

Aquaculture and The Aquarium

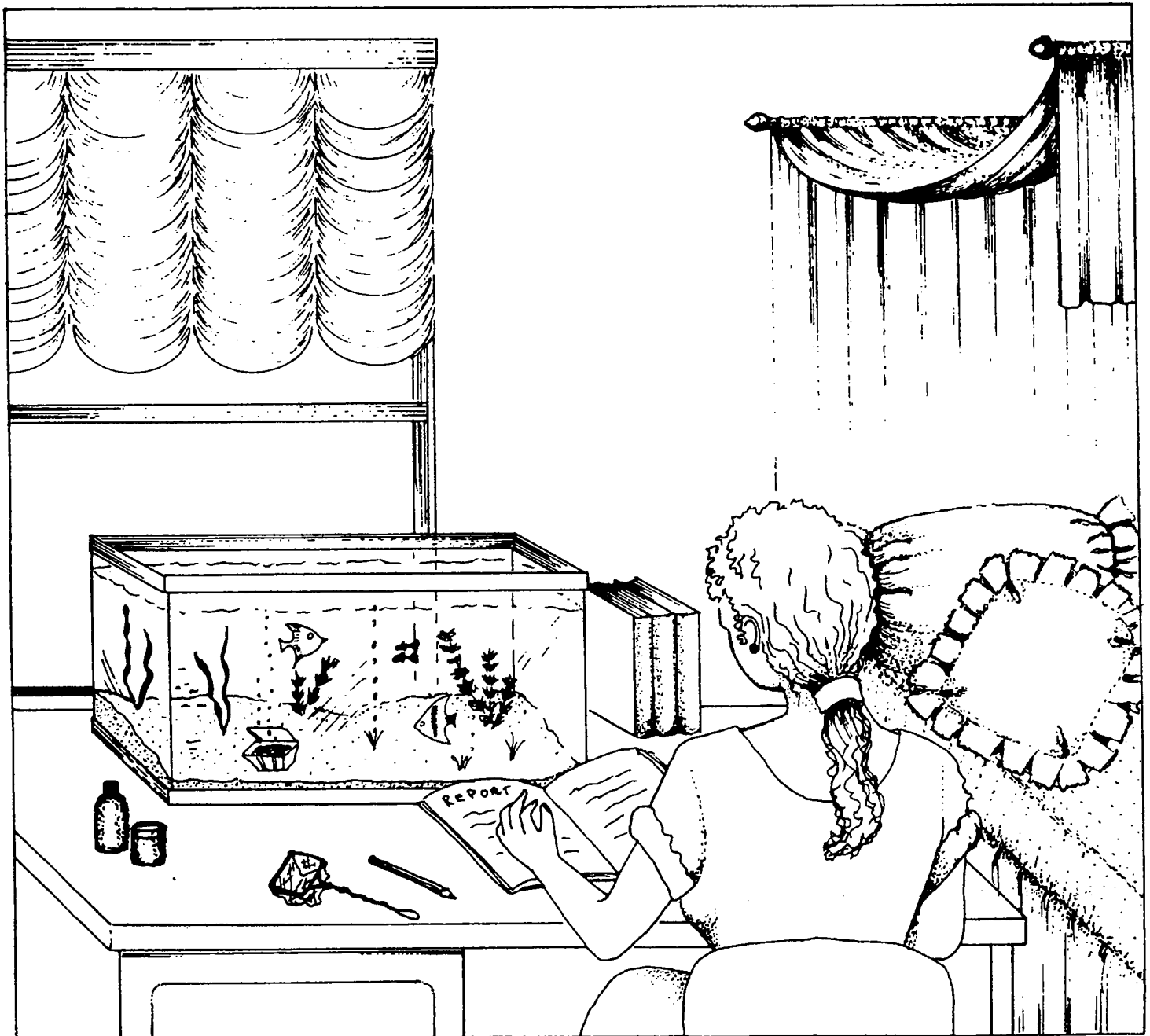
CIRCULAR 848



A 4-H Member Project

Craig Watson

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YEARS IN 4-H _____



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Aquaculture Is...

Aquaculture is simply farming in water. The term is a rather new one that was developed to cover all the components of the field. Fish farmers, clam farmers, alligator farmers and even aquarium plant farmers are all aquaculturalists.

While the word may be a new one, aquaculture itself dates back thousands of years. In China, carp have been raised for food and decoration since the early dynasties. The earliest fish farmers probably didn't do more than just hold the fish in ponds until they wanted to eat them. This allowed them to catch more than they could eat at one time, and store them alive until they were needed.

Today's aquaculture is much different than that of the early farmers, and the field is starting to use technology to its fullest. World-wide, aquaculture is gaining ground, and becoming a major force in farming. Seafood is the only thing left in our grocery stores that is still caught from the wild, and aquaculture is starting to take advantage of this. With more and more people wanting fish and seafood, and less and less being caught from the world's oceans, the only answer is for fish farmers to start growing more fish. The field of aquaculture is becoming an area with great promise for young people who are interested in a career.

The Aquarium: A Little Pond

As a 4-H member, you can learn about aquaculture in much the same way that you learn about any other form of farming - start small. If you want to learn about vegetable farming, you may plant a small vegetable garden, where you could grow a

small crop. If you want to learn about dairy farming, you may raise a dairy cow. If you want to learn about aquaculture, you can keep an aquarium.

The reason this works so well with an aquarium, is that the aquarium will act just like a small pond. The same set of rules and laws that control a big fish farm can be seen in a small aquarium, right in your own room. The other nice thing about aquariums is that you can find supplies for them almost anywhere in the United States.

For this project, it is best to use tropical aquarium fish from your local pet store. These fish are small, and if you pick a type that has been raised on a fish farm, they will be domesticated, or used to being kept in aquariums. Just ask the owner of the store which fish are farm raised, and which fish are from the wild. Domestication is important, since it was years before workers were able to spawn some fish that were from the wild. The common Angel fish were kept by aquarium hobbyist for almost 20 years before they were successfully spawned. Today, they are one of the easiest fish to work with if you get a pair that has been raised on a farm. Since tropical fish are usually small, they are better for this project. Most of the fish that are raised for food are quite large when they are big enough to reproduce. Channel Catfish are too big for the average aquarium. This project is designed for both the beginner and advanced student. Tropical aquarium fish come in over 1,000 varieties, so one can find a fish to suit their project no matter what the level.

As you begin, it is important to always keep in mind that you are trying to create a small pond. A pond is not a sterile place and your pond should not be sterile either. Many aquarium manuals will tell the reader to bleach their gravel, tank and everything else, sometimes on a regular schedule, making it a sterile place. While this will kill many of the bacteria that could cause problems in an aquarium,

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it will also kill the helpful ones. As one learns, there are thousands of things to find out about ponds and water, and if you kill most of the ecosystem with bleach or something else, you won't be able to really study it. A good, healthy aquarium, that allows one to study the rules and laws which control aquaculture, should have nutrients, plants and bacteria, which some people consider dirt. There is a limit to everything, and a big part of this project will be to learn the limits of just how much "dirt" to allow in the aquarium.

Light, Nutrients and Plants

The sun's light is the energy source for plants on earth. Plants absorb nutrients from around them, and with the energy from light, can change these nutrients into plant tissue. The plants of our earth feed all the other life forms, either directly or indirectly. In addition, plants produce the oxygen needed by animals, and use carbon dioxide. The wastes from animals are used as nutrients that the plants need as well. You can look at the plants of the world as the great providers for all other life - they produce the oxygen that we breathe, the food we eat, and they recycle the wastes we produce.

If you were to put all the world's plants on a scale, most of the weight would be from plants in the oceans, lakes and other waters of the planet. Most of the world's oxygen is produced in the surface layers of the oceans, by tiny plants called phytoplankton. Phytoplankton is a word used to describe all of the one-celled and small colonies of algae, that just drift around in water. These plants don't have any roots, and get their nutrients from the water. When a pond's water turns green, it is because of phytoplankton.

