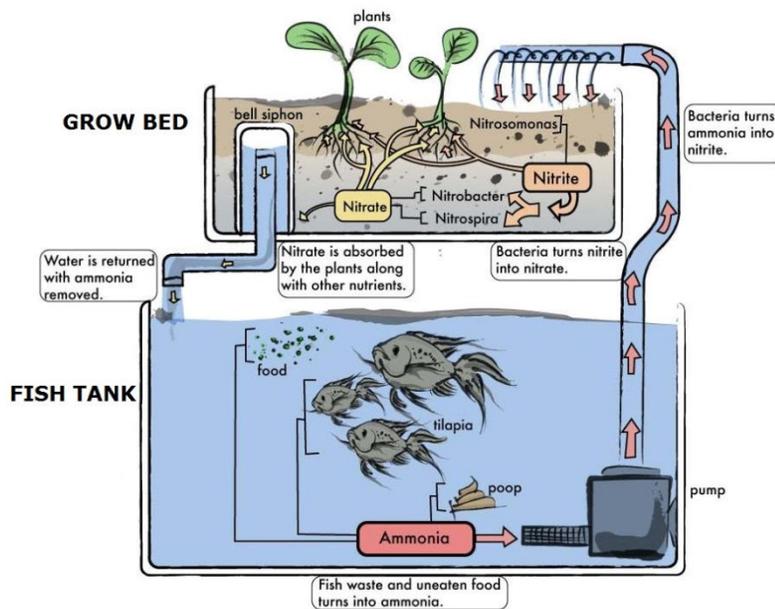


## Aquaponic Set up for classroom or home system

### AQUAPONICS BASIC DIAGRAM



### What is Aquaponics?

Aquaponics is a system for farming fish and plants together in a mutually beneficial cycle. Fish produce wastes that turn into nitrates and ammonia. These aren't good for the fish if they build up too much, but they're great fertilizer for plants. As the plants suck up these nutrients, they purify the water, which is good for the fish.

Fish are kept in large tanks and the plants are grown hydroponically; that is, without soil. They are planted in beds with a little gravel or clay and their roots hang down into the water. The water is cycled through the system, so that it collects the "waste" from the

fish; then it's pumped to the plant beds, where it is filtered naturally by the plants and can then be returned to the fish tanks. Unlike traditional farming methods, no chemical fertilizers are needed for the plants: they all come from the fish-waste. Once the system is set up, only a little extra water is needed to make up for evaporation, because the same water is constantly recycled.

## What You'll Need

Following is a list of the parts you'll need to build an Aquaponic system.

	<p>A tank for the fish: 3-20 gallon, glass or plastic container (\$5 - \$20)</p>
	<p>Gravel - 2.5 lbs./gravel for every 5 gallons of water in the fish tank (\$2 - \$5)</p>
	<p>Water pump / filter - 3-4 watt pump capable of lifting 18” - 54” at 30 - 100/gal/hour (small circulation or fountain pump is ideal) (\$19 - \$40) and tubing for the pumped water to the planting bed</p>
	<p>Aquarium air pump sized for the number of gallons in your fish tank (\$8 - \$16)</p>
	<p>Hydro-Sponge filter provides both mechanical and biological filtration. Aerobic bacteria colonize the sponge providing a bacterial substance to facilitate the nitrogen cycle.</p>

	<p>Grow Bed – Can be anything that will hold the plants on top of the fish tank and be 3” - 8” deep (\$ 5 - \$20)</p>
	<p>Growing Medium – Can be large pea gravel (found in fish store), perlite, coconut coir, expanded clay pebbles or peat moss to fill the grow bed (\$2 - \$5)</p>
	<p>Fish (can be gold fish or feeder fish) and plants (can grow from seeds or grown plants)</p>

### Component Explanation

#### A tank for the fish

The fish tank can be a glass or plexi-glass aquarium or you can use any other clean container that holds water, for example, a plastic tub, bucket or barrel. It can be anything between 3 - 20 gallons, although, you can go with a larger tank if you have the space. Small, clean plastic amphibian cages, available in most pet shops, make an excellent mini-system. They hold about 3 gallons and are quite inexpensive.

The standard sized fish aquariums of 10 and 20 gallons are also reasonably priced. The larger the tank, the larger grow bed area you can support. As a general rule, you can support 1 - 2 square feet of growing area for every 10 gallons of fish tank water.

#### Gravel for tank bottom

The gravel serves as a home to the nitrifying bacteria that convert ammonia to nitrite and then to nitrate, which can be used by the plants. Most pet stores carry natural or colored aquarium gravel. The individual pebbles are about 1/8” in size. Be sure to wash the



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gravel thoroughly before using it because it is often dusty. Unwashed gravel will cloud your tank water.

#### Water pump and tubing

A small water pump is used to pump the water from the fish tank to the grow bed. After the water is pumped into the grow bed, it gravity-feeds back to the fish tank. You'll need enough tubing to go from the outlet on the pump to the top of your grow bed and form a circle within it.

#### Air pump and tubing

You need an air pump to blow air into the tank water for both the fish and the plants. Tubing connects the air pump to bio filter at the bottom of the tank.

