organisms.

2. They are **photosynthetic**, **heterotrophic** or **chemosynthetic** organisms.

3. Reproduction is asexual, generally by binary fission.

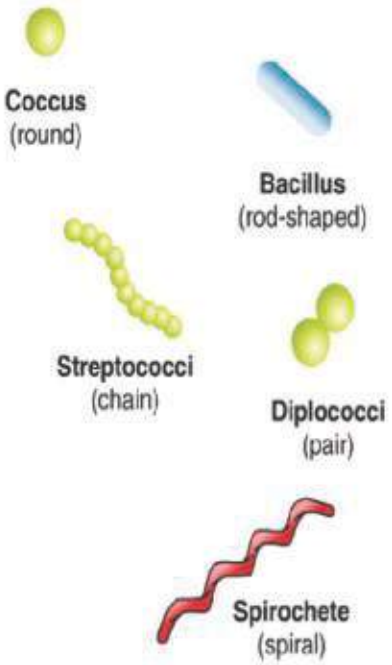
4. Motility is provided by cytoplasmic flow, flagella or gliding.

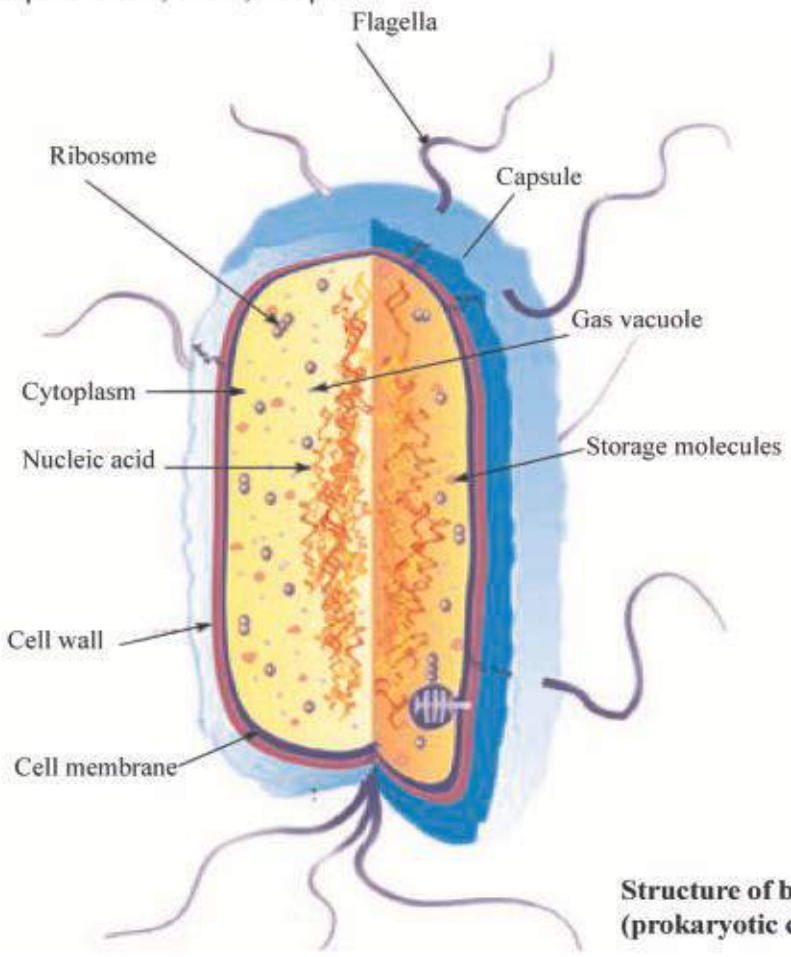
5. Some of them pathogenic and some of them are useful for human.

Structure of Bacteria

Bacteria have no nuclear membrane, chloroplasts or mitochondria. In the cytoplasm there are only the ribosomes peculiar to bacteria. The cytoplasm is coated with a membrane.

Cytoplasmic membranes of some bacteria carry respiration enzymes, photosynthetic enzymes and receptor proteins. Outside the membrane there is a cell wall different from the cell wall of plants. Many bacteria have extensions called **flagella**. These are involved in movement and signal recognition. Bacteria are usually one of three main shapes: bacilli, cocci, or spiral.





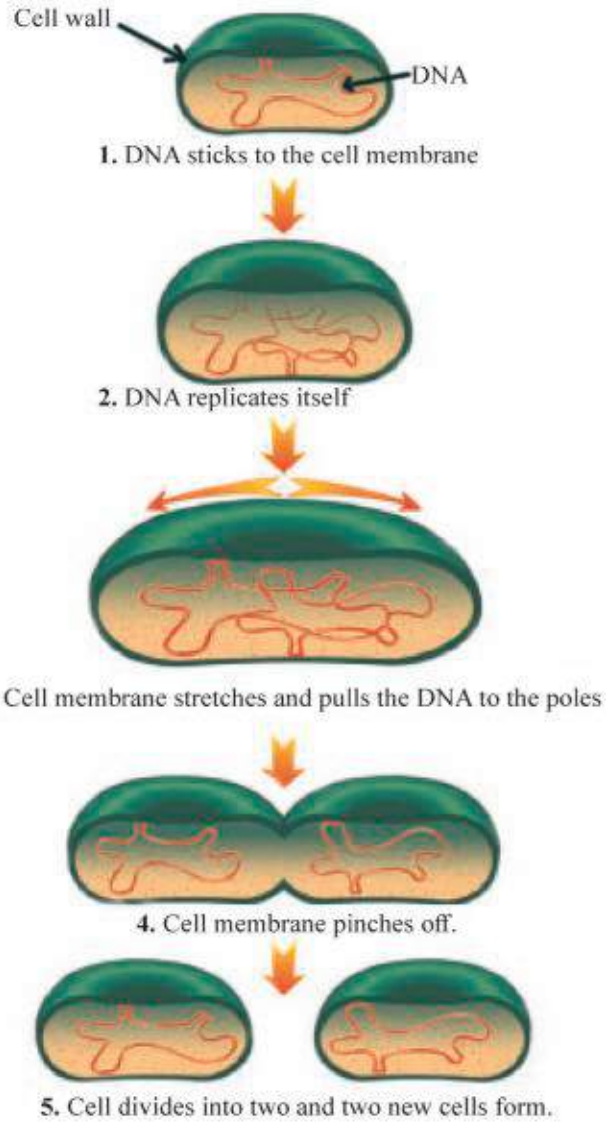
Structure of bacteria. (prokaryotic cell)

Reproduction in Bacteria

Bacteria reproduce by the process called binary fission. Binary fission is reproduction in which one single-celled organism splits into two single-celled organisms.

Endospore Formation

Most species of bacteria do well in warm, moist places. In dry or cold surroundings, some species of bacteria will die. In these conditions, other bacteria become inactive and form endospores. An endospore contains genetic material and proteins and is covered by a thick, protective coat. Many endospores can survive in hot, cold, and very dry places. When conditions improve, the endospores break open, and the bacteria become active again. Scientists found endospores inside an insect that was preserved in amber for 30 million years. When the endospores were moistened in a laboratory, bacteria began to grow.



Reproduction in bacteria (binary fission)

In bacteria, the DNA is single - stranded and circular. During cell division the DNA replicates itself while attached to the cell membrane. The cytoplasm furrows and division is completed.

Bacteria's Role in Nature

Nitrogen Fixation

Plants need nitrogen to grow. Most plants cannot use nitrogen directly from the air. Nitrogen fixing bacteria take in nitrogen from the air and change it to a form that plants can use.

Recycling

Have you ever seen dead leaves and twigs on a forest floor? These leaves and twigs are recycled over time with the help of bacteria.

Cleaning Up

Bacteria and other microorganisms are also used to fight pollution. **Bioremediation** means using microorganisms to change harmful chemicals into harmless ones.

Bacteria in Your Food

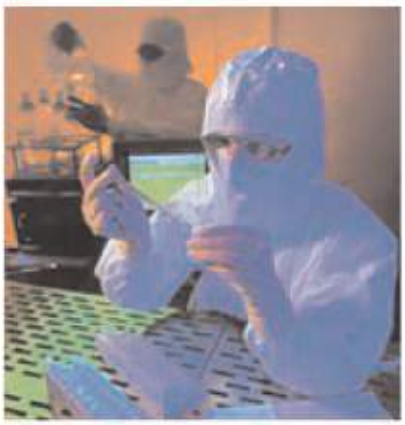
Believe it or not, people raise bacteria for food! Every time you eat cheese, yoghurt, buttermilk, or sour cream, you are also eating bacteria.

Making Medicines

What's the best way to fight disease-causing bacteria? Would you believe that the answer is to use other bacteria? **Antibiotics** are medicines used to kill bacteria and other microorganisms. Many antibiotics are made by bacteria.

Pathogenic Bacteria

Most of bacteria are cause many diseases and called as **pathogenic** bacteria. Cholera. Tetanus, Tuberculosis are some diseases caused by bacteria.



PREPARATION OF BACTERIA CULTURE

Bacteria can easily reproduce in lab conditions. For this, a medium that will nourish the bacteria is prepared. The medium can be broth or agar. If you open a sterile test tube of broth and wait a few days, you will observe turbulence in the tube. Serial dilution can give an idea about the number of bacteria. In the same way, if you open a petri dish, inject some bacteria culture and then close the dish, you will observe some colored spots. These spots show the existence of bacteria.

The most commonly used medium for bacteria is agar. Agar is a gelatin-like substance that dissolves in water at 90 °C and solidifies at 40 °C. According to the bacteria to be grown, necessary nutrients are added to the agar during preparation. The agar is inoculated with bacteria to form pure colonies.

Antibiotic is added to see how bacteria are affected. When affected, no colony forms. If they survive, they are demonstrated to be resistant to the antibiotic. Bacteria can be observed under a microscope. For this a bacterial culture, physiological water, stain, an inoculating loop, a slide, a cover slip, and a Bunsen burner are needed.

First, sterilize the slide by holding it over the flame. Put a drop of water on the slide, and then your specimen. Dry the slide in air and stain it. Use an oil immersion objective to observe your bacterial culture.

SELF CHECK BACTERIA

A. Key Terms

Prokaryotic
Endospore
Flagella
Binary fission
Bioremidiation
Pathogen
Agar
Colony
Antibiotic

B. Review Questions

1. List the important charactheristics of bacteria?
2. Draw the structure of bacteria?
3. Write the steps of binary fission?
4. Explain the nitrogen fixing process
5. Write the roles of bacteria in nature?

C. True or False

1. Yoghurt is formed by aid of bacteria.
2. Bacteria are eukaryotic organisms.
3. Some bacteria are pathogenic.
4. Bacteria have different shapes.
5. Some bacteria move by flagella

D. Fill in the Blanks

1. Bacteria have three different shapes; _____, _____ and _____.
2. Bacteria reproduce asexually by _____.
3. Bacteria form _____ in dry or cold conditions.
4. _____ are medicine used to kill bacteria.
5. Bacteria are _____ and _____ organisms.

E. Multiple choice

1. Which of the following describes the asexual reproduction of bacteria?

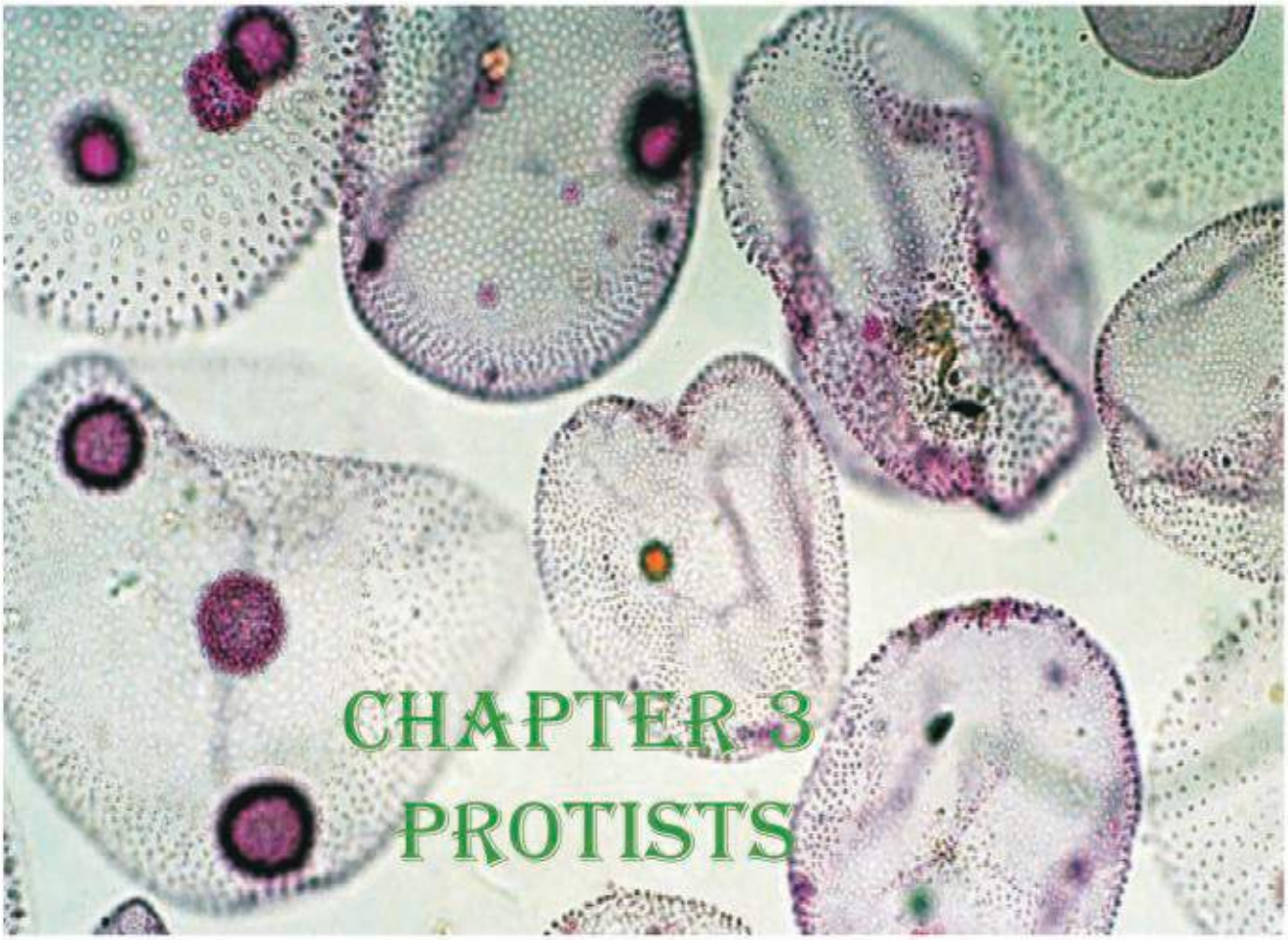
A) Mitosis
B) Isogamy
C) Regeneration
D) Binary fission

2. Which one is not a role of bacteria in nature?

A) Recycling
B) Making medicines
C) Nitrogen fixation
D) Producing peniciline

3. Which part of bacteria provide function of movement?

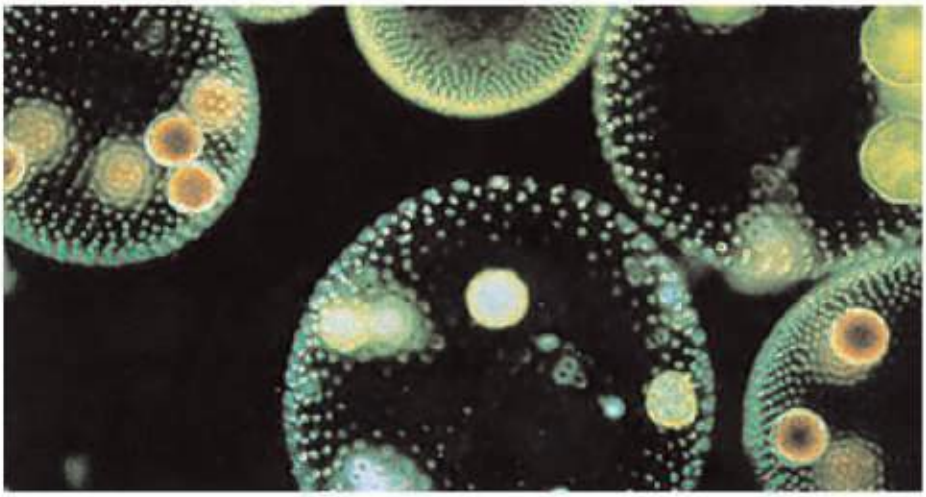
A) Capsule
B) Nucleic acid
C) Flagella
D) Cell membrane



CHAPTER 3
PROTISTS

PROTISTS

Protists have various sizes, shapes, methods of feeding and reproducing, Although their features are obviously different from those of moneras, there are several ways that some protists resemble plants or fungi. Size is generally microscopic, but some examples reach 60 meters in length.

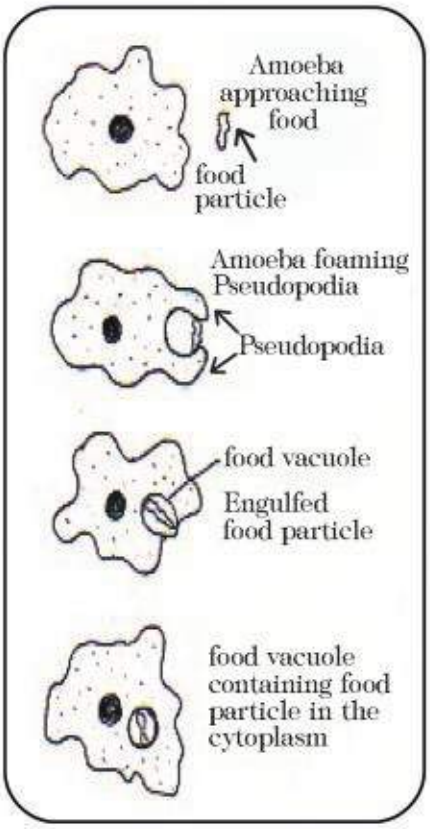


Common Charactheristics of Protists

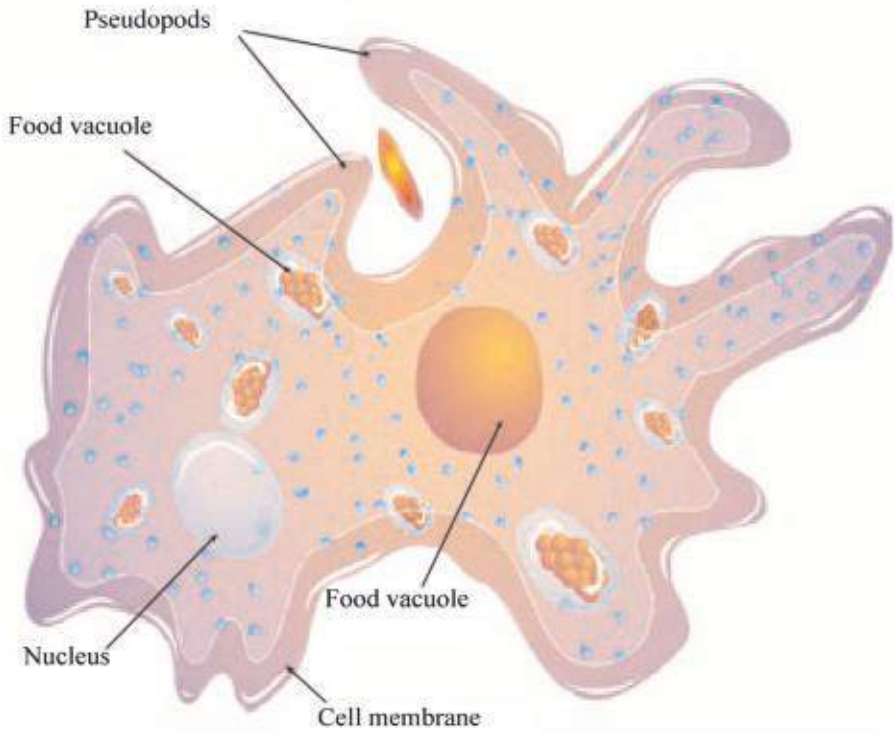
1. They may be unicellular, colonial, or even multicellular, in which a primitive structure is observed while tissue level organization is absent.
2. Protists are found floating freely or attached to a surface, eg. rocks in many aquatic ecosystems. **Terrestrial** protists are mostly found in moist soil .
3. They can be autotrophs, heterotrophs, or both in some members.
4. Mutualistic or parasitic forms are common and parasitic protists can cause diseases in plants and animals.
5. They are motile in certain periods of their lives and locomotion is provided by cilia, pseudopodia (amoeboid movement), flagella or by contraction.
6. Despite the absence of specialized genitals, asexual and sexual reproduction are observed in the group.

Amoeba

These are unicellular organisms living in soil, seas and fresh water. Feeding and locomotion are provided by cytoplasmic extensions called **pseudopodia**. Amoeba can survive in dry conditions by forming a protective covering called a **cyst**. They are found in ponds and streams. Reproduction is asexual through **binary fission.**



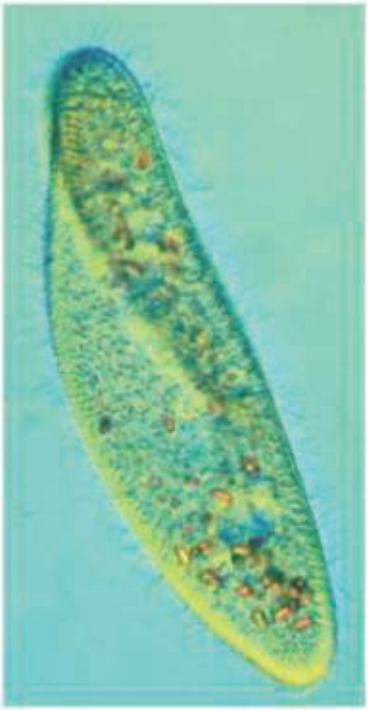
Feeding in Amoeba



Amoeba Structure.
Since amoeba are enclosed with a stiff layer around the plasma membrane, they don't have a fixed shape.

Class: ciliata

Paramecium



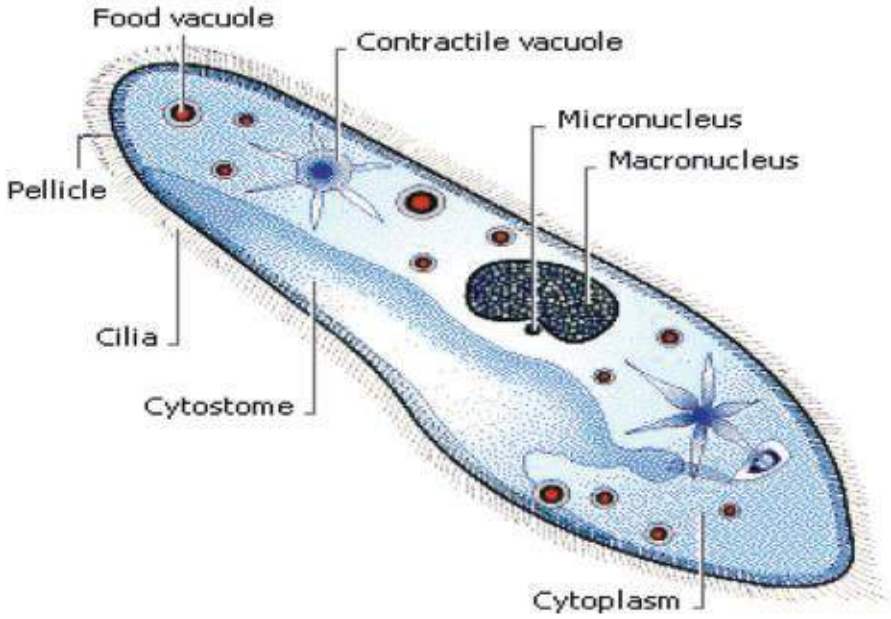
This is the most advanced group of unicellular organisms.

The hard outer part of the cell, called the pellicle, bears cilia and contains trichocysts that are discharged during defense and predation.

There are two nuclei: the macronucleus (used in metabolism) and the micronucleus (used in reproduction).

There is also a cytostome (mouth) which opens to the cytopharynx (cell pharynx), excretion pore, vacuoles, and two contractile vacuoles. These vacuoles provide osmoregulation within the cell by discharging excess of water.

Waste products are removed through excretory vacuoles. Reproduction is usually asexually by binary fission or sexually by conjugation.



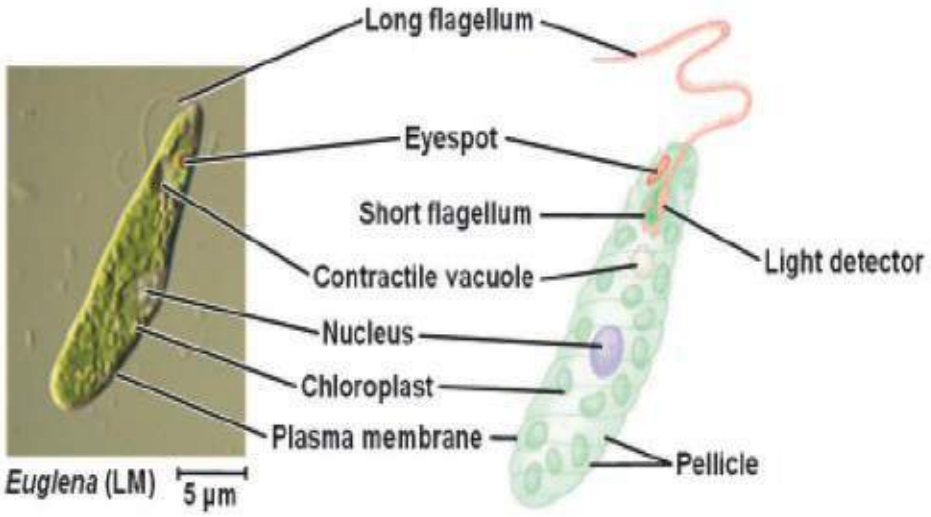
Paramecium

Paramecium. Since the cell surface isn't flexible, paramecia have a definite shape. They have parts that function like the mouth, anus etc. of higher organisms.