In aquaculture, nutrients are added to the pond or tank when one feeds the fish or other animals being raised. The level of nutrients is usually higher than it would be in a natural system, and there are more plants because of this. In most aquaculture ponds, the plants are phytoplankton, and the water is green.

In the aquarium, one doesn't want phytoplankton, since you wouldn't be able to see the fish if the water was green. For this reason, it is important to include plants in the aquarium. They will use the light and nutrients in the same way as phytoplankton. If there are enough plants and not too much light or too many nutrients, they will get rid of the phytoplankton. This is a very important principle for

this project, as the plants will serve as the waste disposal system for the aquarium, just as they would in a pond.

The illustration in Figure 1 gives a simplified picture of what happens in water when light, nutrients and plants are found together.

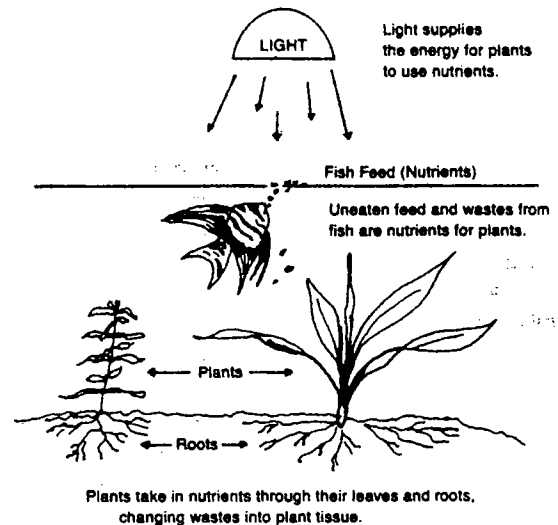


Figure 1. A combination of water, lights and nutrients is necessary to provide fish a habitat.

Light for the Aquarium

There are two ways to get light for your aquarium, sunlight or artificial light. Sunlight is cheap and more natural, but it has a few drawbacks in the aquarium. The first is that it is very hard to control the amount of sunlight that the tank will get. Too much or too little will create problems. The second problem, and the largest, is that the aquarium will be dark when the sun goes down, and this is when most people have time to spend with their aquariums. For these two reasons it is recommended that you use some kind of artificial lighting for your project.

Lights come in two basic forms; fluorescent or incandescent. Both of these have bulbs which have been made to reproduce the light necessary for plants to grow. The following is a list of advantages and disadvantages for each.

Fluorescent Lights

Advantages

- They produce a softer light, which will show off the colors of the aquarium better.
- They use less electricity than incandescents.
- They last longer.
- They produce very little heat, so they won't overheat the aquarium.

Disadvantages

- They are expensive.

Incandescent Bulbs

Advantages

- They are cheaper to buy.
- They produce a beam of light, that can look like sunlight in the tank, giving a more natural look.

Disadvantages

- They have a short life time, so they can be come expensive.
- They use more electricity.
- They produce more heat, and can overheat the water.

The best situation would combine fluorescent, incandescent and sunlight in the aquarium, but this is often impossible. One can purchase lights that are specially made for aquariums, or lights can be made from fixtures bought at hardware and discount stores. Different size aquariums will use different size lights, so don't buy too much or too little for your particular tank. A five gallon aquarium can use one 60 watt incandescent bulb, but a 55 gallon aquarium would do better with two 40 watt fluorescent bulbs (see note). If you are not sure of how much light and what type is best for your situation, speak with someone at the local aquarium shop about it. Just make sure that they understand that you want to grow some plants in the aquarium. Many of the manufactured lights for aquariums don't provide enough light for healthy plant growth.

