Aquaponics Flow Chart

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Sample Aquaponics Flow Chart

This flow chart has been prepared by the Environmental Sciences Department of Morrisville State College

Morrisville State College

G Light

Wood Gasification | Bio-Diesel | Solar

F Heat & Energy

Feed

O_2

CO_2

O_2

Restaurants

Farm Gate

Grocery Store

A Fish

"Cleaned" Water

B & C Plants

Farmer's Market

Restaurants

Food Banks

Water Solids

CO_2

Water NO_3 - Nitrate

- Iron
- Potassium
- Calcium

E Biofiltration

D Mechanical Filtration

NH_3 - Ammonia Water

Fertilizer Compost

To find out more about our aquaponics facility and for sustainability information use the QR code or go to morrisville.edu/aquaponics

Aquaponics flowchart

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I. Resources

A. Fish

Many different species of fish can be raised in a controlled environment aquaponics (CEA) system. Tilapia are an ideal species because they grow in temperatures that are similar to those required by the plants. They also grow fast and are tolerant of a wide range of environmental conditions, which is what makes them one of the most cultured fish in the world. Tilapia are a highly desired food fish because of their mild white flesh.

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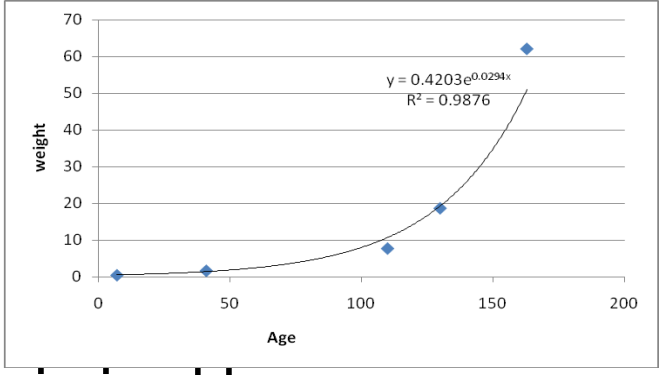
A. Fish



Growth:

In a CEA system, fish growth can be maximized because environmental conditions are controlled and remain consistent. In nature, there are seasonal fluctuations of temperature and light. As it gets colder and days grow shorter the fish's metabolism will slow causing growth to slow as well. Controlling the fish's environment allows the fish to grow consistently at a high rate and the grower can get the fish to market faster.

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A. Fish

In a CEA aquaponics system, fish are usually kept at high densities. While some people may think that this practice is not beneficial for the fish, many fish especially tilapia grow better at high densities. This allows growers to produce more fish in a smaller area to take full advantage of the production per square foot.

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A. Fish

Feeds and Feeding:

Fish are fed a man-made diet that is high in protein. The average weights and lengths of the fish are measured. Feed amounts are increased and pellet size is changed appropriately. The feed must be distributed so that all of the fish get some of the food. If fish are fed properly, the greatest amount of growth can be achieved in the shortest period of time.

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A. Fish

Water Quality:

It is important to test the water quality in order to keep the fish healthy. Oxygen, temperature, pH, ammonia, and nitrite are the most important things to monitor. Fish can get sick and die if the water quality is poor. Even if water quality is only a little bit outside the range in which the fish thrives, it can cause stress for the fish lowering their immune system and slowing their growth.

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A. Fish

Fish produce solids and ammonia which contain nutrients that are useful for the plants. Once the water is treated (see solids removal and biofiltration), it is sent to the plants so they can extract the nutrients that they need.

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B. & C. Plants

The B and C on the flow chart represent two different types of hydroponic culture systems. The first system, B, is what is known as a raft system (left above). The second, C, is a nutrient film technique (NFT) system (right above). The difference between the two types of systems is explained on the next two slides.

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B. Plants: Raft System

Plants are set in foam board and float on top of nutrient-rich water in the raft system, also known as a deep water system. The roots are submerged in water that is constantly flowing through the system. The water is aerated to be sure that the roots get enough oxygen.

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C. Plants: Nutrient Film Technique (NFT)

A thin film of nutrient-rich water flows through channels and only partially covers the roots. The depth and flow of the water is controlled so that the plants can absorb the nutrients. Some of the roots are in the water and some are above it which allows the roots to get enough oxygen.