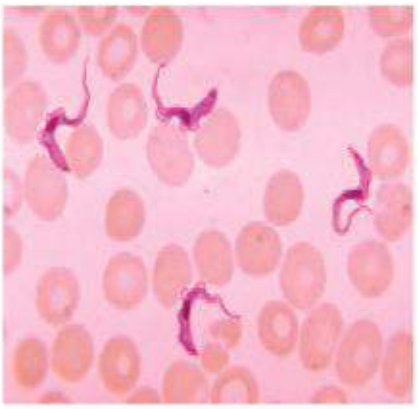
Class : Trypanosoma

Euglena

- These are unicellular organisms with chloroplasts and are photosynthetic in the presence of light. At night they obtain nutrients heterotrophically.
- Carbohydrates are stored as paramylon, a type of poly-saccharide.
- The organism shows both animal and plant characteristics.
- Locomotion is made possible by flagella situated at one end of the cell. Next to the flagella there is a contractile vacuole and stigma (eye spot).
- The pellicle, a protective layer that gives a definite shape to the cell, covers the outer surface.
- It reproduces asexually by binary fission.



How do trypanosomes are useful for human?



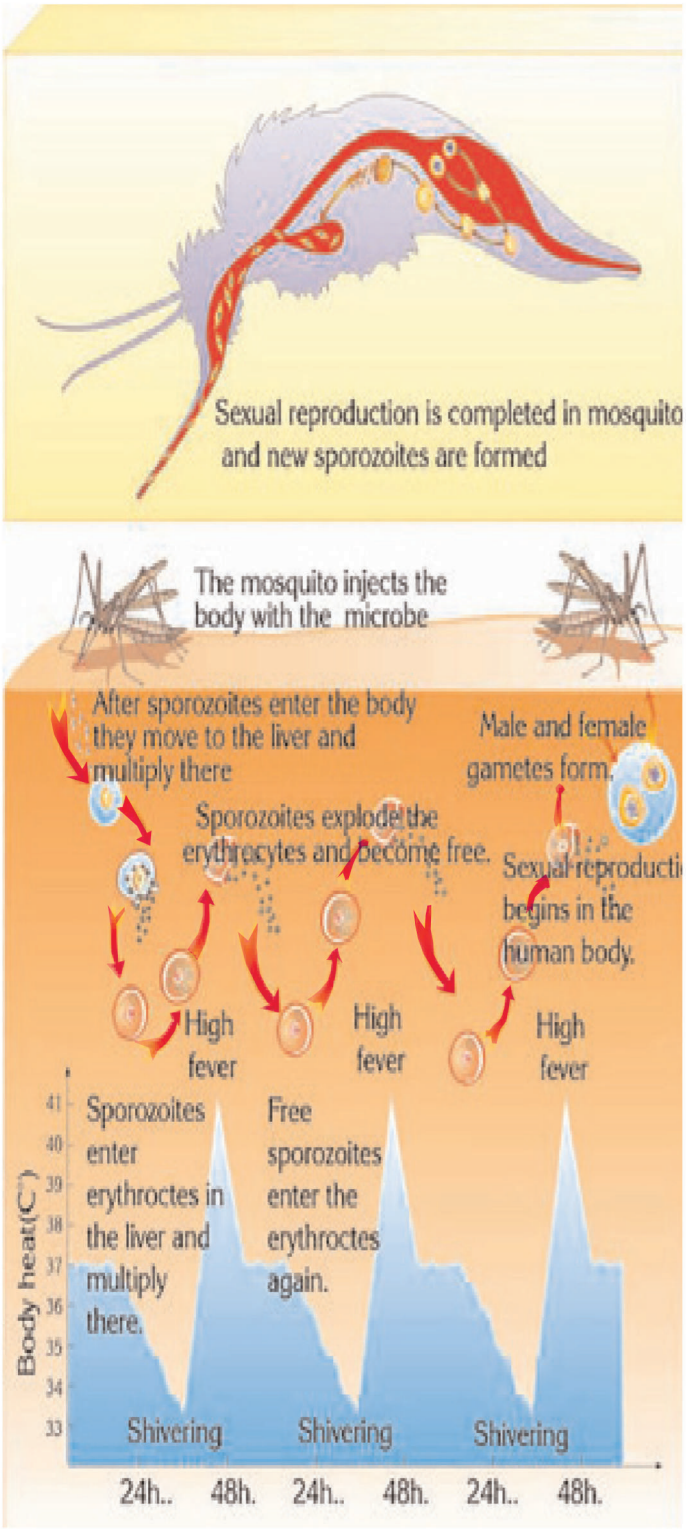
Euglena effects humans by helping to keep our ponds and lakes clean for our use. They fight off the germs and other pollutants that are found in our water sources. It doesn't negatively effect health in humans

Trypanosoma brucei, the cause of African sleeping sickness in humans, is a member of the group. The electron micrograph shows T. brucei as it occurs in the salivary gland of the tsetse fly ready to be injected into the mammalian host when the fly bites.

The disease occurs regularly in some regions of sub-Saharan Africa with the population at risk being about 70 million in 36 countries. As of 2010 it caused around 9,000 deaths, down from 34,000 in 1990. An estimated 30,000 people are currently infected with 7000 new infections in 2012. More than 80% of these cases are in the Democratic Republic of the Congo.

MALARIA

Plasmodium



Where is the best environment to live for Protists; rivers, lakes or sea? Why?

The vector of this parasite is the Anopheles mosquito (definitive host), while the intermediate hosts are humans and other mammals.

Plasmodium lives inside the erythrocytes and epithelial cells of humans. The disease is more common around swamps etc. The female Anopheles mosquito sucks blood from warm-blooded animals and transmits malaria parasites from one to another. The males do not transmit the disease as they feed only on plant juices. Destroying erythrocytes, they cause hemolysis and anemia. Destruction of 30-50% of the erythrocytes causes death. In patients with malaria, the spleen is enlarged and the liver becomes tender which may lead to cirrhosis. Additionally, swelling of the belly and anemia are observed, while occasionally shock and bleeding occur when capillaries are blocked by diseased erythrocytes.

Typical malaria attacks

1. Cold (shaking) stage (1/2-2 hours): There is a consistent shivering and feeling of cold. Headache and nausea may be present.

2. Fever stage (ca. 24 hours): The fever may be as high as 40-41 °C, accompanied by nausea, vomiting, headache, and cold sore on the lips.

3. Wet stage: Body temperature, spleen size, and sleep all become normal, and sweating begins. The normal period continues until the next cycle of paroxysms begins.

Malaria is also seen in reptiles, birds, and other mammals besides humans.Each Plasmodium species causes different types of malaria, for example:

P. falciparum: Plasmodium falciparum causes malaria quartana. The schizogony period inside the erythrocytes lasts 72 hours.

SELF CHECK PROTISTS

A. Key Terms

Pseudopodia	Cyst
Pellicle	Contractile vacuole
Cytosome	Protists

B. Review Questions

1. How do protists move?
2. What is the function of pseudopodia?
3. List the charctheristics of protists?
4. Draw the amoeba and name the parts of it?
5. Draw the paramecium and name the parts of it?

C. True or False

1. Amoeba reproduce asexually by binary fission.
2. Some protists cause disease to human.
3. Paramecium has only one nucleus.
4. Euglena can produce its own food.

D. Fill in the blanks

1. Protists can be autotroph or _____.

2. Amoeba lives in _____, _____ and _____.

3. Paramecium reproduces asexually by _____.

4. Paramecium has two nuclei _____ and _____.

E. Multiple choice

1. Which of the following moves by means of Pseudopodia?

A) Paramecium
B) Amoeba
C) Plasmodium
D) Bacteria

2. Which of the followings is true for protists?

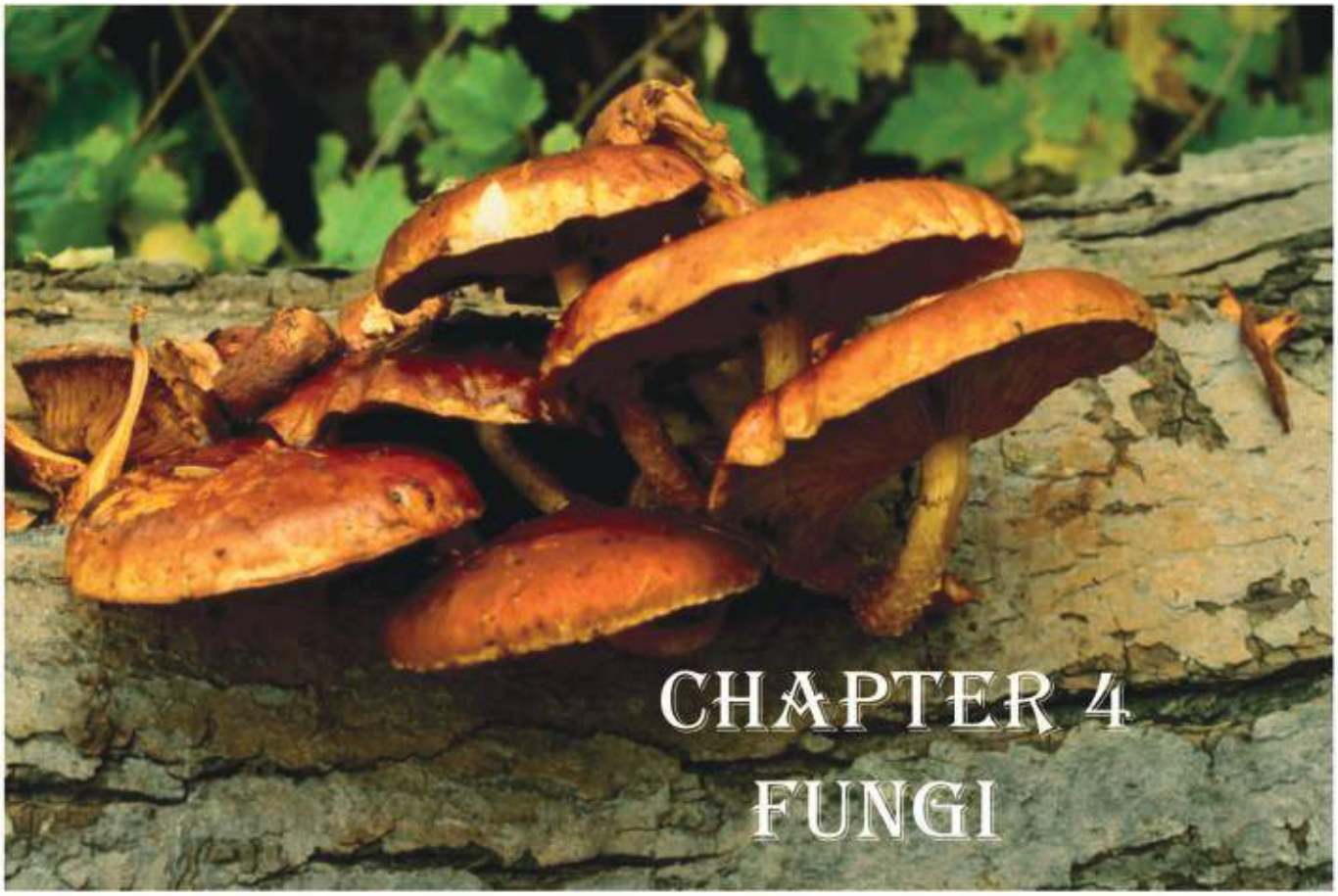
A) They are prokaryotic organisms
B) They are all parasitic and cause diseases
C) They are multicellular organisms with tissues
D) Asexual and sexual reproduction is observed

3. Which part of paramecium is used in osmoregulation by discharging excess water?

A) Cilia
B) Nucleus
C) Contractile vacuole
D) Food vacuole

4. Which of the following is an example for Trypanosomes?

A) Yeast
B) Beans
C) Euglena
D) Paramecium



CHAPTER 4
FUNGI

FUNGI

Fungi are eukaryotic organisms which are filamentous or rarely unicellular.

They are generally terrestrial, but there are many **aquatic** (or marine) species.
Some higher mushrooms are eatable while some are poisonous.
In all stages of the life cycle, cells lack flagella or cilia.

All fungi have chitin materials in their cell walls. Although they have some similarities with algae, they are separate from all similar groups because they lack **chlorophyll**.

Fungi are exclusively either saprophytic or parasitic.
All except for yeasts have hyphal structures. Hyphae are colorless, slender, long filaments forming an interwoven mass called a **mycelium**.

All parts of a mushroom are homogenous. Mushrooms feed and reproduce vegetatively by means of the mycelia. Food is not stored in the form of starch, but rather as lipids and glycogen.

Ecological and Economical Importance of Fungi

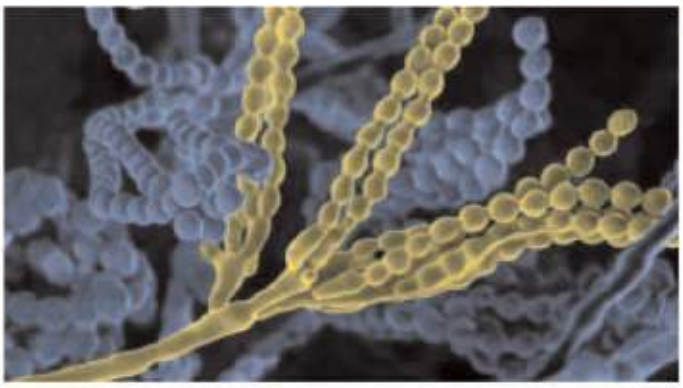
Since many fungi live as saprophytes they have an important role in ecology. They absorb nutrients from organic matter and dead organisms. During this process water, CO_2, and minerals are released back into the environment. The absence of this role would destroy the ecosystem.

Alexander Fliming discovered the penicilium in 1928

Some fungi, like lichens and mycorrhizae, have mutualistic lifestyles. Mycorrhizae is an association between specific fungi and plant roots. In this symbiotic relationship the plant gets water and minerals from the fungus, and in return the fungus obtains nutrients (glucose, amino acids, etc.) from the plant.

Fungi have great economic importance. Nearly 200 eatable species are cultivated and consumed in large amounts. On the other hand, many deaths and poisonings are caused by wild mushrooms. Fungi include many plant and animal pathogens as well.

Apart from food, fungi are used in the baking of bread, the fermentation of alcohol, and the production of various antibiotics. Pain-killing drugs are also obtained from fungi. Some fungi are used in the production of citric acid and other chemicals. Recently, hormone production from fungi has been started using recombinant DNA technology.



Microscobic view of penicilium

Penicilium

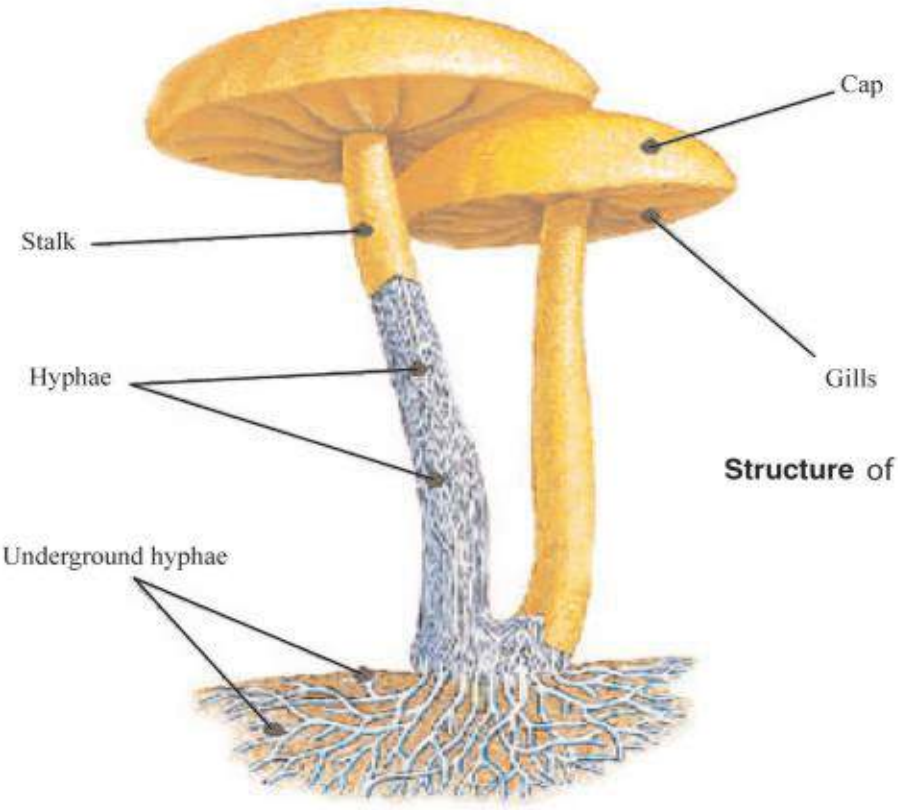
Lives saprophytically on cheese, lemons and some other foods, creating blueish spots. They resemble a brush in shape. Some species are responsible for the flavor of Roquefort, Camembert and Gorgonzola cheeses. Formerly, cheese containing penicillium was given to tuberculosis patients. Penicillium produces penicillin, the antibiotic. Penicillin is used in the treatment of patients suffering from pneumonia, meningitis, fever, nephritis, and carbuncle.Some patients are allergic to it, so use it without a doctor's supervision or in unnecesarry cases may be dangerous.

Mushroom

Mushrooms belong to a group of fungi called **club fungi**. This group gets its name from structures that the fungi grow during reproduction. Club fungi reproduce sexually. During reproduction, they grow special hyphae that form clublike structures. These structures are called **basidia**, the Greek word for "clubs." Sexual spores develop on the basidia.

When you think of a mushroom, you probably picture only the spore-producing, above-ground part of the organism. But most of the organism is underground. The mass of hyphae from which mushrooms are produced may grow 35 m across. That's about as long as 18 adults lying head to toe! Mushrooms usually grow at the edges of the mass of hyphae . As a result, mushrooms often appear in circles.

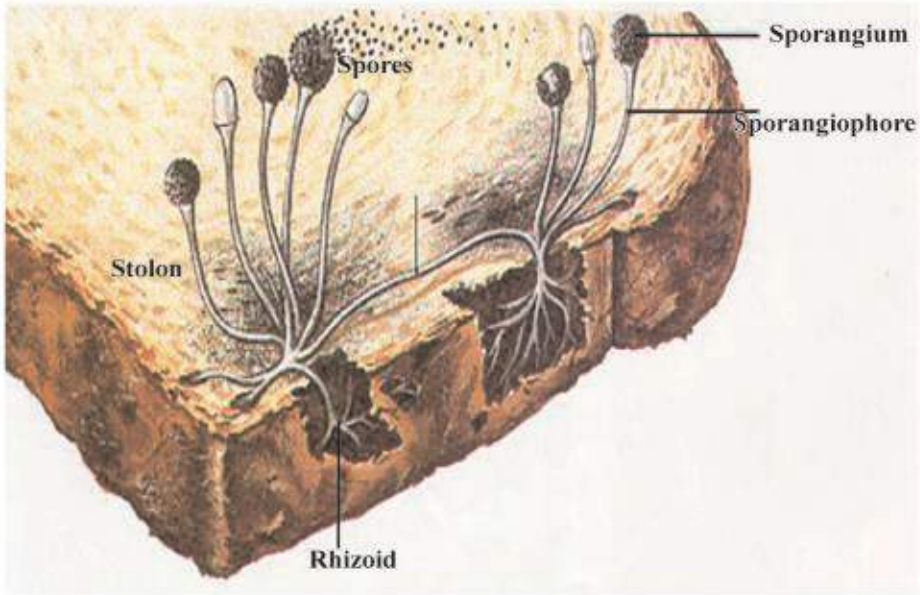
The most familiar mushrooms are known as **gill fungi**. The basidia of these mushrooms develop in structures called gills, under the mushroom cap. Some varieties are grown commercially and sold in supermarkets. However, not all gill fungi are eatable. For example, the white destroying angel is a very poisonous fungus. Simply a taste of this mushroom can be **fatal**.



Structure of **mushroom.**

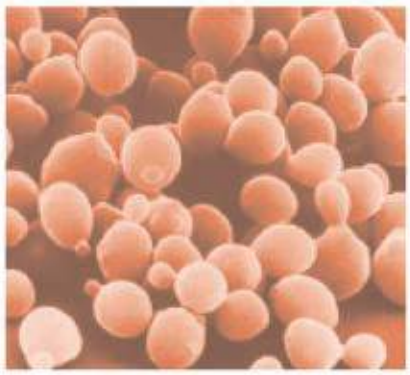
Black bread mold

Rhiozopus stolonifer (black bread mold) lives on some foods (bread, etc.). It reproduces by spore formation. Spore is an asexually reproductive cell that can grow into a complete organism without fertilization. Spores dropped on the bread form hyphae. These get nutrients from the bread. Sporangia are formed at the tip of stalks. Both sexual and asexual reproduction is observed.

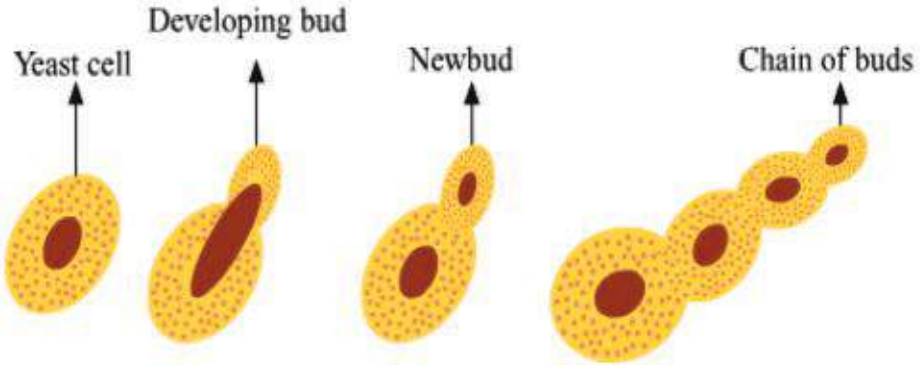


The structure of bread mold. This fungus forms a black cover on bread and similar foods. Reproductive cycle includes asexual (spores) and sexual (isogamy) phases.

Yeast



These do not have hyphae and reproduce by budding and rarely via ascospores. Dried yeasts are economically important in baking, leavening bread. During fermentation, CO_2 is released which causes the sponge-like swelling of the bread. Additionally, yeasts are rich in vitamin B.



Reproduction of Yeast

Yeast reproduce asexually by budding

CHAPTER 5
ALGAE

The producer protists

Many protists are producers. Like plants, protist producers use the sun's energy to make food through photosynthesis. These protist producers are known as **algae**. All algae (singular, alga) have the green pigment chlorophyll, which is used for photosynthesis.

But most algae also have other pigments that give them a color. Almost all algae live in water.

Some algae are made of many cells. Many-celled algae generally live in shallow water along the shore. You may know these algae as seaweeds. Some of these algae can grow to many meters in length.

Types of algae:

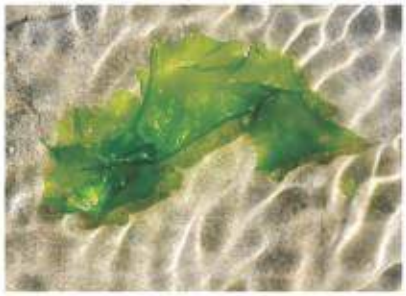
Red Algae

Most of the world's seaweeds are red algae. Most red algae live in tropical oceans, attached to rocks or to other algae. Red algae are usually less than 1 m in length. Their cells contain chlorophyll, but a red pigment gives them their color. Their red pigment allows them to absorb the light that filters deep into the clear water of the Tropics. Red algae can grow as deep as 260 m below the surface of the water. An example of a red alga can be seen in Figure.

Brown Algae

Most of the seaweeds found in cool climates are brown algae. They attach to rocks or form large floating beds in ocean waters. Brown algae have chlorophyll and a yellow-brown pigment. Many are very large. Some grow 60 m—as long as about 20 cars—in just one season! Only the tops of these gigantic algae are exposed to sunlight. These parts of the algae make food through photosynthesis. This food is transported to parts of the algae that are too deep in the water to receive sunlight.

Green Algae



These organisms are unicellular or colonial species, as well as multicellular species that are not organized into tissue. Reproduction may be sexual or asexual. Most species live in freshwater and there are many species of significant ecologic and economic importance. They carry photosynthetic pigments like chlorophyll. They store carbohydrates as starch in chloroplasts. The cell walls are made of cellulose, which is why algae are used in the paper industry.

Spirogyra

These are filament-shaped organisms found on the surface of fresh water. In autumn, Spirogyra produces a bad smell (like dead fish) in bodies of water. They are also responsible for the foaming of fresh water.