The lights on the the aquarium should be left on for at least 12 hours each day. You can leave them

on longer, but anything less than 12 hours isn't enough. One thing that works well is to turn the lights on when you wake up, and off when you go to bed. The thing to watch for is too much light, which will start producing green algae on the glass and rocks in the tank. If this starts to happen, you may be leaving the lights on for too long. Just shorten the time they are on and the situation should be corrected.

Note: If you can afford a large tank, try and get one that is 4 feet long. Discount stores and builder supply shops almost always have a special on shop lights. This is a fixture that is 4 feet long and holds two 40 watt bulbs, which are ideal for the aquarium, while being relatively inexpensive.

Nutrients in the Aquarium

Nutrients in the aquarium will come from the fish feeds. Many companies sell aquarium plant fertilizers, which are made to help plants grow. However, in a well fed tank, you shouldn't need them. If you are sure that you are providing enough light, but your plants are not growing well, you probably don't have enough nutrients in the water for them to thrive. This is the major draw back to the sterile aquarium, where everything is constantly being cleaned.

In the "little pond" aquarium, the fish eat the food you give them, and their wastes become the food for the plants. Without the plants, these nutrients would build up and you would have to constantly clean out the tank yourself. Even with a healthy plant community in the aquarium, you can feed the fish too much, and all of the nutrients won't be used. This eventually ends up as a sour tank.

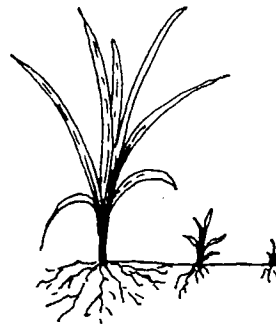
Another source of nutrients you may want to add comes from laying a thin layer (1 inch) of peat on the bottom of the tank, before you add the sand or gravel. This layer will be kept down by the sand or gravel, and the plants with roots will use it to get some nutrients.

Plants for the Aquarium

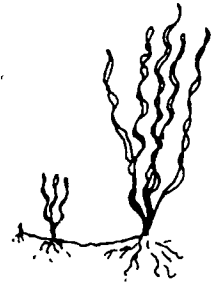
There are hundreds of aquatic plants to choose from that are suited for an aquarium. Most good aquarium shops will carry a few different varieties, and can order others from their suppliers. The following is a list of some of the major groups of plants that are commonly seen in the aquarium

industry, with some comments about each. This list is by no means complete, but should give enough information to get started.

Sagittaria - This is a group of grass-like plants that are native to the Americas. They reproduce by sending off runners, so one need not start with very many to get a nice thick growth of them. There are several varieties available, including a dwarf type which is excellent for planting in the front of the tank.



Sagittaria



Corkscrew Valisneria

Valisneria - Another grass-like plant which reproduces easily by runners. Valisneria also comes in several varieties, with one type having a beautifully spiralled leaf (corkscrew valisneria).

Cabomba - Grown and sold mostly as cuttings, this is a nice plant to fill in areas as it grows quite thick. Does best in bright light and when peat is added below the sand or gravel.



Cabomba

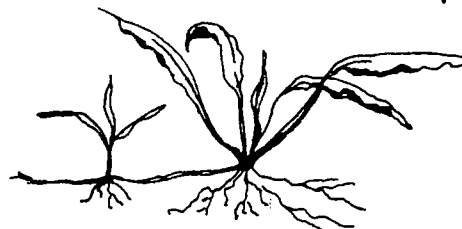


Sword Plants

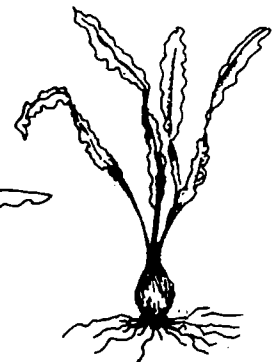
Sword Plants - This is a large group of plants from the Amazon region in the genus Echinodorus. They come in many of sizes and leaf shapes. They have a heavy root base and leaves that can reach over a foot long. Does best with peat around the roots and a lot of light.

