Lesson 29

Title of the Experiment: How to set up an aquarium
(Activity number of the GCE Advanced Level practical Guide – 66)

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Introduction:

An aquarium is a container that can sustain fish and other aquatic life for a longer period of time. The popularity of the aquatic hobby has grown steadily over the years as people look to bring a little piece of nature into their homes. Aquariums offer an amazing way to appreciate the beauty and diversity of aquatic life. Regardless of its size, an aquarium can become a decorative focal point in any environment. Aquariums have many positive attributes that extend well beyond being decorative value. Research has indicated a link between watching an aquarium and the reduction of stress.

Theory

Since fish spend their entire life in water, the success or failure of an aquarium depends on the levels of physico-chemical parameters of water.

Important water quality parameters: Temperature, pH, DO, hardness, ammonia, nitrite, nitrate, suspended solids

Temperature: Fish are resilient enough to withstand a wide range of temperatures, it is seen that warmer temperatures are best for tropical fish. In temperate countries thermostatically controlled heaters are a must if keeping tropical fish. The water temperature affects a wide range of biological and chemical processes in an aquarium. Temperature range of 24-28 °C is suitable for most of the tropical fish species.

pH: pH is a logarithmic scale of the proportion of H+(Hydrogen) and OH-(Hydroxyl) ions ranging from 0-14, with a neutral value of 7. Fresh water fish can live in a wide range of pH but the optimum pH values are for many popular species a slightly acidic to a neutral value, 6.5-7.5.

Hardness: Water hardness refers to the amount of dissolved minerals in your water, especially calcium and magnesium. In most cases, well water can be used to rare fish without manipulating the hardness of the water. Excessively hard water may affect the survival of aquarium fish. Waters found in North, Eastern and north western provinces have hard waters that may not be suitable to use in aquaria.

Dissolved oxygen (DO): The life in the aquarium depends on dissolved oxygen in the water. Gaseous oxygen is absorbed by water. Turbulence at the surface of the water increases the absorption of oxygen. Plants within the aquarium give off oxygen during photosynthesis, but this oxygen is also used up quickly. Just like fish and other animals in the aquarium, plants need oxygen for respiration and will consume a part of the oxygen that they produce. Since all the organisms in the aquarium – including microorganisms, invertebrates and fish – use up the dissolved oxygen quickly it is necessary to keep the aquarium well aerated. Unhealthy and decaying plants will even increase the demand for oxygen in the aquarium. A simple and basic aeration or filtration system is usually more than enough to give plenty of oxygen to an aquarium. Regular water changes, vacuuming off fish wastes and removing any rotting plant material will also help to increase the oxygen levels.

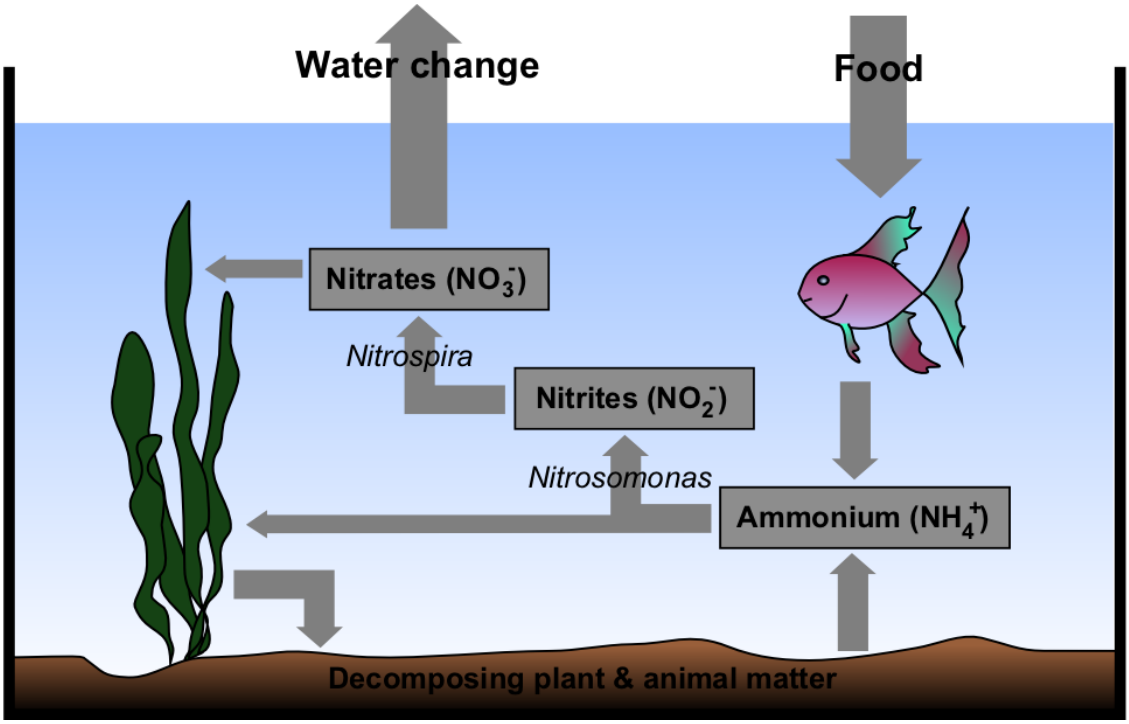
Ammonia: Ammonia is produced by the fish metabolism and excreted via the gills in and the fish feces. Ammonia can also be produced in the aquarium when plant material is broken down.