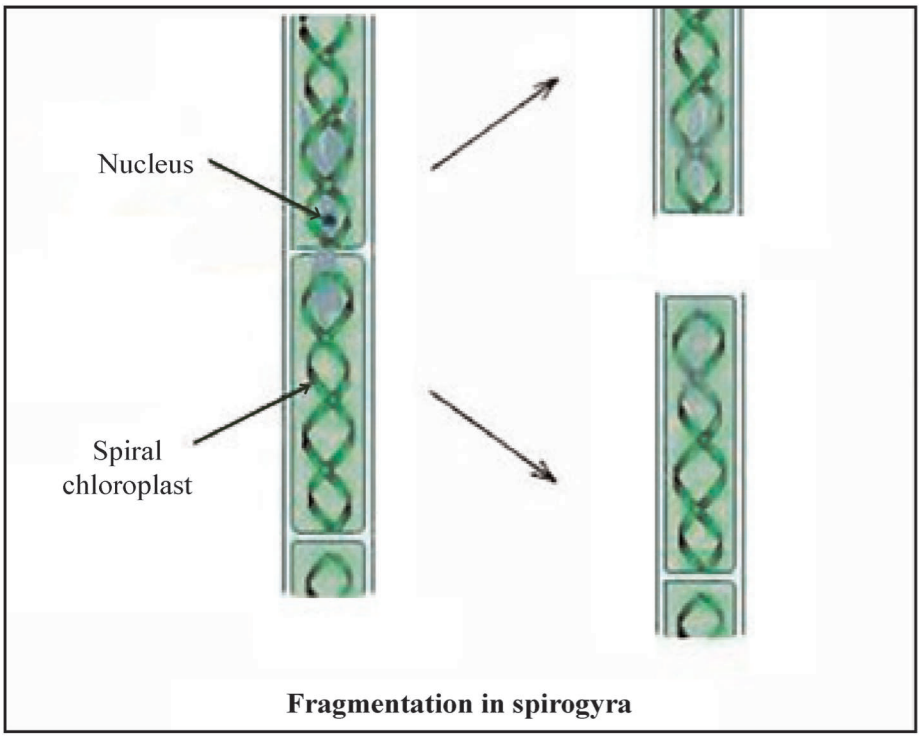
Structure of Spirogyra

It is green colored and filamentous strure, consist of chain of cells that have similar shape, structure and function.There is no coordination between cells and each of these cell perform its life activities independently. There is spiral shaped chlorophyll in each cell with a nucleus.

Peproduction in Spirogyra

1- Asexual Reproduction

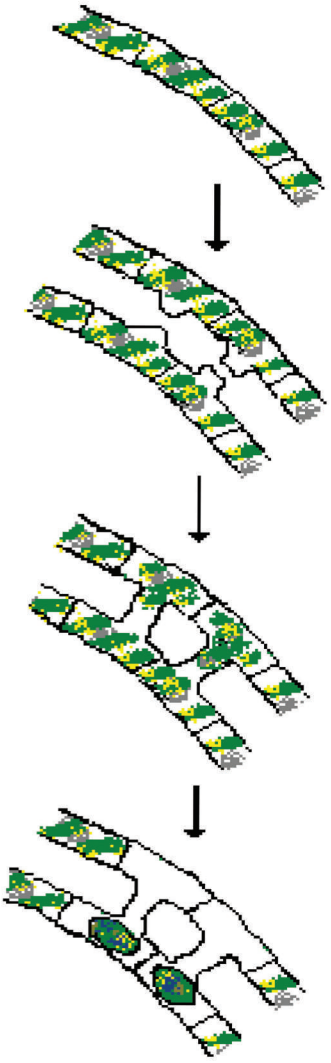
Spirogyra reproduce asexually by fragmentation. Spirogyra filaments can divide into smaller parts naturally or by different environmental factors and each of these parts grow into a complete organism by cell divisions.



Fragmentation in spirogyra

2- Sexual Reproduction

Spirogyra reproduce sexualy by conjugation if environmental conditions are unavailable. Conjugation takes place between two cells of same filament or two different filaments and zygote forms which is covered by a thick wall against environmental factors. When environmental conditions are anailable thick cell wall tears and it grows into a complete organism.



Sexual reproduction in Spirogyra

Chapter 4 & 5 Review

A. Key Terms

Mycelium	Penicilium
Penicilin	Gills
Spore	Algae
Chlorophyll	Spirogyra

B. Review Questions

1. What is the advantage of red color in Algae ?
2. What is the importance of cellulose to Algae?
3. Explain the importance of fungi?
4. Write the important charactheristics of fungi?
5. Explain the structure of spirogyra?

C. True or False

1. All fungi except yeast have hyphal structure.
2. All kinds of mushrooms are **eatable.**
3. Many protists are producer.
4. Red algae live in deep of oceans.
5. Spirogyra is unicellular organism.

D. Fill in the Blanks

1. Green algae carry photosynthetic pigment called as _____.
2. Most of seaweeds found in cool climates are _____.
3. Yeast rich in vitamin _____.
4. The most familiar mushrooms are known as _____.
5. Fungi are different from algae because they lack ____.

E. Multiple choice

1. Ali bought bread from shop. When he came to home, he forgot it in packet. 3 days later he saw it again, but there were a lot of black-green dots on the bread. What were the black-green dots on the bread?

A) Algae
B) Mold
C) Bacteria
D) Viruses

2. Yeast reproduce asexually by _____.

A) Budding
B) Sporulation
C) Binary fission
D) Producing seed

3. Which of the following is false for fungi?

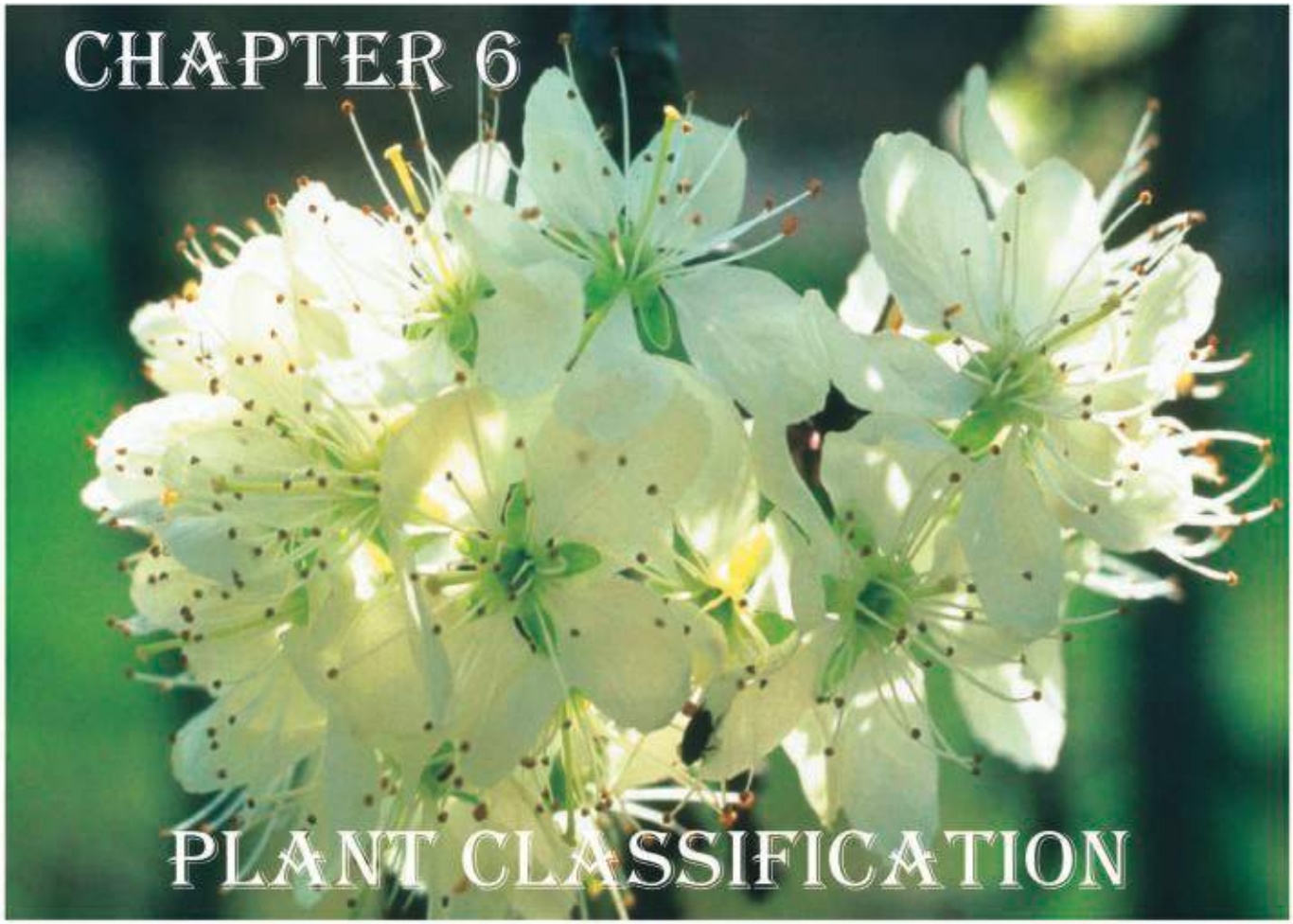
A) They are saprophytic.
B) They have hyphae in their bodies.
C) They are eukaryotic
D) They are photosynthetic.

4. Which of the following is an example for fungi?

A) Paramecium
B) Euglena
C) Mushroom
D) Apple

5. Which one is a protist producer?

A) Amoeba
B) Bacteria
C) Spirogyra
D) Yeast



PLANTS

1. The Nonvascular Plants

Plants that don't have a vascular tissue are called nonvascular plants. They are simpler than vascular plants.

Characteristics of Nonvascular plants

1. Nonvascular plants do not have true roots, stems or leaves. Instead, they have simple parts.

2. Nonvascular plants are relatively short plants.

3. They usually grow in areas where there is an abundant supply of water.

4. They reproduce asexually and sexually.

Mosses

Bryophyta consists of the mosses, and it includes approximately 10,000 species.

Sporangium of moss.

- Mosses are the most common and familiar nonvascular plants.
- They usually grow in a mat formation, which consists of many plants growing in a tight pack to hold one another up. The mat usually has a spongy quality which enables it to retain water, thus aiding in reproduction and preventing the plant from drying out.
- Mosses possess multicellular, rootlike structures known as **rhizoids** which they use for attachment and water absorption.
- All mosses consist of "stems", either branched or unbranched, that bear leaflike structures. It is important to note that these "stems", "roots", and "leaves" are different from those of vascular plants.

2. The Vascular Plants

Vascular tissue is a system of tube-like cells that carry materials throughout a plant. One kind of vascular tissue carries food (phloem). Another kind carries water and dissolved minerals (xylem). Thus, vascular tissue is the transport system of a plant. Plants with vascular tissue are called vascular plants, and have roots, stems and leaves. You are familiar with many vascular plants. Examples of vascular plants are ferns, pine tree, sunflower, grass and onion.

Characteristics of Vascular plants:

1. Vascular plants have a root, a stem and leaves.
2. Most of them live on land.
3. They are more complex than nonvascular plants.
4. Their size ranges from 1 cm to 100 meters.

Ferns

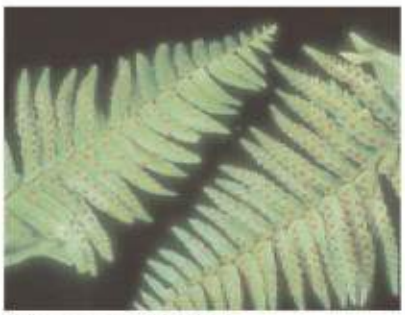
Members of this group are very wide spread in wet areas. Ferns often grow in areas that most other plants cannot, such as on rock cliffs and in the tops of trees. Decomposed ferns can mix with the rocks, providing valuable soil for other plants to germinate in.

Fern

Characteristics of Ferns

1. Members of ferns are spore-dispersing plants.
2. Water is requierd for reproduction of these plants.
3. Their stems are green and do photosynthesis.

Ferns reproduce by alternation of generation. They produce spores on the underside of reproductive leaflets. Sporangia produce spores and release them when they become mature.



Fern sporangium

Why Are Fern Plants Important to All Organisms?

Ferns are some of the oldest plants on Earth. Many species date to the age of dinosaurs. Belonging to the botanical group Pteridophyta, ferns are vascular plants that reproduce by spores and do not require seeds or flowers. Ferns are important to all organisms due to their historical role in the ecosystem as well as their scientific.

Ferns provide natural vegetation that's important to both wildlife and birds. Various animals use the fronds as food while birds and small creatures use the plants for cover.

Seed Vascular Plants

The spermatophytes, which means "**seed plants**", are some of the most important organisms on Earth. Life on land as we know it is shaped largely by the activities of seed plants. Soils, forests, and food are three of the most apparent products of this group. Seed plants have true roots, stems, leaves and flowers. They also contain vessels which allow movement of fluids, carrying water and nutrients to the different parts of the plant.

There are 2 types of spermatophyta, they are Gymnosperms and Aangiosperms

Characteristics of Seed Plants

1. Seed plants are the most complex group of plants.

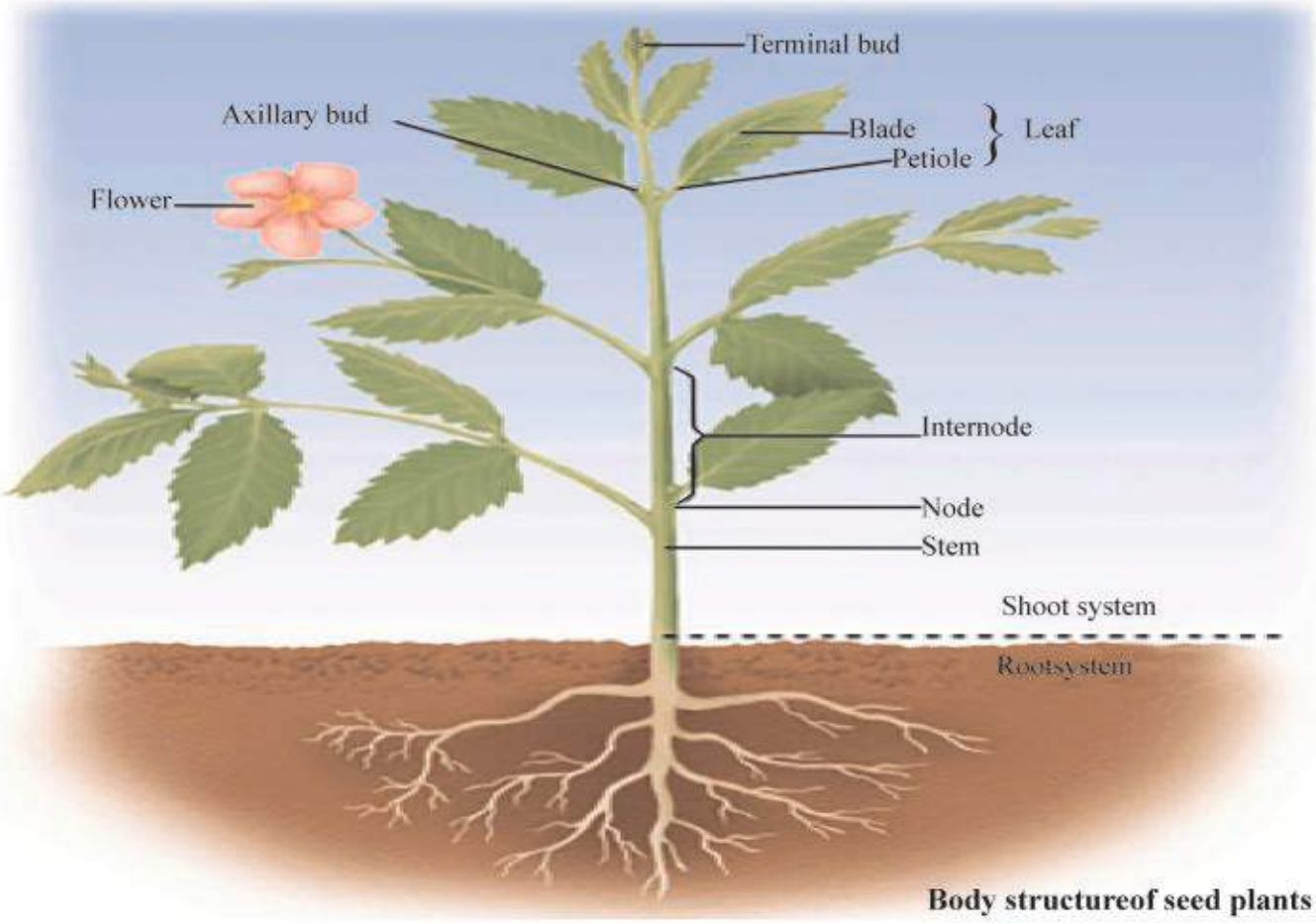
2. They have a root, a stem, leaves and cones or flowers.

3. They reproduce sexually and asexually.

4. They produce seeds.

5. Their size ranges from a few millimeters to 100 meters.

6. There are 260,000 existing species which belong to spermatophytae.



Body structureof seed plants

1. Gymnosperms

Gymnosperm means "**naked seed**". This is because the seeds do not develop enclosed within an ovary but are usually exposed on the surfaces of reproductive structures, such as cones. Gymnosperms have seeds but not fruits or flowers. This group includes all the conifers, such as pines.

Characteristics of Gymnosperms

1. Gymnosperms produce seeds that develop to cones instead of a flower.

2. Most of them have needle-like leaves.

3. They are evergreen.

4. Gymnosperms are woody plants

Pine

This popular group consists of evergreen trees and shrubs that have great decorative and commercial value.

Most of them grow in cold regions, but some are only found in warm or subtropical climates. Pine leaves are arranged in clusters containing from 2 to 5 needles. Male and female cones grow on the same tree in spring or early summer. The female flowers are usually reddish colored, They look like tiny cones.

Cone

2. Angiosperms (Flowering Plants)

Flowers of monocots

Angiosperms are vascular flowering plants. They have stems, roots, and leaves. All flowering plants produce flowers. Angiosperms comprise about 90 percent of the Kingdom Plantae. Pollen can not reach the ovary directly. Upon reaching the stigma, the pollen forms a pollen tube. The pollen reaches the ovum (egg) through the pollen tube and fertilizes the egg. May be herbaceous plants as well as woody plants. The angiosperms are classified into 2 groups. These are monocotyledons (monocots) and dicotyledons (dicots).

a. Monocots

1. Monocots have a single cotyledon (seedling leaf).

2. Monocots have veins which run parallel to the length of the leaf.

3. The monocots also have vascular bundles that are scattered.

4. The monocots have developed an adventitious root structure.

5. Monocots have lost their ability to increase their diameter through secondary growth. This also makes monocots lack wood, except palms and agaves.

6. Monocots have underground storage organs, such as the bulbs present in irises.

Date palm tree

The Date Palm Tree

This tree grow throughout middle east, especially in Iraq. It grows in hot climates and needs less amount of water. It is abundant in south and middle of Iraq. The best quality dates grow in Basra. Date tree share same family with coconut and it is monoic. Pollination naturally performed by wind but to guarantee the pollination human pollinate it artificially. It has a non-branched main stem with (5m) length.

Fruit of cucurbitaceae

b. Dicots

1. Embryo with two cotyledons.

2. Pollen with three furrows or pores.

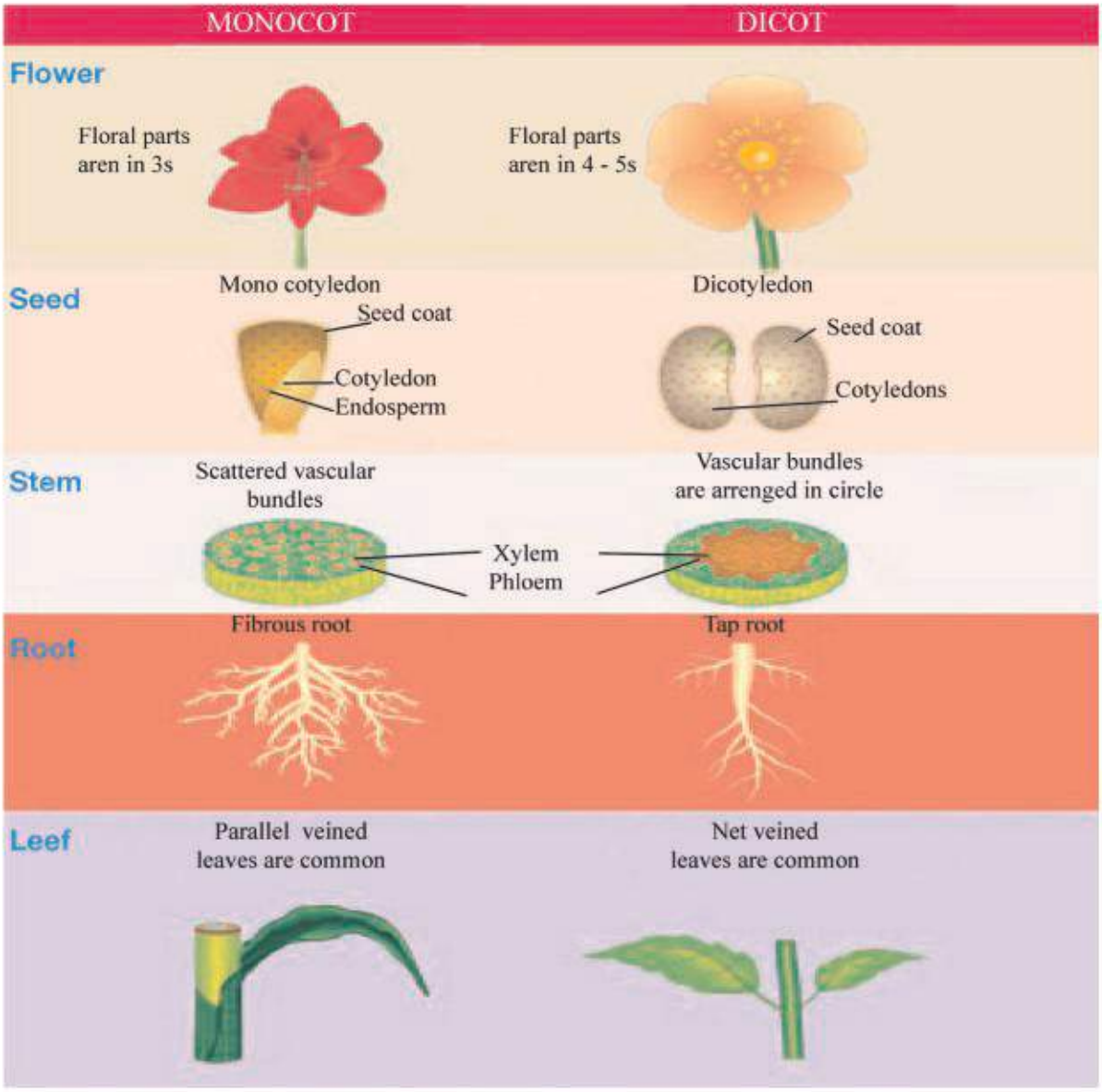
3. Flower parts in multiples of four or five.

4. Major leaf veins reticulated.

5. Stem vascular bundles in a ring.

6. Roots develop from radicle.

7. Secondary growth often present.



Comparison between flower, seed, root and leaf in monocots and dicots.

SELF CHECK
PLANT CLASSIFICATION

A. Key Terms

Rhizoid	Vascular tissue
Non-vascular	Spore
Gymnosperm	Pine
Cone	

B. Review Questions

1. Give two examples for monocot and dicot plants?
2. Explain the date palm tree?
3. What are charactheristics of non-vascular plants?
4. Compare the monocot and dicot plants?
5. Compare the vascularand non-vascular plants?

C. True or False

1. Date palm is a monocot plant.
2. Ferns reproduce by seed.
3. Gymnosperms are evergreen plants.
4. Watermelon is a dicot plant.
5. Monocots generally have tap root.

D. Fill in the blanks

1. Flowering plants aredivided into two groups they are; _____and _____.
2. Non-vascular plants don`t have true _____, _____ or _____.
3. Vascular tissue is the _____ system of plants.
4. Ferns reproduce by _____.
5. Examples for vascular plants are _____and _____.