Cryptocorynes - This is a huge group of plants from the East (mostly Thailand and India) with a great deal of variation. They reproduce in the aquarium by sending out runners from the parent plant. Once established they are extremely hardy and will live for years. However, they will sometimes lose all their leaves when transplanted, but will send up new ones from the roots if left alone. They like peat in the bottom.

Aponogetons - Usually sold as bulbs with a few leaves coming out, these are a good plant for putting in the center of your tank. The bulbs will eventually die off and they are difficult to resprout. The plant will last longer if the bulb is placed in peat. The unusual Madagascar lace plant is in this group.



Cryptocorynes



Aponogetons

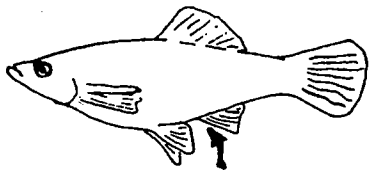
When buying plants from the store, here are a couple things to look for:

1. Make sure that the plants are green and healthy, with good roots. It is sometimes impossible to revive a plant that has been mistreated before you get it.
2. If you are a beginner, don't spend a fortune on plants. There are many inexpensive types to choose from that will serve the purpose of this project, and until you develop your aquatic green thumb it is best to stick with them.

Fish for This Project

Tropical aquarium fish come in over 1,000 varieties and almost this many are being produced by fish farmers in Florida. To the beginner this can be very confusing, but you can divide these fish up into other major groups, depending on the way that they reproduce.

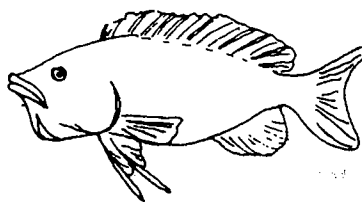
Live Bearers - Probably the most common fish in the pet store belong to this group. They include the guppies, swordtails, mollies and platies. Most of them are extremely domesticated, coming in a huge variety of man-made varieties and colors. They are called live bearers, because the young come out of the female swimming and eating. Because of this, they are an excellent fish for the beginner.



A Live bearer giving birth to a baby.

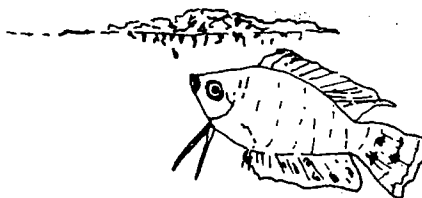
Mouth Brooders - This is a very unique group that has developed an interesting way to help their young survive. One fish (usually the male) will make a depression in the sand or gravel where the eggs will be laid. As soon as the eggs are laid, one of the parents (usually the female) will pick up the eggs in its mouth. The eggs are then kept in the fish's mouth until they hatch. Even then the babies will stay in the mouth of the parent until they are able to swim fast enough to take care of themselves. Because of this unique way they reproduce,

they are extremely good for the beginner, and are also quite interesting.



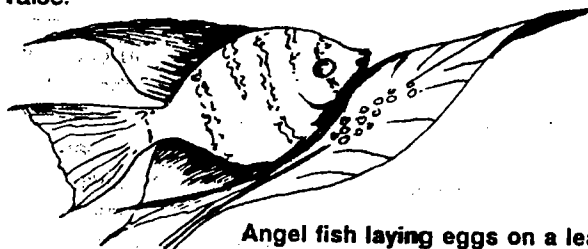
Mouth brooding fish with eggs in mouth.

Bubble-nest builders - The most common two fish in this group are the Kissing Gourami and the Siamese Fighting fish. There are many others that reproduce in the same way. One parent (usually the male) makes a nest of bubbles that float on the surface. By using a sticky mucous, these bubbles will stay together, and don't pop. Some of this group will also mix floating plant material into the nest. The pair will lay their eggs under the nest. Some fish in this group have eggs that will then float up to the surface, but most of them have to place their eggs in the nest themselves (usually the male). The eggs are then closely guarded, usually by the male. After hatching, the babies are protected by the parent(s) until they are old enough to swim away.