Ammonia is highly toxic and will kill fish if the levels get too high. Ideally ammonia levels should always be zero. Ammonia level in the tank should be less than 0.02mg/l.

Nitrites: Nitrites are formed in the aquarium when the Ammonia gets broken down by bacteria (*Nitrosomonas*). Nitrites are also dangerous to fish and unhealthy in too large quantities. Exposure to too much Nitrite can for instance make the fish anemic and eventually kill it. Nitrite binds to red blood cells and blocks their ability to transport oxygen. If nitrite is present in high enough concentration, fish blood will turn a chocolate-brown color. Because of this, nitrite toxicity is also known as brown blood disease. The nitrite level in the water should be lower than 0.01mg/l.

Nitrates: Nitrates are another nitrogen-compound and Nitrate is produces when Nitrite is broken down by another type of bacteria (*Nitrobactor*). High levels of Nitrates are also toxic for fish, but most fish species are more resilient towards Nitrate than towards Ammonia and Nitrite.

Conditioning the aquarium: The water in which the fish live is a whole new ecosystem in itself. There are microorganisms living in this water beside the fish, algae and plants. All the living organisms in the aquarium will produce waste that can become toxic. An aquarium that is just a few weeks or days old is at its most fragile. The water is new; microorganisms in the water may be beneficial or toxic. The key here is to minimize the undesirable organisms while boosting the colony of desirable and helpful bacteria. This is where the NITROGEN CYCLE comes in.



