Volyn National University
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BEGINNER -AQUARIST

Study guide

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The textbook contains the theoretical foundations of aquarium keeping as a hobby, creative tasks and self-check tests, guidelines and samples of educational activities on aquarium topics, photo materials of aquariums. The publication is developed in accordance with the curricula for bachelor's degree training "Primary education", "Economics of Environment and Natural Resources".

This book can be used to study the following subjects such as "Basic Environmental Studies", "Ecoculture of Personality", "Ecological and naturalistic activities in primary school", "Teaching methods in educational field of expertise", "Environmental Studies", "Extra-curricular and out-of-school educational teaching internship, "Environmental Economics and Management".

For students of pedagogical specialties, teachers and educators in educational institutions.

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CONTENT

INTRODUCTION

The aquarium is the first stage of knowledge of the life of aquatic organisms, which, in turn, opens wide opportunities for research work in the educational institution during the school year.

The study guide "Beginner Aquarist" reveals the conditions of aquarium fish farming, focuses on the use of the aquarium for scientific purposes; types of aquariums and their arrangement are characterized; the importance of soil, lighting, heating and devices for the operation of aquariums is clarified. Physico-chemical properties of water, types of fish feed and features of preparation of an aquarium for stocking are described; biological groups of aquarium plants and their significance are characterized. We also reinforce the importance of educational activities on the topic: "Aquarium fish" (the supplements provide plans, scenarios for educational activities).

The study guide “Beginner Aquarist” has interesting sections under the following headings “Give a thought”, “Do you know that…..”, “It is interesting to know”, “Questions for revision”, “Application guidelines”, “Enrich your vocabulary about aquariums”, “Projects”, “Creative tasks to choose from”.

This book can be used to study the following subjects such as “Basic Environmental Studies”, “Ecoculture of Personality”, “Ecological and naturalistic activities in primary school”, “Teaching methods in educational field of expertise”, “Environmental Studies”, “Extra-curricular and out-of-school educational teaching internship, “Environmental Economics and Management”.

The textbook will help students of pedagogical specialties:

– to organize a hobby group “Beginner aquarist”;

– to cultivate children’s love of nature;

– to teach children to arrange the aquarium properly and take care of its inhabitants;

– to raise the aesthetic and moral level of education of schoolchildren;

– to teach children to spend free time in an interesting and meaningful way.

CHAPTER 1 AQUARISTICS. HISTORY AND TODAY'S WORLD

Topic 1.1. *Use of aquarium for scientific purposes*

An aquarium as a part of natural biotope is very important. It is much easier for researchers to observe its dwellers in the aquarium than in the natural habitat, to define special features of their behaviour, coloring, feeding and spawning. A well-decorated aquarium is a unique center-piece of any interior. It attracts attention of guests and especially children. Fish are ideal pets, you don't have to walk them out, they don't litter the room, don't make noise, don't cast their feathers or the coat. You can leave your aquarium unattended for a period of two weeks after the proper preparation.

Doctors agree that an aquarium at home has a therapeutic effect: it supports restoration of vital functions, lowers blood pressure and prevents depression. It is considered in many oriental cultures that aquarium fish bring health, wealth and prosperity to their host.

An aquarium contributes to the creation of favourable microclimate in dwellings, increases humidity and that fact in its turn prevents cracks in the walls of a house, serves as an additional source of light and heating.

Give a thought. What scientific value does an aquarium have?

Scientific aquaristics. At first sight the scientific aquarium husbandary is developing in two opposite directions, they are commercial and experimental and they are united by a common goal – to study more deeply the life of underwater dwellers. On one hand, science goes to the aquarium, to the place where fish live and where they are provided with the proper care. Almost everywhere where demonstration aquariums are available including museums and zoos the related research is conducted. Scientists from scientific research institutes often come to work, conduct their experiments in aquariums of this or that zoo as well as zoo keepers perform different types of research.

Researchers obtain genuine results doing their research at the aquarium. It is worth mentioning as an example that American scientist G.Coates had been observing electric eels for a long time living in the aquaqriums of the New York museum. They continuously generated electric discharges. This fact had been known before, but the researcher found out that some discharges from one fish attracted other individuals. This was for the first time that group communication signals had been discovered among electric fishes and it was later confirmed by special experiments of other scientists.

The second important area in "science at the aquarium" is development of scientific and technical bases, tools and facilities in order to increase exposition i.e. arrangement of conditions for survival and perhaps breeding of exotic and rare fishes in the aquarium. The Biotechnology Laboratory at Moscow Zoo gives us an example of such successful work. Its staff were able to develop and create the life support system in artificial conditions for endangered species of sturgeon – *Amu Darya sturgeon or false shovelnose sturgeon.* Nowadays this fish listed in Red book of Endangered Species is living in the special flowing water tank at the zoo.

Among aquarists there are representatives of various professions such as physists, chemists, biologists, engineers and others. Each of them adds something new to the aquarium art. Specialists keep a wide range of fish species, plants, aquatic invertebrates, they watch them with admiration and delight and involuntarily make scientific discoveries related to special features of behaviour, breeding activities or spawning of the proper species. Thanks to professional aquarists new types of fish feed have been developed, different fish diseases have been studied and methods of their treatment have been specified, new species have been bred, genetic discoveries have been made, reasons for changes in the sex ratio in fish offspring have been examined.

The acquired knowledge is used not only in aquariums and industrial fisheries, but also opens new horizons for biophysical and embryological research and is used in veterinary medicine.

Keeping and breeding exotic and rare species aquarists make a significant contribution to international initiatives related endangered species, the number of some of them has already exceeded the natural population. Thus, due to aquarists a lot of work is being done

to preserve the genetic material.

On the other hand, "an aquarium goes hand in hand with science", where there are qualified specialists and an urgent need to complete tasks whose solution can be found only by means of live experiment. Nowadays this way is promising. Scientists create and keep aquariums in their laboratories and take care of their dwellers by themselves. Such an aquarium for scientific purposes became the most widespread in the research of scientists, since the financial means of research centers are incomparably higher than budgets of museums and zoos. Giant aquariums have been built for scientific purposes in many countries. They operate not only for visitors and tourists but researchers, graduate students, students are constantly working there.

Enrich your vocabulary about aquariums

• ***Aquarium*** *(lat. Aquarium – water reservoir) is a type of vivarium intended for the maintenance and reproduction of aquatic organisms. In everyday life an aquarium is called a transparent fish tank designed to keep tropical fish at home.*

It's interesting to know! The aquarium complex at Dnipropetrovsk National University named after Oles Honchar is designed by an architect S.Kovalchuk (DKM Hiprovuz). It is a unique building in terms of scale and technical equipment. The complex includes 20 small aquariums with a capacity of 1,2 m^3 each and one central aquarium with a capacity up to 100 m^3, which consists of three glass tanks of multifaceted shapes combined at the top into a single structure.

Every year the aquarium complex at Dnipropetrovsk National University named after Oles Honchar attract thousands of visitors including both environmental experts and people from the city, region and many other regions of Ukraine. The staff of the Aquarium closely cooperate with educational institutions of the city giving themed tours and classes that help young people who are studying not only better to master knowledge of biological and ecological disciplines but also to form ecological thinking, friendliness to the environment and its inhabitants.

An aquarium at schools. Each aquarium is a unique ecosystem, just as each body of water in nature is unique in its own way. In schools when the goal is to use the aquarium at lessons of botany, zoology, general biology, its decorative and demonstration function is not the main (pic. 1.1–1.9).

Pic1.1. *The aquarium in the educational complex in the village of Zamshany in Volyn Region*

Pic 1.2. *The aquarium in the educational complex in the village of Hirnyky in Volyn Region*

Pic 1.3. *The aquarium in educational complex-lyceum № 22 in the city of Lutsk, Volyn Region*

Pic 1.4. *The aquarium in the educational complex in the village of Velymche in Volyn Region*

An aquarium can serve as a model of nature study corner – a fish tank where fish behave in the same way as in the natural habitat. You can buy a fish tank in the specialized shops or do it yourself or in a school workshop. In addition, the latter option is the most interesting since it clearly demonstrates students the applied relevance of the

acquired practical skills.

The educational value of a nature study corner at schools and educational institutions lies in the fact that it provides the realistic ideas about representatives of flora and fauna through constant and effective direct contact of students with them. In fact, children's observations in nature take a comparatively short time and happen ocassionally. In the nature study corner its objects are available for observations during the school year and that fact promotes formation of schoolchildren's holistic system of knowledge about them. Observation over the development of plants and animals contributes to the formation of children's observation, arouses their cognitive interest in the further study of nature. Moreover, the nature study corner functions as a kind of laboratory where students can conduct simple experiments and make their own subjective "discoveries". A well-equipped, properly decorated and well-kept corner of nature, of course, is the real decoration of the classroom. It enables to use it constantly to enrich children with aesthetic impressions, teaches them to understand and experience a sense of beauty.

Pic. 1.5. *The nature study corner at the secondary school in the village of Liubiaz, Volyn Region where there are five aquariums of different capacity, the largest fish tank has 80 l*

The main tasks of a nature study corner at school are use of animals and plants at lessons and classes of study clubs as visual and

experimental material; awareness-raising activities about animals and their protection.

Pic. 1.6. *The research corner of young aquarist in educational complex-lyceum № 22 in the city of Lutsk, Volyn Region where there are nine aquariums of different capacity, the largest fish tank has 90 l*

Pic. 1.7. *Study room of aquaristics in the educational complex in the village of Vydranytsia, Volyn Region where there are 16 aquariums of different size and volume, the biggest among them is 140 l*

a) b)

Pic. 1.8. *Decorative (a) and demonstrational (b) aquariums at the Teachers' Training College, Lesya Ukrainka Eastern European National University*

Pic. 1.9. *Study room of aquaristics in Volyn Ecological and Naturalistic Centre, city of Lutsk*

Pic. 1.10. *Aquarium at day-care center №2 "Dzvinochok", Junior class, town of Kamin-Kashyrskyi in Volyn Region*

At preschools for the sake of childrens' safety aquariums don't have water heaters, compression pumps to saturate the water with oxygen. In connection with it such species of fish which are easy to keep and beautiful are selected here (pic. 1.10). Of the live-bearing fish, guppies are kept here. Dozens of types of this fish have been bred and they impress us with their color, size and shape of fins. Preschoolers also get acquainted with platyfish, mollies, bellyfishes.

Of the cyprinoid fishes, in addition to goldfish and its species, zebrafish, China danio and some types of barbs can be kept at a preschool. These aquarium inhabitants coexist well with each other and with other fish.

Climbing perches are interesting for preschools too. They breathe not only dissolved oxygen from water, but also natural air, which is periodically swallowed by mouth, rising to the water

surface. The most famous of them are *fighting fishes, paradise fishes, gourami.*

Fish of local basins can be both permanent and temporary inhabitants of an aquarium corner. Crucian carp, silver Prussian carp, stickleback and loaches mostly adjust well to aquariums and you can make interesting observations.

Justify a statement or give a denial to it:

- ***A professional aquarist*** *is a researcher. They constantly experiment, analyze, make corrections in their activities.*
- ***A professional aquarist*** *is a person who has a thorough knowledge not only of aquarium art.*
- ***A professional aquarist*** *is a manager? That's true, the top-ranked one as they are idea generators, forecaster, policy planners and organizers.*
- ***A professional aquarist*** *is a high skilled specialists in the aquqriu practice.*

Summarize what you have learned on the topic:

1. Explain the concept of "aquarium".
2. Make an association scheme on the topic "Scientific aquaristics".
3. Prove that the value of an aquarium as a part of natural biotope is extremely high.

Topic 1.2. *History of aquarium fish breeding in ancient China and Egypt*

Do you know that… *keeping and breeding aquarium fish is an extremely popular hobby that unites millions of enthusiasts? The first prototype of an aquarium was made in the middle of the eighteenth century. It was completely different from the modern aquarium, equipped with a system of filtration, aeration, automatic lighting, feeding, etc..*

In the Ancient Egypt as early as in the fifth and sixth millennia B.C. a variety of fish was kept in artificial reservoirs, mainly from the Nile, marked by a bright color or unusual shape or behavior. The

facts of captivity of crocodiles are known, but, in addition to their decorative function, they were also used for sacrifice.

During the archaeological excavations in Pompeii fish pools were found as well as frescoes depicting them. In works by Cicero, Aristotle, Theophrastus aquariums are mentioned to be in the houses and yards of Greek and Roman nobles. Aristotle described more than a hundred species of freshwater marine fish in his works. Theophrastus supplemented this list with thirty more species of fish from India kept by local Maharajahs.

In these researchers' works it was indicated that Mediterranean fish, including moray eels and mullets, were kept in those "aquariums". In these tanks the water was constantly changed, and special sheds made shade, which prevented the temperature from rising and the reproduction of brown-green algae. Roman patricians did not only admire the feeding of moray eels, but also loved to taste the meat of this fish.

From the stories of the Spanish conquerors, who landed in Mexico in the sixteenth century, it is known that Montezuma, the ruler of the Aztecs, had a zoo where he kept animals and birds captured in mountains, deserts and forests and colorful fish in pools with fresh and sea water. There were also basin aquariums in Montezuma's private rooms.

But in the ancient world aquarism reached the greatest development in the Orient countries such as China, Japan, Korea, Siam (Thailand). From here, the fame of goldfish spread throughout the world.

The oldest information about goldfish appeared in China in the VI century B.C., at that particular time they began to be kept as decorative pets. The image of a goldfish in the early Chinese manuscripts also appears on the coats of arms of noble families. Fish with red coloration were considered sacred. The work of breeding new types of goldfish reached its peak during the Ming Dynasty. (1368–1644). Just then the ansectors of all modern types appeared. Beijing, Shanghai and Canton became centres of their breeding. Although the Chinese emperors tried to safeguard their living treasures, but in 1500 the goldfish made its way to Korea and in 1502 to Japan, then to Indonesia. Japanese admirers bred many new shapes and colors of goldfish.

This breed of fish comes from the silver carp. Breeders have long and carefully selected the best and brightest specimens from the numerous offspring. So, step by step, working on each generation, they bred about 130 breeds.

Common goldfish have the same shape as silver carps. Only a bright golden color distinguishes them. There are also godfish with flame-red body.

Of great importance in determining the breed and value of the fish is its color. The body can be monochromatic or covered with various spots (white, gold, flame-red, black, pink, blue). The silver fish with red bubble-like hood on their heads are the red-cap orandas and gold-and-red orandas with prominent headgrowth are called "goose head". Sometimes you can see very exotic variants of fish coloring, for example *black telescope with ruby-colored eyes or red pearlscale* (its scales are protruded into white domes that remind pearls). The breed of pearlscales was developed in China in 1725, they were considered to be the national treasure and were allowed to to take abroad only two centuries later. Many breeds developed in China in the 19th-20th centuries still remain rare due to export restriction.

Having acquired a new appearance, goldfish have not lost the habits of crucian carp. They dig in the ground, do not refuse any food, love spacious aquariums and feel good in fresh water.

Chinese emperors kept their living wealth in porcelain vases decorated with lotus flowers. And Chinese peasants wove baskets from rice straw for their pets, which were so dense that the water did not spill out of them. Of course, these aquariums were not transparent and the fish could only be observed from above.

In addition to exotic goldfish, European naturalists tried to keep freshwater and marine fish of temperate latitudes. In the middle of the 17th century mud loaches were kept to observe their behavior and forecast the onset of bad weather.

The first European book about aquarism was published in 1797 in Thuringia, it was "The Natural History of Domestic Animals" by Johann Bechstein where conditions of keeping mud loaches and goldfish in captivity were described.

The difficulties faced by the first aquarists were eliminated thanks to the many achievements of biologists of the eighteenth and

nineteenth centuries: discovery of microrganisms, breathing and photosynthesis of plants, uprising of genetics etc.

At the end of the last century, aquaristics became widespread. Thus, English naturalist and populariser of natural science Philip H.Gosse who worked in the London Zoo offered to use the word "aquarium" for the fish display. Two years later it turned into the permanent London aquarium. Gosse thought that an aquarim is the best of way to disseminate biological knowledge among the population. Aquariums arranged at the World Exhibition in Paris in 1867 were a great success. French devotees gained enough experience and in 1869 Pierre Carbonnier managed to get spawning of the paradise fish and raised the breed in the aquarian conditions.

Topic 1.3. *Aquarium centers and professionals of aquarian industry*

Prince Grigory Potemkin brought goldfish to Russia from France. The Russian Assosiation of Animal and Plant Acclimatization influenced greatly the development of aquarism, it held the first show of aquariums and domestic river fish. In 1870 Aquarian Society was established in St.Petersburg and it was headed by Andriy Nabatov, the author of books *"Sea life aquarium in a room, its equipment and care"* and *"Room Freshwater Aquarium"*.

In Moscow Society of Aquarium and Terrarium Lovers was established in 1899 by Nikolai Zolotnistkiy who wrote "Amateur Aquarium", the first book about aquariums in Russia.

At the beginning of this century, there were about 130 species of fish in the collections of enthusiastic aquarists. Aquarium magazines were published in St. Petersburg, Moscow, and Kyiv. In Kyiv in 1910 Leo Sheljuzhko set up a fish hatchery, it was the first in our country and the largest in Europe those day and it had been operating successfully for a long time. The scientist managed to breed many species of fish for the first time. In recognition of his merits, one of the species of African tooth carps is named *Epiplatys sheljuzhkoi*.

And yet in Czarist-era Russia, aquarism was available only to certain enthusiasts and the rich. And after the revolution, it spread among all segments of the population. The importance of aquaristics for the education of sensitive attitudes to nature was recognized in the People's

Commissariat of Education (for example, by Nadiya Krupska). Aquarium clubs appeared in many cities of the country. To provide them with fish, a fish hatchery began operating at the Moscow Zoo.

