DEFINITION OF FISH AND LIVING CONDITIONS

*Fishes are cold-blooded=poikiloterm vertebrate animal with fins to swim and gills to breathe with the oxygen in water. They adapt to live in aquatic environment and mostly covered with scales on their skin.

Pisces /Fishes
20 000 species

Approximately 70.8 percent of the Earth is covered by water

“Fish can live in almost every places where water is.

- In the surface and underground waters
- -2^0C $+ 44\ ^0C$
- In fresh and 0.142% saline waters
- In rivers and lakes
- 4000 metres above the sea level
- 7000 -11000 metres under the sea level (Mariana trench)

Fish

58% live in the sea

41% in freshwater

1%, the so called diadromous fish,

occur in both ecosystems, at different stages of their life cycle.

Of this total marine fishes (58%),

13% is the marine fish and

they live in the open sea or offshore (PELAGIC)

% 1 surface waters-pelagic

% 5 deep-pelagic

% 7 bottom (BENTIC)

45% lives the costal area (continental shelf) of sea or inshore (LİTORAL)

(continental shelf: Up to a depth of 200 metres)

CLASSIFICATION OF FISHES

There is not still an undisputed and valid classification.

Fish are divided into 3 main classes

Class 1: AGNATHA (Jawless fish)
No jaws and double fins, sucker mouth

Order 1: Petromyzoniformes (Lampreys)
Order 2: Myxiniformes (Hagfish)

(Petromyzoniformes)

(Myxiniformes)

Class 2: CHONRICHTHYES (**cartilaginous fishes**)

They have jaws and double fins.
There are 5-7 pairs of gills and each one of gills is pulled out individually.
They usually lives in seas.

Exm: Sharks

Class 3: OSTEICHTYES (Bony fish)
Skeletons made from bone, There are scales and air sacs
The majority of living fish are in this class
Subclass 1: Actinopterygii (**Ray**-finned fishes)

Subclass 2: Crossopterygii (**fringe-finned fish**)

Subclass 3: Dipnoii (**the lungfish**)

1. Actinopterygii'den Perca

2. Coelogcanhini

3. Lepidosiren

FISH SIZE - BODY SHAPES

Pandaka pygmae (Dwarf goby)…… 8-10 mm.
Rincodon typus (Whale shark)……..18 m.

Fish are living things that best fit the water environment.

1. In general, the body is spindle-shaped (Fusiform) .
Exm. Bonito (Sarda sarda)

2. Laterally compressed forms from the sides.
Flattened from side to side
Exm. Sole (Solea nasuta)

3. Dorsoventrally Compressed
Flattened from top to bottom,
Exm. Homelyn mirror ray (Raja miraletus)

4. Forms with flat and angular body shapes
Exm. Ocean Sunfish (Mola mola)

5. Long and thin, having a body diameter
that is very small compared with the length.
Exm. European Eel (Anguilla anguilla)

6. Special forms
Exm. Seahorse (Hypocampus)
The seahorse has an upright **position**
The head, which is positioned at right angles to the body

FISH BODY PARTS

-Fish body is divided into three body region

There isn’t special neck region.

HEAD: It is the anterior part of the body from the tip of the nose to the gill opening or the last gill opening.

TRUNK: It is the middle part of the body from the gill opening or the last gill opening to the imaginary line drawn from the anus.

TAIL: The posterior part extending from the anal spine to the end of the body.
a) Caudal peduncle (The narrow part of the body to which the tail attaches)
b) Caudal Fin The part where the tail fin rays begin.

Morphological Characters used in fishes.

The total length: the longest lobe of the caudal fin.
The fork length: Between the nasal tip and the deepest point of the tail fin
The standard length : Between the nose tip and the beginning of the caudal fin
Body height: Distance between back and abdomen at the widest part of the body
Predorsal length: Between the nose tip and the beginning of the dorsal fin

MOUTH:

It is located at the front end of the head and is surrounded by two jaws.

Mouth shape
Mouth length
} Depends on the eating habits and lifestyles of fish.

*The mouth is mostly surrounded by lips

*Mucosal (General), Cartilagenous (Rare)

*The lips are without scales Taste-related nerve endings and taste buds carry.

EYES

-It is a pair of sight organs always in the head zone.