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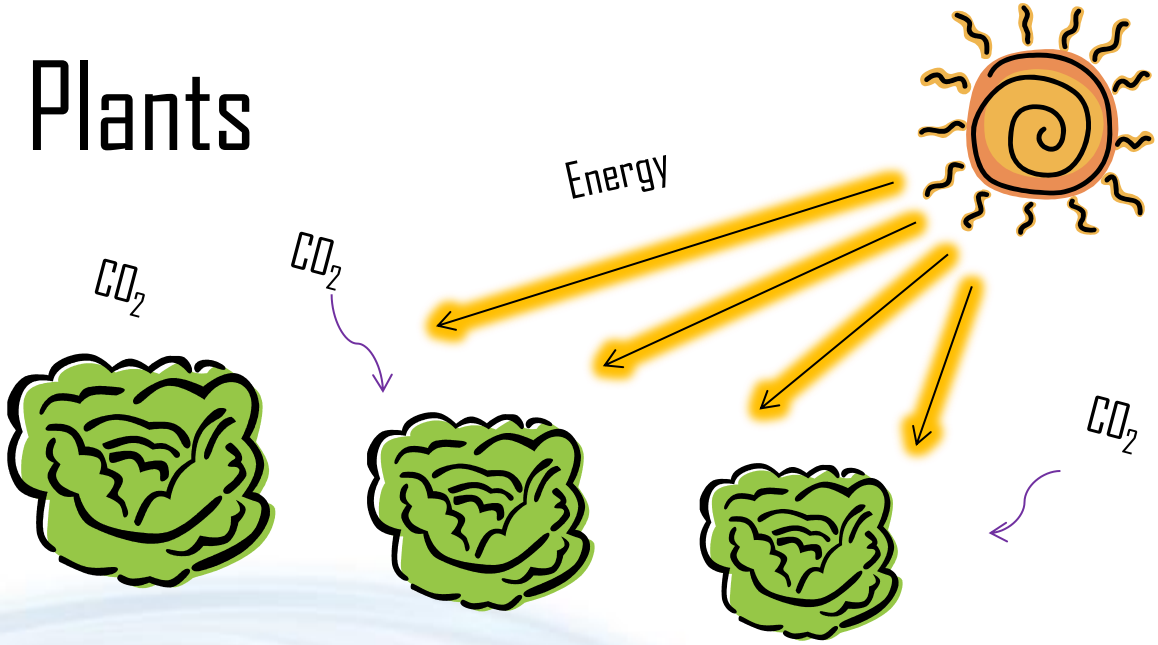
B. & C. Plants



Photosynthesis is the process that plants and other organisms use to convert light energy into chemical energy. The chloroplasts (green part) of the plant uses the light to convert carbon dioxide (CO_2) into sugar. The plant needs these sugars for energy to grow. Aquaponics systems use both natural and artificial lighting.

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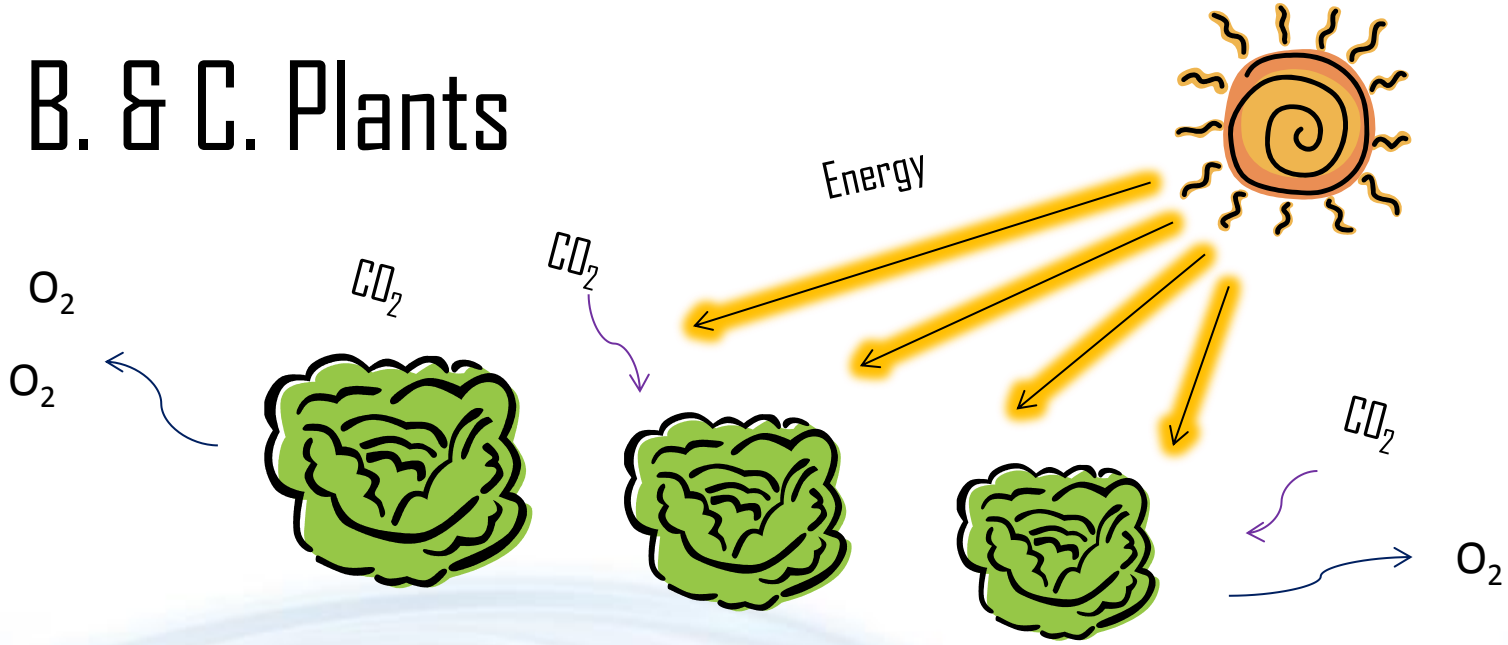
B. & C. Plants