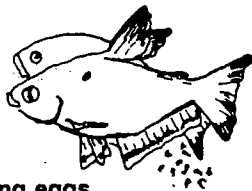
A gourami putting a baby back into the bubble nest.

Egg layers - These fish lay eggs which stick to the side of the tank, a rock or plant, or they make a nest that they lay them in. Most of them will guard their eggs until they hatch and for a short time afterwards. The largest group of fish in this category are the Cichlids (pronounced si-kids) which includes the popular angel fish. Because they will guard their eggs, and even raise the young for a while, they are easier than the egg scatterers to raise.



Angel fish laying eggs on a leaf.

Egg Scatterers - With this group the fish lay their eggs in the middle of the water. The eggs then drift to the bottom, or they are scattered over some plants where they land. Tetras, Barbs and Danios are the most common fish in this group. The eggs and fry for this group are usually very small, making it hard to feed the newly hatched fish. For this reason, only the advanced student should try and work with them.



A Pair of tetras scattering eggs.

No matter what type of fish you decide upon, make sure that you buy healthy fish to start with. When looking at a tank of fish make sure that none of them are showing signs of disease such as sores on their body, tattered fins, swimming on their sides, etc. Buy fish that are eating well, brightly colored and active. A good fish store will sell healthy fish and not any that they are having problems with. Don't ever be afraid to ask, if you think that a fish doesn't look right.

Materials

Now that we know what we will be growing in our aquarium it's time to talk about the aquarium and the supplies for it. As a 4-H project, it is important to keep this project within your budget, so do some shopping around before you start buying anything. Different levels of this project will require different budgets, so see what your's can handle before starting.

Aquariums

Aquariums come in standard sizes ranging from 2 to 125 gallons, so no matter what you want to do with this project you should be able to find an aquarium that will fit your needs. If you buy a manufactured aquarium, they usually come with a guarantee against leakage and you can get many supplies that are designed to fit them (tops and lights, etc.). You can build your own aquarium if you want, but the cost of getting glass that has been custom cut often ends up as expensive as a manufactured one. If you are looking at used aquariums, try to avoid very old ones, as the glass becomes

brittle with age as does the glue that holds it together.

Once you have an aquarium, there are several other supplies that you'll need to get started. The list is not too long, so try and get everything on it before starting.

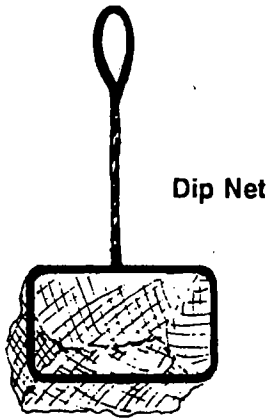
Supplies for the Aquarium*

- Dip net at least 6 inches wide
- Heater large enough for tank . Heaters come in different sizes and watts. Ask your dealer what size is needed for your aquarium.
- A stand or a place to put your aquarium. Water weighs about 8 pounds per gallon. Make sure you have something sturdy enough to hold it.
- A light. See the section on lighting.
- A top for the tank to keep fish from jumping out.
- A thermometer to measure the temperature.
- Gravel or sand. Try and find very fine gravel or coarse sand as the plants will do better. Natural colors are better if you are trying to create a little pond.
- Rocks or Driftwood for decoration and hiding places.
- A filter. Filters which hang on the outside of the aquarium and work on a small motor are recommended. They are quiet, easy to clean, work well and are much cheaper than they used to be.
- Fish food. The type of food to use will depend on the type of fish in the aquarium. If you are not sure which to use, ask your dealer.
- Dechlorinator. Tap water may contain chlorine, which will kill your fish. You can let the water sit for 24 hours to let the chlorine evaporate, or use a dechlorinator.