E. Multiple choice

1. Which of the following is not true for ferns?

A) Theyare spore dispersing plants
B) They produce seed
C) They need water for reproduction
D) They have photosynthetic stems

2. Which of the following is not part of seed plants?

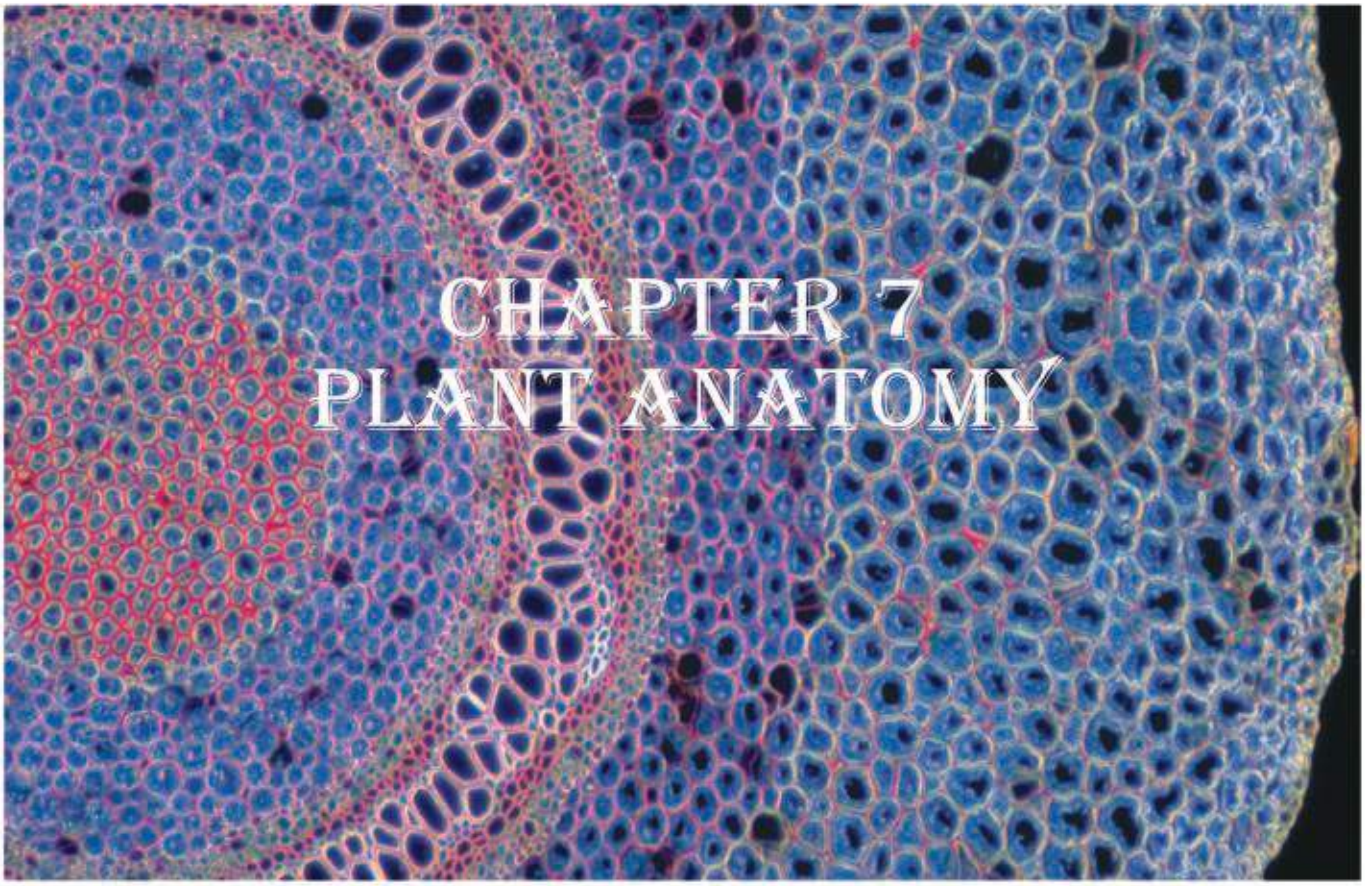
A) Stem
B) Sporangium
C)Flower
D) Root

3. Which of the following is gymnosperm?

A) Cucumber
B) Palm
C) Pine
D) Apple

4. Which of the following is false for dicots?

A) Embryo has two seedling leaf
B) Stem vascular bundle in a ring
C) They have parallel veined leaves
D) They have secondary growth

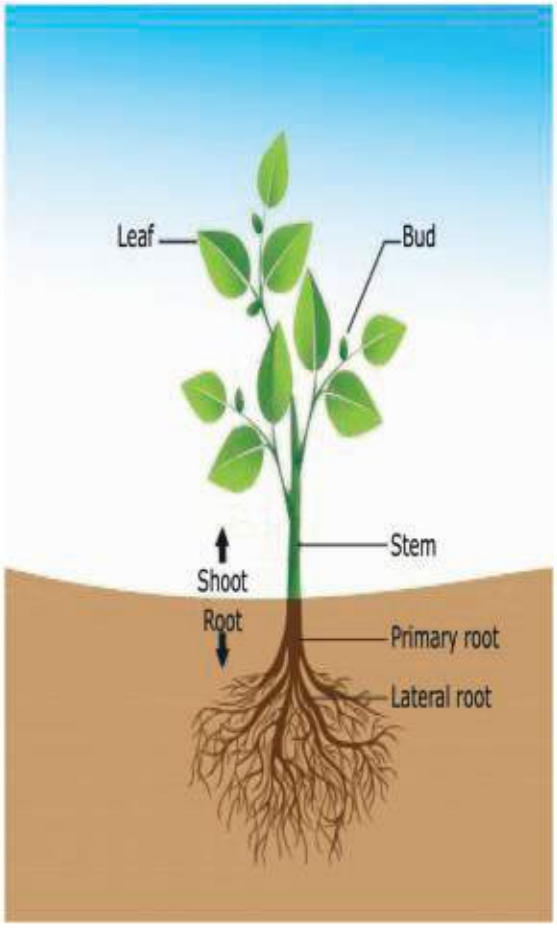


CHAPTER 7
PLANT ANATOMY

Structure of Dicot Plants

The Shoot System

The plant body is organized into a root system and shoot system. The root system is generally the below ground portion, the shoot system consist of a vertical stem which bears leaves, flowers and fruits containing seeds.



Shoot System Functions

- Photosynthesis
- Reproduction
- Storage
- Transport
- Hormones Transport

Root System Function

- Fixation
- Absorption
- Storage
- Transport

Root

Roots absorb water and minerals from the soil and anchor the plant in the ground. They also store food in some plants, such as carrots. There are two basic types of roots: **tap root** and **fibrous root.**

A tap root consists of one main root with many smaller lateral roots coming out of it. It is characteristic of dicots and gymnosperms. Radish and carrot ar examples for tap roots.

A fibrous root has several to many roots of the same size developing from the end of the stem with smaller lateral roots branching off these roots. Onion, crabgrass and other monocots have fibrous root.

In the typical root structure, the tip of the root is rounded and covered with a protective structure called the **root cap**. Just beneath the root cap are dividing cells which provide root growth.

The root hairs, tiny projections growing out from the root, absorb water and minerals. The vascular organs, xylem and phloem, transport water, minerals and food.

Stem

The stem connects the root and leaves. It transports materials between the leaves and root. Stems can be either **herbaceous** or **woody**. Herbaceous stems are soft and photosynthetic. Beans, wheat and tomatoes have herbaceous stems.

Woody stems are hard and not photosynthetic. Pine, oak and redwood have woody stems. Both herbaceous and woody stems have xylem and phloem vessels. They form the transport system of the plant. **Xylem** transports water and minerals from the root to the other parts of plant, and **phloem** transports photosynthetic products between the leaves and root.

Woody stems also have other supportive structures. In woody stems, the outer layer, called bark, helps to protect the inner layers.

The phloem is located beneath the bark. Inside the phloem is a layer called **cambium** whose cells divide to form new xylem and phloem vessels.

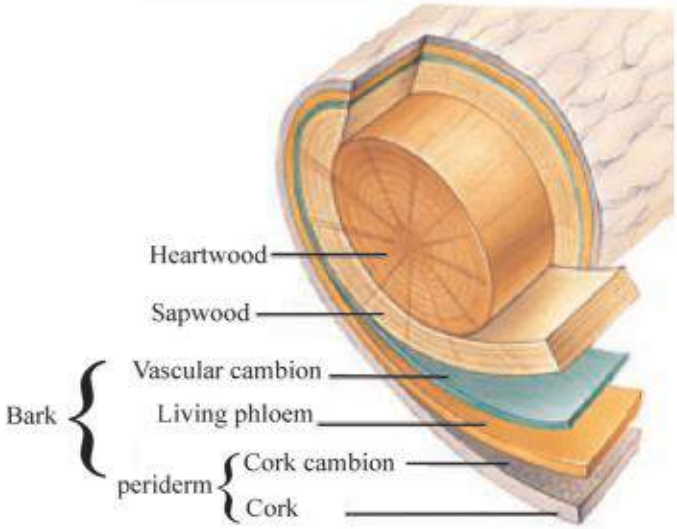
Inside the cambium, the xylem vessel is found. At the core of the stem, the heart wood is found. When you look at the trunk of a tree, you see many concentric circles. These are called **annual rings**, because each pair of them represents one year of plant age.

Growthof Stem

Growing in plants is unlimited which can be longitudinally and laterally.

Growing in grasses: It is a seasonal growth, new cells added to the tip of the plant or laterally in form of buds.

Growing in prennial plants: Dicots contain cambium cells which provide secondary growth (growth in diameter) and also plants grow longitudinally.



Leaf

Leaves are structures which develop from lateral buds on the stem of a plant. The leaf of a dicotyledon consists of a leaf stalk and a leaf blade. The wide surface area of the leaf blade is important for the efficient absorption of sunlight. In some plants, leaves are ribbon-like: straight-sided with parallel veins. In contrast, some other plants have net-veined and rough sided leaves.

The Anatomical Structure of the Leaf

The following prominent layers are observed under a light microscope when a leaf is cut in cross-section:

Cuticle layer **Epidermal layers**

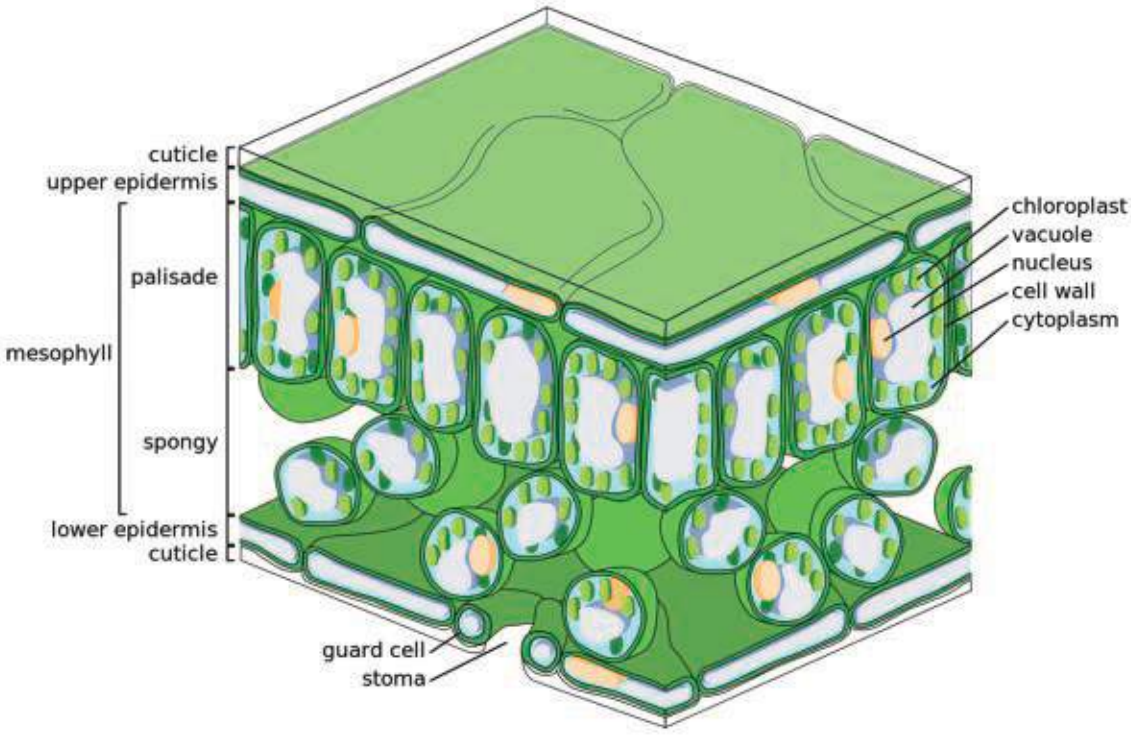
Mesophyll layer **Vascular bundles**

a. The cuticle layer

The cuticle layer is a waxy material which covers the leaf surface and prevents water loss. The cuticle layer is transparent, therefore sunlight can pass through it but water loss is prevented.

b. The epidermal layers

Epidermal tissue forms the upper and lower surfaces of the leaf and comprises a single layer of epidermal cells. Epidermal cells lack chloroplasts and are consequently non-photosynthetic. The holes in the epidermis or the stomata give it a rough appearance. The stomata provide the pathways for gas exchange and water regulation in the plant.



Transverse section through the leaf of a dicotyledon

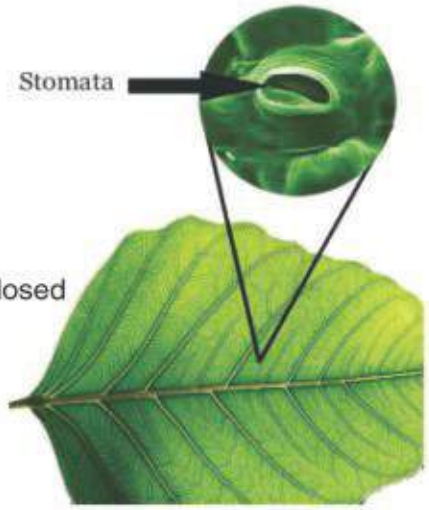
c. The mesophyll layer

The layer between the upper and lower epidermis, known as the **mesophyll layer**, comprises palisade and spongy parenchyma cells. The cells of this layer are photosynthetic.

d. The vascular bundles

The vascular bundles consist of xylem and phloem vessels which transport water from root to leaf and organic materials from leaf to root.

Stomata



The cuticle layer forms an incomplete covering over the surface of the leaf. If coverage was total, transpiration and gas exchange would be prevented. Since the stomata lack a cuticle they can be opened and closed to carry out gas exchange and transpiration.

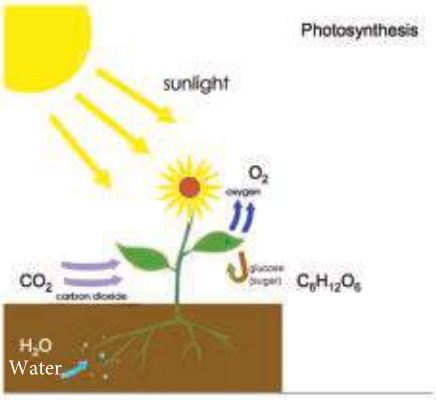
Photosynthesis

The sun is the only source of energy that almost all organisms depend on.

About third of sun energy reflected back to space, and most of remain is absorbed by the earth and converted into heat. Less than 2% of the energy that reaches the earth is captured by photosynthesis. But that is enough to provide the energy that drives almost all of the activities of life on earth.

By this remarkable process, each year nearly 200 billion tons of sugar are produced worldwide, mostly by aquatic photoautotrophs.

In photosynthesis, plants and other photosynthetic organisms capture solar energy and convert it to chemical energy. The chemical energy is stored in seeds or other parts of the plant's body. When an animal eats plants, this energy passes from the plants' to the animal's body. Plants also produce oxygen by photosynthesis, which takes place in chloroplasts. The overall reaction of photosynthesis is:



Flower

Flowers are specialized shoots which have reproductive organs. They have different shapes and colors. A flower is composed of petals, which have different colors in order to attract animal pollinators, and sepals, which are generally green, to protect the stamen and carpel.

1- **Stamens** are the male reproductive organs which produce pollen grains. They consist of two main parts: anther and filament.

a- **Anther:** Each anther is composed of four pollen sacs containing pollen grains. The grains are haploid and contain the meiotically produced male gametes.

b- **Filament:** Its function is to raise the anther into the air so that its pollens can be dispersed by the wind or by an insect.

2- **Pistil:** It is the female reproductive organ of a flower. It is generally composed of three structures: a stigma, a style and an ovary.

a- **Stigma:** It is a specialized area located directly above the style and is the site of pollen reception and germination.

b- **Style:** It is a tube-like structure connecting the ovary and the stigma.

c- **Ovary:** The ovary is a spherical structure at the base of the pistil contains one or more ova and forms fruits after fertilization.

3- **Petals**

4- **Sepals**

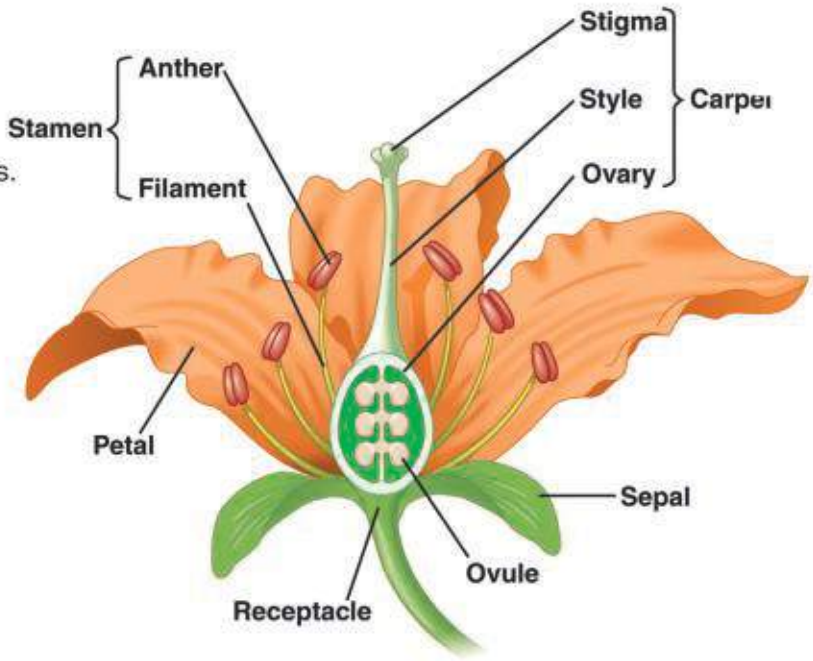
5- **Receptacle** is base of flower where all floral parts are attached, also produces **nectar**, a sugary fluid that provides an energy source for insects and birds.

Reproduction

There are two kinds of reproduction in plants.

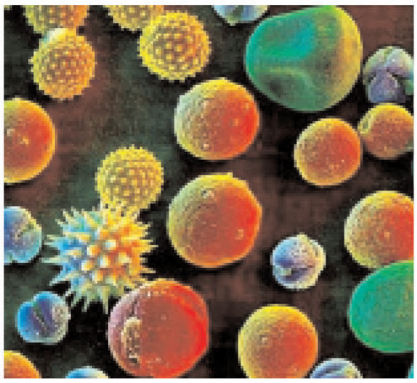
1- Sexual reproduction which is provided by seeds.

2- Asexual reproduction which is provided by vegetative parts of plant (vegetative prpogation).



Parts of a flower

1. Sexual reproduction

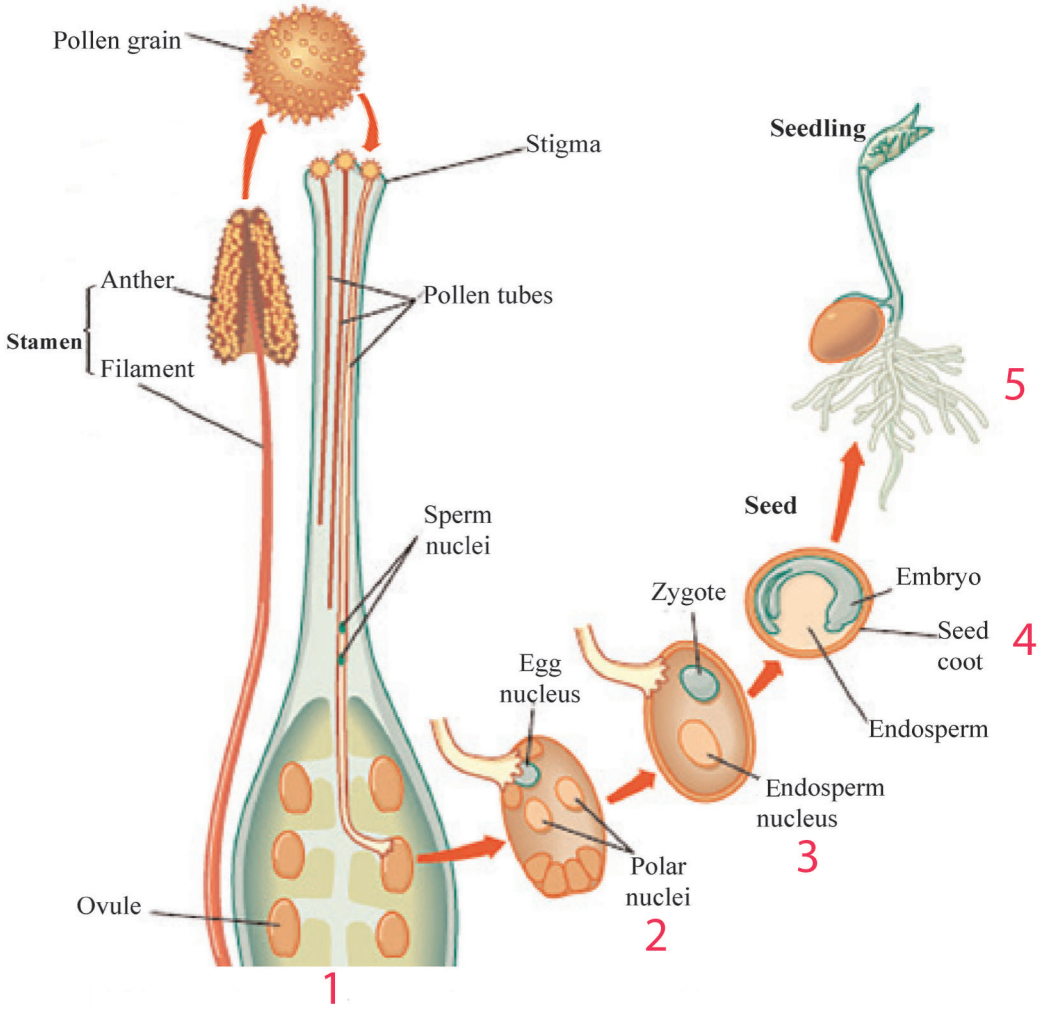


Pollen grains

Pollination:Pollination describes the physical movement of matur pollen grains from the stamens to the stigma. Pollen may move within the same plant - self-pollination -or between plants - cross-pollination. The pollination is generally is performed by aid of wind, water or insect.

Fertilization

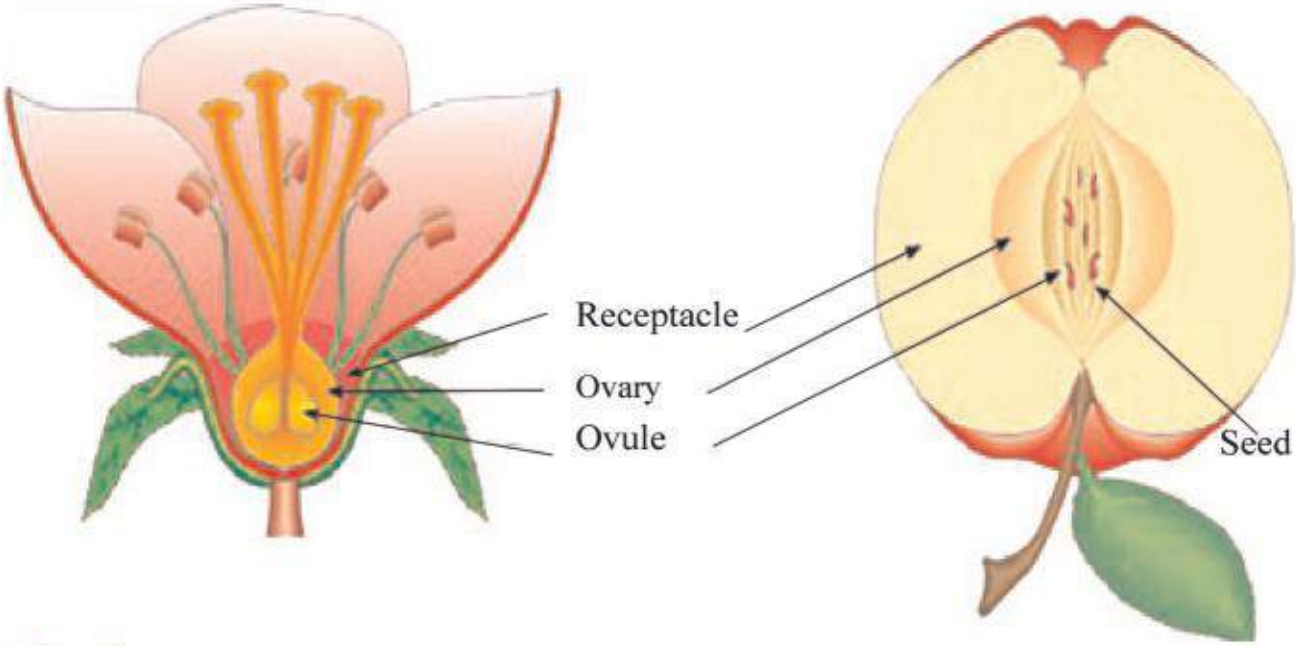
Fertilization is generally known as the union of male and female reproductine cells. In flowering plants double fertilization occurs.



How flowering plants reproduce

Fruits and Seeds

After double fertilization takes place within the ovule, the ovule develops into a seed and th ovary surrounding it develops into a fruit, for example, a pea pod is a fruit and th peas within it are seeds. Fruit protects th seeds and assists in dispersal to colonize new areas away from the parent plant. A fruit may contain one or more seeds.



Seed

A seed is consist of; seed coat, embryo and endosperm. Seed coat consist of one or more parts that cover and protects the internal parts of seed.

Embryo is living part of seed, it consist of reduced root,stem, leaves and one or two cotyledons. Cotyledons are leves of embryo that provide food for embryo during germination.

Endosperm is part of seed which stores food before germination.

Seed Germination

Germination is growing of embryo and transformation into a new plant which can produce its own food by photosynthesis.

The Factors Affect on Seed Germination

There are numerous factors affet on seedgermination they are;

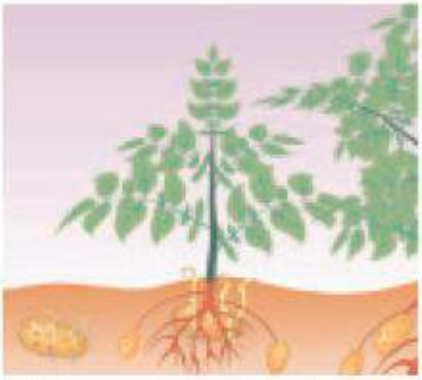
1- Internal factors

- Age of seed
- Storage duration
- Ability of embryo for germination

2- External factors

- Optimum temperature
- Water
- Dissolved oxygen around seed

Asexual Reproduction

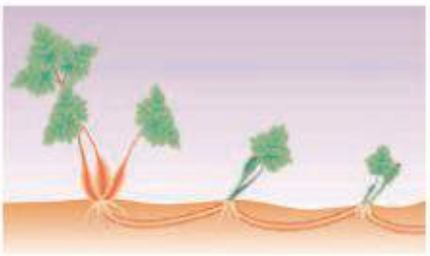


Tubers are specialized stems. They are the means of generating many new individuals from a single parent.

Some plants can reproduce by their vegetative parts (stem, roots and leaves). It is seen mostly in flowering plants. A branch or bud from the parent organism grows into an independent new plant either on the plant body itself.

1- Tuber

tuber stems are formed by projections of the lowest axillary buds. The stems that are produced grow downwards into the soil. Food molecules such as starch accumulate at the tips of these stems, increasing their size to form tubers. A good example of a stem tuber is a potato. If one tuber is planted in moist soil, each bud develops into a new potato plant.



Stolons are an effective means of increasing the size of a population without competition between plants.

b. Stolons

Stolons are horizontal stems that develop from axillary buds. They extend over the surface of the soil forming new plants a distance away from the parent. Strawberry plants, for example, reproduce by using stolons.

c. Rhizomes

Rhizomes are thick, horizontal, root-like stems. They extend from the base of a plant, growing almost always underground. Garden grass is a good example for reproduction by rhizome.

