Water Quality Station

Basic concepts of managing the water within an aquaponics system

- ✓ Water is the life-blood of an aquaponics system.
- ✓ It is the medium through which all essential macro- and micronutrients are transported to the plants, and the medium through which the fish receive oxygen.
    - Dissolved Oxygen (DO) (daily)
    - Temperature (daily)
    - pH (daily)
    - Alkalinity (weekly)
    - Ammonia (weekly)
    - Nitrites (weekly)
    - Nitrates (weekly)
- ✓ Each parameter has an impact on all three organisms in the unit (fish, plants and bacteria), and understanding the effects of each parameter is crucial.

Recommendation: Study your selected fish and vegetables to achieve and maintain a balanced ecosystem.

Ideal parameters for aquaponics as a compromise between all three organisms (fish, plants and bacteria)

	Temperature	pH	Ammonia	Nitrite	Nitrate	DO
Aquaponics	65-85°F	6-7	< 1 ppm	< 1 ppm	5-150 ppm	> 5 ppm

Tilapia: recommended parameters for aquaponics

	Temperature	pH	Ammonia	Nitrite	Nitrate	DO
Aquaponics	81-84°F	7.0	< 1 ppm	< 1 ppm	5-150 ppm	> 5 ppm

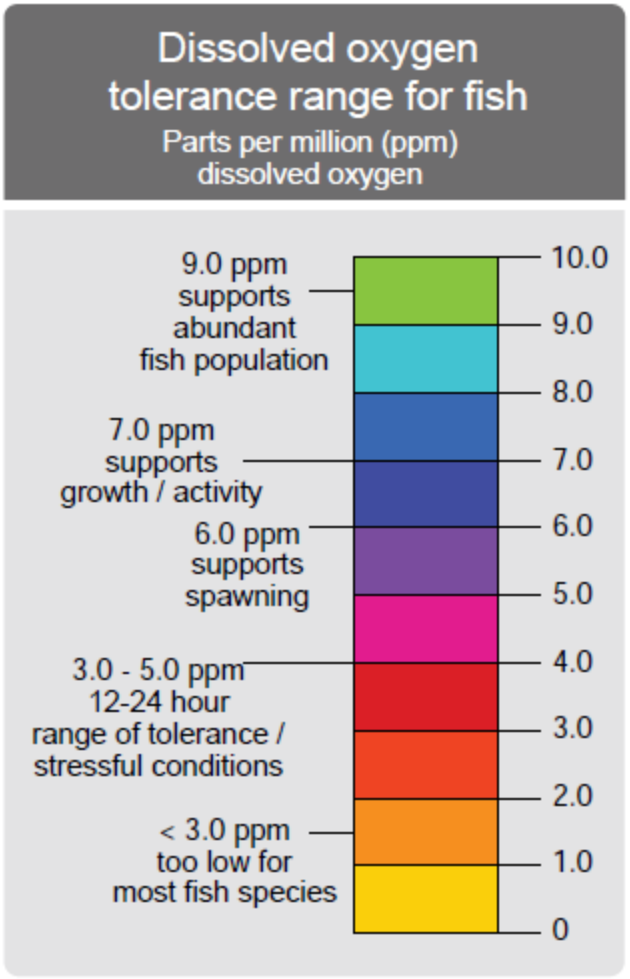
Tilapia prefers 81-84°F
Tilapia growth slow under 70°F
Tilapia die under 50°F
Vegetables prefer 70-75°F

Plants prefer pH < 6.5
Tilapia 5.0-10.0
Nitrifying bacteria perform optimally at pH > 7.5

The overall goal is to maintain a healthy ecosystem with water quality parameters that satisfy the requirements for growing fish, vegetables and bacteria simultaneously.

Dissolved Oxygen (DO) mg/l - ppm

General dissolved oxygen tolerances for fish



- ✓ Maintain DO levels at 5mg/liter or higher
- ✓ Tilapia will come to the surface for oxygen at 1mg/l DO
- ✓ DO is important for optimal fish and plant growth and for beneficial bacteria\
- ✓ Use diffused aeration (air stones)
- ✓ Water holds less oxygen at higher temperatures
- ✓ Measure DO with a meter

pH

- ✓ The pH of the water has a major impact on all aspects of aquaponics, especially the plants and bacteria. For plants, the pH controls the plants' access to micro- and macronutrients.

- ✓ At a pH of 6.0–6.5, all of the nutrients are readily available, but outside of this range the nutrients become difficult for plants to access. In fact, a pH of 7.5 can lead to nutrient deficiencies of iron, phosphorus and manganese. Nitrifying bacteria experience difficulty below a pH of 6, and the bacteria's capacity to convert ammonia into nitrate reduces in acidic, low pH conditions.

- ✓ Ideal aquaponics water is slightly acidic, with an optimum pH range of 6–7. This range will keep the bacteria functioning at a high capacity, while allowing the plants full access to all the essential micro- and macronutrients. However, a pH lower than 5 or above 8 can quickly become a critical problem for the entire ecosystem and thus immediate attention is required.

- ✓ If pH declines < 5.0 add base to maintain pH 7.0 (calcium hydroxide, potassium bicarbonate, calcium chloride, sodium bicarbonate, etc.