During the Great Patriotic War (1941) the Moscow fish farm was destroyed by a bomb, but it was partially rebuilt the following year. The hatchery supplied fish to schools and preschools, provided amphibionts such as axolotls necessary for medicine.

In 1947 the repair and recovery of the Moscow hatchery was completed and then the Kyiv one was also renewed. Societies and clubs of aquarists appeared again. Books by famous aquarists were published such as by F.Polkanov, M.Ilyin, M.Rakhlin, V.Zhdanov. Since 1958 All-Soviet Union magazine "Fish culture and Fishing" had been published, then it turned into "Fishing" which had the section "Aquarium". Later the information for aquarists was printed in magazines "Fisher" and "Nature and a Man".

Large collections of fish are kept in zoos and natural science museums. Many cities have aquarist clubs that hold exhibitions and contests. Many clubs of aquarists have been established at the Palaces of Pioneers and youth biological centers.

Kharkiv, Kyiv, Odesa and Lviv are currently considered to be the largest aquarium centers in Ukraine. In Kharkiv there are powerful fish farms, for that reason the prices for aquarium inhabitants are the lowest here. It is worth mentioning the well-known company "Nature" that is registered and doing business in this megacity. Odessa is interesting because, in fact, it is a delivery point for fish imported from oriental countries (Thailand, China, Taiwan). Lviv is a window to Europe. Accordingly, there are many fish from Poland, the Czech Republic and the Netherlands. And in Kyiv all aquarium streams converge though, of course, for the wide range it is necessary to pay more expensively. Unfortunately, there are no official statistics on the contribution of certain aquarists to the development of this activity within the state, so it is difficult to judge which of them is a more reputable aquarist. In Volyn Region we should mention the following aquarists such as Oleh and Andrii Dyrko, Yurii Kochetov, Petro Milogorodskiy, Yurii Yarmolkevych, Andrii Kolosok. All of them have devoted their lives to the aquarian pursuit (pic. 1.11–1.13).

Pic. 1.11. *Home decorative aquarium*
(author – *Andrii Kolosok*)

Pic. 1.12. *Home aquarium with discuses*
(author – *Andrii Dyrko*)

Self-check test

1. CHOOSE WHAT IS THE BENEFIT OF AQUARIUM USE AT SCHOOL:

a) it teaches students to be responsible and to take care of living creatures;

b) it decorates a classroom aesthetically;

c) it improves sport results;

d) it is used as research and experimental facilities;

e) it reduces the impact of bad habits.

2. WHICH OF THE LISTED BELOW SURNAMES BELONGS TO FAMOUS VOLYN AQUARIST?

a) Sydorchuk;

b) Malenytskyi;

c) Dyrko;

d) Kokhanyi;

e) Romanyk.

3. WHERE IS AQUARISTICS ORIGINATED FROM?

a) Holland;

b) China;

c) France;

d) England;

e) Germany.

4. NAME THE CITIES WHICH ARE THE LARGEST AQUQARIUM CENTERS IN UKRAINE:

a) Chernivtsi, Kamianets-Podilskyi, Sokyrychi;

b) Illichivsk, Horokhiv, Zhytomyr;

c) Rivne, Kuznetsovsk, Berdychiv;

d) Ternopil, Kivertsi, Lokachi, Novovolynsk;

e) Odesa, Kharkiv, Kyiv, Lviv.

5. WHICH FISH WAS DEVELOPED BY SELECTION FROM THE SILVER PRUSSIAN CARP ?

a) goldfish;

b) danio;

c) barb;

d) labeo;

г) Ancistrus dolichopterus.

6. WHICH UNIVERSITY HAS ITS OWN AQUARIUM COMPLEX ?

a) Dnipropetrovsk National University named after Oles Honchar;

b) East European National University named after Lesya Ukrainka;

c) Kyiv National Economic University;

d) Vinnytsia National Medical University;

e) Institute of Regional Researches at National Academy of Sciences of Ukraine.

7. WHO MANAGED TO GET SPAWNING OF THE MACROPOD AND RAISE THE BREED IN THE AQUARIAN CONDITIONS FOR THE FIRST TIME ?

a) Louis Fabel;

b) Mark Dolonier;

c) Yurii Kochetov;

d) Pierre Carbonnier;

e) Henry Mark.

8. WHO SET UP THE FIRST HATCHERY IN THE COUNTRY ?

a) B.Nesterenko;
b) L. Sheljuzhko;
c) V. Naumenko;
d) S. Fesina;
e) O. Rudakova.

9. WHICH NATIONAL FISH LIVING IN AN AQUARIUM FORECASTS WEATHER WITH ITS BEHAVIOUR ?

a) mud loaches;
b) common bleak;
c) gudgeon;
d) roach;
e) perch.

10. WHO INTRODUCED THE TERM "AQUARIUM" ?

а) O. Maxwell;
б) V. Naumenko;
в) M. Dolonier;
г) R. Rolton;
г) P.Gosse.

CHAPTER 2 AQUARIUMS, THEIR STRUCTURE AND MAINTENANCE

Topic 2.1. *Structure and aquarium types, their maintenance*

Approaching the aquarium with fish few people are able to resist the temptation to watch them (pic. 2.1). As a matter of fact, the aquarium tank is beautifully decorated with various decorations, plants; exotic fish swim in it and they can delight not only children but also adults. That is why aquarism has been so popular for a long time.

Pic. 2.1. *School decorative aquariums*

Structure of an aquarium. In pet shops you can buy aquariums of different shapes and sizes (rectangular, cylindric, spherical) (pic. 2.2).

Pic. 2.2. *Aquariums*

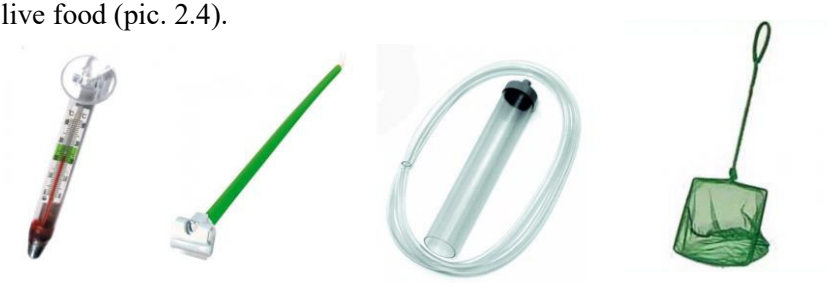
A rectangular aquarium is considered convenient for keeping and breeding fish (pic. 2.3).

a **b** **c**

Pic. 2.3. *Special-purpose equipment*
(a – a fish tank; b – an aquarium lid ; c – an aquarium tray)

The aquarium is installed in a well-lit place. If there is no such a place, then for artificial lighting fluorescent lamps or incandescent lamps are used. The aquarium should be lit for 10-12 hours a day. It is not recommended to install an aquarium on the windowsill, where the light regime and temperature often change. The following equipment is used to maintain the aquarium such as fish feeder; lift nets of different sizes; a tipped hose tube to remove sediment; air supply; a

reflector lamp for illumination; an electric water heater; a thermometer; a spare fish tank; spawning ponds; a handglass to view live food (pic. 2.4).



a **b** **c** **d**

Pic. 2.4. *Aquarium maintenance equipment*
(a – a thermometer, b – a scraper, c – an aquarium siphon, d – a lift net)

Background. Before you completely or partially fill the aquarium with water, you need to decide for yourself the question of the back wall (pic. 2.5).

Pic. 2.5 Aquarium

You can buy a ready-made polyethylene background with an image printed on it. In pet stores, the background is in rolls of different heights, from which the desired length is cut. For freshwater

aquariums different types of images are offered such as stones, snags, plants or their various combinations.

Stones. Stones are a very significant element in the design of the aquarium. They not only decorate the aquarium, but also are a substrate for spawning, a shelter for some species of fish, especially for those that lay eggs in the cave (however, many aquarians prefer decorative ceramic shelters in the form of ships, mills, etc.). The stones are also used to attach some types of plants, hide technical means from viewers, strengthen the walls of terraces and are part of decorative walls.

Before laying the stones should be cleaned of dirt and boiled in water. It is recommended to carefully examine the stone for the presence of impurities, which can form toxic solutions when interacting with aquarium water. To check the stone for lime, you need to sprinkle it with vinegar. If there is lime, foamy bubbles will appear. After inspection and processing stones need to be washed out again with water.

Snags. Snags give the underwater landscape an original look and serve as a shelter for fish, places of attachment for some species of plants, support for terraces. The wood used must be dead and free of vital sap. The best snags are roots of trees that lay in the peat of deep layers of upland bogs for many years. The suitable wood is also dead roots and branches of alder, willow, beech, ash, maple, which have remained for many years in running water habitats.

You mustn't use a tree with a mold, and also from the silty places and the reservoirs polluted with industrial and agricultural waste.

Shells. Shells cannot be considered a suitable decoration of a general aquarium, as they consist of calcium carbonate and can affect water hardness and pH. However, some species of fish need shells: they can be used as a refuge and spawning ground.

Seashells from the sea coast should be pre-sterilized by boiling, and then all their accessible surfaces have to be rubbed off. It is better to use shells that have been empty for some time and well polished with water, as others may contain the remains of dead mollusks.

Other objects. In your aquarium you can place objects from ceramics, plastic and other materials. Being placed in an aquarium, they often please the eye of many aquarists. The main point is that all these products are made of non-toxic and safe materials (pic. 2.6).

Ceramic items must be new, otherwise pesticide residues or fertilizers remaining in the porous clay may get into the water even after thorough washing.

Pic. 2.6. *A decorative aquarium*

Plastic pots should not be used, as the plastic from which they are made can be toxic. Plastic pipes for drinking water supply are suitable for use in an aquarium, but sewage pipes should not be used.

In nature, most aquarium fish live in freshwater at shallow depths. It follows that they need a temperature for normal life, which is usually above 20 degrees, and the pH is close to neutral (pH = 7). Water hardness depends not only on natural conditions, but also on the size of species. For example, if barbs are characterized by a hardness of 10 to 12 dH, then for bellyfish this value reaches 25 dH. It is clear that more active fish contaminate the aquarium faster than less mobile species. In this case, the water in the aquarium should be changed at least twice a week. Aquarium fish are mostly omnivorous. Only those species that do not tolerate life in captivity should receive sufficient animal and plant food.

Aquariums should be populated with such species of aquarium fish that have similar living conditions.

All exotic aquarium fish can be divided into cold-water and warm-water groups. *Cold-water fish such as silver Prussian carp, crucian carp, carp, mud loach, nine-spined and three-spined sticklebacks* tolerate a rise of temperature to 25°C and gradual temperature reduction to 5–10°C. The best possible temperature range for them is 15–20°C.

Warmwater fish (live-bearing ones – guppy, platyfish and egg-laying fish – paradise fish, gourami, zebra danio, cardinal fish, barbs etc.) require a water temperature of not less than 22–25°C, but can withstand a short-term decrease in temperature to 20°C. Keep in mind that a sharp drop in temperature is especially dangerous for fish.

Aquarium care. With proper care, the aquarium will always please the eye with green vegetation and bright healthy fish. Once a week, the aquarium is cleaned using a siphon - a rubber hose with a wide plastic tip, through which water with dirt that has accumulated in the top layer of soil is sucked. Plants and fish remain in the aquarium. During cleaning, to 1/5 of the volume of dirty water is drained up and replaced it with settled water. The glass of the aquarium, which is covered with a green growth of algae, is cleaned with a scraper with a blade. While cleaning an aquarium, the plants are put in order: the yellow leaves are cut off, the bushes are thinned. If the aquarium has a biological balance, complete replacement of water is carried out not more than once every two years, if necessary. When feeding fish, you should carefully monitor whether there are any of them that swim unnaturally, lying on the bottom. If there are any, they are immediately set aside in a separate vessel for treatment, and the net is then rinsed in hot water. To prevent the fish from jumping out of the aquarium, it should be covered with glass.

Fish must receive a sufficient amount of quality food in time and be full. Residues of dry food not used by fish should not be left in the aquarium, as the water will become cloudy (the food rots and decomposes quickly, consuming oxygen).

If you follow the above rules, the care of aquarium plants will bring only pleasure and create a comfortable habitat for fish.

To keep fish and plants in the aquarium, it is also important to maintain a certain temperature at which they live well and reproduce.

Changing the temperature of the environment affects the body temperature of fish and plants and leads to changes in the rate of metabolic biochemical processes in organisms, which significantly influences their health and condition. The simplest device for heating water in the aquarium is a heater with a thermostat, which is attached to the wall somewhere in the corner. The indicator light indicates whether the heater is currently operating. With the help of the water-temperature regulator it is possible to set water heating to the necessary temperature.

Naturalistic cases

1. Equipping the school aquarium, students acted in this way. At first, a place was arranged for it on the windowsill opposite the door. Then they washed the aquarium and filled with water for three days, constantly checking whether it is leaking. Continuing the work, novice aquarists poured it with water and filled the soil. At the last stage, they bedded plants and filled it with fish.

– ***Where and what mistakes did the aquarists make?***

2. Purchasing the necessary equipment for the aquarium, they decided not to take a set of lift nets, a magnetic cleaner (scraper for algae), a siphon with a tube, feeders for live and dry food.

– ***Is it possible to do without these items caring for the inhabitants of the aquarium?***

Creative task

Study pic. 2.7. "Home aquariums" thoroughly and find 12 differences:

(author – Haiduchyk Bohdan)

(author – Anastasia Kotvytska)

Pic . 2.7. *Home aquariums*

Prove or disprove the statements:

- ***Aquarium*** *is not just a nice thing that meets a person's sentience needs and is a means to fill your leisure time.*
- ***Aquarium*** is *a glass tank designed for keeping and breeding animals and plants as well as for observations of their life and development.*
- ***Aquarium*** is *a container for the content of aquatic organisms.*
- ***Aquarium*** is *an acting model of a natural reservoir.*
- ***Aquarium*** is *a model of aquatic ecosystem, where the cycle of substances is similar to the cycle of substances in nature.*
- ***Aquarium*** is *a device that is an active artificial model of a human-controlled reservoir. This definition of an aquarium is the most scientific. At the same time, it emphasizes the role and importance of man, the dependence of the model's life on the knowledge, experience, attention and responsibility of those who manage it. For many of us, it is a meeting with a fairy tale.*
- ***Aquarium*** is *intended for keeping both small representatives of fishes of our freshwater reservoirs, and exotic fishes - inhabitants of tropical reservoirs which are characterized by bigger decorative coloring, forms.*
- ***Aquarium*** is *widely used in research studies. Geneticists, embryologists, histologists, physiologists, entomologists and other specialists work with fish..*
- ***Aquarium*** *helps to study an impact on living form of water containing various fertilizers, herbicides, pesticides, detergents, heavy metals, etc.*
- ***Aquarium*** is *one of the wonders that fascinates people with its enchanting beauty. In less than a hundred years, the home underwater world has evolved from an expensive whim of the upper class of society to the pursuit of many millions of people. It entered the interior of our apartments, became a desirable element of the working space.*
- ***Aquarium*** is *a small copy of any closed body of water (a pond, a lake) intended for keeping and breeding of aquatic animals and plants, as well as for observations of their life and development. Life in it proceeds according to*

the same biological laws. Therefore, the aquarium is development of knowledge about the life of interesting and diverse species of fish and aquatic plants, a window into the world of nature.

Types of aquariums. We are going to tell about the classification of aquariums and their maintenance using the example of aquaristics unit in the educational complex of the village of Vydranytsi, Volyn Region (pic. 2.8).

Pic. 2.8. *Talk with presentation on topic "Aquariums in an aquaristics unit"*

School aquariums are divided into demonstration, decorative and laboratory, spawning, growth, quarantine, etc.

Demonstration aquariums are inhabited by items that can be used directly at lessons (large aquarium fish, aquatic plants with different biological features) (pic. 2.9).

Pic. 2.9. *Demonstration aquarium*

Decorative aquariums are placed in student lounges at school, in rooms for after-school child-care. For this purpose tanks with capacity from 50 to 200 l are used. Large aquariums are more balanced and, therefore, easier to maintain than small ones. It is easier to see the impressive world of animals and plants in them (pic. 2.10).

Pic. 2.10. *Decorative aquarium*

Laboratory aquariums are put in the laboratory rooms, nature srudy corners, in classrooms of biology and aquarisrics (pic. 2.11).

Pic. 2.11. *Laboratory aquariums*

Their decorative effect is optional, but cleanliness and tidiness are essential. Laboratory aquariums are designed for organisms studied in lessons and extracurricular activities. Their size must correspond to the biological characteristics of plants and animals that will be placed in them. Small tanks are enough for some of the simplest small animals (including planarians, Nitella algae, aquatic mosses). You can use glass jars with a capacity of 1–3 l to keep these organisms. When keeping several species of non-predatory aquatic arthropods, mollusks and freshwater hydroids simultaneously you need tanks with a capacity of 10–50 l. Aquariums for 50 l and more are required for many species of fish and plants. There are also spawning, growth and quarantine aquariums (pic. 2.12, 2.13).

Pic. 2.12. *Spawning aquarium*

Pic. 2.13. *Growth and quarantine aquariums*

Fill in the table "Types of aquariums" and draw conclusions.

Table 2.1

Types of aquariums

Name of an aquarium	Features
Demonstration	
Decorative	
Laboratory	
Spawning	
Growth	
Quarantine	
Geographical	
Dutch aquascaping	

Projects to choose from

1. Make a slide film (slide show) about Dutch aquascaping (pic. 2.14).

Pic. 2.14. *An aquarium with Dutch aquascaping*
(author – Andrii Dyrko)

2. Make a multimedia presentation on one of the following topics: "A Freshwater Aquarium", "A Seawater Aquarium",

"Classification of aquariums according to the temperature requirements (tropical, cold etc.)".

3. Study pic.2.15 "Aquariums in the school aquaristic classrom" thoroughly and find 12 differences.

Pic. 2.15. *Aquariums in the school aquaristic classrom*

4. Get ready to answer the questions:

1) Which of your favourite aquarium fish and plants would you paint if you were an artist (pic. 2.16.)?