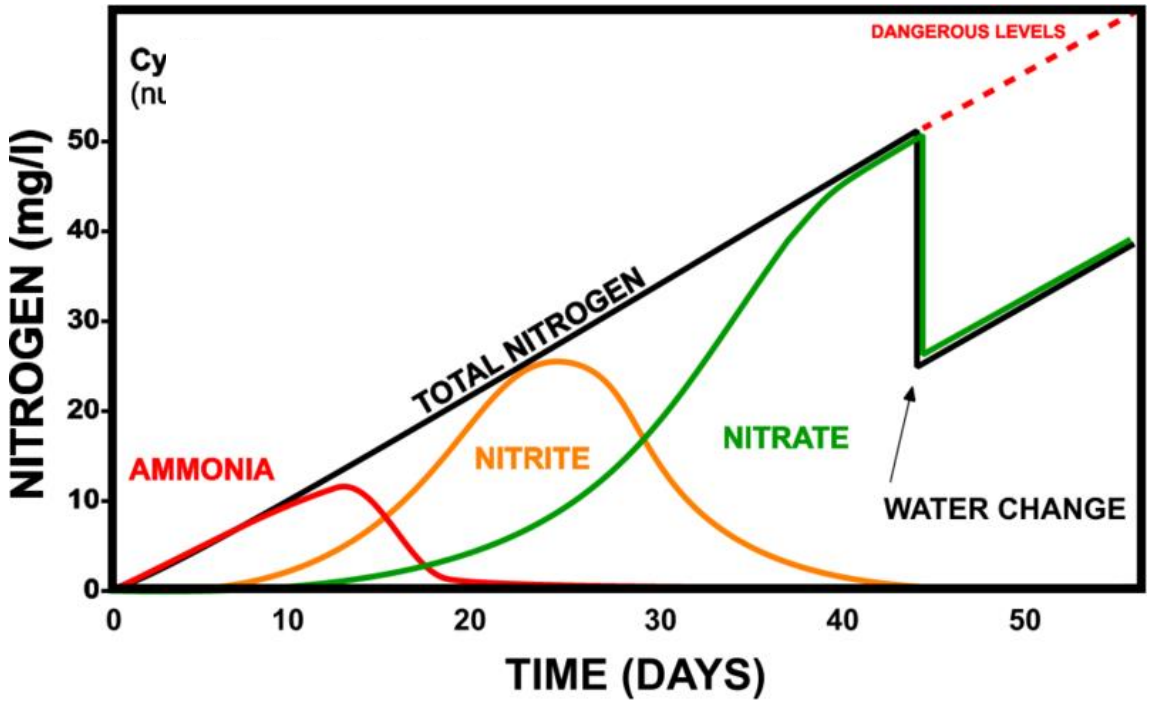
The nitrogen cycle in an aquarium

Nitrogen based substances are the most frequent byproducts of decomposition. The Nitrogen cycle refers to the process in which this decomposition takes place. Nitrogenous waste products in aquarium will first break down into ammonia. Nitrifying bacteria convert harmful ammonia to a more harmless form - nitrate. In nature, there are vast colonies of these bacteria, but when first set up the aquarium this type of bacteria is only minimal in water. In the first few weeks, it is necessary to induce this bacterial colonies to multiply and reach an optimum level. Certain conditions are optimal for the growth of the nitrifying bacteria. They grow well in areas that have a rich supply of oxygen and lesser sunlight (means less heat). Portions of the aquarium that are not disturbed by currents, and are relatively unmoved are also good breeding grounds for the nitrifying

bacteria. This is however only the first half of the nitrogen cycle. Slowly, as nitrites get converted, nitrates start building up. The second half of the nitrogen cycle converts the nitrites into nitrates which are relatively harmless through a process called denitrifying. This is then converted into nitrogen gas, which escapes into the air. It is however impossible to get rid of all the fish waste by simply letting nitrogen gas evaporate. If frequent water changes are not carried out, the levels of nitrate will sooner or later become high enough to seriously harm fish and eventually kill them.

The nitrogen cycle begins when the aquarium is provided with a little bit of ammonia. One way to do this is to add natural plants. The leaves falling off from these plants supply the first doses of nitrogen. Other methods include adding some fish food, adding a few fish to the water (e.g. Zebra Danios, guppy). Using some gravel or water from another aquarium is also a good way to start the cycle since gravel or water from an established aquarium will be filled with the necessary types of bacteria.

In the cycle, the nitrite levels will first go up and then fall to zero. This process may take 2-6 weeks. The speed in which the cycle completes will depend upon the temperature in aquarium. Fish can be added after 1-2 weeks since the bacteria colonies then has grown to a large enough size to support fish. The ammonia levels should be non-detectable before adding fish.



Nitrogen cycling in a new tank

Learning outcomes:

At the end of the practical session, you will be able to,

- Select an aquarium best suited to the requirement
- Select a location to position the aquarium
- Select suitable accessories to the aquarium
- Install a gravel bed, filter and aerator in an aquarium (biological filter)

- Sep up the aquarium to provide a conducive environment for fish and other aquatic organisms
- Describe nitrogen cycling in an aquarium
- Manage a freshwater aquarium successfully

Materials/Equipment:

A list of the items that needs for a basic freshwater aquarium:

- An aquarium tank, glass, fiber, acrylic or cement
- An aquarium stand
- A hood/ cover
- Lighting equipment
- Air pump, air tubes, air stones
- Filters (internal or external)
- Gravel/ pebbles
- Decorations (optional, but interesting if you have these)
- Maintenance items like nets, scrubber, siphon tube, hose etc.
- Few species of ornamental fish and aquatic plants

Methodology/Procedure:

Aquariums are different in shapes and sizes. It is advisable to choose an aquarium that is at least 40L, since small aquariums are much more difficult to maintain.

Why smaller aquariums are difficult to maintain?

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1. How to locate a place for aquarium
    a. Positioning an aquarium requires careful consideration.
    b. The floor need to be flat and strong to bear the weight of the aquarium.
    c. An aquarium needs diffuse light and should not be placed in direct sunlight or unusually bright artificial light.
    d. Avoid places closer to doors, windows, corridors and throughways.
    e. Keep the aquarium away from machines that give out a lot of sound or cause vibration. Eg.,…….
    f. ……
    ……
    ……
    g. ……
    ……
    ……

h. ……
……
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Use the given aquarium accessories, plants and the fish to set up a freshwater aquarium.