-In general, eyes in fishes are GREAT

-Lifestyle is related to Eye size

Turbit, deep-sea fish - SMALL
Clear water fish - GREAT
Dark water fish - BLINDED Exm. Moray

There are no LACRİMAL GLAND and PALPEBRA in the fish. (In some species the eye is surrounded by a structure similar to the palpebra. Exm. Mullet

-View distance (?) 10-12 m.

-The eyes are adjusted close to the rest.

-Some species can make color choices. Ex. Trout

-Viewing angle horizontal 190 ° - 170 °
vertical 150 °

Viewing angle of fish in water

NOSE

-It is the area between the anterior end of the head and the eyes.

-**NOSTRILL** is the outward opening of NASAL CAPSULE which is the olfactory organ

NOSEHOLES NOT USED WITH RESPIRATORY PROPERTIES

-Nose function in fish:
- Finding food
- Choosing partner
- Determining migration routes
- Avoid from enemies

BARBEL

-Outward extension of the skin
-Free nerve endings and taste buds are found on the barbel.
-Finding food

JAWS

-It is the part that closes the mouth from the top and bottom.
Divided into two parts,

MAXILLA (Upper Jaw)
MANDIBULA (Lover jaw)

TEETH

-Tooth shapes, places and numbers change according to the fish species.

Teeth placed on the jaws (**maxillary teeth**) (Crane)

Teeth placed in the mouth **(Palatinal - on palate)**
(Vomer - back of mouth)
(Lingual- on the tongue)

Pharynx teeth (Carp)

-Respiration in fish: External respiration (water and blood) and Internal breathing (blood and tissues) are seen.

-The seven major air breathing organs found in fishes.

1. Skin 2. Gills 3. Alimentary Canal 4. Air Bladder
5. Buccopharynx 6. Opercular Cavity 7. Respiratory Membrane.

-Fish can benefit from 80% of O2 in water.
(Human benefit from 20% of O2 in the air)

GILL

-Gill is the most important organ made of gas exchange..

Cartilaginous fishes 5-7 or more gill pairs are opened separately, and some species have **spiracle** (the first gill opening) that is a small hole behind each eye.

Bony fish There are 4 double gill arch and operculum (gill cover)

GILL VENTILATION MECHANISM IN BONE FISH

-Operculum closed, mouth opens and the water enters into the mouth cavity

-The water passes through the gills

-When the internal pressure in the gill cavity is equal to the external pressure, the operculum is opened and water is removed.

Swim bladder - Air bladder:

It is a membrane formation filled with gas and originated from esophagus. It is not found in cartilaginous fish, bony fishes have air bladder.

Functions:

1. **Respiratory**: Bladder wall is muscular form and internal structure is alveolar in Dipnoi species
2. **Recive sound**: (It works like a conductor of sound (resonator) in some species
3. **Produce sound**: (It can produce sound directly or indirectly in some species
4. **Hidrostatic or Ballast Organ**: Balance and vertical level adjustment

FINS

Support and movement organ in fish

Single (Median) Fins

Median fins are unpaired and associate with the axial skeleton of the fish. (balance and steering)

1. Dorsal Fin
2. Anal Fin
3. Caudal – Tail Fin
4. Adipose Fin

Paired Fins

It acts as the limb (extremity) in vertebrates

1. Pektoral Fin
2. Ventral -Pelvic Fin

SKIN

The outer part of the body is covered with skin. Like other vertebrates

It is consists of two parts;

Epidermis (Outer layer of the skin) and

Corium-Dermis-Cutis (Inner layer of the skin)

SCALE

In most fish skin is covered with scales.
Some fish can be scaleless
The extending transverse and longitudinal SCALE NUMBERS are different in bone fish, This is important in the separation of fish species.

Longitudinal and transversal scales numbers

Scales types;

1. **Placoid**
2. **Ganoid**
3. **Cycloid**
4. **Ctenoid**

Placoid

- Most simple scale type
- The base is flat and upper part is a spine form
- Both dermis and epidermis origin
- Tooth-like structure
- It is seen in sharks and stingrays.