2) What would your aquarium look like if you were among top ten professional aquarians in your city?

Pic. 2.16. *Display of pictures "Aquarium fish"*

5. Mastermind a project: "An aquarium in an educational institution".

The objective of the project: *get acquainted with the rules of arrangement of the aquarium and create your own models of aquariums in the school.*

Sequences of Procedures

1. To study popular science literature on the problem, to consider different variants of types of aquariums with the help of journals on aquaristics.

2. With the help of popular science literature to study the rules of arrangement of the aquarium and care, keeping plants and animals in it.

3. Based on the materials of the project "Aquarium in an educational institution", write an article for the student "Bulletin for aquarists" and prepare a photo collage of this project.

Topic 2.2. *Importance of soil, lighting, heating and devices to support the functioning of aquariums*

Substrates for aquariums. The basis of any soil is a substrate that is indifferent to the aquarium water. As a substrate you can use *quartz sand, pebbles, fine granite and basalt gravel*, etc.

One of the most important characteristics of the substrate is its size. Fine soil with a particle size of less than 3 mm is not very suitable for soil formation. It coagulates quickly, metabolic processes are disturbed in it. Violation of gas exchange in such soil leads to its fermentation and rot of plant roots. As a rule, the biological balance in aquariums with soil consisting of fine sand is very unstable. Even fish and mollusks that loosen the soil do not help. A good substrate is the soil with a particle size of 4-5 mm, metabolic processes in it are not disturbed for a long time. This soil suits both plants with a strong root system and plants with delicate fragile roots, as its relatively small particles almost do not injure the roots when transplanting.

It is better not to use soil with a larger fraction, because it can injure the root system of plants, small aquarium fish can get stuck in it and it will kill them. Large stones are used only for decorative

purposes or to create shelters, or as a means of fixing certain plants or decorative elements.

As already mentioned, as a substrate you can use those types of stone that do not contain soluble elements with calcium and magnesium, i.e. quartz, pebbles, granite, basalt or a combination of them. If you have doubts about the origin and composition of the soil, then you should put a few stones into the vinegar and watch the reaction: if there are any bubbles, then this soil can not be used, and vice versa.

As for the color of the substrate, there are no restrictions, but it is worth remembering that many aquarium inhabitants are gaining soil color such as crayfish, shrimp. Dark fish are also better visible on light soil and vice versa. It is necessary to combine colors, to make dark and light places in order that aquarium inhabitants have an opportunity to choose places of the stay according to their own preferences.

Using decorative forms of natural objects to create landscapes. Stones are not only a successful decorative element, but also a substrate for spawning: with its help algae are planted, technical devices are masked, etc.

Basalt, granite, quartz, sandstone and others are most often used for an aquarium. As for the shape of the stone, it is better that it does not have sharp corners, so as not to injure the fish and the root system of plants.

Before placing the stone in the aquarium, it should be boiled and rinsed well. You should not put the stone just on the ground in the aquarium, where there are fish that like to dig, because it can suppress them. When creating underwater reefs, mind the distance between them so that the fish do not get stuck.

It is worth using smooth stones, because over time it will be easier to wash off the growths of algae and silt (pic. 2.17).

Pic. 2.17. *Smooth stones*

Non-living tree branches and roots of queer shapes will add character to the aquarium (pic. 2.18). Before use, the roots are cleaned, washed, then boiled in salty water, and then kept for at least six months in a tub of water (the water is changed periodically), so that the snag stabilizes, gains weight and stops turning the water brown.

Pic. 2.18. *Decorative aquarium*

Keep in mind that not every type of wood can be used for such purposes. The best suited wood for creating decorative snags is the following trees such as willow, grapevine, oak, apple, tropical types like

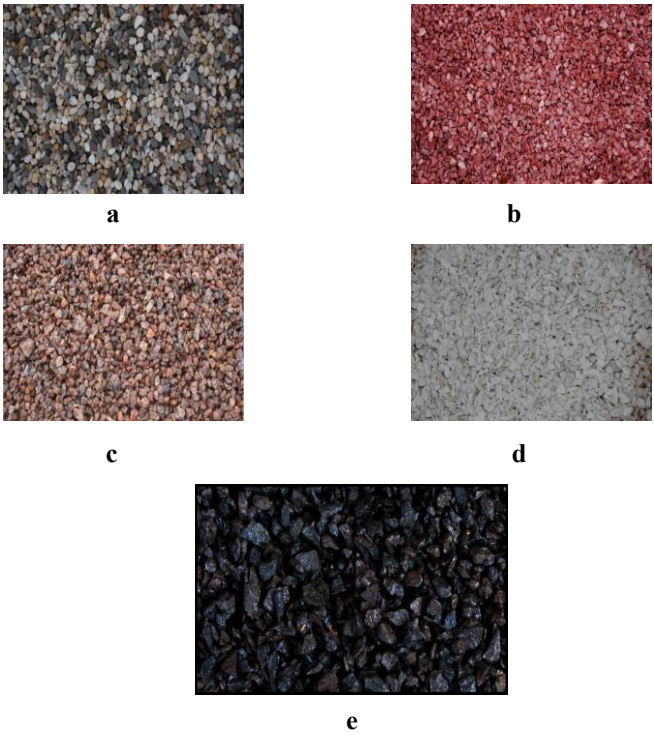
mangroves, mopane and others. In order not to keep the wood in the barrel for a long period, it is better to use the one that has been lying for a long time in a natural body of water with a current.

The exposed roots, which are not sufficiently aged, will paint the aquarium water brown and acidify it, but there are also positive aspects of that. Many tropical fish species like when the water contains tannins, weakly acidic water keeps carbon dioxide better, so some species of plants grow faster in the aquarium. Snags also release certain micro- and macroelements into the water, which are again assimilated by aquarium inhabitants. Therefore, depending on the species composition of the aquarium, driftwood with different degrees of aging can be placed in it.

Importance of soil. Soil is a key element of the aquarium, it provides plants with nutrients, biological processes for processing fish excrement undergo in it. The optimal soil fraction is 4-5 mm, this size provides the best results. The use of a smaller fraction will lead to stagnation and rot, and a larger one will cause inconvenience with planting, injuring fish, etc.

The composition of the soil is important: granite, quartz, basalt and pebbles are most often used because they do not contain soluble salts and significantly increase the overall hardness of the water. When you have soil and you are not sure about its composition, you need to put a few stones in acid or vinegar: if there is a reaction (bubbles appear), then such soil cannot be used in the aquarium. Due to the beautiful white color, novice aquarists often use marble crumbs as soil. You can't do that!

Aquarium soil, in addition to the organic fertilizers acquired over time, provides the inhabitants of the aquarium with the necessary trace elements, which are present in its composition and are gradually released into the water. Over time, the trace elements of the substrate are completely dissolved in water, so the soil must be replaced every two years of the aquarium service (pic. 2.19).



Pic. 2.19. *Types of soil*
(a – pebbles, b – quartz, c – granite, d – marble, e – basalt)

Lighting. Light as one of the main abiotic ecological factors plays an important role in ensuring the life of aquarium plants, as it is a source of energy for photosynthesis. As a result of photosynthesis, glucose is formed, which is used by plants to produce derivative metabolites: nucleic acids, amino acids, fatty acids, cellulose and starch.

In the life of aquarium fish, crustaceans and mollusks, light plays a much smaller role than in plants, as most of them live in natural habitats with very low light levels, which is caused by the turbidity of water bodies. Light for aquarium animals serves for visual perception of the world around.

In home aquariums, lighting is used to meet both the physiological needs of plants and the aesthetic appearance of the aquarium. For this purpose, a number of different lighting devices

are used, in particular incandescent lamps, fluorescent and LED lamps, as well as their combination.

Each of them has its advantages and disadvantages when used to illuminate the aquarium. The incandescent lamp consumes a lot of electricity, but has a favorable spectrum and serves as an additional water heater. Fluorescent lamp is more economical in heating, it evenly scatters light on the aquarium, but is large, requires additional devices to start and contains harmful elements, so it is dangerous to break. A LED lamp is the most economical, most compact, has the longest service life (up to five years), but is the most expensive. In addition to power and size, important characteristics of the lamp are its spectrum, luminous flux and color temperature. In order not to delve into all these features, a novice aquarist should buy lamps with warm (yellow) light (they are best suited for lighting the aquarium) or use specialized aquarium lamps.

All these lamps or their combination can be used to illuminate the aquarium, but, taking into consideration the rapid rise in price of electricity and other factors, we see that the most optimal are LED lamps (pic. 2.20).

a **b** **c**

Pic. 2.20. *Types of lamps*

(a – incandescent, b – fluorescent, c – LED lamp)

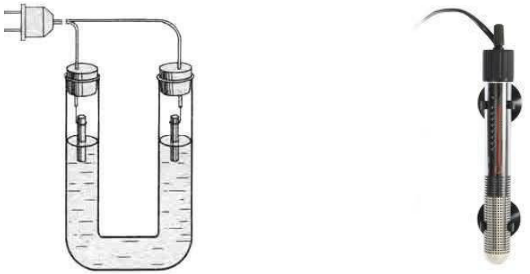
To automate the lighting process, aquarists use mechanical and electrical relays. The mechanical relay does not require a battery, it is cheap, but has limited programming capabilities, and in the case of power cutoff it lags behind in time (pic. 2.21).

a **b**

Pic. 2.21. *Light relays*
(a – mechanical, b – electrical;)

Aquarium heating. There are a number of heaters differing in design and principle of operation (electrolytic, diode and glowing filament). Diode heaters as heating elements use diodes soldered in a certain sequence with a pre-calculated resistance, which are placed in a glass bulb and filled with sand, they are low-power and fail quickly. The basis of electrolytic heaters is a flask in the form of the English letter U. It is filled with a saline solution of distilled water and common refined salt (concurrently the higher the salt concentration, the greater the power of the heater) and two carbon electrodes from conventional batteries are inserted.

The most common and safe are factory heaters working on the principle of glowing filament, but electrolytic and diode in modern aquaristics use little (pic. 2.22).



a **b**

Pic. 2.22. *Types of heaters*
(a – electrolite, b – spiral with thermoswitch)

The glowing filament is used as a heating element in modern heaters, they already have built-in automatic temperature controllers, which greatly simplifies their operation. You can buy a separate heater and temperature relay. This approach is still used if you want to heat the spawning cabinet, where the same temperature is set for many breeding tanks and correspondingly the higher they are placed in the cabinet, the warmer water is. The comfort temperature for a tropical aquarium is 24-25 degrees Celsius.

Aeration and water filtration. Aeration is carried out using electric air mini-compressors, which inject air into the tubes immersed in the aquarium. To increase the efficiency of dissolving air in water, sprays of various shapes and sizes are used. Sprayers are characterized by a microporous structure of the material, which breaks the air flow from the minicompressor into small bubbles that dissolve in water. The movement of air bubbles from the bottom to the surface of the aquarium provides partial mixing of water, which equalizes the temperature at the bottom and surface. Sprays are made of different materials: extruded titanium chips, porous sandstone or microporous plastic.

There are two types of compressors such as diaphragm and reciprocating (pic. 2.23). Diaphragm ones are suitable for maintenance of one or several small aquariums. Reciprocating compressors are used to service fisheries or large aquarium rooms.

In modern home aquariums the newest filters for water aeration are applied to provide both filtration, overturning and aeration. The principle of their operation is not based on injecting air, but on making a flow of water with a screw capturing air from an air tube that is taken out of the aquarium.

Pic. 2.23. *Compressors*
(a – diaphragm, b – reciprocating)

Keeping your water clean is important for the health of your aquarium fish. After all, the remains of food and excrements are a nutrient substrate for the reproduction of microorganisms, including pathogens that can directly affect fish. In addition, in the process of life, microorganisms release toxins into the water, such as ammonia, which can lead to poisoning and death of fish. Water filtration systems have been developed to prevent unwanted events. There are mechanical and chemical filters. In home aquariums, almost exclusively mechanical filters are used, which purify water from suspended mechanical particles that are trapped on porous filter elements. The filtered water is returned to the aquarium.

In addition to the above-mentioned type of modern filters, there are a number of those used by aquarists up until recently, including aquarium airlift filters, which are divided into bottom, inner and outer. The principle of operation in most of them is based on the supply of air from the microcompressor to the intake tube, in which under the action of pushing air with water there is a vacuum that is filled with water, creating an upward flow. Along with water, various particles suspended in the water column are captured and filtered.

When choosing a filter for your aquarium, keep in mind that you always need a supply of power, as the filter will clog and over time may no longer cope with the specified amount of water in the aquarium (pic. 2.24).

a **b** **c**

Pic. 2.24. *Filters*
(a – inner, b – outer, c – airlift)

Safety precautions while doing practical tasks

- While doing practical tasks involving childrens' contact with water in the aquarium, you must turn off all electric appliances connected to it!
- Only clean the aquarium glass with a safe blade in a scraper!
- It is forbidden to use heavy large stones in the decorations for aquariums!

Excercise "Unfinished sentences"

1. Stones are not only a good decorative solution, but also … .

2. Before use, the wood in the aquarium is cleaned, washed in … .

3. The snags are boiled for 5-6 hours in a saturated solution of salt, and then … .

4. Aeration is carried out by means of … .

5. Aquarium filters are divided into … .

6. The modern filter consists of … .

7. The filtered water is returned to … .

8. Ensuring the purity of water has … .

Self-check test

1. CHOOSE THE VOLUME OF A LAB AQUARIUM:

a) 10–20 l;

b) 5–10 l;

c) 20–50 l;

d) optional, depending on the biological needs of the test organisms;

e) 50–200 l.

2. NAME THE AIM OF QUARANTINE AQUARIUM:

a) decoration;

b) baby fish nursing;

c) prevention of diseases and fish treatment;

d) experimantation;

e) plant growing.

3. WHAT DOES TERM DUTCH AQUASCAPING MEAN?

a) a big-size aquarium;

b) an aquarium for young fish nursing;

c) an aquarium for disease prevention and fish treatment;

d) an experimental aquarium;

e) an aquarium magnificently planted with aquatic plants in accordance with certain principles.

4. CHOOSE WHICH TOOLS YOU NEED TO CLEAN AN AQUARIUM:

a) a mop, a bucket, a duster;

b) a scraper, a siphon, a bucket, a towel;

c) a lamp, a bucket, a hose tube;

d) soap, a duster, a scraper, a bucket;

г) a scraper, a siphon, a can, a duster.

5. WHICH IS THE COMFORT SIZE OF AQUARIUM SOIL ?

a) 4–5 mm;

b) 7–8 cm;

c) 8–9 mm;

d) 1–1,5 cm;

e) 1,5–2 cm.

5. WHAT SORT OF STONES (PEBBLE GRAVEL) CAN'T BE USED AS AQUARIUM SOIL ?

a) pebble stones;

b) quartz;

c) marble;

d) granite;

e) basalt.

6. WHAT LAMP COLOUR IS BEST SUITABLE FOR AQUARIUM LIGHTING ?

a) white (cold);

b) warm (yellow);

c) red;

d) blue;

e) violet.

7. WHAT TYPE OF LAMP IS THE MOST COMFORTABLE FOR AQUARIUM LIGHTING?

a) incandescent;

b) all;

c) fluoroscent;

d) none;
e) LED.

8. WHAT IS THE COMFORTABLE TEMPERATURE OF WATER IN THE AQUARIUM ?
a) 24–25;
b) 21–22;
c) 28–30;
d) 31–32;
e) 18–20.

9. CHOOSE WHAT AQUARIUM HEATER IS USED MORE OFTEN NOWADAYS:
a) electrolytic;
b) glowing filament with automatic temperature regulator;
c) diode;
d) infrared;
e) inductive.

10. WHAT DO YOU CALL AN AQUARIUM FILTER WORKING FROM THE COMPRESSOR ?
a) airlift;
b) pump-action;
c) compressor;
d) piston-type;
e) outer.

11. WHAT SUBSTRATE SIZE IS NOT SUITABLE AS AQUARIUM SOIL ?
a) less 3 mm;
b) 4–5 mm;
c) 5–6 mm;
d) 5–7 mm;
e) 4–8 mm.

12. WHAT COLOUR SHOULD AQUARIUM SOIL BE ?
a) red;
b) grey;
c) dark;
d) light;
e) optional but it's worth combining colours.

13. WHY CAN'T FINE SAND BE USED AS AQUARIUM SOIL ?

a) it is dangerous for molluscan shellfish;

b) fish can die in it;

c) because it hurts root system of plants;

d) because it vegetates;

e) there is no right answer.

14. CHOOSE THE RIGHT STATEMENT:

a) if the stones react chemically with vinegar, they are suitable for aquarium soil;

b) if the stones react chemically with vinegar, they are not suitable for aquarium soil;

c) marble chips are ideal for aquarium soil;

d) marble chips should be combined with sandy gravel;

e) there is no right answer.

15. WHY CAN'T THE STONES WITH SHARP ANGLES BE USED ?

a) they enter into reaction with vinegar;

b) they look ugly;

c) they can be used;

d) they hurt fish and root system of plants;

e) there is no right answer.

16. WHY IS IT BETTER TO USE SMOOTH STONES FOR DECORATION ?

a) they look better;

b) it is easier to wash them;

c) they are lighter;

d) they can't be used;

e) there is no right answer.

17. WHAT SORT OF WOOD IS BEST SUITED FOR AQUARIUM SNAGS ?

a) pine;

b) spruce fir;

c) arborvitae;

d) willow;

e) there is no right answer.

18. HOW LONG SHOULD SNAGS BE KEPT IN THE BARELL OF WATER?

a) no less than half a year;
b) one month;
c) one week;
d) two weeks;
e) there is no right answer.