Since plants need carbon dioxide (CO_2) for photosynthesis, they can be used to remove carbon dioxide (CO_2) released by the fish, and in exchange release oxygen into the air. This improves the air quality in the greenhouse.

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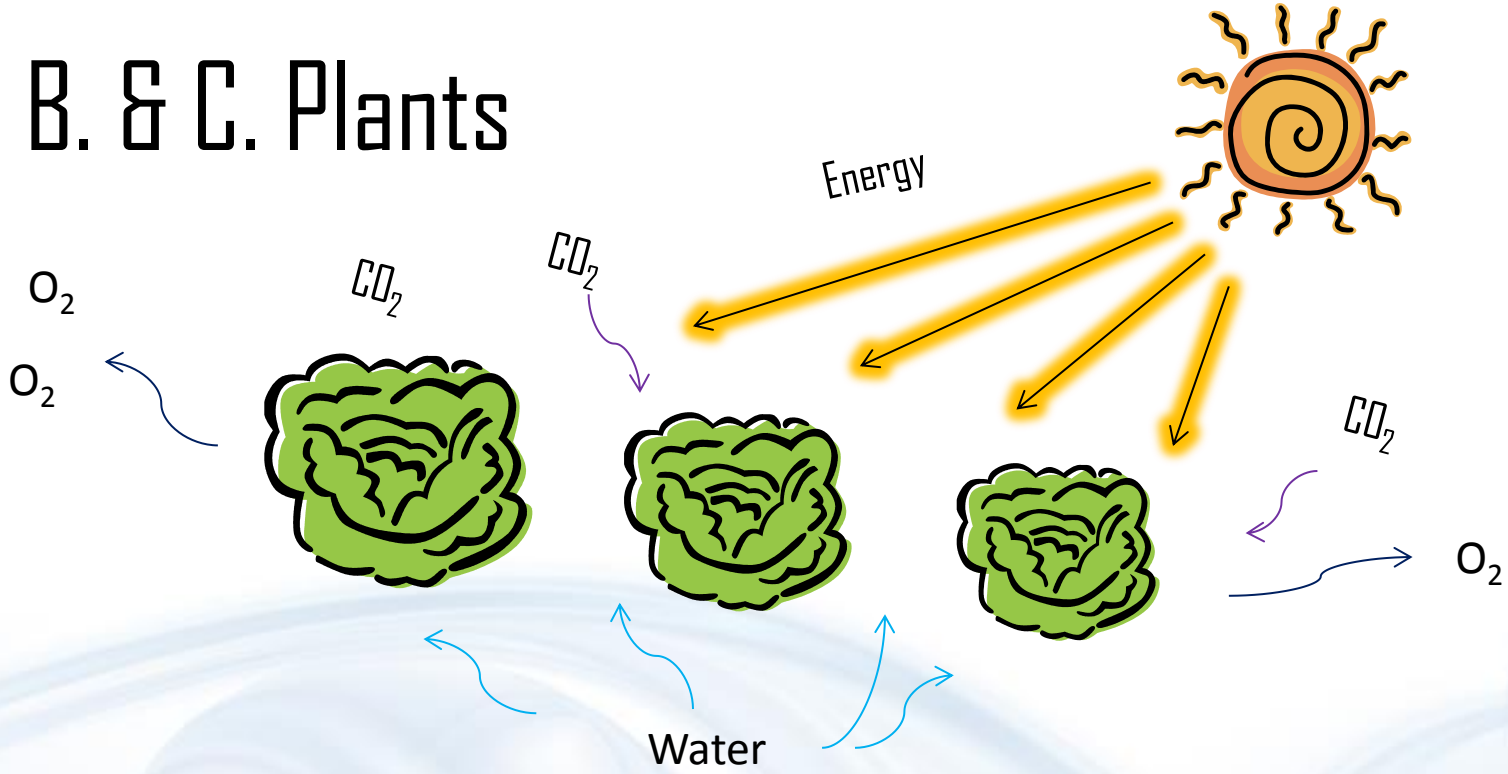
B. & C. Plants



