

Composting

Adapted from: Project Learning Tree: Secondary Environmental Education Program

Grade Level: Intermediate

Duration: No limit

Setting: Classroom

Summary: Students will be able to experience composting and relate it to aquaponics.

Objectives: Students will develop an understanding of recycling, “waste=food”, and how they all relate to composting. Students will be asked to bring in compostable materials to actually complete a composting task.

Vocabulary: Aquaponics, symbiotic, waste=food, sustainability, composting, systems-thinking

Additional Materials (NOT Included in Module):

- Styrofoam container
- Red worms
- Food waste
- Soil

ACADEMIC STANDARDS

English Language Arts Pre K – 5

- 1.5 Speaking and Listening
 - Comprehension and Collaboration
 - Presentation of Knowledge and Ideas
 - Integration of Knowledge and Ideas
 - Conventions of Standard English

English Language Arts 6 – 12

- 1.5 Speaking and Listening
 - Comprehension and Collaboration
 - Presentation of Knowledge and Ideas
 - Integration of Knowledge and Ideas
 - Conventions of Standard English

Writing in Science and Technical Subjects 6 – 12

- 3.6 Writing
 - Text Types and Purposes
 - Production and Distribution of Writing
 - Research to Build and Present Knowledge
 - Range of Writing

Reading in Science and Technical Subjects 6 – 12

- 3.5 Reading
 - Key Ideas and Details
 - Craft and Structure
 - Integration of Knowledge and Ideas
 - Range and Level of Complex Texts

Background

Aquaponics explores the **symbiotic** relationship between

plants and animals within a closed system. Water is circulated between the constituent parts of these systems—aquariums and growing trays—thereby filtering nitrates that are toxic to fish but integral to plant growth. Most systems require little to no inputs and all waste is fed back into the

process; solid fish waste and unused plant matter are composted to grow worms as fish food. As such, aquaponics embodies **sustainability**.

Water from the fish tank is pumped through the growing bed to filter it and remove fish waste. Bacteria play a crucial part in the health of the aquaponics system, as they remove fish waste (ammonia) from the water, converting it to nitrites and later to nitrates. Nitrate-rich water is introduced to the hydroponically grown plants (plants grown without soil). These plants are placed in beds that sit on tubs filled with water. The plants' bare roots hang through holes in the beds and dangle in the nutrient-rich water. The roots of the plants absorb nitrates, which act as a nutritious plant food. Although the nitrates are the primary fertilizer for plant growth, their accumulation would eventually kill the fish in the system. Thus, the symbiosis between plants and fish revolves around production and consumption of nitrogen, and is the same relationship found in every ecosystem around the world.

Plants grown using aquaponics are more likely to be organically grown, which means they are healthier for you. Pesticides and other chemicals cannot be used in aquaponics because they will harm the fish, disrupting the whole system. Additionally, plants grown in aquaponic systems have no threat of carrying soil-related diseases. When indoors, or with the assistance of a greenhouse, aquaponics can grow crops year round – especially useful in Northwest Pennsylvania. Aquaponics can encourage community development and local economic growth. On a larger scale, it is a project the community can care about together, and allows for more food to be grown and sold—or shared—locally. Creating a personal aquaponics system is easy and inexpensive, and can be done on a large or small scale. With a 50 gallon fish tank, you can have one in your own home.

Overview

Students will be asked to discuss with their teachers what composting is and how it relates to aquaponics. Also, students must discuss how waste=food relates to composting and how that is essential to a truly sustainable aquaponics system. Finally, students will be asked to construct a composting system.

Procedure

The teacher must provide the Styrofoam container with several holes on it, including several red worms and some soil. Student will be asked to bring in certain food waste from home, such as banana peels, apple cores, etc. The students must keep a log on how the system is working.

Discussion

Discuss how the steps of a sustainable aquaponics system are dependent on recycling, more specifically composting. Discuss how the composting system feeds the worms which then feed the fish. Fish waste then equals nutrients for the growing plants. Hence **waste=food**.

In the second stage, discuss how most agricultural systems rely on nitrogen fertilizer and how that is bad for the environment, but that in a through **systems-thinking and composting**, farmers can reduce the cost of growing plants while also reducing waste and energy. If you had the opportunity to visit a larger aquaponics system such as the one sponsored by Allegheny or

the one at Tom Ridge Environmental Center, discuss which plants the students would grow in their own aquaponics setup.

Next, discuss what would be left over after harvesting your vegetables. Suggest that good systems-thinkers eliminate as much waste as they can from the system, and ask for ways to use the plant waste. This should lead to the next step, which is composting. Composting takes advantage of other microorganisms to convert waste into food, but it also helps grow worms that can be used as fish food. Discuss how each part of the system is interdependent on the other parts of the system, and talk about how all ecosystems work this way.

Evaluation

The main component of this activity is student participation.

Extensions and Modifications

The activity functions as a stand-alone introduction to composting in relation to aquaponics.

Notes (Please write any suggestions you have for teachers using this activity in the future)