19. WHY CAN'T MARBLE CHIPS AND BROKEN ROCK BE USED AS SOIL?

a) they increase the water hardness;
b) it's difficult to clean them off;
c) because they are unesthetic;
ɾ) they can be used;
e) there is no right answer.

20. WHAT TYPE OF WOOD SHOULDN'T BE USED TO MAKE AN AQUARIUM SNAG?

a) apple tree;
b) spruce fir;
c) willow;
d) oak;
e) there is no right answer.

Summarize what you have learned on the topic:

1. What conditions are required to maintain life in the aquarium?
2. Suggest the sequence of inhabiting the aquarium with living organisms.
3. What water temperature do warm-water aquarium fish need?

Guideline topics of reports:

1. Decorative aquariums are a beautiful decoration for homes and offices.
2. Types of aquariums.
3. Aquarium decorations: artificial ornaments, stones, driftwood.

CHAPTER 3 PHYSICAL AND CHEMICAL PROPERTIES OF WATER

Topic 3.1. *Saturation of water with mineral salts, gases*

You have no taste, no colour,
No smell, it's difficult to describe you,
People take delight in you without
having a clue what you are.
You are not just essential
For life, you are the life.
Antoine de Saint-Exupery

The water in the aquarium is a living environment for a balanced group. Depending on the composition, water promotes the development of life processes or inhibits them. Pure water has no color, has a neutral smell and taste. The substances dissolved in it give color, transparency and a smell to water, and also value of hardness (GN) and an indicator of active reaction of water pH. Clean, transparent, tap water is suitable for a home aquarium, it has GH 5–20, carbonate hardness KH 2–15, pH 6,5–7,5. Before pouring water into the aquarium, it must be either desilted for 2-3 days, or treated with conditioners (e.g. Aqua Safe) to get rid of excess air and chlorine (pic. 3.1).

Pic. 3.1. *Conditioner Aqua Safe*

Recall *how to determine the active reaction of water pH in the aquarium?*

Various devices and techniques are used to measure the active reaction of aquarium pH. pH paper with a color scale on the wrapper

is available to every aquarist (pic. 3.2). To determine the pH of the aquarium water, a piece of paper is immersed in water and compared with a color scale. It is interesting to note that this figure can change even during the day, it can be affected by light, aeration, the degree of contamination of the aquarium with decomposition products, the content of carbon dioxide in the water. The active reaction of water pH also depends on the soil in the aquarium. Basalt or granite do not change the reaction of water. Impurities of marble, shell rock, shell fragments of mollusks in the soil affect the change in the hydrogen index. The accumulation of dead plants, semi-decomposed feed, and other organic residues changes the reaction of water to the acid side, while significantly reducing the content of dissolved oxygen in the water.

Pic. 3.2. *Indicating set to measure pH*

Electronic devices are the most convenient for estimating certain parameters of aqueous solutions and products based on them (pic. 3.3). Their work is based on the use of electrochemical methods of measurement. The Ukrainian market has a huge number of such devices from different manufacturers.

Ph-meter PH-009 (I) is designed to measure the pH level of free hydrogen ions in water, as well as for pH in aquariums, swimming pools, water treatment systems, etc.

Pic. 3.3. *PH meter PH-009 (I) is a device for measuring water pH*

Total hardness of water. Hardness is one of the important parameters of fresh water, on which the possibility of keeping and breeding fish and plants in it depends. Fresh or salt water from ordinary bodies of water has a certain amount of calcium ions (Ca 2+), which is one of the essential elements for aquatic crustaceans and mollusks, using these ions to build carapace or shields, as well as fish in which calcium is a part of the bones. Water also contains magnesium ions (Mg 2^{+}). Together, they determine the hardness of the water.

There are temporary, or carbonate, water hardness and permanent. Temporary hardness is due to the presence of acidic carbonates (hydrocarbonates) of calcium and magnesium: $Ca(HCO3)_2$ and $Mg(HCO3)_2$, and the permanent one is conditioned by sulfates and chlorides of potash and magnesium: $CaSO_4$, $MgSO_4$, $CaCl_2$ i $MgCl_2$. The total hardness of water is the sum of temporary and permanent hardness. Temporary hardness can be removed by boiling, and permanent - by distillation, electrolysis, chemical reactions or reverse osmosis.

Water, which contains a significant amount of salts, is called hard (glassy); and water in which soap dissolves well is soft. Rainwater, distilled and osmosis water have this property.

In an empty aquarium, the hardness of water increases due to its constant evaporation, as well as the transition of calcium into water from the soil. Plants such as hornweed and elodea can be used to soften the water. To set the required hardness in the aquarium, reverse osmosis water is added to the water with the increased

hardness. For greater hardness, you can add small pieces of old limestone, chalk, calcium gluconate tablets to the water or mix crushed shell rock into the soil. In aquaristics, water hardness is measured in degrees. The hardness of tap water, depending on the region, varies and can range from five to 30 degrees.

Enrich your aquarium vocabulary

- ***Reaction of water or pH,*** *is a value indicating the degree of activity of hydrogen ions (H^+) in solution, i.e. the degree of acidity or alkalinity of this solution;*
- *aqueous solutions with pH value which is less than 7 are considered acid, and with more are* ***alkaline;***
- *the concentration of magnesium and calcium salts dissolved in water determines* ***the hardness of water****.*
- ***Water hardness in aquaristics*** *is measured in degrees (°dH). 1°dH = 0,357 mg/L.*
- ***Very soft*** *– 0–4°dH.* ***Soft*** *– 4–8°dH.*
- ***Slightly hard*** *– 8–12°dH.*
- ***Moderately hard*** *– 12–18°dH.*
- ***Hard*** *– 18–30°dH.*
- ***Very hard*** *– >30°dH.*

Every aquarist should know that when the oxygen content in the water increases and the carbon dioxide decreases, the pH increases. The decrease in pH depends on the presence in the water of organic (including humic) acids formed by the decomposition of organic substances. At high concentrations of calcium and magnesium salts, the alkalinity of water also increases. In alkaline water under bright light, green algae develop very intensively and "algal bloom" is observed, which is very harmful for fish and plants. Due to alkaline reaction of water and lack of oxygen hydrogen sulfide is formed (usually in soil). The presence of hydrogen sulfide in the water is evidenced by sulfur bacteria, which cover stones and sand in the aquarium with the whitish plaque.

Dependence of species composition of fish on water properties. Before populating an aquarium, be sure to measure the parameters of the water in it. For some reason, beginners forget about it and, at best, limit themselves to establishing the correct

temperature regime. Each species of fish, in addition to temperature, the right neighbors, still needs a certain acidity and hardness of the water. And inobservance of these properties usually leads to the death of fish.

The hardness of our tap water (applies to Volyn region) is about the same everywhere - within 20-25 degrees. Although these rates are not optimal for tropical fish, they should not lead to their death. It is worth noting that the hardness of the water in the aquarium varies, depending on what water you add; what soil, scenery you use; what fish, plants, snails you keep, etc.

Water acidity is a very important indicator, the wrong value of which leads to the rapid death of fish, and therefore it should be controlled, especially in newly formed and very old aquariums (the water becomes acidic). Regardless of the properties of the water you pour into the aquarium, it will always try to become neutral as a result of the usual chemical processes that take place in it. But there are also some exceptions.

Each species of fish requires its own optimal water parameters. You should get acquainted with them before settling fish in the aquarium. If you neglected all this and let the fish counting on luck, then carefully monitor their behavior. If the fish are restless, jumping, trying to jump out of the water, they have decomposed fins - this is a clear sign that the water in your aquarium is too acidic. You can reduce the acidity of water by adding soda to it, but this should be done very carefully so as not to make the water too alkaline. These changes need to be monitored with measuring instruments so as not to make it worse.

If the fish do not move much, lie on the bottom, keep warm by the lamp, the temperature in the aquarium is too low. And if all the fish have risen to the surface and are breathing hard, then the water lacks oxygen and you need to increase aeration.

The average optimal values of water for the life of tropical fish are hardness in the range of 10-20 degrees and neutral, slightly acidic or slightly alkaline acidity (pH 6,5–7,5).

Topic 3.2. *The value of oxygen dissolved in water*

The concentration of oxygen dissolved in water is directly dependent on the population of the aquarium, its depth, water surface area, light regime, water temperature and some other factors.

Aquatic plants play a huge role in maintaining a normal oxygen regime in the aquarium. In large aquariums, which are well planted with plants and contain a relatively small number of fish, self-sufficiency of oxygen is possible, because it is formed in sufficient quantities as a result of photosynthesis. In summer, the length of daylight allows plants to produce enough oxygen. In winter, the intensity of natural light in the aquarium is low. The amount of oxygen released by plants becomes insufficient for fish to breathe. Therefore, in aquarium practice, various illuminators and aeration of water, namely its enrichment with oxygen by blowing atmospheric air, are widely used.

Oxygen dissolved in water is of great importance both for the respiration of fish and for all aquatic animals and plants. An exception is some species of fish, such as labyrinth fish. A characteristic feature of the labyrinthine family is the possession of a lung-like labyrinth organ, i.e. an epibranchial organ, that has formed as a result of adaptation to life in oxygen-poor water. The labyrinth organ is a system of channels in the cavity located in the broad part of the first gill arch. It has the thinnest bone plates covered with mucous membranes rich in vessels. Fish capture with their mouths the air that enters the labyrinth, where the blood is enriched with oxygen. In their homeland, in the countries of Southeast Asia, labyrinth fish live in ponds that are poor in oxygen.

Do you know that … *without atmospheric air labyrinth fish cannot live and die quickly enough in a tightly closed bowl? The labyrinth organ develops only in 2-3 weeks after hatching larvae from eggs. Under natural conditions, most labyrinthine fish are found in standing or slow-flowing bodies of water (rice fields, irrigation ditches, ponds and rivers), densely covered with vegetation. Often in these reservoirs the water is heavily polluted and poor in oxygen.*

The amount of oxygen dissolved in water is influenced by the content of organic substances in it, namely fish excrement, unused food, products of life of mollusks and other organisms; number of plants; aquarium lighting and other factors (table 3.1).

Table 3.1

Factors affecting the oxygen content in water

Factor	Characteristic
Temperature	*The warmer the water, the less oxygen in it, and vice versa. In addition, high water temperatures accelerate metabolic processes in fish, as a result of which their need for oxygen increases at a time when its content in water decreases. This problem can be solved with the help of more intensive aeration.*
Plants	*Plants are often valued for their ability to release oxygen. But at night they themselves consume oxygen and produce carbon dioxide. At night, all living things in the aquarium compete in the fight for oxygen, the content of which at this time of day decreases. Therefore, in aquariums, densely planted with plants, at night there may be a lack of oxygen.*
Snails and other living things	*A large group of snails can have a significant effect on the oxygen content in the aquarium. Bacteria can do the same. Oxygen consumption by aerobic bacteria involved in the nitrogen cycle is acceptable because, instead, they bring significant benefits. If there is an excessive amount of organic residues in the aquarium (for example due to regular overfeeding of fish), the bacterial population will grow and absorb more oxygen than when fish are fed rationally. Snails also increase the amount of organic waste.*

The value of aeration of aquarium water, which is carried out with the help of special compressors that blow air through it from sprays, is not only in the saturation of water with oxygen. Aeration helps to equalize the temperature in the aquarium at all levels, especially if the water is artificially heated, eliminates sharp changes in water temperature both horizontally and vertically. In addition, the circulation of water, created by a strong flow of air, simulates certain environmental conditions that are necessary for different species of aquarium fish. Aeration of aquarium water helps to increase soil flow, provides the necessary conditions for normal life of soil

bacteria, which prevents the accumulation and decay of organic residues and thus - the formation of harmful gases for fish, such as ammonia, methane and hydrogen sulfide.

Prove the statements right or wrong:

- *The gas regime of water depends on its temperature, atmospheric pressure and lighting.*
- *Cold water has much more oxygen than warm water.При зниженні атмосферного тиску збільшується вміст вуглекислого газу.*
- *In the water of a lighted aquarium there is more oxygen than carbon dioxide, and vice versa.*
- *Plants are often valued for their ability to produce oxygen.*
- *Large populations of snails significantly affect the oxygen content in the aquarium.*
- *Without atmospheric air, labyrinth fish cannot live and die quickly enough in a tightly closed tank.*
- *Aeration of aquarium water helps to increase soil flow.*

When installing the sprayer, keep in mind that the smaller the bubbles coming out of it, the more they will saturate the water with oxygen. The material of the spray (it is better to take titanium) and its area play an important role. Heavy sprays should be used as they stay in place under their own weight and do not require additional holders.

Topic 3.3. *The value of carbon dioxide and its source in the water*

The aquarium is constantly consuming oxygen, while carbon dioxide is released, and when it combines with water, it forms carbon dioxide gas. Oxygen is spent on a normal metabolism in the body of fish, and in addition, during the decay and decomposition of food debris, fish excrement, the dying-off of plant leaves. Carbon dioxide is also required for the life of fish, plants and microorganisms. But if its content in the water is higher than the limit for each species of fish, it negatively affects them, for example, for fish, the concentration of CO2 in the aquarium water should not exceed 30 mg / liter.

Carbon dioxide is the main building material for the synthesis of organic molecules. With a deficiency of carbon dioxide, the growth of aquarium plants can be very slow or stop completely. On the other hand, with an excess of carbon dioxide in the aquarium water, the fish begin to suffocate. Therefore, the aquarist must be able to maintain the optimal concentration of carbon dioxide in the water.

In an aquarium with a sufficient but small number of fish, the required water parameters are usually set by themselves. To prevent them from deviating from the norm in the future, it is necessary not to overfeed the fish, to change about a quarter or a third of the water volume regularly and at least every two weeks. And that will really be enough. Fish in the process of their life emit sufficient amounts of carbon dioxide, nitrates and phosphates. In return, plants provide fish with enough oxygen.

To accelerate plant growth, aquarium water can be artificially saturated with carbon dioxide using a variety of installations. The most common installation is a cylinder of carbon dioxide, equipped with a reducer, from which the finished gas is supplied into the aquarium through a special spray. Aquarists also use homemade units to produce carbon dioxide by yeast fermentation and the chemical reaction of citric acid with soda. They are relatively cheap, but require constant attention and frequent replacement of reagents.

Excercise "Unfinished sentences"

1. In the aquarium there is a constant consumption of oxygen, at the same time … is released.

2. Carbon dioxide is the main building material for … .

3. Plants provide fish with enough … .

Check yourself

1. WHAT SETS THE TOTAL HARDNESS OF WATER ?

a) temporary hardness;

b) temporary and permanent hardness;

c) permanent hardness;

d) variable hardness;

e) there is no right answer.

2. WHAT DO WE CALL THE AQUEOUS SOLUTION, IF ITS PH=7?

a) neutral;

b) acidic;

c) alkalic;

d) mild acidic;

e) there is no right answer.

3. WHICH STATEMENT IS THE RIGHT ONE ?

a) the higher the water temperature, the more oxygen in it;

b) the level of oxygen in the water depends only on the number of living organisms;

c) water temperature does not affect the level of oxygen in the water;

d) the higher the water temperature, the less oxygen in it;

e) there is no right answer.

4. WHAT DO WE CALL THE AQUEOUS SOLUTION, IF ITS PH>7?

a) neutral;

b) acidic;

c) alkalic;

d) mild acidic;

e) there is no right answer.

5. WHICH SPECIES OF FISH BREATHE THROUGH THEIR MOUTH ?

a) cichlids;

b) labyrinth;

c) characids;

d) carps;

e) placodermi.

6. WHICH GAS IS NECESSARY FOR THE PROCESS OF PHOTOSYNTHESIS?

a) argon;

b) neon;

c) nitrogen;

d) oxygen;

e) carbon dioxide.

7. WHAT CONCENTRATION OF CARBON DIOXIDE IN THE AQUARIUM WATER IS DANGEROUS FOR FISH ?

a) more than 30 mg / l;
b) less 30 mg / l;
c) 5–10 mg / l;
d) 15–20 mg / l;
e) 20–25 mg/ l.

8. WHICH STATEMENT IS THE RIGHT ONE ?

a) *plants produce carbon dioxide during the day and consume it at night*;
b) plants produce carbon dioxide at night and consume it during the day;
c) plants do not produce oxygen;
d) plants do not consume carbon dioxide;
e) there is no right answer.

9. WHAT DO WE CALL THE AQUEOUS SOLUTION, IF ITS PH<7?

a) neutral;
b) acidic;
c) alkalic;
d) mild alkalic;
e) there is no right answer.

10. HOW MANY DEGREES OF HARDNESS DOES VERY SOFT WATER HAVE ?

a) 4–6°dH;
b) 2–8°dH;
c) 0–4°dH;
d) 4–9°dH;
e) 3–6°dH.

Creative tasks to choose from

1. Make a multimedia presentation on one of the following topics: “A nature study corner at home”, “A home aquarium with

discus fish", "Fish breeding and their maintenance in home aquariums".

2. Make a crossword and questions in it with the hidden word "water".

3. Create a research project on the topic: "Aquarium as a chemical and biological study object"*(you have to give information about simple and comprehensible methods to study physical and chemical parameters of aquarium water)*.

Exercise "An aquarist's dreams"

Option № 1

Participants of this interactive exercise have to be imaginative. Imagine… you were propelled into the future. What success would the scientific aquarism achieve? What changes in human life would these achievements result in?

Option № 2

You were propelled into the past … who of famous aquarists would you like to meet? What questions would you ask him?

Guideline topics of reports:

1. Use of aquarium for scientific purpose.
2. The main tasks of aquarium fish farming: collecting fish and plants from different zoogeographical zones, their acclimatization.
3. History of aquarium fish farming in ancient China and Egypt.
4. Pioneers in domestic aquaristics.
5. Aquarium centers in Ukraine and specialists of aquaristics.
6. Aquariums at educational facilities and home.
7. Water, its significance for life on the Earth.
8. Physico-chemical properties of water, saturation with mineral salts, gases.
9. Dependence of fish species composition on water properties.
10. The importance of hardness for fish life.
11. The importance of oxygen dissolved in water.
12. The importance of carbon dioxide and its source for water in aquariums.