Nutrients in the water come from the fish and are sometimes supplemented to ensure the health and growth of the plants. The plants remove nitrates from the water which could potentially be toxic to the fish. It is important to ensure proper water quality for both the plants and the fish.

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B. & C. Plants

Many different crops can be produced in CEA aquaponics systems. Morrisville State College produces different types of lettuce, tomatoes, herbs, cucumbers, strawberries, and peppers.

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D. Mechanical Filtration

Mechanical filtration removes solids which can cause problems in the system. Solids can suffocate the roots of the plants and prevent nutrient uptake. If solids are allowed to accumulate, the increased turbidity (cloudiness) and biochemical oxygen demand (BOD), along with hydrogen sulfide from anaerobic decomposition can harm plants and fish. Once removed, solids can be composted and used as fertilizer.

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E. Biofiltration

The biofilter has media which provides surface area on which the bacteria grow. *Nitrosomonas sp.,* and *Nitrobacter sp.* are "good bacteria" or nitrifying bacteria which convert ammonia (NH3) to nitrite (NO2) and then to (NO3) nitrate. Nitrate is the preferred form of nitrogen for plants and is less toxic to the fish. These bacteria require oxygen to survive.

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F. Heat & Energy

CEA Aquaponics systems require energy to provide heat, light, and to run equipment. Heat provides a suitable temperature for the fish and plants. Renewable sources of energy (biomass, solar, geothermal, gasification, etc.) can make CEA more sustainable.

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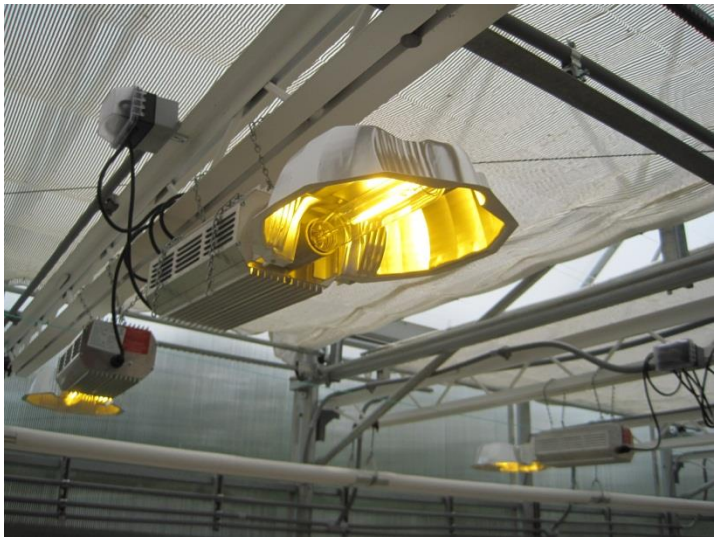
G. Light



To get the best production, supplemental light is typically provided for plants in CEA systems. There are many different options for lighting including high pressure sodium. Much research is going on to develop more efficient and productive LED options.

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Seafood and Produce

The fish and plants go to markets which include restaurants, farmer's markets or stands, grocery and specialty stores, and food banks.

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Reduce, Reuse, Recycle

In CEA aquaponics systems, waste products become bi-products and offer a potential secondary source of revenue. Solids from the fish and plant waste material can be composted and can be used as garden fertilizer.

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Reduce, Reuse, Recycle

CEA aquaponics systems are ideally paired when CO_2 from heat generation fertilizes the plants and waste heat from electrical generation and other industry is used to supplement greenhouse heating.

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Resources:

- Tilapia
  - https://srac.tamu.edu/index.cfm/event/getFactSheet/whichfactsheet/52/

- Aquaponics
  - http://afsic.nal.usda.gov/aquaculture-and-soilless-farming/aquaponics

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