

Anatomical structure of bony fishes

Objective: Learn to make anatomical dissection and familiarize with the structure of the internal organs of fish.

Materials and equipment: Fresh fish – 5–8 species (preferably pike, perch, carp), wet preparations. Tables: "The internal structure of the fish", "Fish musculature", "The circulatory system of fish", "The respiratory system of fish", "The digestive system of fish", "The nervous system of fish", "The excretory system of fish", "The reproductive organs of fish." Tools: scissors, scalpel, dissecting needles, ruler, cuvettes, Petri dishes, tweezers.

Basic theoretical information

All of the internal organs of fish are in the body cavity coelom. Coelom is divided into two unequal parts by thin transverse membrane, which is located near the pectoral girdle; these parts are small anterior pericardial bag that includes heart and back abdominal one, where all internal organs are located (Fig. 10).

Figure 10. The internal structure of the fish (A – pike, B – perch, C – carp): 1 – gills; 2 – gill moiety; 3 – heart; 4 – liver; 5 – stomach; 6 – intestines; 7 – pyloric appendages; 8 – anus; 9 – spleen; 10 – pancreas; 11 v gonads; 12 – genital opening; 13 – swim bladder; 14 – kidney; 15 – the main kidney; 16 – bladder; 17 – urinary opening.

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The muscular system of fish is divided into the somatic (body muscles) and visceral (muscles of internal organs). The somatic musculature consists of skeletal striated muscle comprising the muscle segments – myomeres separated by connective membranes – myosepts. This segmentation is typical for trunk and tail sections. Musculature of fins is more differentiated, so that fish can carry out complex movements. Significant development has muscular system of the respiratory system and gill covers. Visceral musculature of fish is represented by smooth muscles.

The respiratory system of fish is represented by gills, which include gill lobes located on the gill arches [9]. Gills develop from ectoderm and are derived from the skin. On each side the bony fish have four full gills, and one half gill (fifth gill arch is devoid of gill petals). At the

outer end of the gills gill lobes are placed in two rows that are covered by transverse, thin pleats – petals that increase the contact area with water, i.e. respiratory surface. On the inside each branchial arch has gill stamens that form a kind of filter apparatus

The digestive system is represented by the digestive tract and digestive glands. It begins with oral cavity. The teeth of the fish are not only in the jaws, but on other bones of the mouth and even on the tongue. Next is the pharynx, which goes into the esophagus, and into the stomach (most fish). The stomach can have a different number of pyloric appendages (salmon has multiple, perch has three). The intestine is behind stomach. A large liver with gall bladder is under the stomach. The pancreas is located along the gallbladder. In place of transition of the stomach into the duodenum there is a compact spleen. A specific hydrostatic body of fish (swim bladder) is located under kidneys and above intestines

In the posterior part of fauces cavity there are pharyngeal teeth. Perch, burbot and pike have the upper and lower pharyngeal teeth. Carp fish have no upper teeth and lower are developed quite well, solid food is crushed by them. The function of the upper pharyngeal teeth has a solid horny formation – millstone. The number and structure of pharyngeal teeth is important systematic feature of the carp family

Circulatory system of fish is closed and consists of the heart and blood vessels system. Two-chamber heart is located at the bottom of the body cavity. It includes the following sections: venous sinus, atrium, and ventricle. Unlike cartilaginous fish bony fish do not have a fourth department called arterial cone. Directly from ventricle large vessel departs – abdominal aorta, which has some expansion in the start – aortic bulb. Blood in the heart of fish is venous only

Oxygen-rich blood is collected in remote gill arteries flowing into the roots of the dorsal aorta. Dorsal aorta divides into numerous arterial vessels through which blood flows to all internal organs. The main department of the aortic root forms the main arterial circle

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Venous blood from the tail section moves in odd tail vein, which is divided into two and passes through the kidneys. After it blood goes forward by the back cardinal veins, at heart level they merge with the front one, which carries blood from the head. As a result of the merger paired Cuvier's ducts are formed that fall into the venous sinus. Blood from the intestinal flows through the portal vein to the liver and there it forms a portal system. Blood from the liver gets into the venous sinus by the hepatic vein. Bony fishes have one closed circle of circulation

Hematopoiesis organs of bony fishes are the spleen, which is located in one of the bends of the intestine and is maroon, kidney, thymus, gill apparatus, blood vessel walls

The nervous system of bony fishes is divided into central, peripheral and autonomic. Central nervous system is clearly differentiated into brain and spinal cord. The brain has five sections which are front, intermediate, middle, back and the medulla oblongata. Compared with the nervous system of cartilaginous fish, bony fish can be characterized by a smaller size of the forebrain, the lack of nervous substances in its cover and separation of the front brain cavity by the longitudinal partition. Most of the forebrain consists of the striatum. On top of the intermediate brain goes pineal gland at the bottom of an intermediate brain there is a funnel, which is connected to the pituitary gland. The average brain compared to other more .developed departments. Cerebellum is large

The spinal cord has segmented structure; the number of segments corresponds to the number of vertebrae. Two dorsal nerves that connect and branch out into three branches - .dorsal, ventral and internal branch out from the both sides of each segment

The autonomic system includes two beds of ganglia which are associated with spinal cord and brain, as well as with each other. It runs along the spinal cord and enters the brain, .innervating internal organs of fish

The peripheral nervous system is represented by nerves and nerve endings that are primarily .associated with the senses of the skin

Bony fish are able to distinguish the smell and taste, hear, see, perceive temperature and .fluctuations in the environment

Excretory organs are paired and ribbon-shaped mesonephric (truncal) kidneys that extend on either side of the spine above the bladder. Front slightly enlarged ends form the main kidney, which is well expressed in perch and carp. In the back part right and left kidneys merge. On the inside part of the kidneys there are ureters that are homologues of Wolff ducts. Ureters come out from kidneys and merge into unpaired duct, which opens by .separate hole near the genital opening

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Reproductive organs of fish have a number of features. Males have the testes, females have ovaries and they are located on either side of the swim bladder. The degree of development depends on the season and the age of the fish. Testes are long paired organs on the upper edge of which there are spermaducts that open out by small genital opening. Ovaries are paired in the most fish (perch has unpaired). Elongated rear parts of the ovaries go into the output channel that opens by independent unpaired genital opening. Fertilization of most .fish is external

Progress of work

Make anatomical dissection of fish. Abdominal cavity should be cut the three sections. At .1 first the wall of the abdomen just above and in front of the anus should be pierced by scalpel. Insert blunt end of scissors in the puncture and make the first cut, which should be along the abdomen forward along its midline and terminate on the basis of the pectoral fins. Continue to cut the abdominal wall and back to the front edge of the anal fin. It should not touch the hole on the left side of the body wall. Then completely remove the left wall of the body cavity. The third section should be made along the back edge of the belt of pectoral and abdominal fins. 2. After removing the wall of the abdominal cavity and the gill cover to examine the overall placement of internal organs. 3. For examination of digestive system cut all the ripples that connect parts of the digestive tract between them. 4. Make a scratch of gills, indicating their elements, and digestive tract, indicating its departments and depicts .circuit of circulation

Questions for individual work

What are pharyngeal teeth and millstone? 2. Tell the structure of the gill apparatus of fish. .1 3. What are the parts of the digestive system of fish? 4. Which species do have stomach and which do not? How does this relate to the nutrition of fish? 5. Which fish do have open bladder and which do have close bladder? 6. Tell the structure of the heart and circulatory system of fish. 7. What are the organs of fish that may perform hematopoietic function? 8. Reproduction organs of fish. Which fish have paired ovaries? 9. What are the parts in the ?brain of fish? What are their functions