CHAPTER 4 FEEDING STUFFS AND THEIR PROPERTIES

Topic 4.1. Basic requirements to aquarium fish feeding

Fish health and well-being directly depend on the right complete, balanced feed composition. Vitaminized, corresponding to a particular species of fish, it increases the body's resistance to disease and parasites.

According to the type of food, fish are divided into herbivores, carnivores and omnivores. The first group has a better developed intestine, the latter does the stomach. The main parts of the digestive tract of fish are mouth, mouth cavity, pharynx, esophagus, stomach, intestines, rectum and appendages.

Feeding is one of the most important factors in keeping fish in the aquarium. Rational feeding of aquarium animals with a variety of quality feeds containing the necessary substances, preserves their original natural data (color, disease resistance, ability to produce offspring).

Fish that take food from the surface can stay hungry if the food falls quickly and lies on the bottom. The size of the feed should also be taken into account, for example, large carnivorous cichlids simply do not take notice of small daphnia and cyclops in the dry or frozen state.

Peaceful herbivorous fish eat almost continuously, because the food in them does not stop down in the anterior intestine, but, as on a conveyor belt, moves along the digestive tract and is gradually digested. In omnivorous fish with a weak stomach, the need for food usually arises after 14-15 hours, and the intervals between feedings in predators can reach two days due to a fairly long digestion of food in the stomach.

The bigger the fish, the longer it may not eat. The most common aquarium inhabitants in adulthood can live without food for up to two weeks without harm to their health. Therefore, if you are going somewhere on vacation, it is better for your pets to be on a diet than to be fed by an incompetent person (a neighbor) and, as a result, all

will die from overeating or fermenting water. There is a golden rule of the aquarist: "It is better to underfeed fish than to overfeed".

Digestibility of animal food is 84-90%, plant - 80-90%, detritus - 10-15%, etc. The structure and name of the mouth of fish determines the type of food consumed: grasping, grinding, planktonic, scraping, etc.

Do you know that … *A.Kochetov believes that short-term starvation stimulates the function of reproduction and caviar is more often deposited a day after moving the prepared fish in breeding containers?*

Fish food exists in the form of dry granules, tablets, sometimes sublimated (dried organisms such as moths or sewage worms) (pic. 4.1). There is also still frozen food and live; and the one that affects the color of fish, growth of young, and so on. It is not necessary to buy feeding more than a month in advance as at long storage its quality decreases.

Pic. 4.1. *Dry food for aquarium fish*

It is interesting to know! Regarding the importance of artificial food for aquarists in Germany, which among European countries (excluding Russia) ranks first in the number of aquarists, R. Riel and X. Bensch note: "80% of all aquarists now feed their fish exclusively with artificial food in the form of flakes and tablets. About 15% of aquarists additionally (once a week) give the fish live food (sewage worm, moth, daphnia), which they catch themselves or buy. And only 5% of aquarists give live food from spring to autumn, and in winter corespondingly the artificial one only when nothing can be caught. And further: “Without a variety of artificial feed in the form of flakes, aquaristics today would be impoverished. Millions of

German aquarists have about 36 million ornamental fish. Where to get about 3 thousand tons of live feed per year? Many aquarists would liquidate their aquariums if they had to feed the fish only with live food."

Artificial food, of course, is very convenient for aquarists. But the best food for aquarium fish is live food. Most fish are fed with tubifex or sewage worms. It is eaten by almost all aquarium fish.

Tubifex worms are oligachaete segmented worms that inhabit the sediments of water reservoirs with a high content of organic content (in the silt of ponds, in swampy river banks). High concentration of worms in the soil is a sign of water pollution. Pushing the upper body out of the ground, they constantly make oscillating movements, capturing food: bacteria, protozoa, organic residues. In places of accumulation of worms, the bottom seems to be covered with mobile reddish "moss".

Sewage worms live where there are many rotting remains, so be careful not to poison or infect fish. It is better to collect any food for an aquarium in reservoirs where there are no fish, as far as possible from sewage pipes of the enterprises. Newly caught worms are not given to the fish for several days, but kept in running water, or replacing it to wash away the harmful remains. It is best to store worms in running water, it is possible without water in a basin and in the refrigerator; there is no point in freezing and drying the Tubifex worms.

Blood worm or Mosquito larva is the larvae of non-biting midge, family *Chironomidae*, which is similar to a small bright red worm 10–12 mm long that lives in the bottom silt of ponds, lakes, and river bays. It lives there for about a year, and then turns into a pupa, from which a mosquito emerges (pic. 4.2).

The worm lives in ponds and natural reservoirs. To get it out of the silt, people use special buckets, attached to a long stick. The sludge thus obtained is washed

Pic. 4.2. **Blood worm or Mosquito larva**

through a sieve until a worm remains on it. It is stored at a temperature of 13-15 C in a damp cloth in the refrigerator for up to eight days or in a special basin in the toilet tank (until you run out of the worms).

Black blood worm is a mosquito larva but unlike the blood worm, it is a larva of common biting mosquito or Culex pipiens L. These insects live in different bodies of water: rivers, ponds, puddles, rain barrels (they are often caught in barrels, because barrels are much cleaner than ponds and natural puddles), where the larvae hang near the surface of the water upside down. You can catch them at any time of year, until the water is not frozen. The worms caught in a puddle or in a rain barrel are considered absolutely safe from the sanitary and epidemiological point of view. (pic. 4.3).

Pic. 4.3. *Black mosquito larva*

Glassworms are transparent larvae of a midge genus called *Chaoborus*, they are not longer than 15 mm, their body has 13–14 segments. They are sometimes so transparent that fish do not

immediately see them and begin to recognize the glassworms only over time. However, the color of the larva can vary from light yellow to dirty red depending on what it feeds on. The larva is held in the water column by two air bags, clearly visible on its body: one is near the head, the other one is in the back of the body. With these bags, the larva regulates the air in them and can be placed in different layers of water, as well as move in it and be in a vertical position. Glassworms spend a lot of time in the upper and middle layers of the reservoir, rarely sink to the bottom. They have a beak-shaped mouthparts.

Glassworms eat plankton, small crustaceans (cyclops with daphnia, etc.). Glassworms are predators! Therefore, it is strictly forbidden to feed fry and young fish with them! It can seriously injure them (pic. 4.4).

Pic. 4.4. *A glassworm*

Daphnia is a genus of small planktonic crustaceans with size of 3–5 mm. Most of them are found in shallow water in summer. Daphnia can be main food for fish (pic. 4.5).

Pic. 4.5. *Daphnia*

Daphnias are highly nutritious food, so in the summer you should feed the fish with them as often as possible. Daphnia is readily consumed by almost all species of aquarium fish. In addition, getting to the plant type aquarium, where there are not many fish, crustaceans contribute to the establishment of biological balance, water purification,

consuming a large number of different microorganisms, unicellular algae, bacteria, fragments of organic detritus suspended in the water.

Cyclops are representatives of copepods (pic. 4.6). Unlike daphnia, they are slightly smaller: their length reaches only 3-4 mm. The body of the cyclops is segmented, pear-shaped, the abdomen is elongated in the form of a tail. Long antennae do not have branching, as in daphnia.

Pic. 4.6. *Cyclop*

Cyclops live in the same reservoirs as Daphnia. When it gets cold and the water temperature in the pond drops, daphnia disappear, but cyclops are kept in small numbers for almost the entire winter. The number of cyclops in reservoirs usually increases from March to May inclusive, and especially many of them occur in September and October. In the summer months, the cyclops does not occur so often, and in some bodies of water disappears completely. The nature of the movement in the water is also excellent. Daphnia's movements are slow, while the Cyclops makes rapid jumps, quickly covering long distances in the water. Cyclops swims, rolling on its back.

The cyclops also has one eye, its body is devoid of a hard shell, which in combination with its small size allows it to feed small fish, as well as growing fry. Thanks to its qualities, the cyclops is an excellent live food. It contains chitin, so fish, that eat cyclops, gain a rich bright color. But keep in mind that when feeding fry, cyclops should be carefully filtered to prevent large individuals that are predators from getting into the water because conversely they can eat your fry. A very valuable food is the larva of the cyclops, nauplius, which is usually used to feed the fry. Nauplii are so small that it is almost impossible to see them with the naked eye.

Quite often among cyclops there is another crustacean - diaptomus. It has the same food properties, but most fish refuse or are reluctant to eat because of the strong shell.

Topic 4.2. *Rules and methods of food conservation for aquarium fish*

Proper feeding of fish is the key to their good development and reproduction. The aquarist's golden rule "it's better to underfeed than overfeed" should not apply to fry. More food is required during spawning and when fish breed seasonally. Preparation for spawning of some species of fish generally requires a special diet. The amount of food consumed by fish also depends on water temperature. The higher the water temperature (in the optimal temperature range for this species), the better their appetite is. The appetite of fish is also influenced by other factors, including the oxygen content in the water and others.

It is better to use live food than dry food, but you should be cautious with live food: various pathogens can be transmitted with it. Live food caught from ponds can be dangerous for aquarium inhabitants, as it is a potential intermediate host for fish parasites. However, live feed has an advantage in its nutritional value because it contains biologically active substances and easily digestible organic components.

Conservation of Tubifex worms. The Tubifex worms are collected in gloves together with the sludge in a bag in the form of a sieve, where it is washed from the sludge. Then the washed sludge is thrown into a basin, covered with a sieve and filled with water. The worms will gradually crawl into the water and gather in a mobile hairy ball on the sieve, leaving the debris under it. Freshly received food should be carefully inspected: it can have planarians or leeches and they can get into the aquarium. They need to be detected and laundered. You can separate a live worm from a dead one, as well as from dirt, by placing the whole mass of worms without water in a basin and leaving it for 20-30 minutes. Then you need to remove the upper mass of feed carefully. If the removed food is not completely clean, the procedure is repeated.

Conservation of daphnia and cyclops. Water crustaceans, namely daphnia and cyclops, are considered to be no less valuable food. They are caught with a modular net (from 50 cm to 4 m long) of light fabric with a fine mesh, and fed to fish fresh, frozen or dried. They most often occur in thickets of plants, near the surface, in lighted areas. They are stored by pouring a thin layer of water into any flat dish. Aeration is mandatory.

Sun-dried daphnia is stored for a long time, but this food loses most of the vitamins. If you feed fish only with dried daphnia, they develop slowly, often do not acquire the color of adult fish. Constant feeding with dried daphnia can cause digestive disorders in fish. At the same time excrements are stretched by long threads, they have a lot of mucus and blood, fishes get exhausted and sick.

Methods of catching cyclops in natural reservoirs, its transportation are the same as for daphnia. But, compared with daphnia, the cyclops is more resilient, does not die in large numbers in the aquarium or in containers for its storage. To catch a cyclops you need a net made of thin but dense fabric, otherwise very small cyclops and nauplii are not caught (pic. 4.7).

It is best to freeze freshly caught daphnia and cyclops in flat briquettes after filtering and washing, and then, if necessary, to chip off and feed the fish.

Pic. 4.7. *Photocollage "Catching microsporic crustaceans"*

Excercise "Unfinished sentences"

1. Fish health and well-being depend directly on … .

2. By type of food fish are divided into … .

3. Fish food exists in the form of dry granules, tablets, sublimated (dried organisms such as moths or tubeworms), there are also … .

4. Sun-dried daphnia is stored for a long time, but … .

5. *Newly caught Tubifex worms are not given to the fish for several days because….*

Self-check test

1. WHICH FISH HAS A BETTER DEVELOPED INTESTINE DEPENDING ON THE TYPE OF NUTRITION ?

a) herbivorous;
b) carnivorous;
c) omnivorous;
d) the intestine is the same for all types;
e) there is no right answer.

2. HOW LONG CAN ADULT FISH LIVE WITHOUT FOOD?

a) up to 3 weeks;
b) up to 2 weeks;
c) up to 3 days;
d) up to 4 weeks;
e) up to 5 days.

3. WHAT DOES A GOLDEN RULE OF AQUARIST SAY?

a) "Fish should be fed with the light on";
b) "Fish should be fed as long as they eat";
c) "It is better to overfeed fish than to underfeed";
d) "It is better to underfeed fish than to overfeed";
e) there is no right answer.

4. WHAT KIND OF LIVE FEED ENHANCES THE COLOR OF AQUARIUM FISH?

a) glassworm;
b) Tubifex worms;

c) bloodworm;
d) cyclop;
e) black bloodworm.

5. FROM WHAT KIND OF LIVE FEED FOR AQUARIUM FISH IS THE COMMON MOSQUITO BORN ?

a) glassworm;
b) Tubifex worms;
c) bloodworm;
d) cyclop;
e) black bloodworm.

6. INDICATE HOW TO PRESERVE TUBIFEX WORMS BEST:

a) under a layer of still water;
b) frozen;
c) in the fridge;
d) in the running water;
e) dry.

7. HOW IS THE CYCLOP LARVA CALLED?

a) nauplius;
b) bloodworm;
c) pliuplius;
d) glassworm;
e) black bloodworm.

8. WHICH OF THE LISTED SPECIES ARE PREDATORS ?

a) glassworm;
b) Tubifex worms;
c) bloodworm;
d) cyclop;
e) black bloodworm.

9. WHICH OF THE FOLLOWING FEED CANNOT BE CAUGHT IN WINTER ?

a) glassworm;
b) Tubifex worms;
c) bloodworm;
d) cyclop;
e) black bloodworm.

10. WHICH OF THE FOLLOWING SPECIES CAN INJURY FISH JUVENILE?

a) glassworm;
b) Tubifex worms;
c) bloodworm;
d) cyclop;
e) black bloodworm.

Creative task

Write a reference paper on topic “Feeding stuffs for aquarium fish” (pic. 4.8).

Pic. 4.8. *Photo collage “Feeding stuffs for aquarium fish”*

CHAPTER 5
DIVERSITY OF AQUARIUM ANIMALS AND PLANTS

Topic 5.1. *Aquarium fish for beginners*

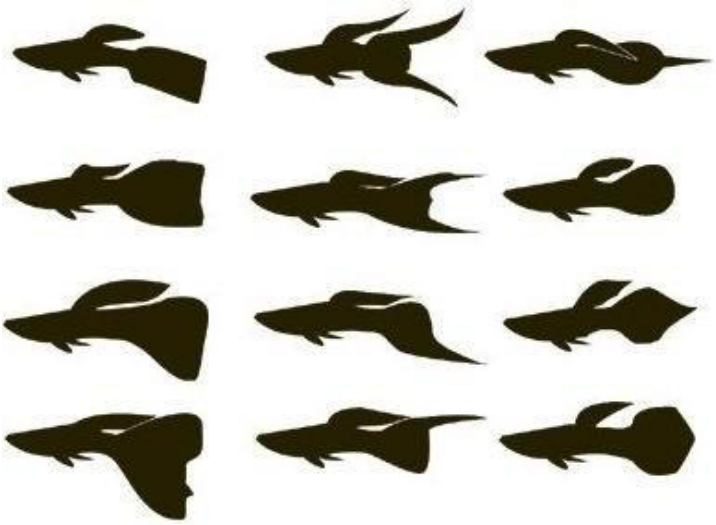
In this section, we will try to describe the most common species of aquarium fish that are best suited for beginners, are compatible, and have similar maintenance requirements. Recommended water parameters: temperature 24–26° C; close to neutral acidity, ie pH 6.5-7; total hardness (stiffness) 10–20°. If the fish have some special characteristic features, they will be indicated separately.

Guppi. Guppies are the most common fish among beginners, due to its tolerance to water parameters and temperature (pic. 5.1). The fish has a variety of colours, they are not big and grow to 2–6 sm, this type is pantophagous, with a good appetite, they consume both dry and frozen food. The male differs from the female by a large colorful caudal fin, a smaller abdomen and a sharp anal fin (gonopodium). Fish easily tolerate lower temperatures and feel good even at 20° C.

Pic. 5.1. *Guppy*

Guppies reproduce easily, giving birth to small fry, which immediately eat small food, such as artemia or crushed dry food. Beginners should remember that the more selective (expensive) the form of guppies (this also applies to other species of fish) is, the more demanding and less resilient it is. This should be taken into

account when buying. You should also be careful when choosing neighbors for guppies, as their velvet fins can be pinched out by other species of fish. In particular, it is not recommended to house barbs (except the cherry barb), veiltails (goldfish), scalares and other cichlids or predators. Guppies are the fish that are best suited for breeding research (pic. 5.2).



Mollies (poecilia). It is a widespread aquarium fish, usually with a combination of yellow, red and black colours (other variations are possible), its size is 4-5 cm (pic. 5.3). The male is smaller and has a sharp anal fin. The molly is a live-bearer and it easily reproduces, the fish gets along with all peaceful fish, including guppies.

Pic. 5.3. *Mollies*

Aquarium enthusiasts have developed sailfin and disc-shaped mollies. The conditions of their maintenance are the same.

Xiphophorus (swordtails). An adult swordtail reaches up to 10 cm without its tail "sword", it is the very attribute together with the presence of gonopodium that distinguishes males from females. There are many color options for this fish, but the most common is red.

Pic. 5.4. *Swordtails*

Aquarists have selected sailfin and veil-shaped swordfish, and in the latter both the male and the female have swords, the sex can then be distinguished only by the anal fin and the shape of the abdomen (in females it is rounder). Swordfish reproduce easily, giving birth to already formed fry (pic. 5.4).

Black Molly. Black Molly is selected from the grey (natural) from of mollies. The fish is a melanistic breed which are black all over, its size is 4–8 cm, compared to other livebearers, it is the most demanding, because it is very sensitive and reacts sharply if temperatures lower below 25 C°, rising into the upper layers of aquarium water and warming up near the lamp. If you do not regulate the temperature, the fish will die. The male molly is smaller and has a well-defined gonopodium.

Pic. 5.5. *Black Molly*

The black molly has two types of fins – triangle and round (pic. 5.5). You should be careful with sailfin forms of mollies, as they are sensitive to the chemical composition of water, and some forms need salting and will not feel well in a normal aquarium. Mollies need to add vegetational foods to their diet.

Zebra danio. The most common member of this family is the veil zebrafish (pic. 5.6). There are leopard, pink (coral), green and other forms of this highly popular fish. They do well in shoals of 5-10 fish, then the fish will feel more natural and will look much more spectacular.

The zebrafish can reach up to 5–7 cm in length, they fill the upper layers of the aquarium very effectively, where they spend most of their lives. The female differs from the male and has a larger belly, they carry eggs. The stimulus for spawning is a rise in temperature or partial replacement of water.

Pic. 5.6. *Zebra danio (pink or coral)*

Ancistrus. Ancistrus is extremely popular among beginners, due to its individuality, dissimilarity to other species of fish. It has an oral cavity similar to a sucker, so it is sucked to smooth surfaces and lip scrapers clean plaque (pic. 5.7). Ancistrus is a phytophagan, i.e. the main food in its diet is plant food, but it is happy to pick up the remnants of dry food from the bottom, and can suck on the feeder and not let others in there

until it is full. The fish grow up to 12–13 cm, the male differs from the female by horny growths on the head which aquarists call tentacles.

Pic. 5.7. *Ancistrus*

When buying ancistrus, you should prefer a larger fry, which is more resistant to environmental changes and can already hide from larger neighbors. Ancistrus should be given additional food such as boiled cabbage, carrots, pumpkin or specialized dry food. Ancistrus lay eggs in a hiding spot (in a pot, tube, under a snag), after that the male protects it until the larvae form full-fledged fry. The fish has a veil shape and might be yellow.

Veiltail. The veiltail is a bred type of goldfish. It is suitable for keeping in spacious aquariums, greenhouses and decorative ponds. Every beginner aquarist wants to buy it for their aquarium without thinking about the consequences. This fish is peaceful and coexists with others without harm, only while it is small, but growing up, it can eat everything that comes into its mouth, including small fish while they sleep, and young leaves of plants (pic. 5.8). The veiltail digs hard in the soil, collects it in the mouth, and then spits out, which creates turbidness. On the other hand, this fish is very clumsy, which Sumatran barbs make use of and pinch its fins out. Therefore, we recommend keeping the veiltails alone or with specially selected neighbors and large plants with a strong root system.

Pic. 5.8. *Veiltail*

These fish grow large, up to 10-15 cm, and their fins can have the same size as their body, and a well-fed veiltail cannot be squeezed into a three-liter jar. The male differs from the female only when it reaches adulthood by the presence of white bumps (grains) on the fins. The anal aperture in females is rounder and more bowed and in males it is thin and concave.

Paracheirodon (neon tetra). Paracheirodon tetras belong to the family Characide and reach length to 4 cm, they are schoolfish and have black and red shapes (pic. 5.9). The female differs from the male in larger size and rounded belly. This fish is picky about water quality, difficult to tolerate transportation, loves cool water (22– 24 C °), therefore they often do not get accustomed from the first time at beginners. Scalares, vailtails can beat or eat tetras, and therefore, they cannot be kept with these species of fish.

Pic. 5.9. *Neon tetras*

The most beautiful representative is red neon tetra, which grows a little bigger (5 cm) and has a bright combination of blue and red colors all over the body, including the belly. Neon tetras are bred only by experienced aquarists, because for spawning they need special water parameters that are difficult to reproduce without special equipment.

Minor tetra. Minor tetra is the most common representative of the family Characide, in amateur aquariums it reaches 4-5 cm in size (pic. 5.10).

Pic. 5.10. *Minor tetra*

The fish has a beautiful red color with black spots on the body and fins, flocks of 6-12 fish in the middle of the aquarium look great. The male is slimmer, has a flat abdomen, brighter color and more expressive white ends of the lower fin. The fish is peaceful, gets along with all non-aggressive representatives of aquarium fauna. For beginners, spawning and feeding minor tetras is a complex process.

Bettas (Siamese fighting fish). Due to their eye-catching appearance and behavioral features bettas are one of the most interesting fish to keep in the aquarium (pic. 5.11). The male is larger than the female, grows up to 7 cm, has long fins. The color range of this fish is simply amazing. In addition to solid red, blue, yellow, white, black, green bettas, there are species that combine these colors in different proportions. Special attention should be paid to the male's veiled fins, which can be in the form of a crown, semicircle, forked (two-tailed) and other variations. Bettas are anabantoids which means they can breathe atmospheric air using a unique organ called the

labyrinth, therefore, during its maintenance or transportation it is necessary to provide air space.

The idea that a betta is a fighting fish and can only be kept alone in a separate vessel is wrong. The male betta shows aggression only to another male (female) in the presence of limited space or the lack of it or presence of other irritating factors. In a spacious aquarium with plants and other inhabitants

Pic. 5.11. *Betta*

you can keep several males and females. It is clear that there will be periodic fights, but they will not lead to death, but it is very interesting to watch. If you want your bettas to get along together, they should be bought small (1–3 cm) and then grown together. Males which were bought as adults and sold from individual cups will be aggressive and likely to die, but will not reconcile with their opponent. Bettas are indifferent to other species of fish and do not disturb them. However, it is important to remember that some mobile fish, such as Sumatran barbs, will pinch the bettas' fins and be eaten by predatory fish. Spawning of bettas is a very interesting process. The male builds a nest from bubbles and plant material on the surface of the water, captures the female in a ring, squeezes the eggs, and then catches it and places it in the nest. Improperly organized spawning usually leads to the death of the female. The male guards the nest, takes care of the fish larvae until they form full-fledged fry.

Rainbow krib (Pelvicachromis pulcher). It got its name due to the bright color of adult fish (fry are gray and unattractive), whose abdomen is bright red, along the body there are yellow stripes,

pectoral fins have a blue edging, and dorsal and caudal fins are covered with black spots (pic. 5.12). The male differs from the female in larger size, elongated dorsal and caudal fins and the presence of more black spots on them. During courtship the female body becomes black with a distinct red belly. The male grows up to 9 cm, the female - up to 7 cm, they form a family and live in pairs. The fish are peaceful, but fiercely defend their territory, so it is better to keep them with neighbors in spacious aquariums of 50 liters or more.

Pic. 5.12. *Rainbow krib*

Rainbow kribs breed by laying eggs in hiding. It can be a pot, a tube or a hole in the ground. It is very interesting to watch how fish in pairs take care of their offspring: take turns swimming to eat, walk their fry together, keeping the neighbors off to a safe distance (pic. 5.13).

Pic. 5.13. *Photocollage "Laying eggs"*
(by Vasyl Chuiko)

Topic 5.2. *Aquarian mollusks*

An aquarium, like a natural body of water, is an ecological system in which many different biological objects live in constant interconnection. The normal coexistence of living organisms requires the so-called biological equilibrium, in other words, it is a state in which all parts of the ecological system (biocenosis) operate in harmony in partial or complete dependence on each other. An important element in the ecological system of the aquarium is mollusks.

Recall what the mollusks are? *Free-living three-layered invertebrates with an unsegmented body in which there is a secondary cavity. They live in all major aquatic and terrestrial environments.*

Do you know that… mystery snails (pomacea brigesii) were brought to Europe from the tropical countries where they live in swamps and ponds? In nature, these creatures consume mainly plant foods, in the aquarium they prefer food of animal origin. Therefore, in aquariums mystery snails are welcome guests, as they perform a sanitary function.

Mystery snails are distributed throughout the tropical zone of the globe. They have a big hard shell. Large size, striped color, interesting biology make this mollusk desirable in any aquarium. There are several forms of these mollusks. We have two widely known: the light one that has a yellowish shell and almost white soft parts of body (pic. 5.14) and dark brown. The latter occurs most often. Mystery snails are gonochoristic. They lay eggs on the glass of aquarium above the water line in the form of bunch. In conditions of high humidity, young mollusks appear on the 16th-20th day.

Mystery snails feed mainly on plant food, willingly also consume leftovers of fish feed. Adults can feed on young shoots of plants in the absence of food. In aquariums, the main food for mystery snails is algae.

Pic. 5.14. *Mystery snail*

Planorbis carinatus (the ram's horn snails) lives in our water bodies. It has been kept in aquariums for a long time. Its albionotic form with a red color is quite popular among aquarists. The mollusk has a thin half-transparent shell through which the internal organs are translucent. It lays eggs. It feeds on algae, dendrites, fish leftovers. The mollusk is undemanding to living conditions.

Bladder snails (Physidae) occur in our water bodies. They lay a lot of eggs in an aquarium. As an element of the ecological system, they bring significant benefits, as they consume a large amount of ballast organic residues, promote their faster mineralization.

The red-rimmed melania. This freshwater snail belongs to the subclass of prosobranch gastropods (pic. 5.15). It is distributed from Eastern Africa to Thailand. It has a spirally twisted, conical shell as majority of prosobranch mollusks. It is almost always in the ground. It crawls out of it at night, as well as when the water lacks oxygen. It feeds mainly on dendrites and algae. Moving between soil particles, the mollusk loosens it, which significantly improves the conditions for oxidation processes, prevents soil agglomeration, has a positive effect on plant growth and development. The red-rimmed melania does not lay eggs, it gives birth to mollusks. The mollusk is undemanding to the conditions of maintenance: the desirable range of water temperature is 20–28°C, the chemical composition of water is of no particular importance.

Рис. 5.15. *The red-rimmed melania*

Value of aquarium mollusks. Feeding on leftover food, dead fish, algae, detritus, bacterial slime on the water surface, aquarium mollusks not only contribute to the mineralization of large amounts of organic matter, but also significantly improve the conditions of growth and development of fish and plants.

Creative project

Make a multimedia presentation on the following topic: "Diversity of aquarian mollusks" (pic. 5.16).

Pic. 5.16. *Photocollage "A large variety of aquarian mollusks"* (sample)

Topic 5.3. *Plants in aquarium*

Aquarium plants mainly belong to flowering plants. There are relatively few true aquatic (i.e. not able to live outside the aquatic environment) among freshwater aquarium plants (e.g. duckweed, tapegrass etc.). Swamp plants (for example, representatives of the genera burhead, cryptocoryne) predominate, which are able to live both in a submerged state and in a humid greenhouse or paludarium.

Aquarium plants by shape and location can be divided into several groups: plants floating on the surface of the water; plants floating in the midwater; long-stemmed plants that take root in the soil (this group also includes plants with long, upgrowth leaves) – they are used to decorate the side walls and background; large bushy plants are for the design of the central positions of the aquarium; small bushy plants are for design of the foreground.

The beginner should be observant and determine in which neighborhood the plants that interest them occur in the aquariums of more experienced amateurs, at exhibitions, in photographs of aquariums in books and magazines.

In terms of light, aquarium plants are divided into light-demanding and shade-enduring. Practically all cryptocoryne, burhead as well as plant types floating on the water surface require quite strong lighting. Some types (Java fern, anubias and others) feel better in the darkened parts of an aquarium.

There are aquarium plants that are not rooted to the soil (eg duckweed, elodea), others are rooted (water lilies). According to the way of development they are divided into:

- emergent hydatophytes – plants immersed in water, the growth and development of which occur only in water;
- submergent hydatophytes – plants completely immersed in water, which grow in water, and pollination of flowers occurs over water;
- floating hydatophytes – plants in which part of the leaves and stems are immersed in water, and the other part of them floats on the surface; pollination of flowers occurs over water.

Plants floating on the surface or in the midwater. Plants floating on the surface and in the midwater are not planted in the substrate, they are simply put into the water. They grow best in aquariums where there is a good balance between flora and fauna.

Common duckweed. It lives in slow-flowing or still water bodies of Asia, Africa, Europe. It is also widespread in our country. The plant has a rounded shape, the diameter of the leaf blade is 2–5 mm. On the underside several very thin roots grow up to 5 sm in length (pic. 5.17).

Pic. 5.17. *Common duckweed*

It needs bright top lighting for reproduction in an aquarium. It is undemanding to temperatures. It can be kept in an aquarium for a year. Covering the entire surface of the water, duckweed is an excellent light filter protecting water from blooming. Due to its root system, it absorbs mud particles suspended in water. It is used as food for many herbivorous fish.

Riccia fluitans is one of the representatives of hepatics. It is distributed in the waters of southern Europe, Asia, America, Africa and New Zealand. This original plant floats on the surface of the water in the form of bright green balls. It consists of numerous branched plates. Growing quickly, it covers the entire surface of the water in the aquarium.

For reproduction it is enough to put a small piece of riccia on a water surface in an aquarium with bright top lighting and temperature of 22–24°C. It can endure significant temperature fluctuations. In winter, in the absence of additional lighting, the riccia breaks up into small brown plates, giving rise to new vegetation in the spring. The plant serves as a shelter for fry and material for building nests in some labyrinth fish (pic. 5.18).

Pic. 5.18. *Riccia fluitans*

Salvinia natans. Salvinia (commonly known as floating fern) is a very popular aquatic plant. In wild it is widely spread in North Africa, Asia Minor and Europe. It grows in river basins of the Dnipro, the Volga and the Don. Salvinia belongs to the fern family and has very thin branched stems, on which oval bright green leaves, covered with small hairs, are symmetrically placed. The plant requires good overhead lighting, in terms of temperature it is undemanding. It is used as a natural light filter and shelter for fry of live-bearing fish. This plant can be cultivated only in summer, because in autumn it dies, leaving spores, from which young plants reappear in spring. (рис. 5.19).

Pic. 5.19. *Salvinia natans*

Pistia, water lettuce. It is distributed in waters of the subtropics and tropics. It is one of the largest plants floating on the surface of the water. Large juicy green leaves of pistia are collected in a rosette. The root system is well developed and consists of numerous long roots, so in the aquarium it serves as a spawning ground for many fish, as well as a shelter for fry.

It is desirable to cover the aquarium with pistia with glass to create an environment saturated with water vapor (pic. 5.20). The plant requires bright light. The water temperature should be within 23–25°C. In winter, it is desirable to reduce the temperature slightly (up

to 18–20°C). With good overhead lighting and the required temperature, pistia can produce a small peduncle. The flowers are small, yellow or whitish. It reproduces vegetatively and rapidly.

Pic. 5.20. *Pistia, water lettuce*

Azolla. Azola is attractive for its whimsical feathery leaves, that resemble velvet moss (pic. 5.21). With the help of the roots hanging down, the plant absorbs nutrients from the water. Azola is hardy, though, but not hardy enough, so for the winter it is caught from the ponds and placed in a glass container with water and soil, which is brought into the room. In autumn, azolla leaves turn red. Two species of azolla are usually cultured such as subtropical Azolla pinnata (feathered mosquitofern) and the Carolina azolla, due to their intensive growth, they are not recommended for large bodies of water. Plants floating on the surface, as well as those that live in the midwater, are reproduced by division. There is no simpler way to reproduce: they are taken out of the water, divided into several parts and thrown back. Many deep-sea plants reproduce on their own, without any human involvement.

Pic. 5.21. *Azolla*

Plants that take root in the soil or attach to the substrate

Java fern. It is common in still and slow-flowing waters of India, Thailand and Southern China. Dark green hard leaves reach a length of 15-25 cm (pic. 5.22). Numerous roots covered with small hairs are derived from the rhizome. It is propagated by rhizome growth and the appearance of daughter shrubs on the main leaf.

The plant requires clean, slightly acidic water and temperature of 25 °C for development. When planting in the area of the back side, where it creates a wonderful decorative background, it is enough to press the roots of the fern with a small stone. It easily tolerates shading. It is used as a spawning substrate for spawning fish, whose caviar does not tolerate light.

Pic. 5.22. *Java fern*

Java moss. This succulent-green species of moss, capable of forming dense and very ornamental shrubs, is common in many bodies of water in the tropics. Long stems, covered with small dark green leaves on all sides, form bundles, which over time are firmly attached to the stones and soil. The plant is quite undemanding to the conditions of maintenance, it grows in water of any hardness and at

different light intensities. The desirable temperature of water is within 22–26 °C, but it also can grow at a temperature up to 32 °C. Java moss is an excellent spawning substrate for many spawning fish (pic. 5.23).

Pic. 5.23. *Java moss*

Cabomba aquatica. This type of cabomba is the most common in aquariums of beginners. Its distribution in wild nature is from Southern Mexico to North Brazil. Stems, decorated with ciliform bright green leaves, can reach a length of 1.5-2 m. It is propagated by shoots deriving from the root. To form a bush, the stem is cut into small pieces, which are planted in coarse-grained sand or gravel. The plant is light-demanding, it grows well in bright overhead lighting and at water temperature of 22–25°C. It poorly tolerates frequent transplants. When it is used as a spawning substrate it quickly dies, but in a decorative aquarium in the form of a well-developed bush it serves as a shelter for fry (pic. 5.24).

Pic. 5.24. *Cabomba aquatica*

Elodea canadenis (Canadian waterweed). Elodea is common in almost all parts of the globe, although its homeland is Canada and the United States. Long, repeatedly branched stems bear dark green leaves up to 1,5 sm. Reproduction occurs mainly vegetatively. Under optimal conditions, elodea grows rapidly, forming dense thickets. In summer it grows rapidly, and by winter it usually dies down. It looks good in an aquarium with clear water and moderate diffused lighting. It is unpretentious to the temperature (pic. 5.25).

Pic. 5.25. *Elodea canadenis*

Cryptocoryne Blassii. It is one of the most popular choices for amateurs' aquariums. Leaves give this plant the decorative appearance, the upper side of which can be from olive green to dark green, and the lower has a beautiful purple hue.

Pic. 5.26. *Cryptocoryne Blassii*

Cryptocoryne Blassii is native to Thailand. The plant is quite large, the leaves together with the shoots reach 50 cm in length. A bush containing 10-15 leaves is used as a substrate for scalares spawning, as well as as an artificial darkening of some part of the aquarium (pic. 5.26).

Echinodorus horizontals. It is distributed in the Amazon basin. This is a beautiful aquarium plant that does not exceed 15-25 cm in

height. The adult plant has up to 20 leaves, arranged mainly horizontally. The leaves are large, about 15 cm long and up to 10 cm wide (pic. 5.27).

Pic. 5.27. *Echinodorus horizontals*

It prefers soft, slightly acidic water, part of which should be changed periodically. The temperature of water is 22–26°C. The lighting should be bright and permanent enough. Under the root, if it is possible, you need to put a little extracted peat or a tablet with nutrients.

Echinodorus amazonicus (Amazon sword plant). It is distributed in the river Amazon. Due to the large size (height up to 60 cm) and a significant number of leaves should be cultivated in high aquariums. The leaves are bright green. Under optimal conditions, echinodorus amazonicus propagates rapidly with the help of sprouts, where a large number of young plants appear. The best soil is coarse-grained sand or gravel, under which peat is laid. It prefers soft water, bright overhead lighting and temperature of 24–26°C, although it can stand short-term significant increases in temperature (pic. 5.28).

Pic. 5.28. *Echinodorus amazonicus*

Nymphaea. It is one of the most beautiful aquaristic plants. Depending on the lighting, it can change its color (pic. 5.29). The leaves reach more than 20 cm in diameter. It is greenish or red with purple spots of different sizes. The plant prefers fairly bright lighting and water hardness of 10–14°. It propagates vegetatively. The water must have a temperature of 24–26°C. The plant loves swampy soil.

Pic. 5.29. *Nymphaea*

Nomaphila stricta(Giant hygrophila). The plant is distributed in water bodies of Thailand and Indonesia. The stem of the plant is thick, long, similar in structure to a tree branch. The leaves are arranged in pairs facing each other, their color is pale green or green (pic. 5.30). It propagates by stem shoots. It can grow both emmersed

and submersed in water. It prefers bright light. The plant is unpretentious to the temperature and water quality.

Pic. 5.30. *Nomaphila stricta*

Vallisneria spiralis. Vallisneria is one of the most common aquarium plants, which is planted in the background of the aquarium (pic. 5.31). It is very unpretentious. In the aquarium it reproduces all the year round, mostly by shoots. The leaves are ribbon-shaped, up to 60 cm long, mostly bright green. It provides water with oxygen and takes an active part in the cycle of organic and inorganic substances. It requires regular thinning.

Pic. 5.31. *Vallisneria spiralis*

Hygrophila polysperma. It occurs in slow-flowing waters of Southeast Asia. Due to its unpretentiousness it is common in amateur aquariums. Long, rather narrow leaves of light green color are placed

in pairs on a long and thick stalk (pic. 5.32). The plant is undemanding to light, hardness and acidity of water. It well tolerates temperature fluctuations from 20 to 30°C, but the optimal conditions can be considered such as water temperature of 22–25°C, bright lighting and rigidity within 6–10°. Due to the ability to stay without light for a long time it is a good spawning substrate for spawning fish.

Pic. 5.32. *Hygrophila polysperma*

Ludwigia. The plant is distributed in water bodies of the USA. The leaves of small size grow on long rounded stems. Their size and shape depend on the conditions of maintenance (pic. 5.33). The upper side of the leaves is from light green to olive, the lower is usually reddish. Ludwigia propagates by cuttings. It prefers strong overhead lighting and water temperature from 20 to 27°C. At low water levels it can grow above its surface, then small flowers appear on it. The best results in cultivation can be achieved by planting ludwigia in pots with sand.

Pic. 5.33. *Ludwigia*

Value of aquarium plants. Aquarium plants are of great aesthetic importance in the aquarium, and they also saturate the water with oxygen and are a spawning substrate for spawning fish. Small-leaf plants play the role of a kind of filter that promotes water purification. Some species of aquatic plants serve as additional food for herbivorous fish. Most freshwater aquarium plants belong to the angiosperm division and are of tropical origin; the marine aquarium is dominated by algae.

Basic rules for planting aquarium plants

1. Sun-loving plants should be placed in the brightest place; large plants that are able to grow should be planted one by one.
2. Plants with thin feathery leaves will look good if they are planted in a bush.
3. The tallest and deciduous plants should be planted in the corners or near the back glass, small bushy plants - in the middle of the aquarium, and the smallest - closer to the front glass.
4. When planting young plants that have not yet reached the maximum size, you should take into account their further growth.

Basic rules for maintenance of aquarium plants

1. Plants have to be cleaned of harmful algae.
2. Before moving to the aquarium, the roots should be pruned, leaving 4-5 cm.
3. Do not plant the plants closer than 7 cm from each other.
4. In an aquarium with fairly mobile fish, the plants are placed in special pots.
5. Lighting should be at least 12 hours a day.
6. Large plants (especially angiosperms) are placed in the aquarium earlier than the fish.
7. Plants need fertilizing.

If you follow the above rules, the care of aquarium plants will bring you only pleasure and create a comfortable habitat for fish.

Prove or disprove the statements:

- *Without plants, fish will not be able to adapt to life in the aquarium.*
- *Among many representatives of the aquatic flora, aquarists usually choose the highest spores (for example, Java fern).*
- *For fish that are not sensitive to water hardness, small-flowered echinodoruses are quite suitable.*

Complete the table "Biological groups of plants".

Table 5.1

Biological groups of plants

Group of plants	Representative
Plants floating on the surface or in the midwater	
Plants that take roots in soil	
Plants that attach to substrate	

Enrich your vocabulary about aquariums

- ***Aquarium plants*** *are the collective name of taxonomically heterogeneous plants of aquatic organisms, which are kept in aquariums for decorative purposes.*
- ***Pleistophytes*** *are plants which are not fixed by roots and float freely in the midwater or on its surface. Representatives are duckweed, hornwort, salvinia.*
- ***Hydrophytes*** *are plants that are partially immersed into the water.*
- ***Hydatophytes*** *are aquatic plants that are completely or mostly immersed in water (unlike hydrophytes immersed in water only in the lower part).*

Summarize what you have learned on the topic:

1. What biological groups of aquarium plants are distinguished?
2. Give a brief description:
   a) plants floating on the surface;
   b) plants that take roots in soil;
   c) plants attached to the soil.

3. What ecological value do aquarium plants have?

Creative tasks to choose from

1. Make a project on the topic "Green joy of the aquarium or why you need plants in the aquarium?"

2. Game "Aquarium plants"

Objectives. *Reinforce what you know about aquarium plants, their appearance, requirements for living conditions. Develop coherent speech. Foster interest in plants.*

Material: *aquarium plants.*

Rules:

1.Buyers go to the shop and the rest of participants follow if a buyer gives a correct desxcription of plant.

2. Shop assistants have to name the plant correctly.

Course of play

Aquarium plants are placed on the tables. The head of the young aquarists' club addreses the children and says: "We have a new aquaristic shop "Aquarium Plants". Have a look how many beautiful aquarium plants it has got. To buy your favorite plant, you must meet one condition: don't call its name, but describe its appearance and its preferences. A shop assistant has to recognise it according to your description and can sell it to you".

The first buyer is an educator. He/she describes a plant: "It has …. It likes….".

The shop assistant guesses what kind it is, for example, a cladophora.

"Buyers-children" describe aquarium plants, and "sellers" guess a plant and sell.

The game continues until all the children buy aquarium plants. The role of the seller is performed in turns.

3.Consider attentively pic. 5.34 "Demonstration aquariums" and name types of aquarium plants.

a

b

Pic. 5.34. *Demostration aquariums (a, b)*

4.Make a report on the topic: "Diversity of aquarium plants"(pic. 5.35).

Pic. 5.35. *Photocollage "Diversity of aquarium plants*"

5. Photoquiz "Aquarium plants" (pic. 5.36).

(sample)

1. WHICH OF THE MENTIONED BELOW SPECIES OF FISH TAKE CARE OF THEIR OFFSPRING IN PAIRS ?

a) guppy;
b) bettas;
c) black molly;
d) rainbow krib;
e) minor tetra.

2. WHICH OF THE MENTIONED BELOW SPECIES OF FISH CARRY EGGS?

a) guppy;
b) poecilia;
c) black molly;
d) swordtails;
e) neon tetras.

3. WHICH SPECIES IS LIVE-BEARING FISH?

a) neon tetras;
b) minor tetra;
c) poecilia;
d) ancistrus;
e) zebra danio.

4. THE MALE OF WHICH SPECIES TAKES CARE OF FISH LAVRAE?

a) neon tetras;
b) minor tetra;
c) swordtails;
d) ancistrus;
e) zebra danio.

5. THE MALE OF WHICH SPECIES BUILDS NEST FOR SPAWNING ON THE SURFACE OF WATER ?

a) bettas;
b) minor tetra;
c) swordtails;

e) zebra danio.

6. WHICH FISH OF THE MENTIONED BELOW SPECIES CAN HURT NEON TETRAS?

a) guppy;

b) minor tetra;
c) scalares;
d) black molly;
e) zebra danio.

7. WHICH FISH OF THE MENTIONED BELOW SPECIES IS PHYTOPHAGAN?

a) bettas;
b) minor tetra;
c) neon tetra;
d) ancistrus;
e) zebra danio.

8. WHICH FISH OF THE MENTIONED BELOW SPECIES IS NOT VEILTAILED?

a) goldfish;
b) rasbora;
c) oranda;
d) comet goldfish;
e) telescope eye.

9. WHICH FISH OF THE MENTIONED BELOW SPECIES IS HARD TO DEAL WITH DECREASE IN TEMPERATURE ?

a) guppy;
b) black molly;
c) neon tetra;
d) rainbow shiner;
e) telescope eye.

10. WHICH MALE FISH OF THE MENTIONED BELOW SPECIES HAS GONOPODIUM?

a) bettas;
b) minor tetra;
c) mollies;
d) ancistrus;

11. THE BODY OF MOLLUSKS:

a) consists of the same segments;
b) consists of different segments;
c) is unsegmented;

d) is unsegmented, divided into sections.

12. MANTLE CAVITY IS A SPACE:

a) between internal organs;

b) between shell and mantle;

c) between mantle and body;

d) between heart and body.

13. THE CIRCULATORY SYSTEM OF MOLLUSKS:

a) close without heart;

b) close with heart;

c) open with heart;

d) open without heart.

14. A KIDNEY, AN ELIMINATIVE ORGAN OF MOLLUSKS, HAS:

a) one exit opening into the mantle cavity;

b) one exit opening outside;

c) one exit opening into the cavity surrounding the heart and the other into the mantle cavity;

d) one exit opening into the cavity surrounding the heart and the other into the intestinal cavity.

15. MOLLUSCS' SHELL IS FORMED AS A RESULT OF ACTIVITY OF:

a) cutaneous glands of the mantle;

b) salivary glands;

c) liver;

d) ink sac.

16. THE RADULA, AN ANATOMICAL STRUCTURE FOR CUTTING FOOD IN MOLLUSKS, IS LOCATED:

a) in the mouth cavity on the tongue;

b) in the intestinal tract;

c) in the throat;

d) in the food pipe.

a) mystery snail;

b) bladder snails;

c) red-rimmed melania;

d) planorbis;

e) anentome helena.

18. WHICH TYPE OF MOLLUSKS IS CARNIVOROUS?

a) mystery snail;

b) bladder snails;

c) red-rimmed melania;

d) planorbis;

e) anentome helena.

19. WHICH TYPE OF MOLLUSKS IS LIVE-BEARING?

a) mystery snail;

b) bladder snails;

c) red-rimmed melania;

d) planorbis;

e) anentome helena.

20. WHICH TYPE OF MOLLUSKS PUT A BUNCH OF EGGS ABOVE THE SURFACE OF WATER?

a) mystery snail;

b) bladder snails;

c) red-rimmed melania;

d) planorbis;

e) anentome helena.

21. FOR WHAT KIND OF PLANTS IS LAKE SVIATIAZ A NATURAL BIOTOPE ?

a) sphere-shaped cladophora;

b) nymphaea red;

c) cryptocoryne blassii;

d) echinodorus horizontalis;

e) vallisneria spiralis.

22. WHAT KIND OF PLANTS PERFORMS THE FUNCTION OF THE LIGHT FILTER?

a) sphere-shaped cladophora;

b) nymphaea red;

e) vallisneria spiralis.

23. WHAT KIND OF PLANTS DO NOT HAVE TO BE PLANTED IN THE SOIL?

a) Java moss;

b) nymphaea red;

c) cryptocoryne blassii;
d) echinodorus horizontalis;
e) vallisneria spiralis.

24. WHAT KIND OF PLANTS IS REPRODUCED BY DIVISION ?

a) Java moss;
b) nymphaea red;
c) cryptocoryne blassii;
d) echinodorus horizontalis;
e) vallisneria spiralis.

25. WHAT KIND OF PLANTS IS REPRODUCED BY STALKS?

a) Java moss;
b) nymphaea red;
c) cryptocoryne blassii;
d) echinodorus horizontalis;
e) vallisneria spiralis.

26. WHAT KIND OF PLANTS FLOATS ON THE SURFACE ?

a) Java moss;
b) nymphaea red;
c) common duckweed;
d) echinodorus horizontalis;
e) vallisneria spiralis.

27. WHAT KIND OF PLANTS IS ATTACHED TO SUBSTRATE?

a) common duckweed;
b) nymphaea red;
c) Java moss;
d) echinodorus horizontalis;
e) vallisneria spiralis.

28. WHAT KIND OF PLANTS BLOOM WHEN ATTACHED TO THE FORM OF ALGA ?

a) common duckweed;
b) nymphaea red;
c) Java moss;

d) echinodorus horizontalis;
e) vallisneria spiralis.

29. WHAT KIND OF PLANTS CAN BE REPRODUCED BY STEM DIVISION ?

a) common duckweed;
b) nymphaea red;
c) giant hydrophila;
d) echinodorus horizontalis;
e) vallisneria spiralis.

30. WHAT KIND OF PLANTS DO SIAMESE FIGHTING FISH USE TO BUILD A NEST ?

a) riccia fluitans;
b) nymphaea red;
c) giant hydrophila;
d) echinodorus horizontalis;
e) vallisneria spiralis.

SUPPLEMENTS

Supplement A

EDUCATIONAL ACTIVITIES ON THE TOPIC: "AQUARIUM FISH"

Plan
of an oral journal on the topic:
"In the world of aquarium fish" *(sample)*

Aim: to deepen knowledge, expand the worldview of aquarium enthusiasts about the diversity of aquarium fish species.

Equipment: aquariums, wall newspapers, a memo to a young aquarist, photos of aquarium fish, handouts on the topic of the meeting of the club of aquarists.

Progress:

I. Introduction.

II. Main part.

Page 1. Characteristics of the family Characines. Morphology and behaviour of minor tetras, neon tetras and black tetras.

Page 2. Characteristics of the family Cyprinidae. Morphology and behaviour of barbs, China danio, zebra danio.

Page 3. Goldfish, the history of their breeding. Telescope eyes, veiltails. Morphology and behaviour.

Page 4. Characteristics of the family Poeciliidae. Morphology and behaviour of guppy, swordtails, poecilias, mollies.

Page 5. Catfish. Their role in aquariums.

Page 6. Characteristics of the family Cichlidae. Morphology and behaviour of firemouth cichlids, scalares.

Page 7. Gouramis. History of their appearance. Color variations.

Page 8. The lung-like labyrinth organ as an adaptation to life in oxygen-poor water.

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III. Conclusions. Variety of aquarium fish species

Continuation of supplement A

Creative task

Prepare a photo collage on the topic: "Aquarium fish".

As a good example we are giving a photo collage of aquarium fish made by Romanyuk Natalia, a member of Young aquarists' club (pic. 1).

Pic. 1. Photo collage "Diversity of aquarium fish species" (a sample)

Continuation of supplement A

Plan of the express exhibition of aquarium fish and poster presentation "Interesting and unknown labyrinth fish"

(Sample)

1. Prepare the text and form of the invitation to the express exhibition.

2. Invite aquarium specialists, ecologist, parents of the club members to the express exhibition of aquarium fish.

3. Decorate the biology classroom and assembly hall, where the express exhibition will take place, hang posters, drawings; organize an exhibition of students' summer research works; exhibition of aquarium fish; make the newspaper "Word of a young aquarist" and collage "Aquarium Garden" (from colored leaflets, photos).

4. Announce a competition for the best aquarium expert.

5. Make crossword puzzles, tests and tasks.

Program
of express exhibition and poster presentation of aquarium fish "Interesting and unknown labyrinth fish"

(sample)

1. Meeting participants of the express exhibition of aquarium fish and poster presentation, invited guests and parents.

2. Collective excursion around the express exhibition of aquarium fish and poster presentation "Interesting and unknown labyrinth fish".

3. Tour around the exhibition of summer research works of young aquarists' club members and the express exhibition of aquarium fish in the assembly hall.

4. Grand opening of the express exhibition; introductory speech of the head of the club "Young aquarists"; talks of invited professional aquarists; a performance.

5. Workshop "Arrangement of an aquarium for labyrinth fish", contests on a theme "Labyrinth fish are the oldest inhabitants in an aquarium".

6. The results of all types of competitions.

7. Closing ceremony of the express exhibition of aquarium fish (pic. 2).

a

b

Pic. 2. *Express exhibition of aquarium fish and poster presentation "Interesting and unknown labyrinth fish" at the Department of Theory and Methods of Natural and Mathematical Disciplines in Primary Education, the Pedagogical Institute at Lesya Ukrainka National University, Lutsk*

Continuation of supplement A

Scenario
the final class in the club of young aquarists
on the topic: "Aquarium fish"
(sample)

Aim: generalize, systematize and check the assimilation of the educational material on the topic, skills, and abilities of the club members; develop the ability to analyze, compare, systematize, draw conclusions.

Equipment: photos of aquarium fish, multimedia presentation, test tasks, interactive exercises on aquarium topics.

Methods and techniques:

- reproductive: answers to test questions;
- problem solving and research: search for answers to challenging questions.

Basic concepts and terms: concepts and terms that were studied during the familirization with the topic.

Progress:

I. Організаційний етап.

Introductory word of the teacher. We have already learned about the peculiarities of the morphology of aquarium fish and their importance, the maintenance of common aquarium fish, their diversity. The theme, purpose, and plan of the final lesson of the club of young aquarists are announced.

II. Numeric dictation "Aquarium fish of the Labyrinth family".

Pupils of the circle are asked to answer twelve questions. The answers are written in the score card in the column " Numeric dictation" in the form of a digital code. The correct answer is 1 point.

Which fish belong to the Labyrinth family?

Mark the answer "yes" with a plus, and the answer "no" with a minus.

1. Gourami +; 2. Bettas +; 3. Zebra danio - ; 4. Minor tetra - ; 5. Paradise fish +; 6. Gold fish - ; 7. Black molly - ; 8. Dwarf gourami +; 9. Neon tetra - ; 10. China danio - ; 11. Barbs - ; 12. Striped gourami + .

Continuation of supplement A

III. Research work with aquarium fish.

As an example, we present research on "Conditioning under the action of various stimuli."

Goal: *show how conditioned reflexes to the action of various stimuli are formed.*

Objects and equipment: *aquarium with several fish of one or different species; two lamps: with blue and red light.*

Experimentation

Before experimenting in order to form a conditioned reflex to the sound fish should not be fed for several days. Then before each feeding you need to knock on the wall of the aquarium with a coin or some other metal object and, observing the behavior of fish, give them a little food. The experiment is performed daily. After the fish have eaten the food, they are given another small portion while tapping on the wall of the aquarium.

Fish should be fed in the same place. The time between the action of the conditioned stimulus and its reinforcement should be gradually increased with each feeding. The conditioned reflex is considered to be produced when the fish after the signal gather near the feeding place in the absence of food there.

Students should know that the reaction to a conditioned stimulus persists only if it is supported by food or another unconditioned stimulus..

Approximately in the same way as with the sound, carry out the formation of a conditioned reflex to light. Outside the walls of the aquarium attach a light bulb from a flashlight. To prevent the light from spreading in all directions, you can make a small reflector - a cone of a piece of foil glued to thick paper. The light bulb is connected to the battery with the help of wires.

Fish are not fed for 1-2 days before the experiment. Students are asked to turn on the lights and observe how the fish will behave, and then give them some food. The experiment is repeated several times a day. Herewith note how the behavior of fish changes; in how many days they will arrive at the feeding place immediately after the light signal.

Such an experiment can be offered. In two aquariums or jars with water and water plants one small crucian carp is placed. After knocking on the wall of the aquarium, one fish is fed with food that falls to the bottom (Enchytraeidae worms, tubifex worms, bloodworms, small or cut earthworms), the other - with food floating on the surface (dry daphnia, gammarus, dry bloodworm). Each knock on the wall of the aquarium is accompanied by feeding.

During the experiment, it is determined how many days it takes (or, even better, after how many feeding sessions and signal action) after putting crucian carps into a shared aquarium, one of them will go down during tapping, and the other will go up.

During the experiments, students can observe whether conditioned reflexes are produced equally quickly in different species of fish, for instance, guppies or swordfish.

During the experiments, children keep a journal of observations, after finishing the experiments they make conclusions.

IV. Project "Aquarium fish. What are they like?"

The club members are offered to make a project on the topic: "Aquarium fish. What are they like? "

V. Photo quiz "Aquarium fish". The club members are asked to answer the questions of the photo quiz (pic. 4).

Continuation of supplement A

Pic. 4. *Photo quiz "Aquarium fish"*

VI. Creative tasks. Pupils of the hobby group are offered creative tasks, which are evaluated by one point. The answer to the question is registered in the score card "Aquarium fish".

The game develops personal creative abilities. There is no mental development without games. The game is a spark that ignites the fire of curiosity.
V. O. Sukhomlinsky

1. Game "Recognize the aquarium fish"

Pic. 5

Pic.6

Pic. 7

Pic. 8

Pic. 9

Pic. 10

Pic. 11

Pic. 12

Pic. 13

Pic. 14

Pic. 15

Pic. 16

2. Game "In the world of aquarium fish". Slides of the multimedia presentation "Home aquariums" are shown, where different species of aquarium fish are shown. Players need to name them, determine their systematic position. The correct answers are

evaluated by three points. Results. Defining a winner and greeting teams.

continuation to supplement A

3. Game "Decorative aquariums"

A photo album "Decorative aquariums" is demonstrated (pic. 17–19). Players need to name the aquarium inhabitants of decorative aquariums. The correct answers are evaluated by three points.
Summing up. Defining and greeting teams.

Pic. 17. *Decorative aquarium*
(author – Vitalii Diumen)

Pic. 18. *Decorative aquarium*
(author – Andrii Kolosok)

Pic. 19. *Decorative aquarium*
(author – Olena Andriichuk)

4. Game "Who eats whom?"

Pupils of the club "Young aquarists" make a large circle, they count off in ones, twos, threes. The first numbers receive a green card, the second – brown, the third – blue. Students with a green card have pictures with aquarium plants, with brown – aquarium mollusks, with blue – aquarium fish. (pic. 20–25).

The head of club offers to make food chains "Who eats whom?". Everyone must find food to save their lives. If the general chains are made, students indicate the species names of animals and plants. Then the game is complicated by increasing the number of cards.

Pic 20. *Vallisneria spiralis*

Pic. 21. *Red-rimmed melania*

Pic. 22. *Mystery snail*

Pic. 23. *Barbs*

Pic. 24. *Cladophora*

Pic. 25. *Discuses*

5. Game "Ecological auction of knowledge of modern aquarist"

Anyone can take part in ecolgical auctions. The essence of an ecological auction is that children talk about a natural object or phenomenon which is put up on auction. For example:

Moderator. Types of aquarium fish are put up for auction. Starting price is 10 points.

Buyer 1 tells about the biological features of the morphology of aquarium fish (10 points).

Buyer 2 reads a poem about aquarium fish (10 points).

Buyer 3 sings a song about aquarium fish (10 points).

Buyer 4 tells a fairy tail "Goldfish" in a modern way (10 points).

Buyer 5 tells about the traditions associated with aquarium fish. (10 points).

Continuation to supplement A

The winner is the one who will be the last. He earns the most points for which he receives a prize.

VI. Creative task.

Why was fish gambusia put and allowed to develop in ponds in the 30s? What kind of its relative can be seen in almost every aquarium?

Solution. *Gambusia was bred in natural resorvoirs to fight malaria. This fish eats the larvae of the malaria mosquito developing in ponds, swamps, and other bodies of water. Guppies bred by aquarists can also eat the larvae of the malaria mosquito.*

VII. Control, self-control, mutual control. Knowledge analysis.

At the final lesson pupils of the club exchange score cards and perform calculations, summarizing the points obtained at different stages of the lesson on the topic "Aquarium fish". The maximum number of points – 32.

VIII. Results.

Score card on topic: «Aquarium fish»

Participant……..……..variant…….

Stage	Answer	Score
Numeric dictation	+ + + + =	
Research work with aquarium fish		
Project "Aquarium fish. What are they like?"		
Photo quiz "Diversity of Aquarium fish"		
Creative tasks		
	Total number of points for the class	
	Grade point for topic-related assessment	

Continuation to supplement A

Typical topics of experiments with aquarium fish

1. Research on the diversity of guppies' species.
2. Research on conditions for preservation of breed forms of a guppy.
3. Investigation on the memory of generations of the tail fin pattern in guppies.
4. Investigation of the memory of generations of the shape of the cadual and dorsal fins in guppies.
5. Research of conditions of breeding interspecific hybrids of guppies and mollinesias - gupinesias.
6. Study on spawing stimulation in American cichlids.
7. Study of conditions affecting the sex ratio during the reproduction of black-striped cichlidis.
8. Study of American cichlids behavior and the formation of conditioned reflexes.
9. Influence of lighting on fish reproduction, growth, and development of fry.
10. Color change, depending on environmental conditions. Keeping a crucian on light and dark soil.
11. Dependence of fish growth on the volume of the aquarium (on the example of a goldfish).
12. The effect of water temperature on the growth and development of fish.

Sample topics of essays

1. Aquarium plant production is an integral part of aquaristics.
2. Ecology and biological features of aquatic plants.
3. Ecological groups of floating plants: hygrophytes and hydrophytes, their importance in biocenoses.
4. Reproduction of floating aquatic plants..
5. Flowering plants in the aquarium, their general characteristics.
6. Caring for aquarium plants.
7. Reproduction of higher aquatic plants.
8. Freshwater fish species.

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The end of supplement A

9. Variety of fish body shape as a result of adaptation to different living conditions.

10. Bottom-dwelling and pelagic fish.

11. Special features of keeping fish in the aquarium. The value of the volume of the aquarium.

12. Morphology and behaviour of minor tetras, neon tetras and black tetras..

13. Morphology and behaviour of barbs, China danio, zebra danio.

14. Goldfish, the history of their breeding. Telescope eyes, veiltails. Morphology and behaviour.

15. Morphology and behaviour of guppy, swordtails, poecilias, mollies.

16. Catfish. Their role in aquariums.

17. Characteristics of the family Cichlidae. Morphology and behaviour of firemouth cichlids, scalares.

18. Labyrinth family. Distribution of fish of this family.

19. Typical representatives of labyrinth fish: climbing perch, bettas or Siamese fighting fish, dwarf gourami, paradise fish, gourami.

20. Gouramis. History of their appearance. Color variations.

21. Breeding live-bearing fish in the aquarium.

22. Biology, keeping, and breeding of fish of the genera Brachidanio rerio, zebrafish and labeo.

Supplement B

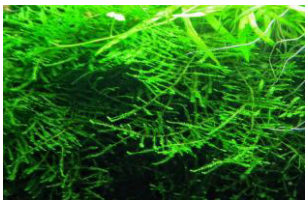
PRACTICAL TRAINING OF FISH-KEEPING HOBBYIST

(sample)

1. Match the photos and names of aquarium plants.

	Name of plant		**Photo**
1	Cladophora	A	
2	Nymphaea	B	
3	Java moss	C	
4	Vallisneria	D	

Continuation of supplement B

5	Anubias	E	
6	Echinodorus bleherae	F	
7	Giant hygrophila	G	
8	Elodea canadenis	H	
9	Cryptocoryne brown	I	

Continuation of supplement B

10	Riccia fluitans	J	

2. Match the photos and names of aquarian fish:

	Name of fish		Photo
1	Minor tetra	A	
2	Bettas	B	
3	Cherry barb	C	
4	Swordtail	D	

Continuation of supplement B

5	Goldfish	E	
6	Honey gourami	F	
7	Chocolate gourami	G	
8	Kissing gourami	H	
9	Paradise fish	I	

Continuation of supplement B

10	Sumatran barbs	J	
11	Guppy	K	
12	Scalares	L	

3. Match the definitions and the answers

	Definition		Answer
1	a type of vivarium intended for the maintenance and reproduction of aquatic organisms	A	Aeration
2	Enrichment of water with air	B	Aquarium
3	Water with a significant content of calcium and magnesium salts	C	Water hardness

Continuation of supplement B

4. Find the odd one out

Echinodorus horizontalis, vallisneria, cherry barb, cryptocoryne brown, cladophora.

5. Game "Unscramble the word" (pic. 1).

Pic. 1. *Game "Unscramble the word"*

6. Find the names of popular aquarium fish species (in Ukrainian).

Г	У	Р	А	М	І	Н	Л	Л	П
У	Х	А	Н	О	П	Ж	А	Р	Р
П	Е	Ц	И	Л	І	Я	Б	П	В
П	Ю	І	В	Л	Ч	М	Е	О	А
І	Т	Л	Ж	І	О	Т	О	К	Я
М	Е	Ч	О	Н	О	С	Е	Ц	Ь
М	И	Й	Е	Е	К	Д	И	В	К
Я	К	Р	Н	З	О	Ф	К	К	А
Г	Р	І	М	І	П	Р	В	А	Л
С	К	А	Л	Я	Р	І	Я	Б	В

Continuation of supplement B

7. Game "Recognize by description".

According to the description of external signs it is necessary to recognize the offered aquarium fish.

Card № 1

The body is 6 cm long. It is slightly compressed on the sides, elongated, grayish-green. The male during mating season has a very bright color of red, green, blue, purple. Its homeland is Singapore, Thailand.

Card № 2

The fish is 4–6 cm long. The body is rounded, very compressed on the sides. Abdominal fins are elongated with threads. The color is yellowish-brown. During spawning it turns into red.

Card № 3

Silver fish. The sides of the body are pale purple with spots resembling pearls. The color of the female is pale.

Card № 4

The body is elongated on the sides, tall, silvery-purple with dark blurred transverse stripes. There are two large dark spots in the middle of the body and near the caudal fin. The length of the fish in nature is up to 10–12 cm.

Card № 5

The body is elongated, very compressed on the sides, its length is up to 10 cm. The long dorsal and anal fins of the male are pointed and end in threads. The body is brown, alternating green and red vertical stripes. The fish is native to the lakes of Vietnam and China.

the end of supplement B

8. Photo quiz "Aquarium plants". The club members are asked to answer the questions of photo quiz (pic. 2).

№ 1

№ 2

№ 3

№ 4

№ 5

№ 6

Pic. 2. *Photo quiz "Aquarium plants"*

9. Exercise "Amazing moments from life of aquarium fish" . Describe the most amazing and interesting moments seen by you while you were observing fish behaviour and growth in aquariums.

Supplement C

PORTFOLIO OF YOUNG AQUARIST-RESEARCHER
(sample)

INTERESTING EXPERIMENTS WITH AQUARIUM FISH

An interesting experiment is to find out the ability of fish to respond to colors. On the outer wall of the aquarium two light bulbs with reflectors are attached. One of them is pre-painted in red, the other - in blue. At first in fishes the conditioned reflex on a red bulb is formed, then alternately blue and red bulbs are turned on, and when the blue is on, the feed stuff is not given. First, the fish respond to both bulbs, and then only to the red. Short-stopping is performed in reaction to the blue light (pic. 1).

Pic. 1. *Lab aquarium to conduct an experiment "Development of conditioned reflexes in the inhabitants of the aquarium to the action of various stimuli"*

During the experiments, students keep a diary of observations, after the experiments they have to draw conclusions.

continuation of supplement C

Fish have the ability to change body color according to soil color. To check this fact, prepare three small aquariums without plants with different soils (white, red, dark). Aquariums are wrapped in paper or cloth that has the same color as the soil, then they let one fish of each species that previously lived in the same conditions (pic. 2). To control the same fish are kept under normal conditions. The experiment lasts from three to four weeks.

Pic. 2. *Lab aquariums to conduct an experiment "Influence of external conditions on the body color of aquarium fish"*

The growth of fish is affected by the amount of food in the pond. To make sure of this, you should take three aquariums of the same size and let in the same number of fish (pic. 3). In the first aquarium feed is placed daily in excess, in the second - two or three times less, in the third - little by little and not every day. The size of the fish can be compared in one or two months.

The end of supplement C

Pic. 3. *Lab aquariums to conduct an experiment "The effect of the amount of feed on the growth of aquarium fish"*

Supplement D

SEMINAR CLASS FOR STUDENTS OF PEDAGOGICAL AND ECONOMICS FACULTIES IN THE FORM OF WITS AND HUMOUR COMPETITION

Topic: Decorative aquarium is an artificial water ecological system

Aim: refresh the special features of a decorative aquarium. Develop attention, analytical thinking, interest in aquaristics. To cultivate a careful attitude to nature and the ability to rationally use natural resources.

Equipment and materials: pictures, books, flashcards, a set of postcards.

Process:

I. Set-up.

II. Actualization of basic knowledge.

– What are the special features of a decorative aquarium?

(demonstration of pictures, portfolio "Home aquariums", photos of aquariums).

III. Motivation of educational activity. Introduction of the topic, aim, tasks, process of the seminar class.

IV. Conducting the game.

Contest 1 'Presentation of teams'.

Captains of teams have to announce the name of the team, to present their logo.

Contest 2 "Aquarium as seen by students".

Prepare a poster presentation on the topic: "Types of aquariums: aquarium-picture, aquarium-column, corner aquarium, cubic aquarium, panoramic aquarium, aquarium-pool".

Contest 3 "Young classifiers". Find the systematic position of aquarium plants and animals (the right answer– 1 point).

Contest 4 "Panorama in an aquarium". Decorate the aquarium with floating aquatic plants.

Evaluation criteria. Selection is based on the following criteria:

- compliance with the topic of the competition, the completeness of its covering;
- own creative uniqueness;
- the urgency of the problem;
- a scientific approach to solving the problem;
- cognitive and educational value of work;

- skill level;
- quality of work performed.

Contest 5 "Home assignment". The envelope with their home assignment was given to the students at the previous class: make a short video or a slide show on the topic "Decorative aquariums are centre-piece for homes and offices".

V. Outcomes of the seminar class.

VI. Home assignment. Revise the material on the topic "Decorative aquarium is an artificial water ecological system".

Portfolio "Home aquariums"

a

b

c

d

Home aquariums
(author – Oles Rotar)

a

b

Home aquariums
(author – Ivan Biruk)

a

b

Home aquariums
(author – Mykhailo Partakevych)

a

b

c

Home aquariums
(author – Vitalii Diumen)

Home aquarium
(author – Andrii Dyrko)

a

b

Home aquariums
(author – Andrii Dyrko)

The end of supplement D

a

b

Home aquariums
(author – Andrii Kolosok)

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FOR NOTES

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