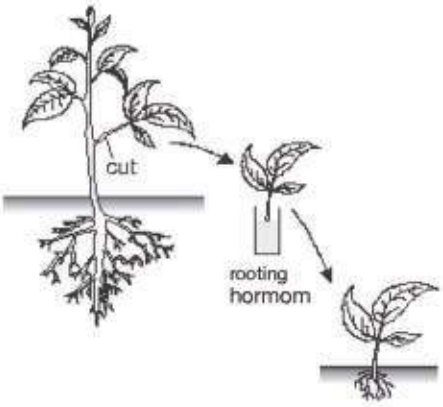
An underground rhizome gives rise to a number of new plants. Ginger is an example for rhizome.

d. Propagation

A new plant may be artificially produced or propagated from its parent plant by different techniques, such as grafting or cuttings.

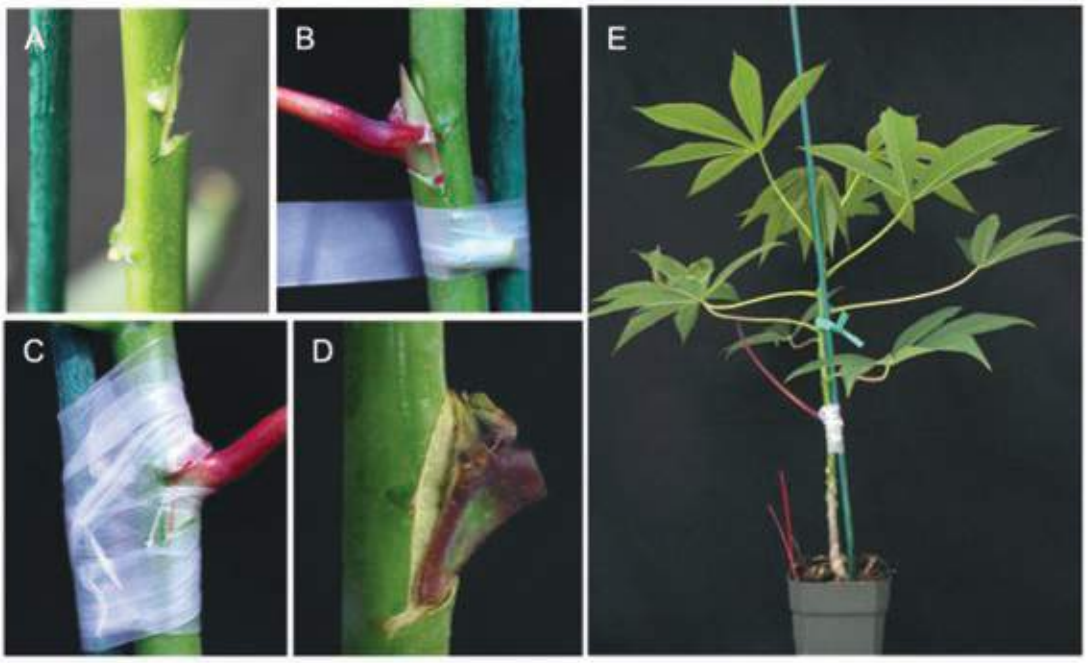
1. Cuttings

A root or shoot of the parent plant known as a cutting is severed and used to form a new plant. The cutting quickly produces new roots to absorb water from the soil. Willow, poplar and quince trees are all produced commercially using this method.



b. Bud and Stem Grafting

Grafting involves the artificial joining of the stem of one plant to the roots or rootstock of another. By this technique, the stem of one species may be grafted to another of the same genus. This technique is used commercially in the propagation of fruit trees.



Bud grafting

SELF CHECK
PLANT ANATOMY

A. Key Terms

Tap root
Root cap
Cuticle layer
Stomata
Style
Annual ring
Root hair
Vascular bundle
Flower
Pollination

B. Review Questions

1. Explain the structure of seed.
2. Write factors affecting on seed germination.
3. What is fertilization?
4. What is the importance of stomata?
5. Write the functions of root.

C. True or False

1. In woody plants outer layer of stem called as bark.
2. Growing in plants is unlimited.
3. Leaf is important for sun light absorbtion.
4. Cuticle layer produce food for plants.
5. Sugar is produced at the end of photosynthesis.

D. Fill in the blanks

1. Stamen consist of two main parts; _____ and _____.
2. Pistil consist of three main parts; _____, _____ and _____.
3. A good example for tuber stem is _____.
4. A seed consist of ; _____, _____ and _____.
4. There are two types of pollination they are; _____and _____.
5. Plant body consist of _____and _____.

E. Multiple choice

1. Which of the following is not function of shoot system?

A) Reproduction
B) Photosynthesis
C) Absorbtion
D) Transport

2. Which of the followings has tap root?

A) Corn
B) Bean
C) Radish
D) Onion

3. Which of the following not a part of leaf in cross section?

A) Cuticle layer
B) Epidermal layer
C) Mesophyll layer
D) Root hair

4. _____ important for attraction of pollinators?

A) Petal
B) Sepal
C) Pistil
D) Stamen

5. _____ is a part of seed which provide food for seed before germination?

A) Seed coat
B) Embryo
C) Endosperm
D) Leaf

CHAPTER 8
INVERTABRATES

invertebrates

Animals are some of the most common organisms found from the oceans to the high mountains. Except for some animals like sponges, most animals are easily differentiated from other groups (e.g. plants or fungi).

For definite separation, the characteristics used are these:

- All animals are eukaryotes and (multicellular).
- All animals are heterotrophs. Most digest their food internally.
- Most animals are motile during at least a certain period of their life.
- Many animals have a well-developed nervous system and sensory organs.
- Most animals reproduce sexually. The organism develops from a zygote through embryonic stages.
- Animals possess organs for respiration, excretion, and circulation, except for primitive phyla which use diffusion for these functions.

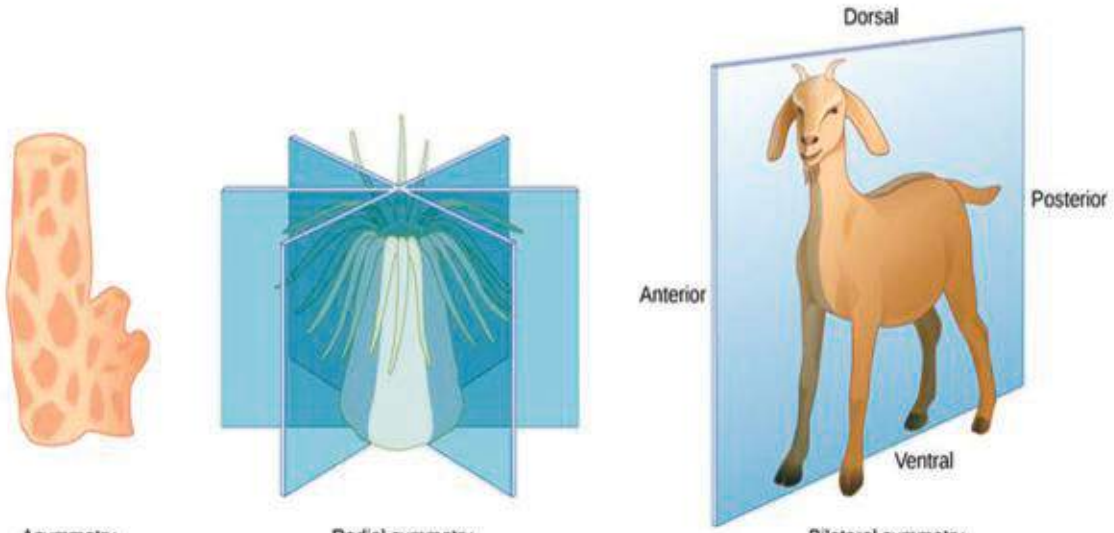
Over one million species are already known to science, and millions more are expected to be discovered in the future. A minority (5%) of all animals are vertebrates. **Vertebrates** are animals that have a backbone. Those without a backbone are called **invertebrates**. Examples sponges, jellyfish, insects, snails, etc.

Symmetry

Except for a few groups, the majority of animals exhibit **bilateral symmetry** and can be divided into parts e.g. head, torso and limbs. For identifying various features of such animals, the terms anterior, posterior, dorsal and ventral are used. In the same way, for understanding the inner structures, vertical, transversal, and horizontal planes (sections) are defined.

Symmetry is the presence of one or more planes that divide an organism into identical sections.

Sponges are **asymmetrical** (no equal parts). In metazoans, radial (cnidaria) and bilateral (many groups) symmetry is seen. Organisms with **radial symmetry** can be divided into equal pieces by any number of planes passing through the main body axis.
Bilaterally symmetric animals can be divided into two pieces by a single longitudinal medial plane.



Types of Body Symmetry

Animal Classification

There are millions of different animal species around the world. Because of this diversity, all groups have to be studied separately. In this chapter, kingdom Animalia will be divided into the classes **sponges, coelenterates, platyhelminthes, nematoda, mollusca, annelida, arthropoda, echinodermata** and **chordata.**

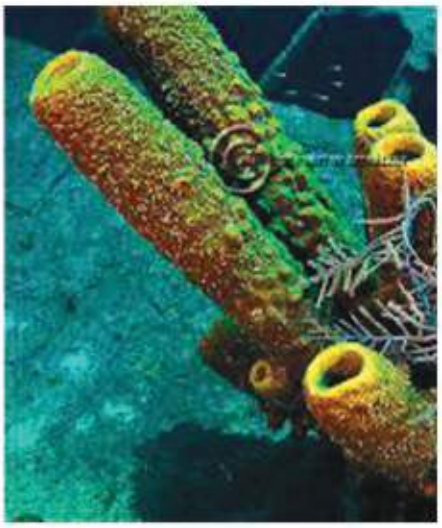
We will now explore the great diversity of animals according to their similarities and differences.

Biologists have identified more than a million species of animals. Several million more remain to be discovered and classified.

Invertabrates

They are animals that have no a backbone (vertabrae).

1. Phylum:Porifera (Sponges)



For a long time people thouth that sponges were plants because they don't look or act like most animals you know. Like plants, adul sponges are immobile, but all other features qualify them as members in the animal kingdom.

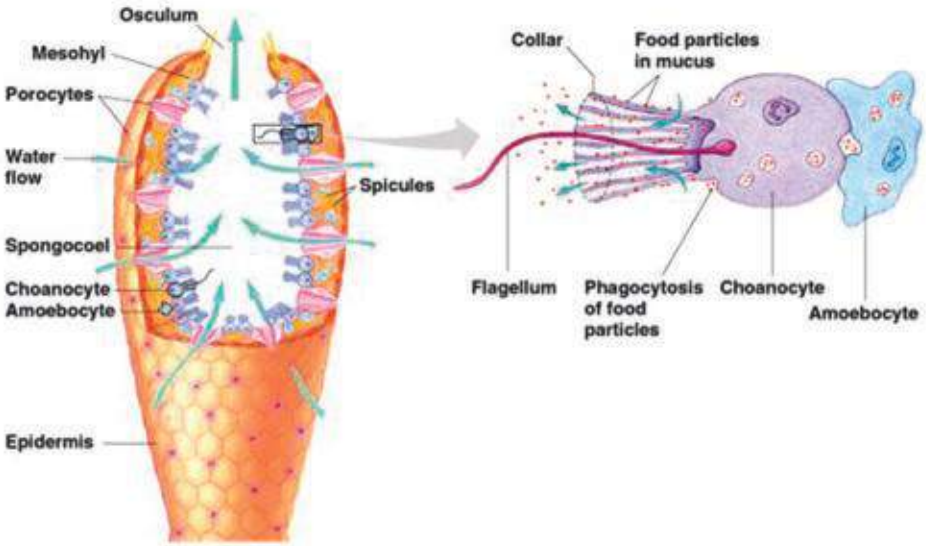
Habitat: They are mainly marine animals with the exception of a few freshwater groups. Today there are about 10,000 species alive. Only about 1% of the species live in freshwater. They are sessile and mostly attach themselves to hard surfaces like rocks and shells. They may be flat, ball or vase-shaped.

Body structure: Sponges are the simplest animals. They have a lot of pores on the body through which water is taken to the body cavity.They don't have any specific type of tissue, system or organ.

Supporting the body: Sponges have an endoskeleton and differ on the basis of the type of skeleton they secrete.

Getting food and oxygen: Moving water carries food and removes wastes. They are filter feeders that filter the water passing through the pores to trap food particles. A sponge gets its O_2 from water too. O_2 moves from the water into the sponge's cells by **difussion**. Difussion also removes waste from the sponge.

How fast
Some sponges arevable to move about 4 mm per day.

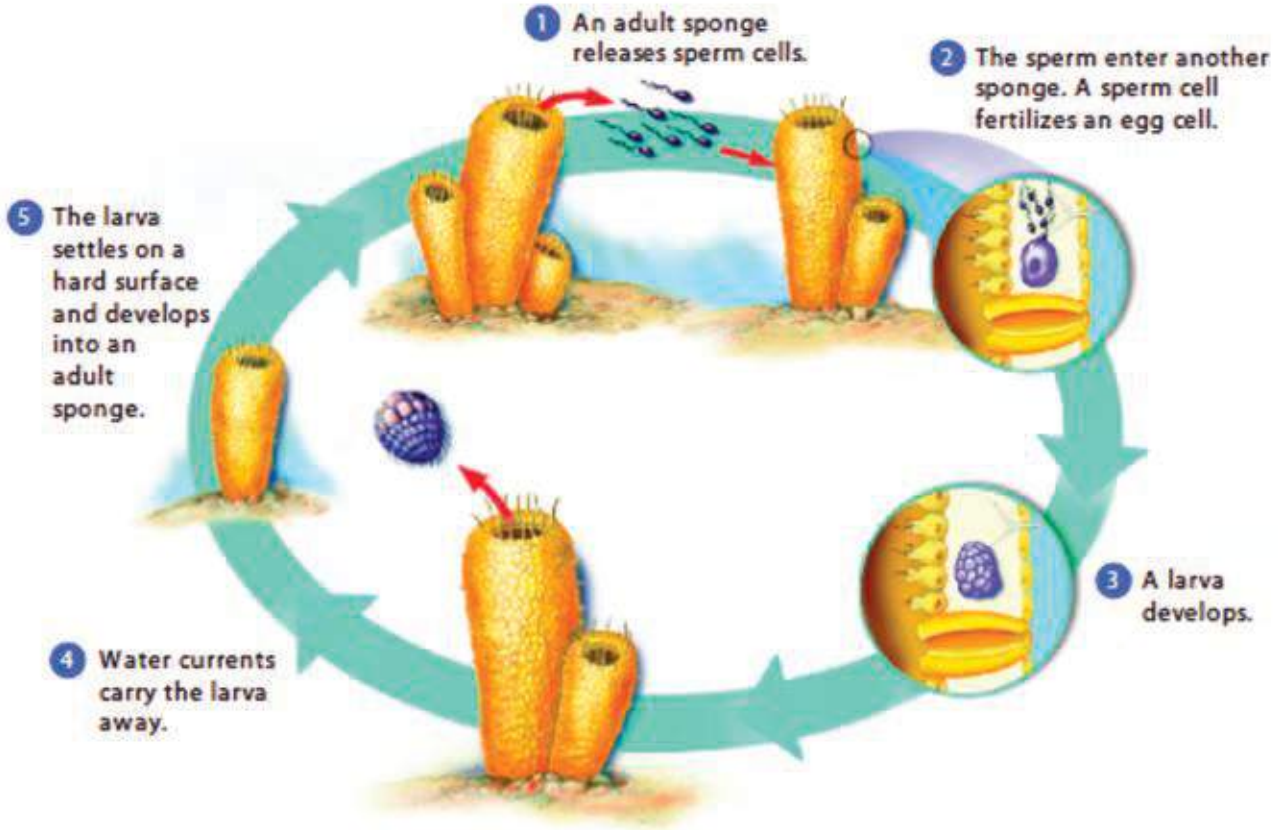


Structure of sponges. Pores connect the inner cavity to the outer surface. A section from the body wall shows spicules, choanocytes

Reproduction in Sponges: In Porifers, reproduction is sexual or asexual.

Asexual Reproduction in Sponge: Budding or regeneration are asexual forms of reproduction. In budding, small new sponges grow from the sides of adult sponges. Sponges have a remarkable ability for **regeneration**. When injured they can repair themselves and regenerate lost parts. When the cells of sponges are separated from one another in the lab they regenerate, forming a complete sponge again.

Sexual Reproduction in Sponge: Most sponges are **hermaphroditic:** male and female gametes are produced by the same sponge. But some others may be monoic. That is, the gametes are produced by different individuals.



Sexual reproduction in sponges

2. Phylum:Coelenterata (Cnidaria)

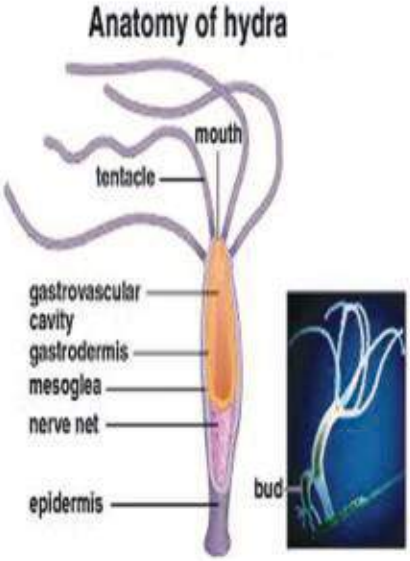
Coelenterate means "hollow (animal)" in Greek. There are over 10,000 species in this group. Most are marine but there are a few freshwater representatives. They live solitarily or in colonies. They have projections called as **tentacles** which used in feeding and movement.

Hydrozoa (Hydra)

Nearly 2700 mainly marine species, but some freshwater; both polyp and medusa stages in many species, some form colonies.

Hydra is the typical representative of this group. Hydra have only polyp body form (appr. 5-6 mm in length), and live in streams, ponds and lakes. Aboral side is attached to the substrate. The mouth is positioned on the upper tip. Around the mouth there are 6-8 tentacles active in movement and feeding.

Reproduction in Hydra



They reproduce asexually by budding or regeneration, but they can also reproduce sexually. Sexual organs can be seen as small buds on the tube-shaped body. They may be **hermaphroditic** or **monoic**.

Some of them can form **colonies**. There is a remarkable organization in these animals. Some individuals of the colony are specialized for feeding, while some others lack tentacles and even a mouth, serving only in reproduction.

Free-swimming medusae reproduce sexually and form zygotes. Zygotes develop into swimming larvae. Larvae attach to some solid object and devolop into a polyp which may form a new colony.

3. Phylum: Platyhelminthes (Flat-worms)

These are flattened, soft-bodied organisms, and are the first animals with bilateral symmetry. There are 20,000 known species. They are mostly aquatic (marine or freshwater), but there are some terrestrial species of moist soil, and many parasitic species are found in various organisms. Parasitic species often lack digestive and sensory organs. They are mainly hermaphroditic.

Tapeworm

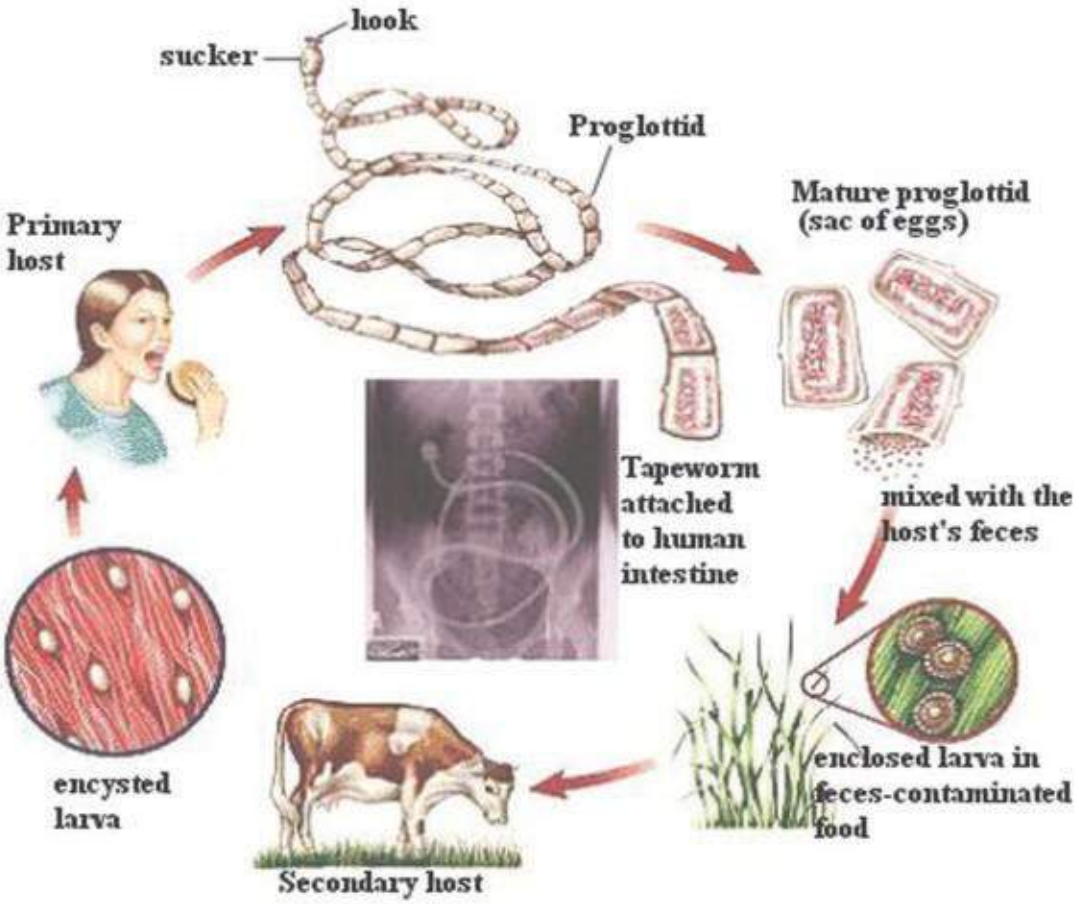
These are all hermaphroditic animals. The tapeworm has an anterior region containing hooks and suckers for attachment to the intestinal wall of the host. Behind the head region there is a short neck and then a long series of proglottis.

Proglottis are body part which has full set of both male and female reproductive organs. They have excretory canals but no digestive system.

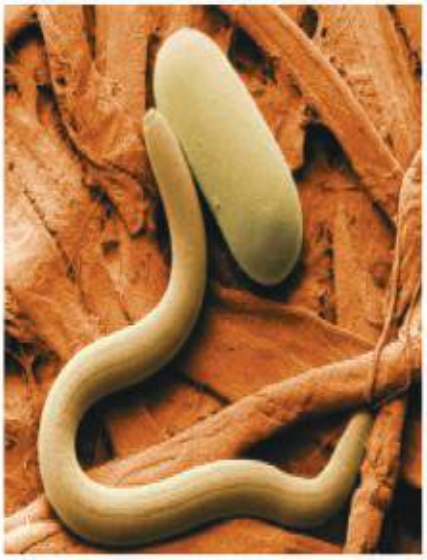
Life Cycle of Tapeworm

The adult tapeworm lives in the human intestine its body consist of head and proglottids. Proglottis produce sperm and eggs. The eggs are fertilized and stored in the proglottis. A single proglottis may contain nearly 80.000 - 100.000 fertilized eggs. The fertilized egg may break away from the tapeworm and pass out of the host body in feaces. The fertilized egg may be deposited on the ground and on grass.

So if cow eat this grass, fertilized eggs can pass into new host body. In the cow' intestine, eggs develop into structures. They cross the intestine enter the blood and lodge in the tissues (usually brain and muscle tissue) where they form capsule around themselves. At this stage new organisms called bladder worm (8-12 mm long). Meat containing bladder worms may be eaten by humans. If the cow meat is not fully cooked, bladder worms enter into human intestine they grow into adult tapeworms and complete their life cycle.



4. Phylum:Nematoda



Nematodes have cylindrical, smooth bodies and bilateral symmetry. Their bodies are long, thin and pointed at both tips. Sense organs are not well-developed.

There are about 12,000 species. They usually have separate sexes and internal fertilization is seen. Mostly they inhabit sediment layers in water (both marine and freshwater), and are abundant in soil. Ecologicaly they are very important. Their importance comes from their major role as **decomposers**. They provide material recycling.

Although there are many free-living species, some species are plant or animal parasites. Parasitic roundworms obtain nutrients and oxygen from their host. A complete digestive system is seen in roundworms. Roundworms also have a waterproof, flexible body covering.

Ascaris lumbricoides

Ascariasis is an infection caused by a parasitic roundworm, Ascaris lumbricoides. This is the most common intestinal worm infection.

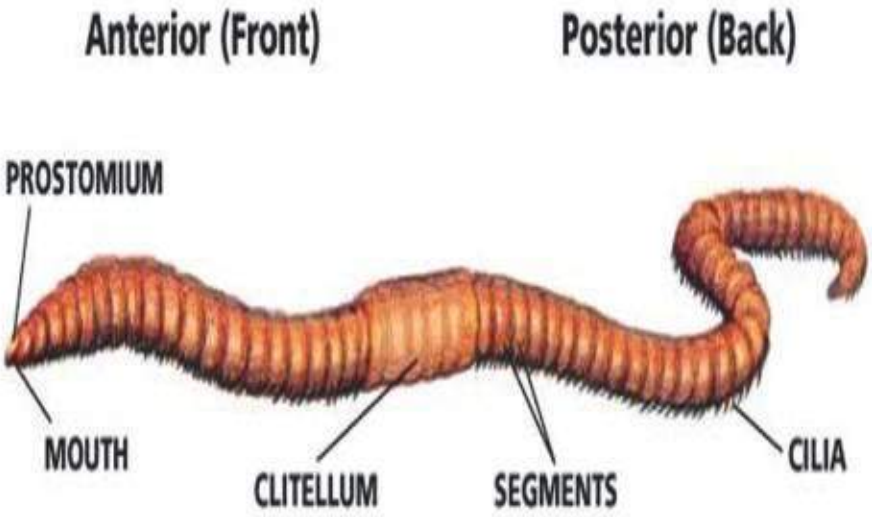
It is found in association with poor personal hygiene, poor sanitation, and in places where human feces are used as fertilizer. Intake of food or drink contaminated with roundworm eggs causes infection.