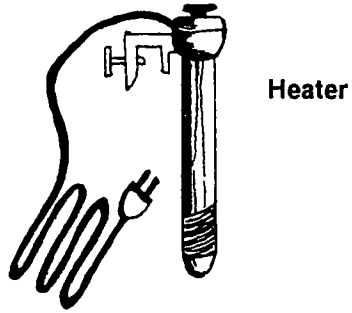
* See page seven for illustrations.

Projects

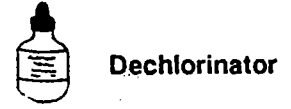
Following are two suggested projects that you can use, one for the beginner, and one for more advanced 4-Hers. You can follow them exactly if you wish, but they are designed to be guides for you, not rules. The vast variety of fish, plants and aquariums will not allow for all the possibilities to be described, so if you want to be creative, please do so. The only rule is to keep your aquarium as natural as possible, so that it is a little pond that you can learn about fish farming with.



Dip Net



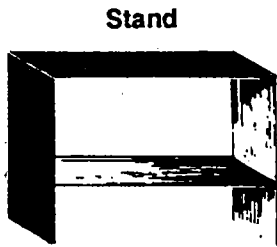
Heater



Dechlorinator

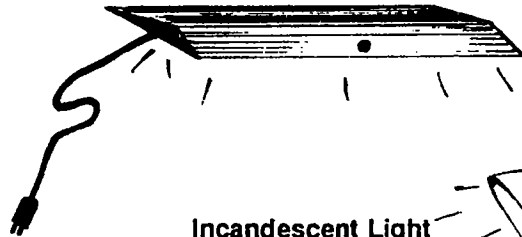


Fish Food

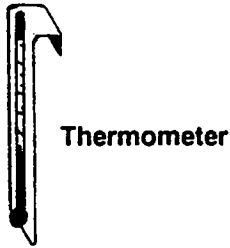
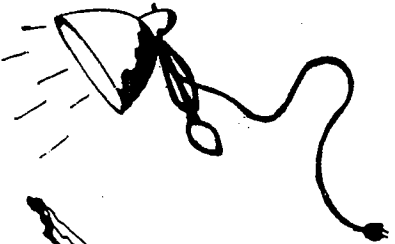


Stand

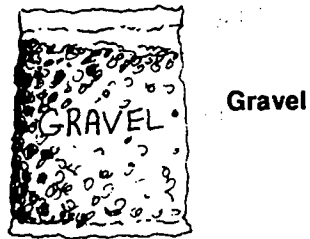
Manufactured Cover and Light



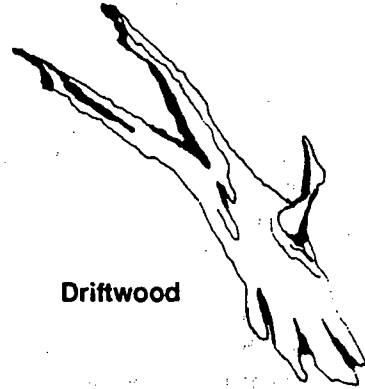
Incandescent Light
with Clamp



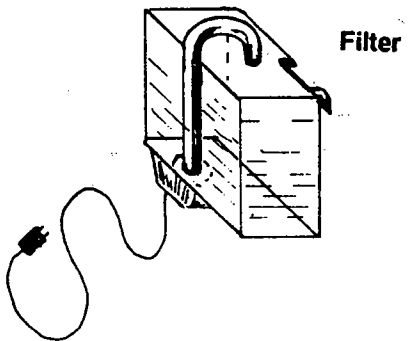
Thermometer



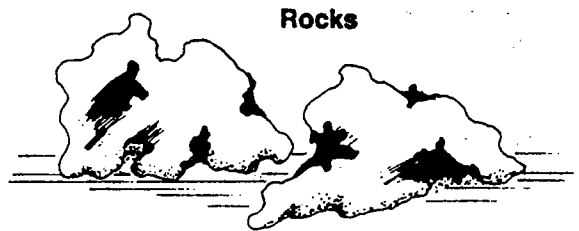
Gravel



Driftwood



Filter



Rocks