Alkalinity

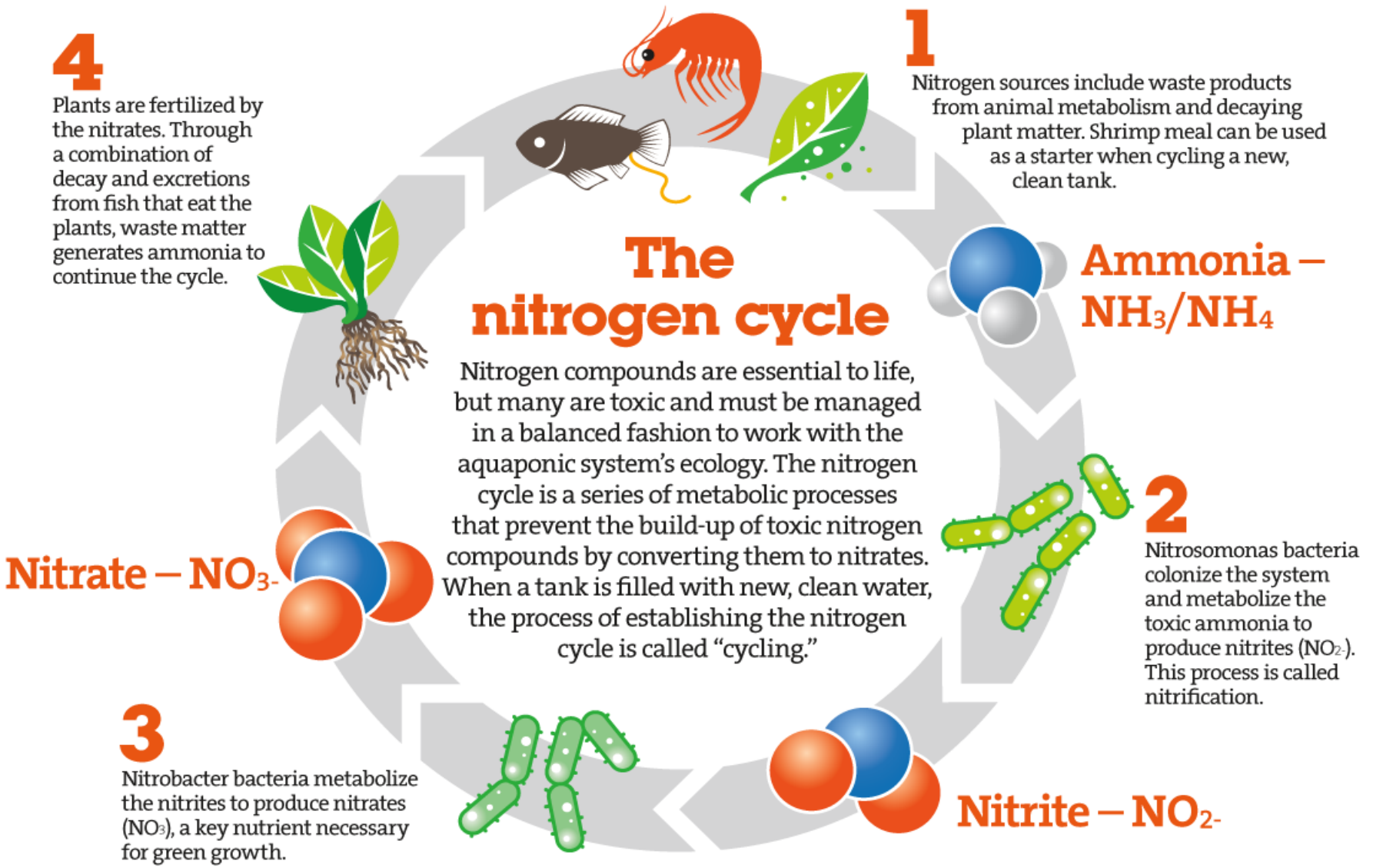
- ✓ There is much confusion around the terms Alkalinity and pH as they are often mistaken for each other. Why, because they are both measurements, but they measure two different things which are related but not the same.

- ✓ Alkalinity is a measurement of water's ability to neutralize acids also called water's buffering ability so it refers to the ability of water to resist change in pH. These buffering materials are called bases and primarily include bicarbonate and carbonate.

- ✓ pH is basically the measurement of the concentration of hydrogen ions in water, in terms of acidity or alkalinity. Water with low alkalinity is very susceptible to changes in pH.

- ✓ Water with high alkalinity is able to resist major shifts in pH.

- ✓ Alkalinity is expressed in units of milligrams per liter (mg/l) of calcium carbonate. The acceptable level of alkalinity in aquaponics has a broad range between 50 and 300 mg/l. Maintain alkalinity > 100 mg/l as $CaCO_3$



Nitrogen cycle

In a nutshell: Fish excrete Ammonia, Ammonia gets converted by good bacteria into Nitrites. Nitrites get converted by other good bacteria into Nitrates. And plants absorb the Nitrates as nutrients to grow, completing the Nitrogen cycle. The water is returned to the fish tank where the cycle begins again.