The eggs hatch and release larvae within the intestines. The larvae then move through the bloodstream to the lungs, exit up through the large airways of the lungs, and are swallowed back into the stomach and intestines. During movement through the lungs the larvae may produce an uncommon form of pneumonia called eosinophilic pneumonia. Once back in the intestines, they mature into adult roundworms. Adult worms live in the intestines where they lay eggs that are present in feces.

5. Phylum:Annelida

There are about 15,000 species in this group. Typical examples are the medicinal leech and earthworm. They have segments that make up their body. Segments are divided internally by septa and each segment has setae that aid the annelids in moving. Digestive tract and nerve fibers are continuous throughout the segments but other structures are repeated.

The segmented body provides agility, and elasticity results from the separate body cavity and muscles of each segment. These body cavitities and muscles function as a **hydrostatic skeleton**. Body movement is provided by circular smooth muscle. Annelids have simple eyes similar to cnidarians. They don't have a special respiratory system. Gas exchange take place by diffusion across the cuticle-layered skin.

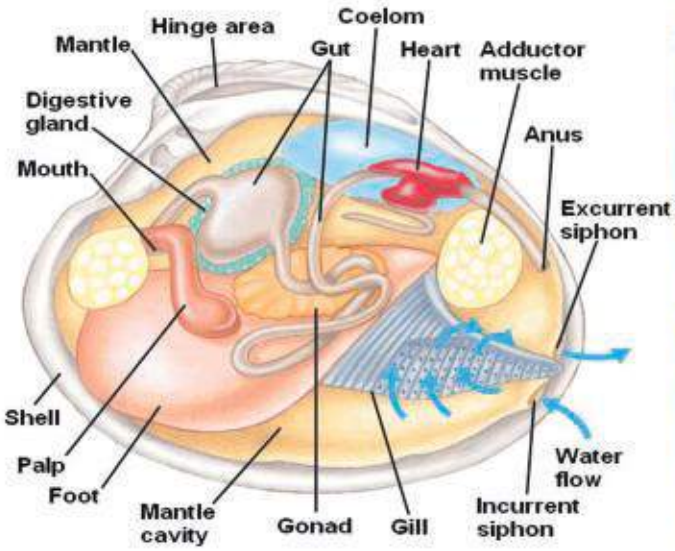


6. Phylum:Mollusca (Mollusks)

Mollusks are soft bodied, bilaterally symmetrical animals. About 50,000 living and 35,000 fossil species of mollusks are known. Examples of the group include mussels, octopuses, snails, slugs, oysters and squid. Many species are marine but there are some freshwater mussels and snails, and many terrestrial slugs and snails.

Their soft bodies are usually covered dorsally with a hard **shell mantle** made of $(CaCO_3)$ Both mantle and mantle cavity carry shell-producing glands. A flat broad, muscular foot is used for locomotion.

Mollusks have a complete digestive system. Food is ground in the mouth by specialized structures known as radula. It is similar to a tongue with hard teeth. After mechanical digestion the food material forms a cord-like structure and is transported down the esophagous to the stomach. The final products of digestion are absorbed by the stomach and intestine.



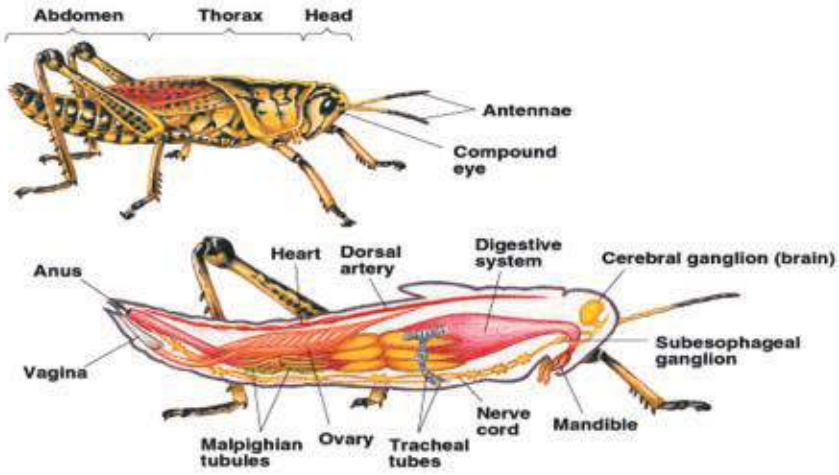
Octopus

7. Phylum:Arthropoda (Insects)

There are about 1,000,000 species of arthropods found in all habitats. Arthro means joint, pod means foot. All arthropods are bilaterally symmetrical, and their bodies are covered with a tough exoskeleton.

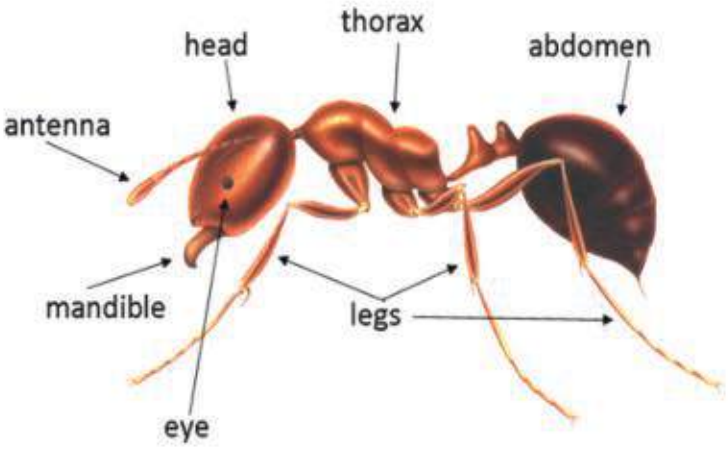
The arthropod body, like that of the annelid, is segmented. In contrast to most annelids, each arthropod has a fixed number of segments, which remains the same throughout life.

Segments are usually arranged in groups to form a head, thorax and abdomen. The skin is covered by a cuticle made of chitin polysaccharides, or $CaCO_3$ is a component. This hard covering protects the animal, and provides points of attachment for muscle cells.



Once the arthropod has grown too large for its exoskeleton, it is shed and a new skeleton is grown. This entire process is known as **molting**.

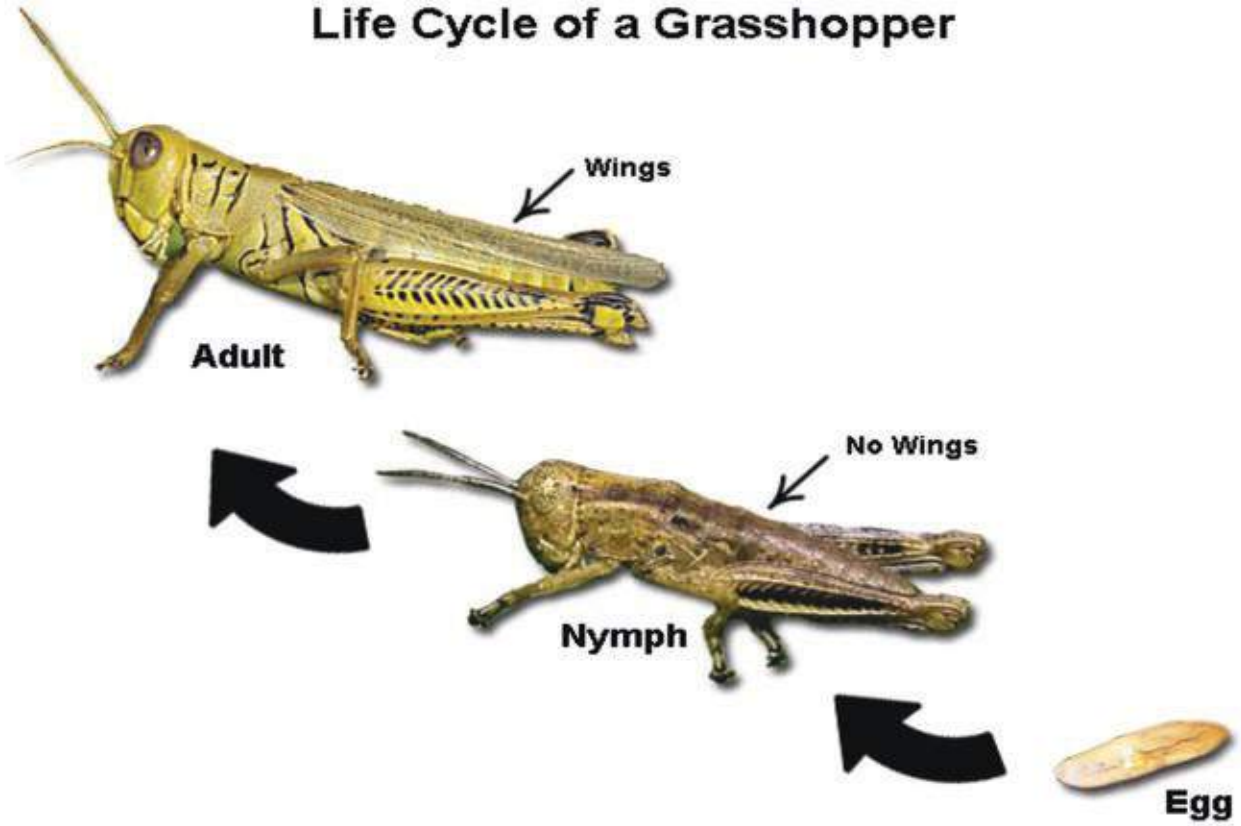
They have very effective sensory organs. Many have organs of hearing Arthropods have special respiratory systems. Aquatic forms have gills for gas exchange and terrestrial groups have trachea made up of many internal tubules which carry air to the body cells. There are separate sexes. Direct development or **metamorphosis** are seen.



Insects go through a series of changes as they develop from egg to adult.
This series of changes, or growth stages, is called metamorphosis.

Grasshopper

They are common animals which are have ability to migrate and harm the crops. They are hermaphrodite organisms and internal fertilization is seen. Female lays fertilized eggs in holes in soil.And after a while organisms similar to the parents are seen and after a series of changes (metamorphosis) complete insects are formed.



Honey bee

Characteristics:

- Body thick, marked with yellow and brown.
- Eyes hairy.
- Body length: 1/2-1 cm

Habitat: Manmade beehives or hollow trees.

Behavior: Honeybees emit a characteristic buzz and feed on the nectar of flowers such as clover and apple blossoms. Their social order is rigid and effective; each hive has a queen, who lays eggs and is the largest bee, workers, the most abundant members of the colony who harvest nectar, and drones, who serve the queen. Honeybees communicate through a language of dance, sound, and smell. A worker returning to a hive can tell the others about a new place to gather nectar; through a dance, he indicates the direction of the place and its distance from the hive. By smelling him, the other bees can determine the type of flower.

The Queen: The queen is the only sexually developed female in the hive. She is the largest bee in the colony. A two-day-old larva is selected by the workers to be reared as the queen. The queen starts to lay eggs about 10 days after mating. A productive queen can lay 3,000 eggs in a single day.

The Drones: Drones are stout male bees that have no stingers. Drones do not collect food or pollen from flowers. If the colony is short on food, drones are often kicked out of the hive.

The Workers: Workers, the smallest bees in the colony, are sexually undeveloped females. A colony can have 50,000 to 60,000 workers.

To produce 45 gr of pure honey, 17,000 honey bees work about 7000 hours.

The life span of a worker bee varies according to the time of year. Her life expectancy is approximately 28 to 35 days. Workers that are reared in September and October, however, can live through the winter. Workers feed the queen and larvae, guard the hive entrance and help to keep the hive cool by fanning their wings. Worker bees also collect nectar to make honey. In addition, honey bees produce wax comb.

8. Phylum:Echinodermata (Echinoderms)

Star Sea

Echinoderms are all marine animals. There are 7000 living and 13,000 fossil species known. Their name means "spiny-skinned". They are covered by calcified spines or plates. Under this special skin there is an endoskeleton. Althought adult echinoderms are radially symmmetrical, they have some bilateral symmetry characteristics. The digestive system includes a mouth and anus.

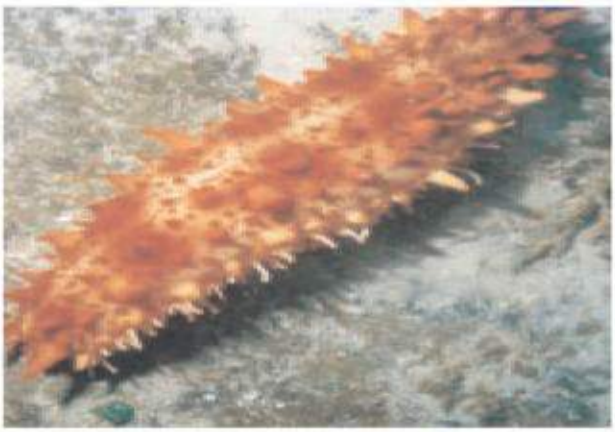
Respiratory organs are small **gills** through which oxygen dissolved in water is absorbed. hey have no a true circulatory system.

They have separate sexes. Asexual reproduction is by **regeneration**. Metamorphosis is observed during development.

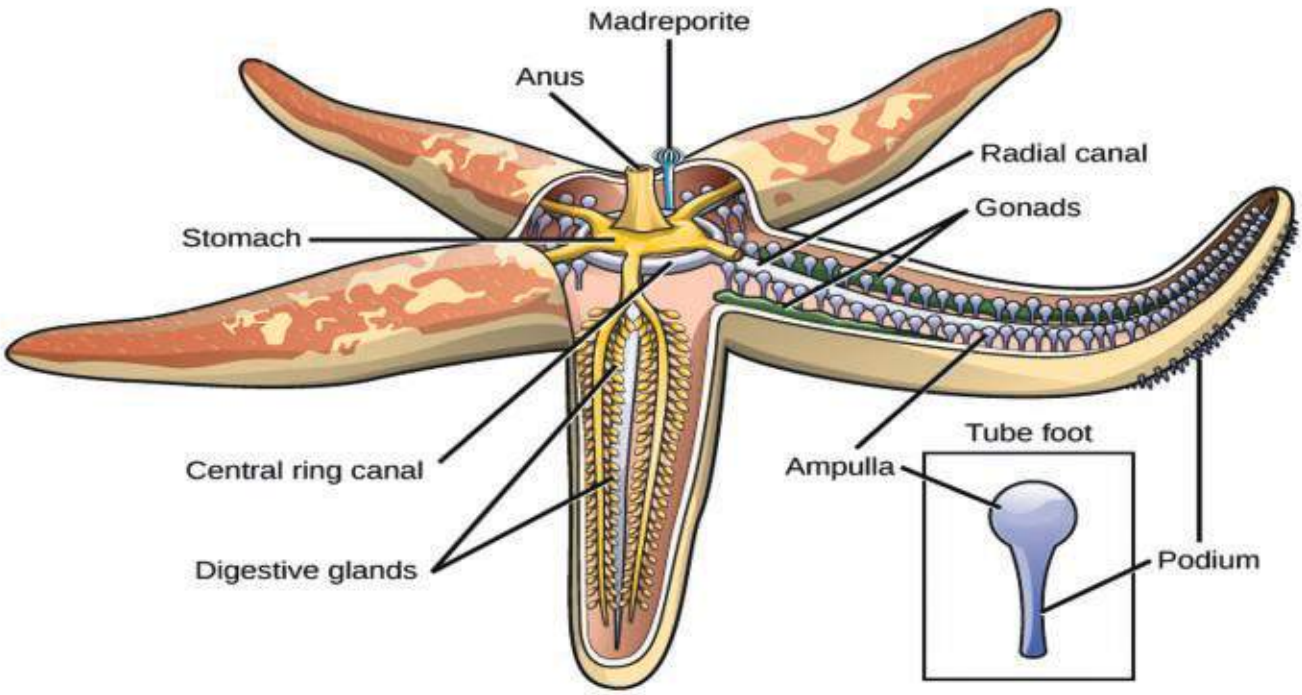
They don't have a brain.

Examples are sea star, brittle star, sea cucumber, sea urchin and sea lily

Sea urchin



Sea cucumber



Bullinus truncates

The most important shells, perform the middle host to schistosoma worm in Iraq found in different areas of Iraq.
The worm transmitted to human by swimimg in lakes and streams ,especially to children .

Middle host: an individual hosts another living organism (parasitic) to spend part of its life cycle before settling in final host body.

SELF CHECK
INVERTABRATES

A. Key Terms

Invertabrates	Larvae
Hermaphrodite	Segment
Shell	Metamorphosis
Tentacle	Hatching

B. Review Questions

1. Explain how sponges get oxygen.
2. How does tapeworm infect human body?
3. What is importance of earthworm?
4. Write the charactheristics of animals.
5. Explain the life cycle of tapeworm.

C. True or False

1. If sea star cutten into two parts each one complete itself and become two sea stars.
2. Grashopper harms the crops.
3. The arthropods body is segmented.
4. Mollusks have bone in their bodies.

D. Fill in the blanks

1. _____ is an example for segmented worms.
2. _____ are flat bodied freshwater worms.
3. Hydra reproduce asexually by _____or _____.
4. _____ are immobile animals.

E. Multiple choice

1. Which of the folllowing statements is false for animals?

A) All animals eukaryote
B) All animals are heterotroph
C) All animals reproduce sexually only
D) Most animals are motile

2. Water enters the sponge body through _____.

A) Mouth
B) Flagella
C) Osculum
D) Pores

3. Which of the following is a flatworm?

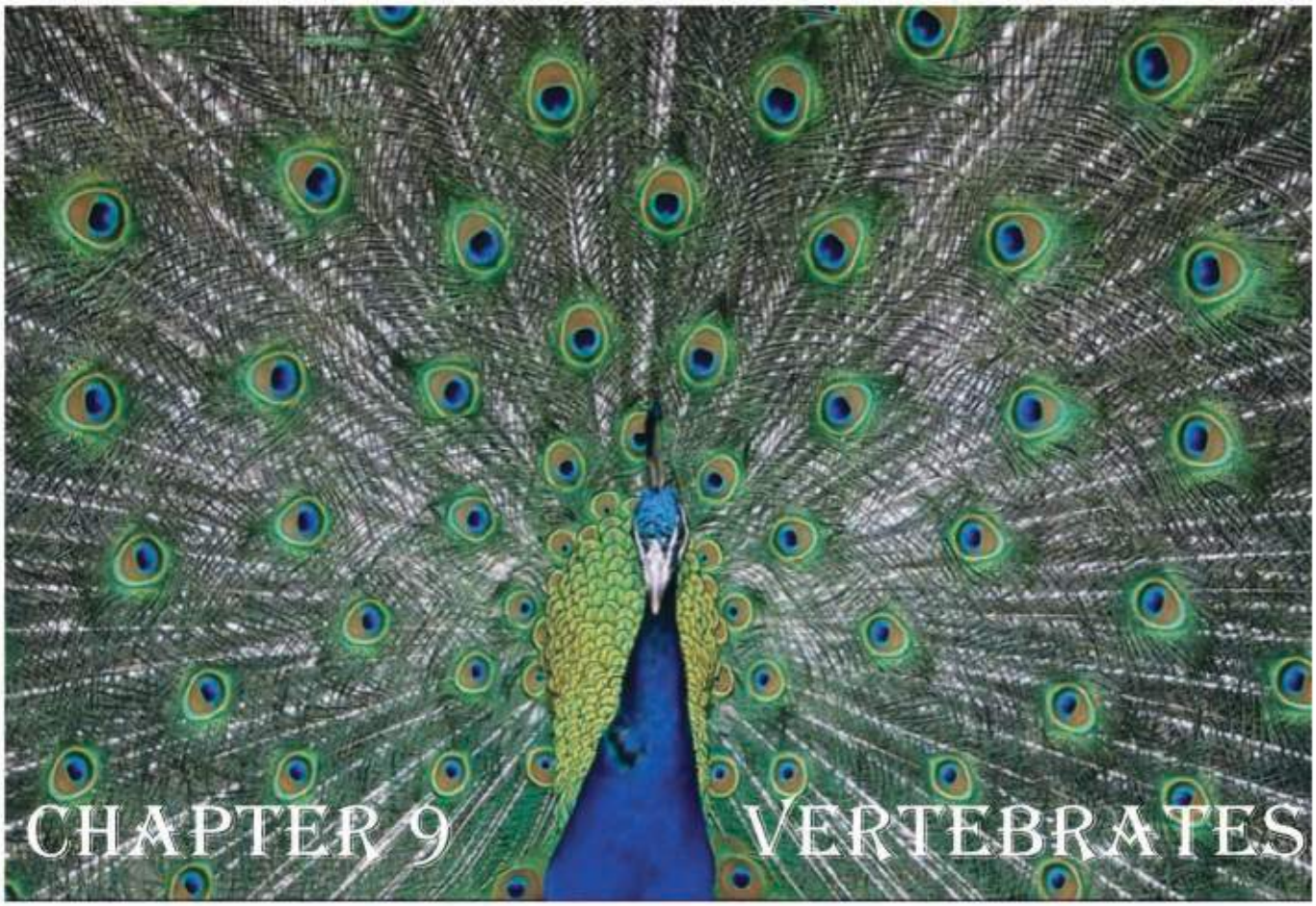
A) Jelly fish
B) Ascaris
C) Tapeworm
D) Hydra

4. _____ increase the soil productivity?

A) Earthworm
B) Ascars
C) Sponges
D) Molluscks

5. Arthropods body consist of three main parts. Which of the following is not a main part of their body?

A) Head
B) Tail
C) Abdomen
D) Thorax



CHAPTER 9 VERTEBRATES

Chordata

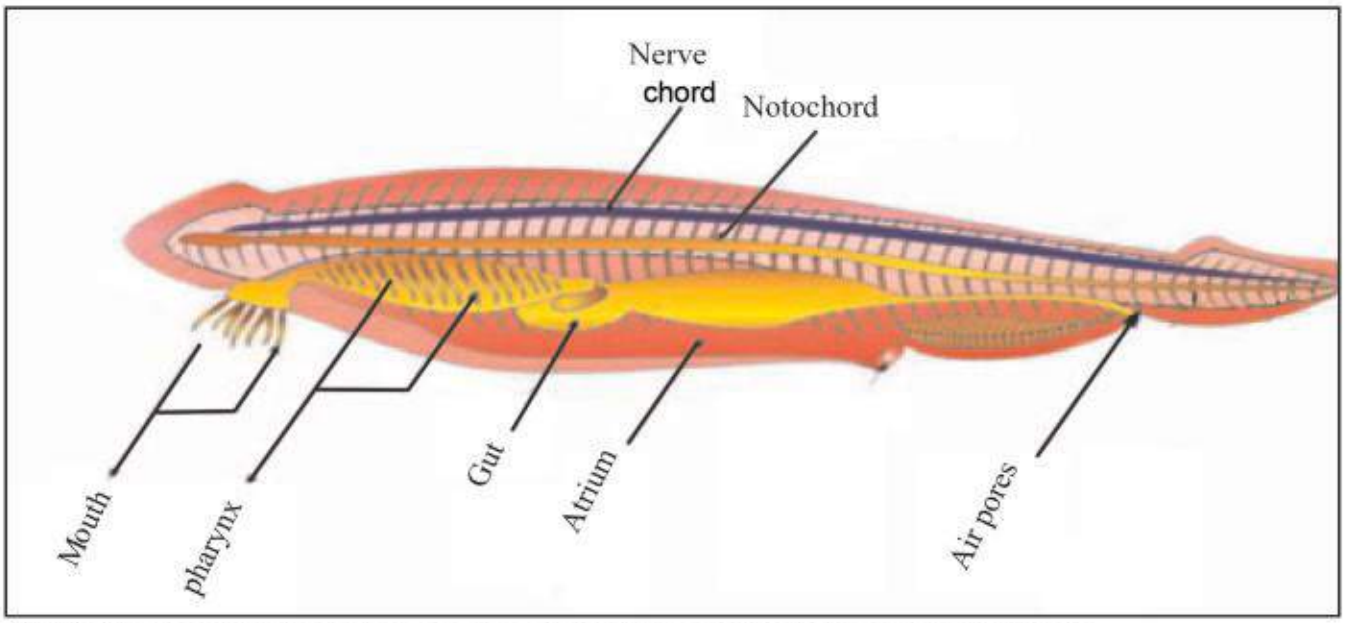
Chordata is the animal phylum which everyone is most intimately familiar, since it includes mammals and other vertebrates. However, not all chordates are vertebrates.

Chordate characteristics.

- Bilateral symmetry, three germ layers and a well-developed coelom.
- Segmented body, including segmented muscles.
- Single, dorsal, hollow nerve cord, usually with an enlarged anterior end (brain), posterior spinal cord.
- Tail projecting beyond (posterior to) the anus at some stage of development.
- Pharyngeal pouches present at some stage of development.
- Ventral heart, with a closed blood system, complete digestive system,

Amphioxus

Amphioxus species are littoral, small (5-6 cm long), translucent yellow animals. Both ends are pointed. To the anterior part of the digestive tract there are gill slits in pairs. In the area between the nerve cord and gut, is the notochord, which persists in the adult.



Structure of Amphioxus. They are intermediates between invertebrates and vertebrates.

Vertebrates

All vertebrates have developed brains and skulls (crania). The notochord is observed only in the embryo, in the fetus and adult being replaced with vertebrae. Vertebrates have an endoskeleton.

Vertebrate Characteristics

- Skeleton is jointed, either cartilaginous (in sharks and jawless fishes) or bony (all others).
- They use lung, gill and skin for gas exchange, according to their habitats.
- Digestive tract begins at the mouth, which opens to a stomach, followed by intestines, and ends in the anus. There are digestive glands.
- Circulatory system is closed. **Hemoglobin** is the pigment that carries CO_2 and O_2 in the blood. Blood is red. Heart contains 2 to 4 **champers** (atria and ventricles).