2. Wipe the tank using a paper towel
3. Check for the leaks; If leaks are detected drain the tank and use silicon tube to stop the water leakage
4. Install the filter bed, gravels, air stones and air tubes (Biological filter)

    - Biological filters: It consists of a small perforated plastic box and a bubble air lift tube attached to a one corner. Cover the perforated plastic box by the filter media (coarse gravel). The thickness of the gravel layer is more than 3cm (5-10cm thick layer of substrate is recommended for plants, since this will help them to establish their root system).
    - Once you calculate the area of your aquarium, it is easy to calculate the volume of substrate that needs to go in. Simply multiply the area of the aquarium with the desired height for substrate.

    How does biological filter work?

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5. Fill 25% of the tank
6. Arrange the plants and decorations

    Aquascape is an aquarium layout with gravel, rocks, tree roots, plants and other decorations. Creating a hardscape is entirely up to one's imagination.

    - Find the appropriate pieces of wood, rocks, stones and other decorative elements.
    - Paste a background wall paper inside the back wall of the aquarium and that simulate real aquatic ecosystem in a more realistic way.
    - For decorative purposes fake plants can be used. They are easy to clean, do not need any trimming, and will never decay or die.

    Plants for the aquarium

    The right balance between plants and fish in the aquarium are important for ensuring a healthy environment, which promotes natural fish behaviour. Most fish feel safest if they can hide quickly and easily. People often prefer attractive colours and want to look at their fish in a densely planted aquarium.

    Why use plants in aquarium

    - ……
    - ……
    - ……
    - ……

Name four plants widely used in Aquariums in Sri Lanka

1…….

2. ……..

3…….

4. ……..

7. Fill the rest of the tank
8. Introduce fish
    - It is better to plan to start with a few fishes of the hardier varieties until the essentials of aquarium keeping are well understood.

      Eg. Guppy, platy and mollies
    - Schooling fish such as tetras, danios and barbs seek refuge in large groups known as shoals.
    - Digging and herbivorous fish including goldfish, carps and some cichlids may dislodge the plants and eat the leaves.
    - Territorial fish want to have their own space – either all the time or only when they are young. Eg. Cichlids
    - Requirement of different substrates to attach: American sailfin catfish/ Tank cleaner fish (*Perygoplichthys pardus*) and snails (*Pomacea diffusa*) needs water worn rocks or wood as substrate to attach.
        - Type or species of fish:
          ……
          ……
          ……
        - Number and size of fish:

          ……
          ……
          ……

Selecting Healthy Fish

The following list represents general characteristics of most healthy fish:

- Clear Eyes (not cloudy)
- Undamaged fins
- Scales should be intact, parallel with body (not sticking outwards) and no red blotches
- No holes, ulcerations, or lumps
- Species with translucent bodies, no inner appearing whitish areas
- Active, lively, normal swimming patterns (some species are naturally shy)
- No white spots (salt grain size) or white cottony growths on the fins or body
- Respiration rate should be regular and steady (in unstressed circumstances).

Introduction of fish to the aquarium

Dealers put fish into water in plastic bags which is then inflated with oxygen or air. If fish are transported for a long distance oxygen needs to be filled into the bags. Inflated bag then tied off with a rubber band.

- Before fish are introduced into the tank float the sealed plastic bag on the surface of tank water for at least 30 minutes.
- Then open the bag and allow small amount of tank water flows into the plastic bag. So gradually mix the water in the bag with the tank water.
- Number of fish stocked into a tank depends on many factors. As a general guideline introduce 1 cm fish per one litre of aquarium water.
- Do not feed the animals the first day they are in the aquarium. They will be recovering from the stress of transportation and adjusting to their new environment.
- Watch the fish closely for the first few hours/days. Any sick or dead animals should be discarded.

9. Close the aquarium using the cover, switch on the lighting
   - Light that is close in spectrum to daylight is more suitable for aquaria. Why?

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     Use small fluorescent tubes and LED lights
   - The ideal position for the light is directly above the tank. It is necessary to illuminate all the corners of the aquarium to have a proper view.
   - Set the lighting time to 6 hours a day in the first 2-3 weeks. Then you can increase to 8-10 hours a day. Never keep the lights on the whole day.
10. Observe the water movement pattern

Observations:

1. Observe the aquascape and do the necessary changes to look the aquarium more appealing
2. Observe the behaviour of fish and fill the following table

Fish species	**Bevaviour of fish**	
	Just after introduction	**02 hours after introduction**

Note any abnormal behavior or change of colour patterns of fish.

3. Draw your aquarium and label all the components.