Ganoid (Rhombic)

- Rhombic shaped.
- Dermis origin
- They are covered with bright substance called GANOIN (Different from Mina layer)
- It is seen Acipenceridae family

Cycloid

- Present in most bony fishes
- Easily pliable and usually circular form
- They are arranged like roof tiles
- The base part is located in the pocket of the dermis and the posterior ends are free.
- Ex. Carp

Ctenoid

The structure is similar to cycloid scales, but its free ends are like a blade
Ex. Freshwater Grain

Bioluminescence is the production of light by a living organism as the result of a chemical reaction.

It is some kind of chemical light (chemoluminescence) and heat is not formed in **bioluminescence** event.

$$\text{Luciferin} \quad \underline{\text{Luciferase}} \quad = \quad \text{LIGHT}$$
$$\text{(Heterocyclic Phenol)} \quad O_2 \quad \text{and ATP}$$

Luminescence can occur inside and outside the cell

THE LATERAL LINE

The lateral line, also called **lateral line organ**, is a system of sense organs found in aquatic vertebrates, used to detect movement, vibration, and pressure gradients in the surrounding water.

Made from porous scales with connection of neural canal The lateral line may not be present at all species. It may be long, short or different forms.

DIGESTIVE SYSTEM

It is generally the same structure in freshwater fish species.
(It can be some differences according to feeding habits)

Mouth
Pharynx
Esophagus
Stomach
intestines
Anus

MOUTH AND TEETH;
(Previous subjects)

PHARYNX;
Some fish species (ex: carp) have pharynx teeth on the phaynx region
It helps filtration (mud filters), grinding and shredding (Removing some insects' shells)

ESOPHAGUS;
Not so much distinguished from the stomach
It is short
Carries muscles that prevent ingested water from entering the stomach

STOMACH;
Continuation of the esophagus
There are two parts;
Cardiac section (There is undigested food)
Pyloric part (It is the opening part of the pyloric cecals-blind sacs)

INTESTINIUM

Starts after the stomach and continues until the anus
Carnivorous fish (Crane) - intestine short
Herbivorous fish (Carp) – intestine long

ANUS;

Usually located just behind the anal fin

FOOD TYPES AND NUTRITION

Fishes;
Carnivorous
Herbivorous
Omnivorous (Carnivorous-Herbivorous)

FISHES;

Feeding Based on Diet

- Euryphagous – Mixed diet
- Stenophagous – Limited number of food sources
- Monophagous – Using only one food source

According to food intake;

Predator
Filtering
Grazing
Parasitic

THE CIRCULATORY SYSTEM

According to primitive vertebrates, fishes have closed and well developed circulatory system. It doesn’t compare with mammals circulatory system.

The circulatory system organs;

Heart

veins

Artery

Vena

Capillary

Heart;

Located on the anterior side of the pharynx.

Consists of four parts;

Snus venosus (Ductus venosus);
Hepatic veins from the liver is opened to this section. At the end of this part, there is a flap named SİNO-ATRİAL (SİNATRİYAL).

Atrium;
The wall is thin-walled. At the end of this part, there is a valve named ATRIO-VENTRICULAR

Ventriculus;
The wall is thick. There are thick veins feeding the heart on the outside section . There are a pair of valves at the end

Bulbus arteriosus;
Thick walled. Its elastic structure is more important than contraction

Blood:

Blood volume is significantly less in fish

It is 1.5-3% of body weight (up to 2-4 ml per 100 g)

Fish blood coagulates lately (substances such as fibrinogen and prothrombin are less)

Blood cells;

Erythrocytes (Oval and nucleated)

Leukocytes

- Granulocyte
  - Acidophil
  - Basophil (less)
  - Neutrophils
- Agranulocytes
  - lymphocytes
  - platelets
  - monocytes

Blood-forming organs;

Spleen Medulla (Lymphocyte + Granulocyte)

Cortex (Erythrocyte + Platelet)

- Gastrointestinal tract mucosa
- Kidney (Head kidney part)

} Erythrocyte

- Mesenterium
- Eye socket (Orbit)
- Brain membrane
- Head-Skull

} Leukocyte

LENF SYSTEM

It consists of Lymphatic vessels and sinuses
Lymph volume is 4 times more than blood volume
It coagulates (There are Leukocytes and Platelets)
No lymph nodes in fish
Lymph fluid is collected in the lymphatic vessels and sinuses and passes into the main bloodstream