- Birds and mammals are warm-blooded, all other vertebrates are cold-blooded.

- There are two pairs of extremites. These are fins in aquatic species and limbs in terrestrial ones. Joints attaching limbs to the vertebral column are at the scapular arch and the sacral arch. Skeletal muscles function in movement.

- Most have separate sexes. Paired gonads produce germ cells released from an opening near the anus. Kidneys are the urinary organs. Metabolites, filtered by kidneys, and germ cells are carried through a common channel. Because of this, the system is called the **urogenital system**.

- Well-developed nervous system with brain and sensory organs.

Classification of Vertabrates

Class	*Example*
Cartilaginlous fishes	*Shark*
Osteoginous fishes	*Lung fish*
Amphibia	*Frog and salamender*
Reptiles	*Snake, Crocodile, Turtles*
Birds	*Eagle, Ostrich*
Mammalian	*Mice, Rabbit, Fox, Cow*

Class:Condrichthyes (Cartilaginous fish)

fish ray

Sharks, skates, and rays, make up the Chondrichthyes. Chondrichthyes all lack true bone and have a skeleton made of cartilage. Only their teeth, and sometimes their vertebrae, are calcified.

In cartilaginous fish, lungs or **swim bladder**-like structures (which help to keep fish at a certain depth) are absent, and the fish must maintain its level in the sea by the muscular efforts of swimming. Their scales are placoid (isolated structures made of dentine resembling simple teeth) that are present all over the body surface.

Their gas exchange is provided by gills. There are 5-7 gill pairs and no operculum (a flap that closes the gills). They reproduce sexually with internal fertilization. They are generally streamlined hunters.

Shark

Sharks are chiefly marine fishes found in all seas. Sharks are streamlined fish that swim by moving their trunk and powerful tail from side to side.

Sense organs of shark are more complex, particularly those for smell and vibration. Most sharks are meat eaters and active hunters. However, the two largest sharks (whale shark and basking shark) are filter feeders. They obtain food by straining microorganisms from the water.

Class :Osteichthyes (Bony Fishes)

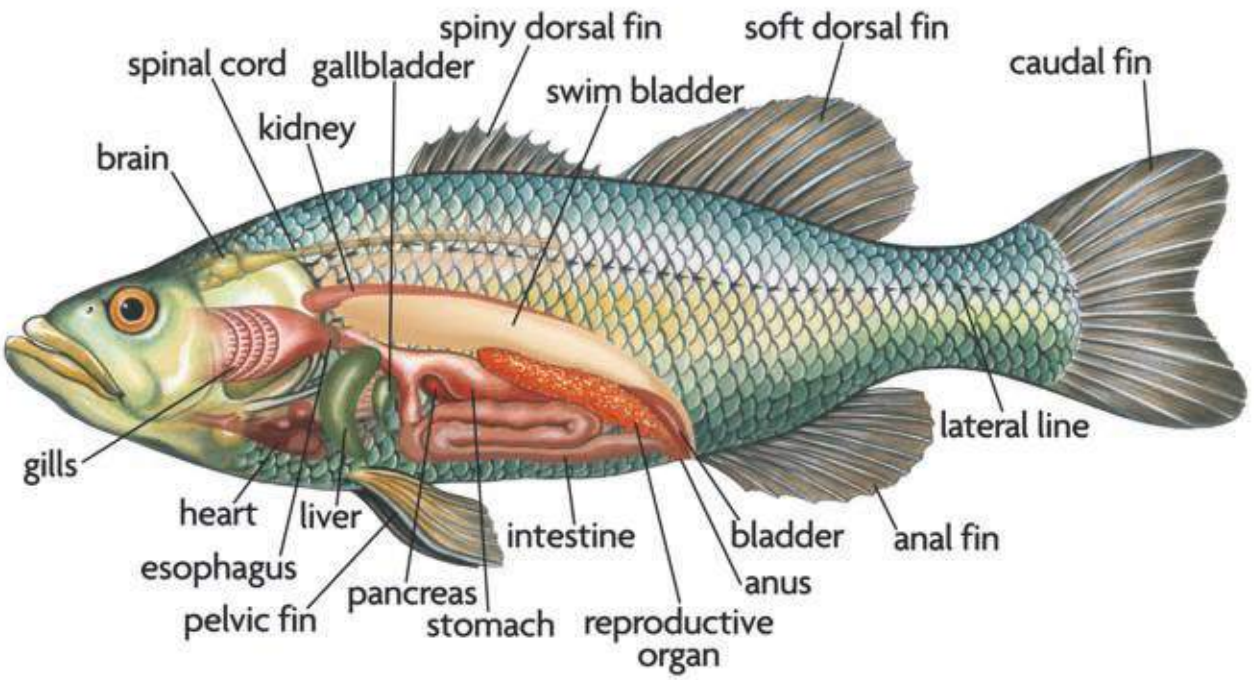
They are the most diverse group of vertebrates. They have a bony skeleton. Like Chon- drichthytes they respire by gills, but their gills are coverd by operculum. Like cartilaginous fish they have a single loop blood circulation from heart to body organs. They have a 2-chambered heart which contains only deoxygnated blood.

The nervous system of bony fish includes the brain, spinal cord and nerves.

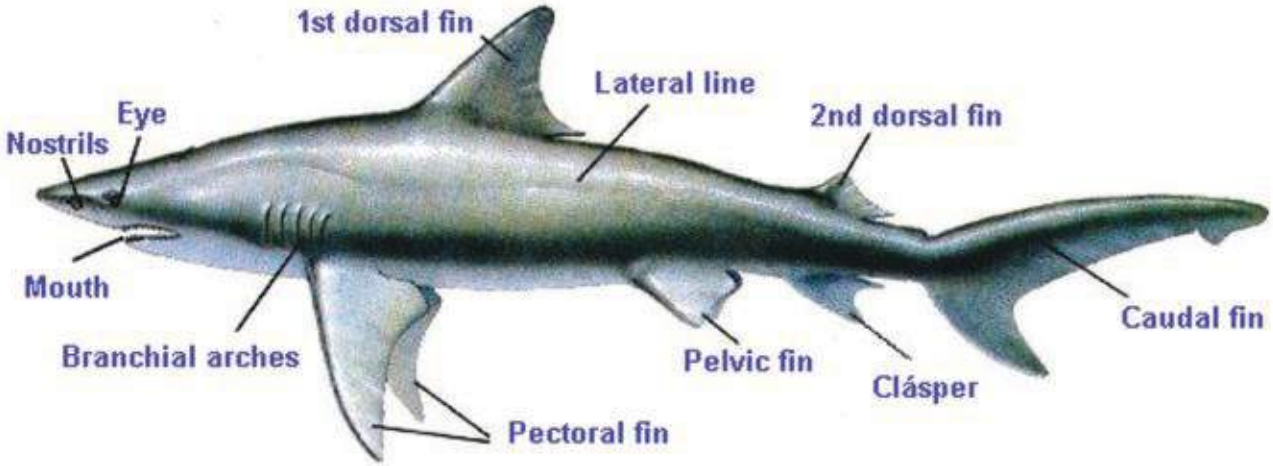
Sexes are separate.They reproduce sexually and external fertilization is seen in which sperm from the male fer-tilize eggs out of the female body. In sea horses, the female gives its eggs to the male. The male takes care of the eggs inside of its body and offspring are born alive.

Gills are the respiratory organs. In cartilaginous fishes, there are (5-7) gill pairs, but 4 in bony fishes. Unlike cartilaginous fish, bony fish have a swim bladder (a gas filled sac), because bones are heavier than cartilage. Swim bladder lets a fish control its depth in the water. Gas from the fish's blood diffuses into the swim bladder and fills it like a balloon. The fish then floats higher in the water. When gas diffuses out of the swim bladder, the fish can go deeper.

SEA HORSE IS THE SMALLEST BONY FISHE , IT HAS UNIQUE REPRODUCTION MECHANISM



Internal body structure of bony fishes



External body structure of bony fishes

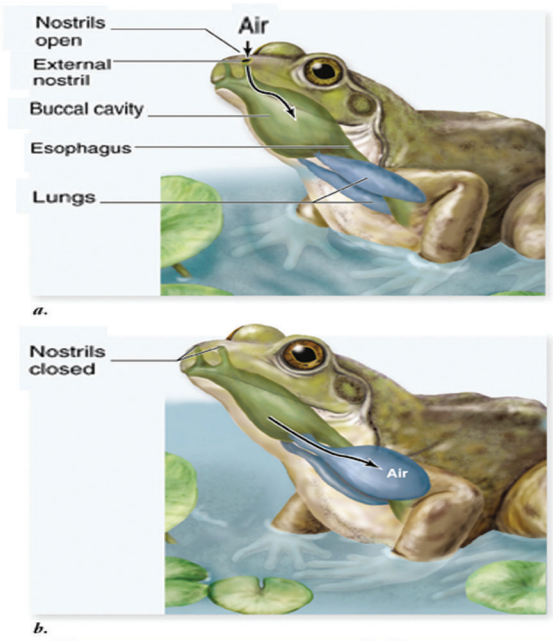
Class: Amphibia

Amphibia means double-life. Amphibians either live entirely in water or usually, they return to the water for reproduction. Eggs hatch in water. The embryos develop into larvae which are called tadpoles. They live in water and completely depend on gill respiration (some salamenders remain in this form). They feed on aquatic plants. After some time, tadpoles undergo metamorphosis. During metamorphosis some hormonal changes occure and larvae become adults. Adult amphibians lose their gills, tails and caudal fins.

Amphibians have mucus glands and poison glands under the skin. Skin secretions protect the body from bacteria and retain moisture. Amphibians are the first vertebrates with legss. Previous classes have no legs, but amphibians use their legs for movement.

The amphibian respiratory system

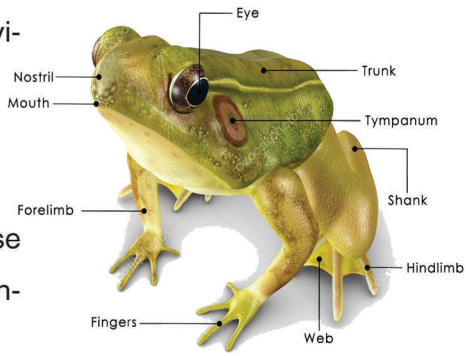
Amphibians have interesting respiration characteristics. The larvae of amphibia respire by their gills, while they exchange gases through their skin and lungs in the adult phase, since the absence of alveoli in the lungs of an amphibian reduces the available respiratory surface area. As a result, during the life cycle of an amphibian, three types of respiration are observed: through gills, lungs and skin.



The amphibian respiratory system

The amphibian circulatory system

The amphibian heart consists of two atria and a ventricle. It pumps blood to tissues and lungs. They are known as **cold blooded** (poikilothermic) animals. Their body temperature depends on environmental temperature.



Hibernation

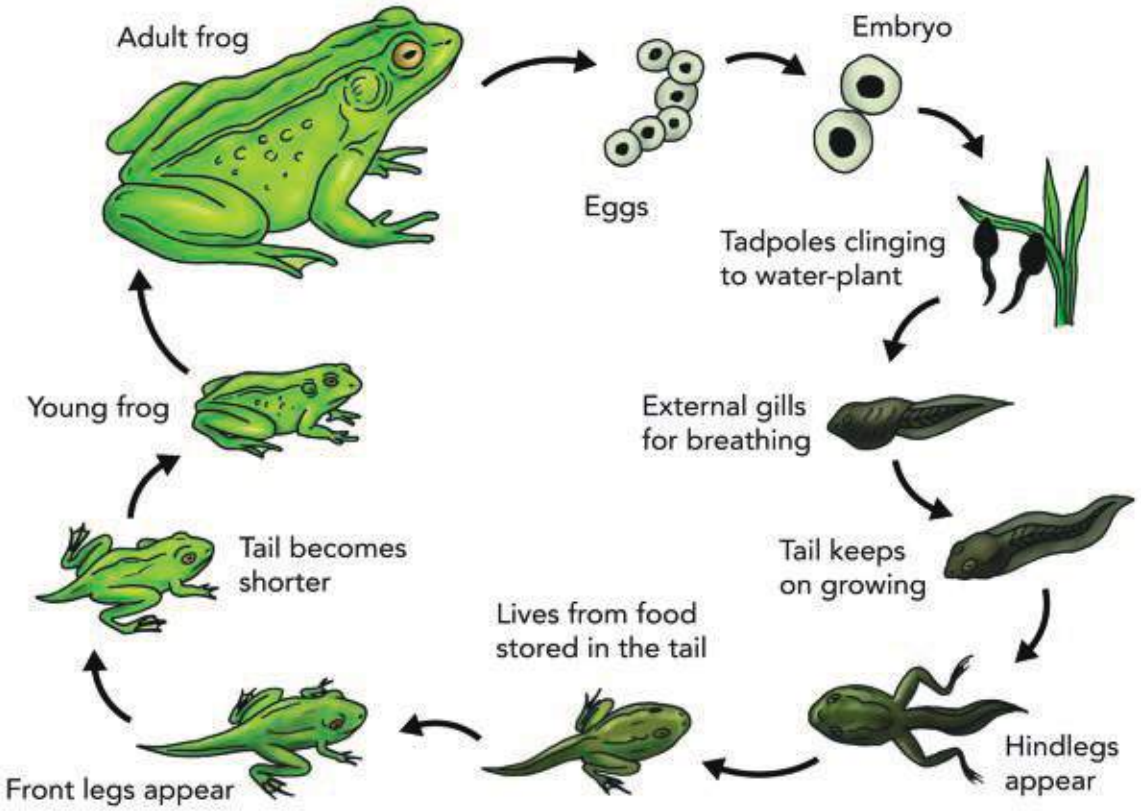
Hibernation is a period of life in some animals which decrease their life activities to the lowest level. Frogs body temperarure is not constant (cold blood animals) ant they are also hibernating animals.

During this period;

1- They move to the deep of water and hide themself in mud.

2- Close their mouth and nose and respire with skin and use stored fat in their body as source of energy.

3- As spring comes their body temperature increse and start an active life.



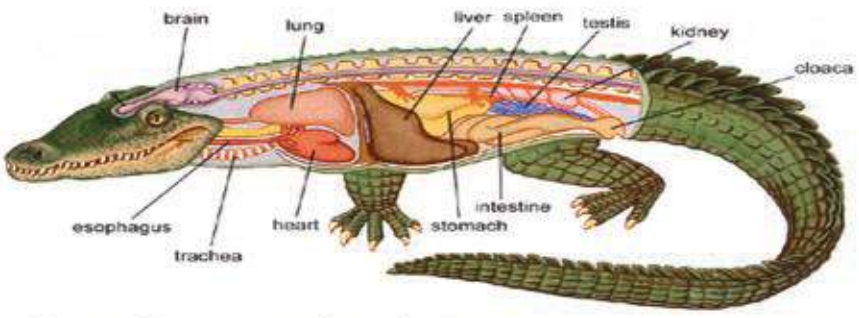
Life cycle of frog

Class: Reptilia

- They have dry, scaly, waterproof skin which protects the body from drying out and from predators.
- They have some glands in their skin.
- They can not internally regulate their body temperature. Their body temperature depends on the environment temperature.
- Because of their scales, reptiles can not use their skin for respiration. Therefore, reptiles have well-developed lungs
- Reptiles have a circulatory system with a 3-chambered heart.
- The nervous system of reptiles is similar to other vertebrates'. Brain and spinal cord direct and coordinate body functions.

Reproduction in Reptiles

- Unlike amphibians, reptiles do not need water in which to reproduce. Reptiles have reproductive organs that are adapted for intenal fertilization.
- The female then lays the egg on land. The shell keeps the egg moist and protects it from injuries.
- An embryo passes its early period of development within an egg. When the reptile hatches, it can breathe on land. There is no larval stage.
- The young reptile looks like a small adult. As in birds, reptilian eggs are rich in yolk, but the shell is more flexible.
- Reptiles are cold-blooded animals like amphibians.



Internal anatomy of reptiles

Snake

All snakes have a tubelike body covered by scales. They have no legs, so they move on their belly. On the other hand they have some special organs for hunting. Snakes have several well-developed sense organs that help them in finding prey.

Snakes have an inner ear, but no external opening. They can not hear but they can detect vibration in the ground through their lower jaw.

Snakes have pour vision. They do not have movable eyelids. The eyes of snakes are especially adapted to detect quick movement.

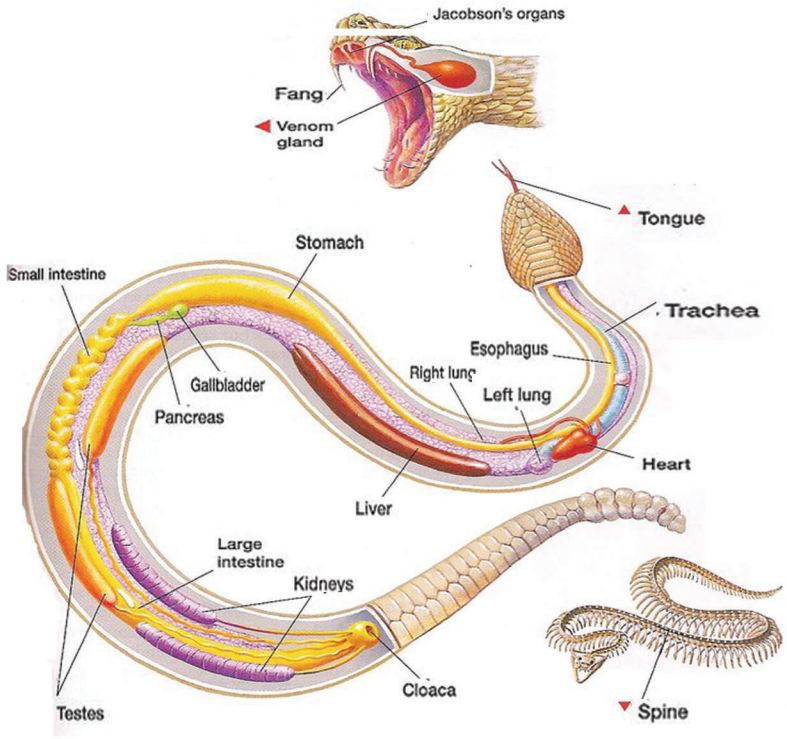
They have a special organ in the mouth called the Jacobson's organ. Jacobson's organ is a sense organ for smelling.

They also have a thermoreceptor, called a pit organ, on their head between the eye and nostril. It is a heat detecting organ. By using this organ snakes can track and strike warm-blooded prey, even at night or in deep burrows. Snakes are **carnivores**.

They eat other animals and the eggs of other animals. Snakes swallow their food whole even when the prey is much larger than their mouth, because their jaws unhinge. This structure allows the mouth to open very **wiht**. The ribs of snakes are unattached at one end, so the snake body stretches to make room for the food. After a large meal, a snake may go for weeks or months without eating.

Actually snakes have a bad reputation, because only 200 of the 2500 known species are poisonous. They produce venom. They kill their prey by injecting them with special teeth called fangs. Venom is produced by special glands located in the head.

Some poisonous snakes are the rattlesnake, cobra, and eastern green mamba Other snakes, such as boa constrictor and python, kill their prey by strangling it. The anaconda is the longest and most powerful snake in the world. An adult may be 6m long and weigh 107 kg. The anaconda kills its prey by constriction, or squeezing.



Class: Aves (Birds)

There are over 8,000 species of birds which vary in sizes, shape and colors. Because they can fly, distribution of birds is wider than other terrestrial vertebrates. Birds show great diversity. The **beaks**, foot, wing and tail are highly variable and adaptable organs.

The bird body is remarkably covered with **feathers**. Feathers provide insulation and prevent water loss, and function in flight.

Their tongues are hard and they have **beaks** without teeth.

Their anterior extremites are wings which function in flight.

A rib cage protects internal organs.

Birds are warm-blooded: they maintain a constant body temperature as result of metabolic heat. Birds have no sweat glands and cannot cool the body by perspiring.

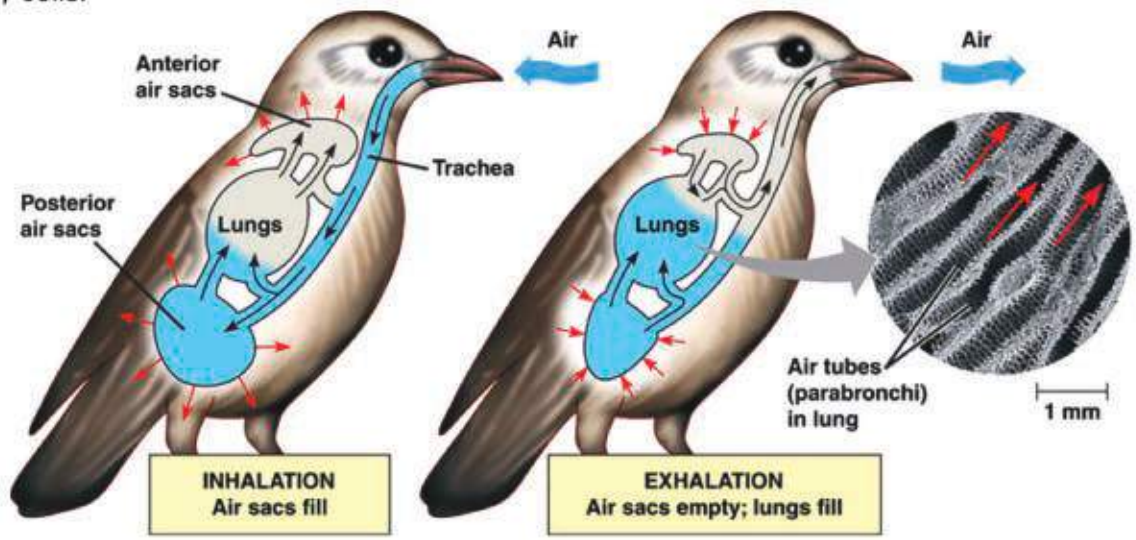
Development and reproduction is similar to that of reptiles.

Eyelids are movable. There are upper, lower and inner eyelids.

Respiratory system

Birds need high amounts of energy to fly. Where do birds get this energy? They have very complex systems to take in oxygen and transport it to their cells. Birds have lungs and a series of **air sacs** throughout their body for breathing.

These sacs cause much of the body cavity to be filled with air. Air enters the respiratory system through the nostrils and flows into the lungs and then to the air sacs. Air sacs increase the oxygen storage capacity of birds. The oxygen taken by the lungs passes to the blood and is carried to the body cells.



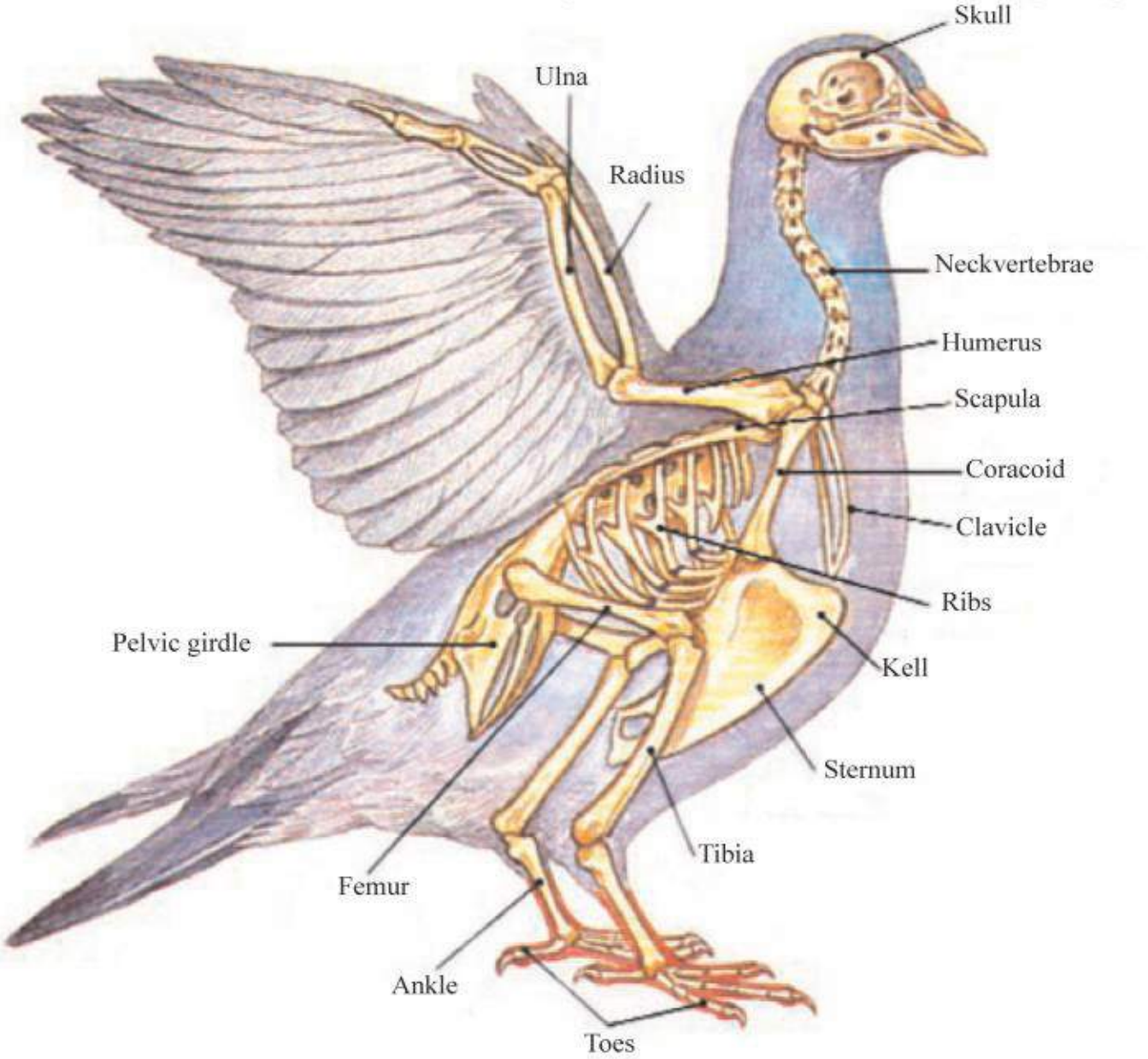
respiratory system of bird

Circulatory system

Birds have a four-chambered heart. The heart completely separates oxygenated and deoxygenated blood. These two kinds of blood do not mix.

