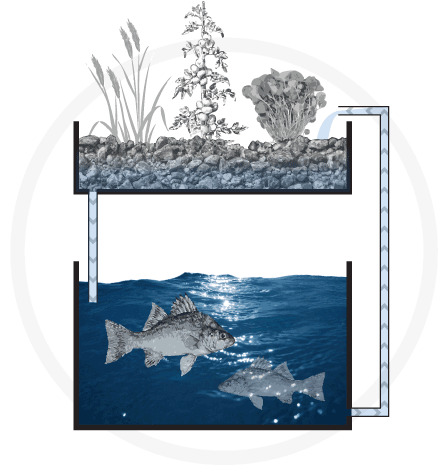
**Unit Essential Question:** *How does energy and matter flow within natural and designed systems?*

**Challenge**

Real ecosystems, like the river environment you saw in the Lift-Off, have natural cycles that keep them functioning and healthy all on their own! By studying real ecosystems, we can learn how to replicate these cycles in artificial environments of our own making. Aquaponics systems, like the one shown to the right, use our understanding of real ecosystems to create an environment that sustains itself (keeps itself going on its own). Matter and energy flow within and between the garden on top and the fish tank below, providing each environment with the factors it needs to thrive.



http://www.next.cc/journey/design/aquaponics

For this unit’s project, your group’s task is to use what you learn about how energy and matter flow through ecosystems in order to design and build a sustainable aquaponics system that mimics the properties of a river environment. Individually, you will then write an instruction manual that describes your aquaponics system and explains the science behind how it functions.

**Group Project Criteria for Success**

Your sustainable aquaponics system should include:

* A garden and a fish tank, connected
* Essential non-living parts of an environment needed to support life
* Living organisms that do cellular respiration and photosynthesis
* Heat-regulation devices to maintain the temperature of your fish tank

**Individual Project Criteria for Success**

The instruction manual for your aquaponics system should include:

* A diagram of your aquaponics system
  + Label all living and non-living parts in your system
* Identify at least one organism that does cellular respiration in your aquaponics system
  + Model and describe the process of cellular respiration (using pictures, labels, arrows, and captions)
  + In your model, make sure to show and explain how matter is conserved in this chemical reaction
* Identify at least one organism that does photosynthesis in your aquaponics system
  + Model and explain the process of photosynthesis (using pictures, labels, arrows, and captions)
  + In your model, make sure to show all forms of energy and matter involved
  + Cite evidence from Task 3 to support your explanation
* Model and describe which processes of the rock cycle might occur in your aquaponics system over time
  + Identify the flow of energy that drives the processes you identify
  + Explain why some of the rock cycle processes you explored in Task 4 will not occur in your aquaponics system and are not seen in short time periods
* Identify and explain one physical and one chemical change that will occur in your aquaponics system
  + Use data from Task 1 to explain how looking at macroscopic properties of matter can help you determine whether physical or chemical changes are happening at the microscopic level
  + Describe any effects these changes will have on your system and propose potential solutions to minimize these effects
* Draw a diagram of the heat-regulation device you designed and explain how it will work in your aquaponics system
  + Describe the design process that led you to your final product
* Discuss the benefits and limitations of an aquaponics system
  + How does this model help us mimic a natural environment that sustains itself, like the river environment?
  + How does an aquaponics system not function exactly like a natural system?

**Instruction Manual Peer Review Feedback**

Complete after you have a full first draft of your instruction manual.

|  |  |
| --- | --- |
| Instruction Manual Owner’s Name |  |
| Instruction Manual Reviewer’s Name |  |

**Review the following sections of the Instruction Manual:**

* A diagram of your aquaponics system
  + Label all living and non-living parts in your system
* Positive Comment:
* Constructive Comment:
* Identify at least one organism that does cellular respiration in your aquaponics system
  + Model and describe the process of cellular respiration (using pictures, labels, arrows, and captions)
  + In your model, make sure to show and explain how matter is conserved in this chemical reaction
* Positive Comment:
* Constructive Comment:
* Identify at least one organism that does photosynthesis in your aquaponics system
  + Model and explain the process of photosynthesis (using pictures, labels, arrows, and captions)
  + In your model, make sure to show all forms of energy and matter involved
  + Cite evidence from Task 3 to support your explanation
* Positive Comment:
* Constructive Comment:
* Model and describe which processes of the rock cycle might occur in your aquaponics system over time
  + Identify the flow of energy that drives the processes you identify
  + Explain why some of the rock cycle processes you explored in Task 4 will not occur in your aquaponics system and are not seen in short time periods
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* Draw a diagram of the heat-regulation device you designed and explain how it will work in your aquaponics system
  + Describe the design process that led you to your final product
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  + How does this model help us mimic a natural environment that sustains itself, like the river environment?
  + How does an aquaponics system not function exactly like a natural system?
* Positive Comment:
* Constructive Comment: