

Aquarium as a Tool for Teaching Sciences at All Grades Levels

Seixas S and Martinho M

Introduction

Teaching sciences is not easy in classroom and students need to contact with real situations to understand the theoretical concepts. Is also not easy arranging an activity that involves and allows practical activities for disciplines such as biology, physics, chemistry and mathematics. One toll that can be used is aquarium in classroom. Normally the aquarium stimulates a lot of interested in the students, and is a moment of learning and relaxing.

What kind of environment and fishes in it

The first step is to choose what kind of environment. If the objective of set-up an aquarium is to study a determine environment, is easy. Otherwise if objective is using the aquarium as a tool to teach sciences in general, our advice is to choose a warm freshwater environment, because is easy to maintain and have a lot of potentialities as you can understand below.

Our advice is chosen environments with warm water. Is easy to put a thermostat and maintain the temperature than put a chiller to maintain low temperature and the last equipment is very expensive. The other reason to choose warm water is because fishes that lives in that conditions are colourful and have more attractive, in general.

The marine aquarium can be done in classroom, but the price of the equipment is higher, time necessary to the stabilization of the aquarium is longer and his maintenance is more complicated.

Choose a freshwater environment aquarium allow the classroom study in advance what kind of river or lake they like to set-up.

In first levels the teacher can explain that the current, temperature and water chemistry is different. This can be done showing photos of rivers and lakes and chemistry is easy if different kinds of bottled mineral and natural water are given to taste to the students.

In high levels can be explain the different conditions of environments and put students to study what the differences in water chemistry, current, etc, between the

different environments. Can also study what species are in endangerment in each habitat. Our advice is to study a river environment with current, one of lakes of rift (Malawi or Tanganyika), Amazonian environment and Asian environment. The students can also study the needs of the fishes of each environment and compatibility between them. Composition of decoration must be study and the possibility of introduce it in each environment. Is also necessary study the behaviour of fishes if is better to maintain a couple or maintain a shoal. If were considering: a rift lake of Africa, which has high pH, calcareous stone and gravel, must be chosen, Amazonian river that have low pH, natural roots are the appropriate. The necessary current also be study and students calculated the power of the pump need for an aquarium and to a determine environment.

Temperature is very important and in warm water are a lot of fishes with different requires. For example Amazonian environment the temperature is 28°C and in Rift Lake is 25°C.

Fishes live in different water layers. There are fish species mostly swim near the surface, in the middle or near the bottom of the aquarium. In order to have fish in all water layers is necessary considerer this when selecting the fish.

Plants

The aquarium must have plants. A beautiful planted aquarium is a relaxing and decorative. Apart of decorating plants also help the maintenance of a healthy aquarium and offer the fish hideaways and reduce the stress. Plants are also, good places to young fish hide from the adults.

Plants are an excellent oxygen provider and remove nitrate that is an algae grow promoter.

The plants to introduce in aquarium must be of different types and with optimum of living appropriate to environment chosen. Is interesting choose a plant that gives flowers. In classroom can be discuss the different types of plants and their requirements. The quantity of light, radiation necessary and temperature are essential to a good grown and to maintain healthy plants.

Another aspect to take in account is avoiding plants that the fish chosen to eat.

When was considered the height of plants there are three types. Foreground Plants that must be smaller to not obstruct the view into the aquarium. Middle ground plants that can be solitary or planted in groups and backgrounds plants that decorating the back of aquarium and help to hide the material necessary for the correct functioned of it.

Depend of the environment chosen can also be introduce floating plants.

Plants must be “fed”, they must be had a good substrate (like home plants) and in some cases must be added to water a fertilizer.

Set-up the aquarium

To set-up the aquarium is need the glass aquarium. The aquarium of 80 cm length is enough, if there is space limitation it can also be an aquarium of 60 cm length.

The localization of aquarium in classroom must be appropriate. Choose a quiet

place away from direct sunlight, because sunlight can promote algae growth. The power supply should be above the aquarium, if possible, to prevent water spills going into the outlets during maintenance. After put the tank in final localization, must prepare the other equipment necessary: filtration system, heater and lighting. To have a good water quality is necessary have mechanical filtration and biological water cleaning. In the last one microorganism, such as bacteria, make that pollutants such as fish excrements and dead plants are broken down biologically. Both of these process can be done by modern extern filters, is only necessary put inside the filter sponge to made mechanical filtration and a substrate that provides ideal condition for bacteria (these must have large and rough surface).



Figure 1. Scheme of an aquarium with equipment. 1 – External filter, 2 – Water from filter to aquarium, 3 – Water from aquarium to filter, 4 – Lighting, 5 – Heater

Figure 2. Aquarium with 60 cm length after set-up with Amazonian environment

The bottom must have a substrate that contains essential nutrients, valuable humid acids, as well as trace elements, that provide the plants with everything they need. After that a layer of gravel were added (Figure 1).

The gravel and decorative pieces must be natural, such as roots, bog wood, stones (granite, limestone, lava, etc.), these as referred above must respect the environment chosen.

Before start put decoration and plants inside the aquarium must be planning the decoration design, technical equipment in the aquarium (filter, heater, etc.) can be hidden in such a way that they become invisible when you look to the aquarium.

After decorating the aquarium and put the plants you can fill it with water and turn on the equipment. Tap water needs to be conditioned according to the requirements of the fishes. The tap water quite often has disinfecting chemicals such as chlorine to kill dangerous bacteria and pathogens. But the chemicals also provoke damages in fish and kill bacteria of the biological filter. The products to conditioner the tap water are easily found in commerce. When fill the aquarium put a plate in bottom to avoid the flux of water remove the gravel.

Fish are only added a few days later, with this allows the bacteria to grow in our

filtration system and all small particles that stay in suspension after filled the aquarium will be in the bottom of the aquarium or in the filtration system.

Maintaining the aquarium

After the aquarium is functional, with all animals and plants in it (Figure 2), another step is begun - the maintenance period.

Students collect data, with a periodicity estimate before, from an aquarium by measuring and recording water temperature, pH, GH, KH, nitrate, nitrite and ammonia levels. The data can be plot in a graph, and the information studied. Observe the trends can be correlating the differences with events in aquarium. For example if water is changed and the new water is from home canalization can be seen pH variances. After setup and before the aquarium is stable the levels of nitrate, nitrite and ammonia are an excellent period to explain in high levels the nitrogen cycle. If pH must be correct, adding products, the quantity of product necessary can be done as an exercise of chemistry in classroom.

In biology classes the student can observe the growth rates of the different animals and plants and register these.



Figure 3. Cichlid Fishes with fry



Figure 4. Cichlid Fish protecting the nest

The type of food added to fish can be also a good example to study different types of alimentation. Introduce a leaf of spinach in aquarium lead to some herbivorous fishes going to eat it and some carnivorous will try it and then throw out the spinach. Is interesting observe some herbivorous graze on algae that grow in glasses and decorative things.

The observation of coloration of fishes (when they have sexual dimorphism) is a good away of understanding the differences and also observed that before spawning period the colours are intensifying. The courtship period, if the students were lucky to be observed the aquarium in this period, is also very interested to observe a particular behaviour.

The different types of reproduction can also be observed, if you choose a fish that easily reproduces and in aquarium you have fishes that the parents take care of the fry, like the fishes belongs to cichlid family (Figure 3) the students can observed a

very interested behaviour (Figure 4).

If the aquarium have livebearers can be easily observe the behaviour of viviparous and students can compare the differences.

There are some cares that is necessary for a healthy aquarium. One is water changed, 20 % per week is good. Cleaning the external filter is also necessary. The sponge can be wash normally but biological part no, because is necessary prevent the dead of the bacteria. Algae can be removed from the tank glass with an algae magnet or scraper. Regularly remove any dead leaves from live plants as was done to home plants. If plants need some substrate it must added to water.

The alimentation required by fishes lived in an aquarium can be different and is necessary given different kinds of food in a way of given to everyone their appropriate food. Take care to do not overfeed the fishes as this will cause excess waste in the water which will settle at the bottom of the tank and need to be removed.

Final Consideration

With an aquarium in classroom students understand the relationship between producers, consumers, scavengers, and decomposers.

The aquarium allows students to understand the biological concepts as competition for a territory, between animals and between plants. Furthermore, by studying its chemistry, students realize how quite dependent the biotic community is on the abiotic components of the system.

In relation to chemical of water students can learn the nitrogen cycle, pH, hardness of water and how these parameters changed.

Students become sensitive to the effects of destroying part of an ecosystem or removing a particular organism. They also consider more complex issues, such as endangered species and the impacts of human intervention in a habitat.

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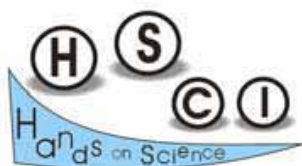
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Edited by:
Associação Hands-on Science Network
NIPC 508050561
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