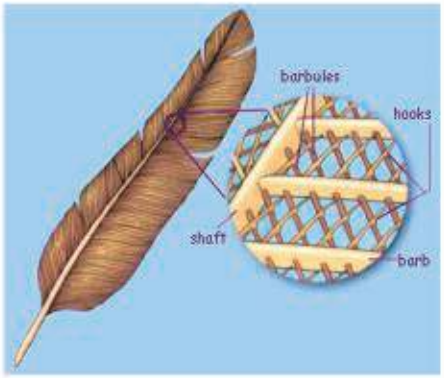
Skeletal and Muscular System

The bones of birds have hollows in their structures. No other vertebrates have hollow bones. The hollow spaces are filled with air and make the bones light. Thus, the bones of birds are both strong and light.



Skeletal system of birds

Feathers



Feathers are lightweight and flexible. They provide a body covering that protects the skin, supports the bird in flight, and provides insulation from the weather. In many species, the male and female differ in coloring, with the male generally brighter. Birds have three types

Feeding and Digestion

Birds need high amounts of food to satisfy their high energy needs. For example, a hummingbird may eat an amount equal to 100 percent of its body mass each day. Birds do not have teeth and can not chew their food. Instead, they take in food using their beaks.

The beaks of birds may have different adaptations according to their feeding strategy. Woodpeckers have long, thin, tweezer-like beaks to pull insects from cracks in the bark of trees. Ducks have wide, flat beaks to strain food from water. Hawks have sharp and hooked beaks to tear the flesh of their prey. The pelican uses its long, sharp beak for catching fish. Birds swallow their food whole and grind it down in a structure called a **gizzard**. Birds feed their offspring by vomiting through their gizzard. Food is digested very quickly. For example, a bird can eat berries and digest them.

Variations in Beaks and Feet of Some Birds of Prey

Reproduction

In birds, fertilization is internal and embryos develop inside shelled eggs. Birds lay eggs with a hard shell. Bird embryos need to be kept warm to develop. Therefore, adult birds incubate their eggs or warm them with their bodies.

The hard shell keeps the growing embryo from being crushed during incubation. When a chick is completely formed, it cracks through the shell with a special egg tooth on its beak. This tooth falls off soon after the chick hatches. When most birds hatch, they are covered only by down feathers and are completely helpless. Their parents keep them warm and bring them food until they are ready to leave the nest.

Migration

One of the most interesting behavior of birds is migration. **Migration** is the instinctive movement of animals, usually between their wintering grounds and their breeding seasons.

Most of the arctic birds and some tropical birds migrate. However they have regular seasonal movements away from and back to the breeding area. The most famous is the arctic tern, which migrates from the northern latitudes of Eurasia and North America to Antarctica.

Long distance migration raises the intriguing question of how birds find their way. Some fly only at night, others over trackless seas. Scientists know that no single navigation system exists. Some birds seem to steer by star patterns and others by the angle of the sun. At least some birds can detect ultraviolet radiation or the magnetic field of the earth, but the actual sensory mechanism by which birds translate environmental signals into navigational aids is still a puzzle.

Hawk

Owl

Duck

Pearching bird

Hauk

Class: Mammalia

Mammary glands (in females) and hair covered bodies are characteristics of mammals. Other features include: hair covers the skin. Hair originates from the epidermis, while hair follicles are in the dermis. They are warm-blooded and their hearts have 2 atria and 2 ventricles. Respiratory system is well-developed. Most have a placenta and give birth to live young. Fertilization is internal but their young develop in different ways. Female mammals have mammary glands which produce milk. They feed their young with milk. Brain function and mobility are developed. Mammals range
in size from 5 cm to 30 meters.

Classification Of Mammals

Egg-laying mammals

These organisms do not have a placenta. The urogenital opening is a cloaca into which the large intestine, and urinary and genital ducts open. This feature is shared with reptiles and birds. These are egg-laying animals, but they feedtheir young with milk produced by mammary glands.

Spinny anteater

There are many extinct species and a few living species.

Examples are the duck-billed platypus and the spiny anteater.

Marsupial

Worldwide, there are approximately 272 species of marsupials (subclass Metatheria). The vast majority (about 200 species) live in the Australian region, while another 70 marsupial species are found in Central and South America.

A marsupial youngster is so tiny at birth that its mother's pouch is effectively the only environment in which it could survive. Infants typically weigh less than 1% of their mother's body weight.

At birth, newborn marsupials emerge from their mother's reproductive tract and crawl immediatelyand instinctively into her pouch. Using their forelimbs, the young pull themselves along the mother's belly by grasping hairs and begin to suckle from her nipples.

Tasmanian Devils

Tasmanian Devils are large, meat-eating marsupials. They have large powerful jaws and teeth. They are black in color, with a white band. They have hairless pink ears. Females have a backward-opening pouch. Tasmanian Devils are found only in Tasmanian habitats, including rainforests, eucalyptus forests, farmlands, and even outer city suburbs. Tasmanian Devils are nocturnal, spending the daytime sleeping in dens made in hollow logs, caves or old wombat burrows which they line with grass and leaves.

Tasmanian devil

Placental Mammals

Nearly 95% of mammal species found today are in this group. The placenta plays an important role in embryonic development, functioning in excretion, respiration, and the transfer of nutrients from the mother to the embryo.

Unlike egg-laying and pouched mammals, the young of placental mammals develop totally within the female. The placenta is a structure by which the embryo receives food and oxygen from its mother and removes waste materials before birth. After the young are born, females supply their young with milk.

There are more than 20 groups of placental mammals. They are grouped according to how they eat, how they move or where they live.

Flesh eating mammals

Flesh-eating mammals are called **carnivores**. Carnivores are predators. Most carnivores have sharp, pointed teeth, called canines, that they use for tearing meat. You also have canines; two in the top set of teeth and two at the bottom. Most carnivores are strong, fast and have sharp claws.

They also have a well-developed sense of smell. Their powerful jaws, large claws and good sense organs help them in hunting. Most carnivores, such as lions, wolves and bears, have very strong, muscular legs that help them chase other animals.

Flying mammals

Bats are the only flying mammals. Bats are able to fly because they have skin stretched over their arms and fingers, which forms wings. There are two types of bats: fruit eaters and insect eaters. Fruit-eating bats are found in tropical areas, such as Africa, Australia, India and the Asian countries. Insect-eating bats live almost everywhere.

The vampire bat, which is found in Central and South America, hunts mainly cattle. To obtain blood, the bat bites off a small piece of skin and then laps up the blood.

Bat

Hoofed mammals

What do sheep, camels, horses, and rhinoceroses have in common? Not much at first glance. They look very different. Yet look again. The feet of these animals end in hooves. One kind of hoof has an even number of toes and belongs to such mammals as deer, hippopotamus, llama, camels, goats, cows and giraffes. The other kind of hoof has an odd number of toes and belongs to mammals such as horses, rhinoceroses, zebras and tapirs.

Hoofed animals are among the most important "partners" of human beings and have been for thousands of years. People eat their meat, drink their milk, wear their skins, ride on them and use them to pull devices used in farming. Most of the hoofed mammals are herbivores. Herbivores are organisms that feed on plants .

Rhino

Zebra

Mammals with trunks

This group includes only elephants. They are the largest land animals. The trunk is the distinguishing feature of all elephants. It is powerful enough to tear large branches from trees. Yet, at the same time, elephant trunks are capable of such delicate movements as picking up a single peanut thrown by a child at a zoo. The trunk of an elephant contains 50,000 different muscles. This trunk can hold about 4 L of water. Elephants consume as much as 225 kg of forage a day and drink as much as 190 liters of water.

The largest animal on land at the moment on this planet is a mammal; the bull African Elephant. The largest specimen recorded stood around 3.96 m at the shoulder and weighed over 12 tons.

Aquatic mammals

There are 78 known species of aquatic mammals, like dolphin, whales and dugongs. Whales and dolphins spend their entire lives in the ocean and cannot survive on land. They can remain underwater for long periods of time. Dugongs live in shallow water, often in rivers and canals.

Aquatic mammals are air breathers. Like other mammals, aquatic mammals give birth to live young, which are fed with milk.

Whales are huge aquatic mammals. They have lungs like other mammals. They breathe air through a single nostril on the top of the head. Some whales can hold their breath up to 50 minutes while diving, and others up to 75 minutes. The life span varies: for small toothed whales such as the beluga it is thought to be about 30 years; for the sperm whale it is up to 70 years; and baleen whales probably live for as long as 80 years.

Dolphin

Dolphins, like whales, breathe through a blowhole at the top of the head. Dolphins are superbly streamlined and can sustain speeds of up to 30 km/h, with bursts of more than 40 km/h. They dive to depths of more than 300 m. Dolphins are intelligent. They are able to learn and perform complex tasks in captivity. Some investigations suggest that the animals might be capable of learning a true language and communicating with human beings.

Dolphin

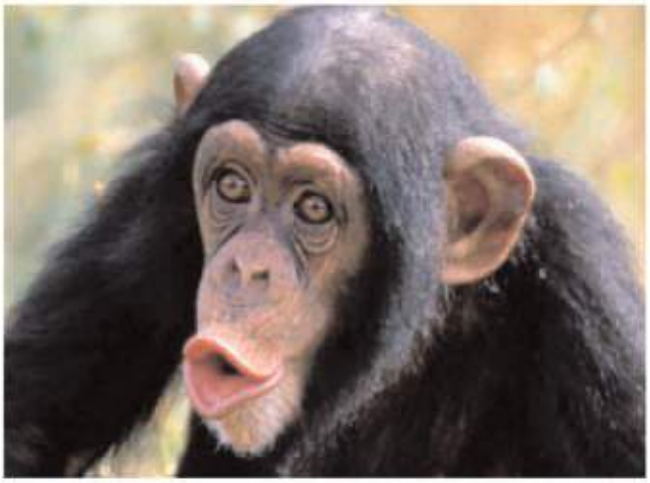
Primates

Baboon, lemur, gibbon, chimpanzee, orangutan, monkey, and gorilla are members of the same group, called primates. The primates have five fingers on each hand and five toes on each foot. The fingers are capable of very complicated movements, especially grasping objects. Their fingers and toes have flat nails instead of claws. Most primates live in trees, gorillas and baboons, which live on the ground. Primates eat both plants and meat. Monkeys and apes walk on all four limbs, but they may run upright using only their hind legs.

Baboon

Orangutan

Chimpanzee



Interesting Facts About . . . Cats

1. On average, cats spend 2/3 of every day sleeping. That means a nine-year-old cat has been awake for only three years of its life.

2. A cat can't climb head first down a tree because every claw on a cat's paw points the same way. To get down from a tree, a cat must back down.

3. A cat can travel at a top speed of approximately 31 mph (49 km) over a short distance.

4. A cat can jump up to five times its own height in a single bound.

5. Some cats have survived falls of over 65 feet (20 meters), due largely to their "righting reflex." The eyes and balance organs in the inner ear tell it where it is in space so the cat can land on its feet. Even cats without a tail have this ability.

6. Most cats give birth to a litter of between one and nine kittens. The largest known litter ever produced was 19 kittens, of which 15 survived.

7. Cats hate the water because their fur does not insulate well when it's wet. **8**. The Turkish Van, however, is one cat that likes swimming. Bred in central Asia, its coat has a unique texture that makes it water resistant.

9. A cat's jaw can't move sideways, so a cat can't chew large chunks of food.

10. Cats have 32 muscles that control the outer ear (humans have only 6). A cat can independently rotate its ears 180 degrees.

11. A cat has 230 bones in its body. A human has 206. A cat has no collarbone, so it can fit through any opening the size of its head.

12. A cat's heart beats nearly twice as fast as a human heart, at 110 to 140 beats a minute.

The Van cat is a distinctive landrace of domestic cat, found mainly in the Lake Van region of eastern Turkey. It is large, all-white, and frequently odd eyed.

SELF CHECK
VERTEBRATES

A. Key Terms

Hemoglobin	Gills
External fertilization	Swim bladder
Tadpole	Hibernation
Poikilothermic	Gizzard
Migration	Primates

B. Review Questions

1. Give an examples for each group of mammals .
2. Explain the respiratory system of birds .
3. Draw the structure of bird's egg .
4. Explain what frogs do during hibernation .
5. Draw the internal body structure of bony fishes .

C. True or False

1. When gas diffuses into swim bladder fishes can go deeper.
2. Adult frog respire by skin.
3. Reptiles have 4 chambered heart.
4. Birds are warm blooded animals.
5. Bats are only flying animals.

D. Fill in the blanks

1. Flesh eating mammals are called as _____.
2. Embryo receives food and oxygen from its mother by _____ in placental mammals.
3. In birds embryo grows in _____.
4. _____ increase the oxygen storage capacity of birds.
5. Reptiles are cold-blooded animals like _____ and _____.

E. Multiple choice

1. Which of the following is false for vertebrates?

A) Circulatory system is closed
B) Most of them hermaphrodite
C) They have skeletal muscles for movement
D) They have digestive glands

2. Which of the following is a hoofed mammal?

A) Elephant
B) Bat
C) Tiger
D) Zebra

3. Amphibia have three kinds of respiration in their life cycle. Which of the following is not one of them?

A) Gills
B) Lungs
C) Tracheal
D) Skin

4. Which one is false for reptiles?

A) They have waterproof skin
B) They have three chambered heart
C) They do skin respiration
D) They are cold blooded

5. The beaks of birds have different types according to .

A) Ability of flying
B) Respiration type
C) Feeding strategy
D) Shape of egg

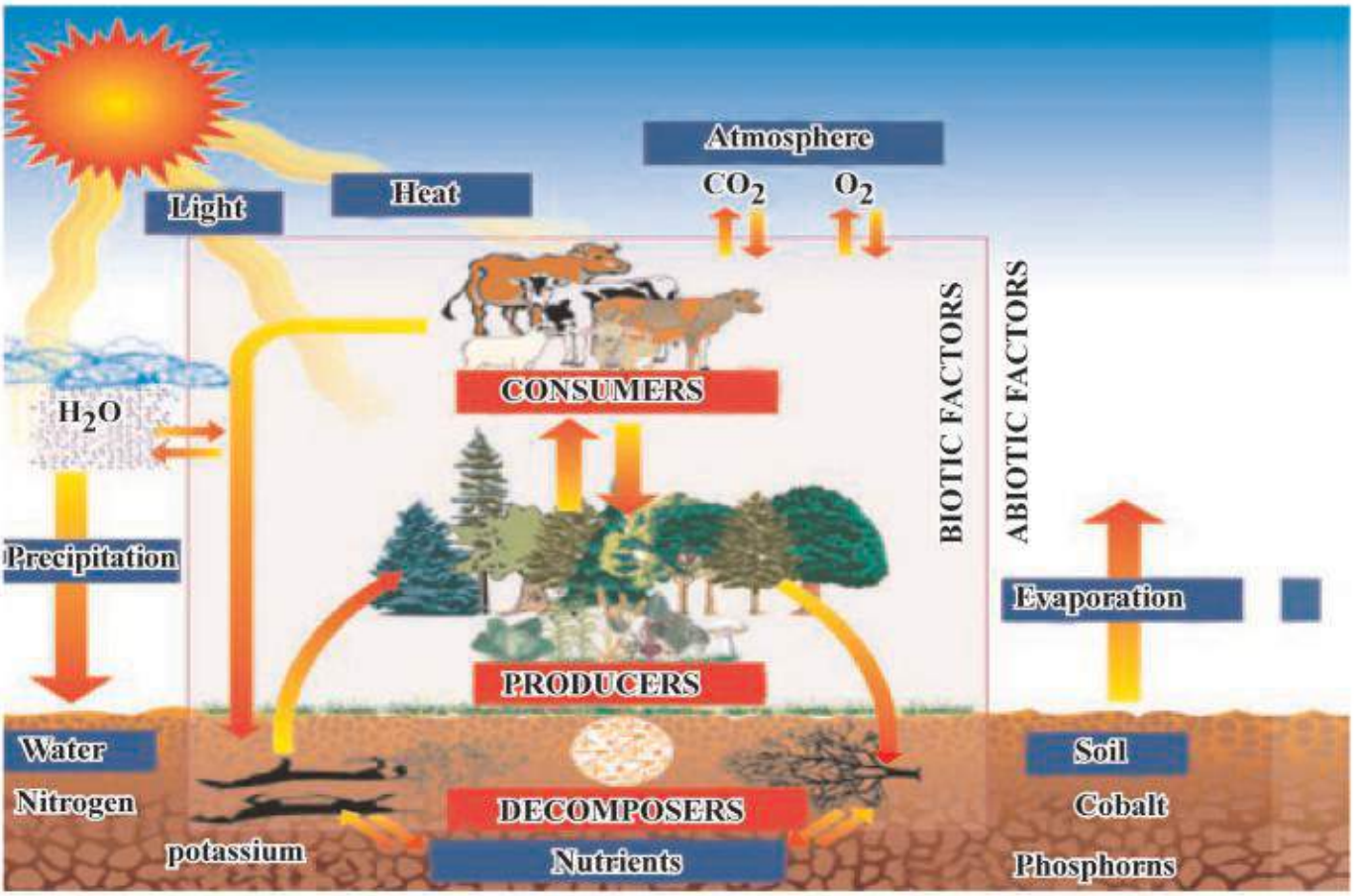
CHAPTER 10
INTERACTIONS OF LIVING ORGANISMS

Ecology

Ecology is the study of the interactions between organisms and their environment. An ecosystem (environment) is all the living and non-living factors that surround an organism. The ecosystem includes the biotic (living) community, together with the associated abiotic (nonliving) components. The abiotic components of an ecosystem include soil, water, light, inorganic nutrients, and weather.

Consumers are heterotrophic organisms that can not produce their own food. Four types of consumer can be identified according to their food source. **Herbivores** (also called primary consumers), such as sheep, eat plants directly. **Carnivores** (secondary or tertiary consumers), such as lions, feed on other animals. **Omnivores**, such as humans, feed on both plants and animals. Decomposers are organisms of decay.

Interaction is a key idea in ecology. No organism is completely self-sufficient. Organisms depend upon other organisms and upon the environment for survival.

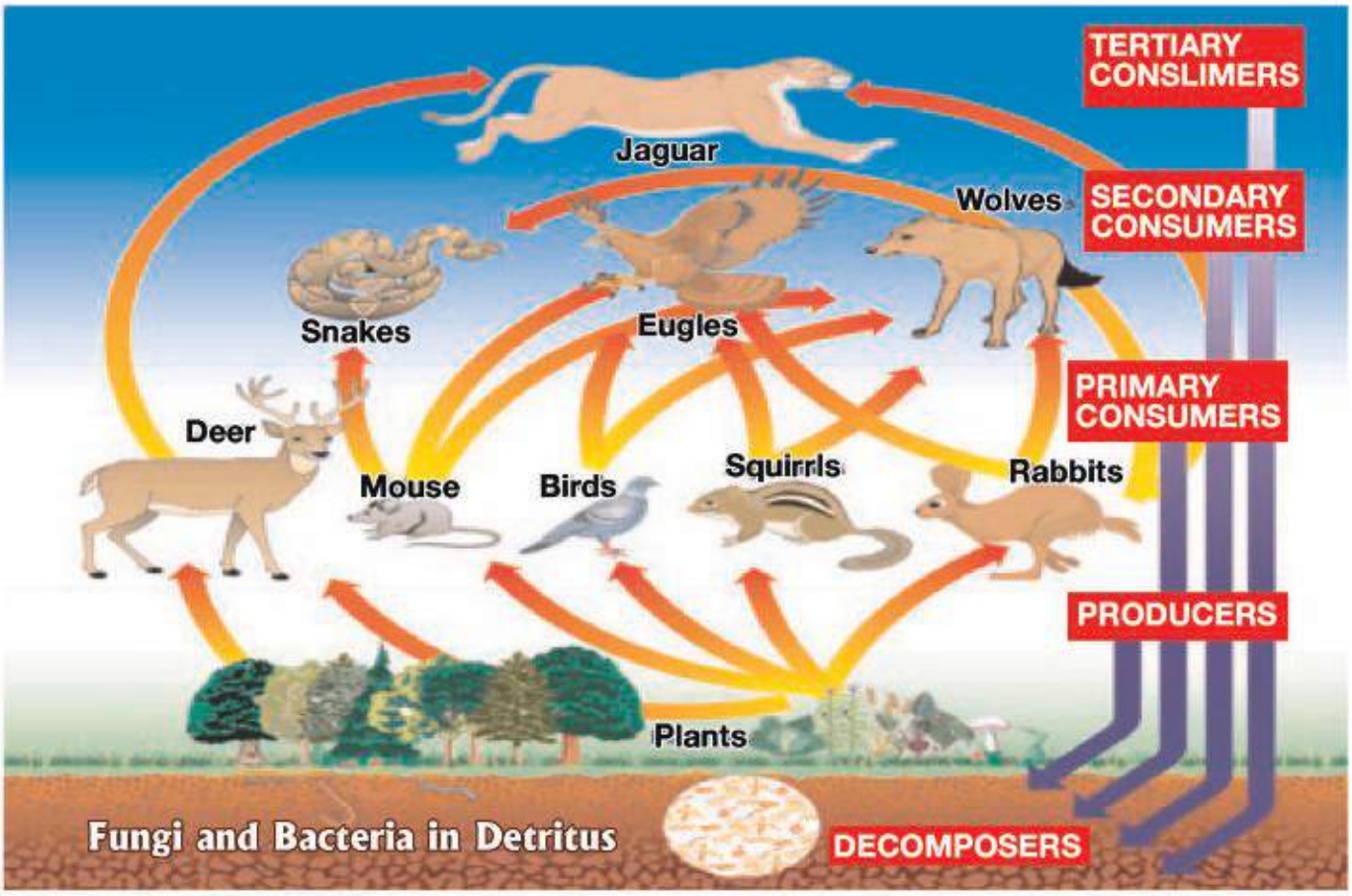


Food chain

All organisms need energy to live and complete their life cycle. The main source of energy is the radiant energy from the sun, but not all organisms can use it directly.

The series of steps through which energy is transferred from the sun to organisms (producers, consumers, decomposers) in an ecosystem is called the **food chain**. In any region, there are producers, consumers and decomposers. These are like the links of a chain. The absence of a link breaks the association. Plants and other photosynthetic organisms produce food and oxygen. Animals, fungi, and other nonphotosynthetic organisms must consume other organisms for food.

Actually a single species interacts directly or indirectly with nearly all the other species in its environment. For example, a bird in a forest interacts not only with the plants it eats or with the predators that eat it but also with the plants it uses for cover or shelter, with insects that share its nest, with other animals that use its abandoned nest for shelter, with the bacteria that live on its skin, and so on.



Food web

Extinction

Human activities day after day change the ecological balance in the world. Changing the ecological structure reduces the natural habitat of many wild animals. Some animals can migrate to other places, but many other plants and animals can not. Remaining in the same place leads to their **extinction**.

A reduction in biological diversity is occurring worldwide. When the last member of a species dies, that species becomes extinct. A species whose numbers are severely reduced so that it is in danger of extinction is called an **endangered species**.

When extinction is less eminent but the population is quite low, a species is called a threatened species. Many human activities, such as habitat destruction, pollution and hunting, reduce biological diversity. Habitat loss is the most significant factor in the decline of biological diversity.

Environmental problems

A balance in environmental systems ensures the continuity of living and nonliving components. Up until the second half of the 20th century, there was a balance between input matter and output matter (examples of input and output matter include gases, water, salts, energy and various wastes). A great increase in population, and scientific and technological revolutions, are some modern features of the century we are living in. Human activities have increased the manufactured substances that pollute our environment. Modern economic development sometimes disrupts nature's delicate balance. There are many types of environmental pollution.

Greenhouse effect

Production of atmospheric pollutants traps solar heat in the atmosphere and may affect the earths climate. Carbon dioxide (CO_2) and other greenhouse gases cause the air to retain heat, which warms the earth. The increase in CO_2 and other greenhouse gases in the atmosphere is causing concerns about major climate changes that may occur during the next century. The **combustion** of fossil fuels produces pollutants, especially CO_2 and other greenhouse gases like methane, nitrogen oxide, CFCs, and ozone.

Effects of global warming

Global warming may cause a rise in sea level, changes in precipitation patterns, the death of forests, the extinction of animals and plants, and problems in agriculture. It could result in the displacement of thousands or even millions of people.

SELF CHECK

INTERACTION LIVING ORGANISMS

A. Key Terms

Ecology
Abiotic
Consumer
Carnivores
Biotic
Herbivores
Omnivores
Decomposers

B. Review Questions

1. Draw a simple food web.
2. Explain why organisms not completely self sufficent.
3. Explain environmental problems.
4. Explain how organisms become extinct.

C. True or False

1. Oxygen and other greenhouse gases cause warm the earth.
2. Global warming may cause a rise in sea level.
3. A reduction in biological diversity occuring worlwide.
4. The main source of energy on earth is sun.

D. Fill in the blanks

1.Carnivores are animals like _____.
2. _____ is a key idea in ecology.
3. _____ are organisms of decay.
4. CO_2 and other gases like _____, _____, are green house gases

E. Multiple choice

1. Dominant producers are _____ in frshwater ecosystem.

A) Algae
B) Fungae
C) Plants
D) Consumer

2. Which of the following absorb sunlight energy directly?

A) Carnivores
B) Herbivores
C) Producers
D) Parasites

3. Which of the following is not abiotic factor?

A) Soil
B) Water
C) Plants
D) Light

4. Which of the following is not a greenhouse gas?

A) Carbondioxide
B) Ozone
C) Nitrogrn oxide
D) Methane