Aquaponics
Moving Toward Urban Sustainability

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Water & Food Production

- 70% of freshwater used goes to agriculture
- Roughly 30% of the food produced worldwide (about 1.3 billion tons) is lost or wasted every year, which means that the water used to produce it is also wasted
- When we look at water on a world scale, water scarcity directly impacts food security
- Global food and nutritional security, requires producing more nutritious food with less water
- Aquaponics is one alternative to conventional farming that uses significantly less water.
Did You Know?

• More than 50% of the world seafood supply is provided by aquaculture.
• The global human population is expected to grow to 9.7 billion by 2050 and will require 70% more food.
• The US imports more than 90% of its seafood at a cost of $20 billion per year.
Aquaculture production accounts for nearly half of the seafood worldwide.
Areas without easy access to fresh foods:
• No market is available
• Lack of resources to purchase healthy food
• Unaware of what is healthy
• A plethora of fast food options
Food for Thought = PARTNERSHIPS

Our Foods + USC Wrigley Institute for Environmental Studies + USC Student Interns + USC Sea Grant Program + School Partners + Boeing Foundation + Local Communities
School Partners: Los Angeles

- Alliance Merkin Middle School
- Bravo Magnet High School
- Clinton Middle School
- Foshay Learning Center (MS/HS)
- Fremont High School
- John Liechty Middle School
- Orthopedic Magnet High School
- Port of Los Angeles High School
- Santee Learning Complex (HS)
- 32nd Street School (HS)
Food for Thought: creating sustainable sources of produce and fish in urban communities
Water has always played a critical role in aquaponics systems.
Aztecs farmed “floating” islands

Chinampas today
Students who participate in the program are able to explain:

- The role of water in supporting life on our planet, and more specifically in the food supply
- Innovation in systems - from water flow to monitoring the health of the aquaponics system
- Food deserts and the relationship between water and food justice
- Fish as a major worldwide sustainable source of healthy protein
Similar farming practices today

rice fields + fish + birds
that began as early as 6\textsuperscript{th} century in Southern China
What do you notice is similar between these three systems?
Hydroponics – Large scale plant production with nutrient solution and without soil
Aquaculture
Large scale fish, crab, lobster, snail and clam farming
Aquaponics

- **Aquaculture** + **Hydroponics** = **Aquaponics**

- *Aqua*: from Latin for water

- *ponics*: from Greek, to work or labor; refers to roots growing in water, without soil
Aquaponics

- raise both animals and plants
- nutrients produced are used by the system
- everything cycles
- less water, less power needed
- less expensive than hydroponics
- creates natural nitrogen balance
Teacher Workshops

- Develop a network of educators with common challenges
Classroom lesson plans to explore concepts in depth

- Water in aquaponics systems
- Nitrogen cycling
- Air lift pump
- Microbes in aquaponics
Using a sheet of paper, work in teams to create a model of an aquaponics system.

- How does water move through the system?
- Remember to label all of the processes and interactions.
- Put model aside for a few minutes, we’ll come back to it later.
**The Nitrogen Cycle**

Plants use NITRATE to grow, and anaerobic (oxygen-hating) bacteria feed on it. In the wild, fish feed on the plants and the cycle continues.

In our aquaria, we trim plants and change water to remove NITRATE.

Leaving only NITRATE in his wake. NITRATE is safe for our aquatic friends at moderate levels.

Not to worry, since NITROBACTER is rarely far behind! He eats NITRITE...

Which is also dangerous to fish!

...He also generates NITRITE as a by-product...

...Fish respiration, waste and decomposition create AMMONIA!

Ammonia is poisonous to our finned friends...

But never fear! Our good friend NITROSOMONAS to the rescue! This bacteria eats ammonia, but...

Say what?

Doh! Swoooop!...
Measuring Nitrogen

- Nitrogen can be found in three forms in your system so we measure all three
  - Ammonia – from fish wastes and decomposition; high levels *can be deadly to fish*
  - Nitrite – after bacteria convert the ammonia to nitrite; *still a problem for fish*
  - Nitrate – a form of nitrogen plants can use to grow and *not harmful to fish* in limited amounts
Water Test Kits

- Used to measure water quality – the health of the water. The water test kits use reagents that are added to the sample of water to find the levels of important parameters of:

  - dissolved oxygen
  - nitrite
  - nitrate
  - alkalinity
  - ammonia
  - temperature
  - pH
Temperature

- Temperature effects:
  - the ability of bacteria to convert ammonia to nitrates that can be used by plants
  - Oxygen availability in water for fish, roots, microbes

- Time of day, heat of the room can both effect temperature.

- Most fish can handle wide temperature changes over several hours but not rapid changes.
Temperature

- Water temperature ranges for fish and microbes must be monitored.
- Different species of fish, have different temperature needs based on their native habitat.

<table>
<thead>
<tr>
<th>species</th>
<th>Trout</th>
<th>Tilapia</th>
<th>Goldfish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thriving temperature (surviving temperature)</td>
<td>55 – 65°F (38-68°F)</td>
<td>74 – 80°F (60-95°F)</td>
<td>65 – 75°F (45-90°F)</td>
</tr>
</tbody>
</table>
Monitoring Changes in Water Quality

- What might change in your system from morning to afternoon that would change water quality?

- What other clues can you use to tell the water quality is changing, before you do a test?

- Aquaponics allows us to explore one alternative to conventional farming that has less impact on the environment in the urban setting.
Student Growth

- Students questioning and learning becomes self directed as they make time to observe, to reflect, and to record changes.
- Students develop their own research questions.
- Students share their system with others with great pride.
Evaluate

- Take a few minutes to look back at your model.

- What can you add or change to reflect your new learning about the system?
Next Steps

- Teacher workshops within school, to build cross curricular engagement – Santee Learning Complex
- Students and teachers networking throughout the city
- Developing internships for students in aquaculture and aquaponics programs
Questions?

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