#### Grow bed

The grow bed, which sits on top of the tank. The grow bed is filled with a growing medium that the plants grow in. A plastic Rubbermaid container, a garden planter or other container that will sit on top of the tank will work fine. The container should be between 3" - 8" deep.

You can use a plastic tub or, for a very nice looking unit, build one out of plexi-glass and seal it with a non-toxic, silicone glue. If you build the grow bed, you can accommodate an aquarium light by making a cavity in the grow bed that the light can slide into. If you are using some other kind of container, a light can sit just behind it if there is room.

#### Growing medium

A growing medium can be rocks that are used for the aquarium floor but larger grain or a porous, chemically inert material that holds the plant roots and maintains moisture. Examples include: perlite, expanded clay pebbles, peat moss, pea gravel and coconut coir. You need enough to fill your grow bed.

#### Fish and plants

In an aquaponic system, the fish provide the nutrients the plants need and the plants purify the water by consuming those nutrients.



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## **Optional Components**

Grow light for the plants

If you establish your system in an area with low light levels, you may need to add artificial light for healthy plant growth. Keep in mind that bright light will quickly encourage algae growth in the fish tank. You should try to point an artificial light in a way so that it does not directly penetrate the fish tank. If you do have rapid algae growth, you can scrape the interior walls of the fish tank or buy a plecostomus, a fish that eats algae. If the grow bed is in a windowsill with bright sunlight, in a greenhouse or planted with plants requiring low light levels, a grow light isn't necessary.

## **Assembly Instructions**

### **Step 1**

Thoroughly wash the gravel and place in the bottom of the fish tank.

### **Step 2**

Drill 1/8" or 3/16" holes in the bottom of the grow bed every 2 square inches so the water can drain into the tank. In one of the back corners of the grow bed, drill a 1/2" hole for the tubing from the water pump to pass through.

### **Step 3**

Place the water pump in the fish tank then set the grow bed on top of the tank. Feed the tubing from the water pump through the 1/2" hole. Leave enough tubing to extend about 3/4 the height of the grow bed and to loop around the inside of the grow bed. Cut off any excess tube and fold the end over. Seal the folded piece with electrical tape.

### **Step 4**

Fill the grow bed with the growing medium to just under the top of the tube.

### **Step 5**

Puncture small holes every 2 inches in the section of tubing that loops in the grow bed.

### **Step 6**

Cover the loop of tubing with an inch or two of growing medium.

### **Step 7**

Fill the fish tank with water. Plug in the pump to ensure that the water is pumped into the grow bed, trickles down through the growing medium and continuously back into the tank. Depending on the size of your tank, grow bed and pump, you may have to adjust to flow.



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### **Step 8**

Connect you air pump to the bio filter with the air tubing. Place in the tank and plug in the air pump. A steady stream of bubbles should rise through the water, providing fresh air

### **Step 9**

Allow the unit sit for 24 hours to be sure all chlorine has dissipated from the water. If you want to stock you fish right away, you'll need to add a chlorine remover, which is available from aquarium shops and pet stores.

### **Step 10**

Add your fish to the fish tank. Initially, you should lightly stock your tank with no more than 1/2" of fish per gallon of water. Once your system has been established for over a month you can increase to fish density to 1" per gallon of water.

### **Step 12**

Ideally you should wait approximately 4 weeks to add plants to your system, but if you are eager to plant it, add just a few plants or seeds and increase plant density in a month or so when your system is well established.

## **Fish and Plant Selection**

In selecting your fish, choose hardy species like goldfish, guppies, angelfish and other common varieties available from your local aquarium or pet store. A desktop aquaponic garden will support most varieties of house plants, lettuce, spinach and herbs. Ideally, you should start your plants from seed in a grow cube (also called jiffy cubes) or loose in the growing medium in your grow bed. Very small seed can be sprouted by placing them between two paper towels that are kept warm and moist. You can also transplant plants from an existing hydroponic system with good results.

If you must transplant from soil, thoroughly wash away all of the dirt surrounding the roots and wash the leaves being sure to remove any pest insects.

You will have the most success with leafy vegetables like lettuce, spinach and herbs or houseplants such as anthurium, dracaena, dieffenbachia and philodendron.

You can also plant aquatic plants in the fish tank. They will provide a more natural habitat for the fish and aid in purifying the water.

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## Nitrification Cycle

Fish excrete ammonia in their wastes and through their gills. In sufficient quantities ammonia is toxic to plants and fish. Nitrifying bacteria, which naturally live in the soil, water and air, convert ammonia first to nitrite and then to nitrate. In your aquaponic system the nitrifying bacteria will thrive in the gravel in the fish tanks and in the growing medium in the grow bed. Nitrate is used by plants to grow and flourish. The plants readily uptake the nitrate in the water and in consuming it, keep the levels safe for the fish.

## System Maintenance

The only daily input in this system is fish food. With any aquarium, frequent small feedings are better than fewer large feedings. Unless you have a really large tank, a pinch of food is all it takes. You should never feed more than the fish can completely consume in 5 minutes.

The water level in the tank will slowly decrease as some water is absorbed by the plants and some evaporates. Every few days you should refill the tank to the top.

## Sample Aquaponic System:

