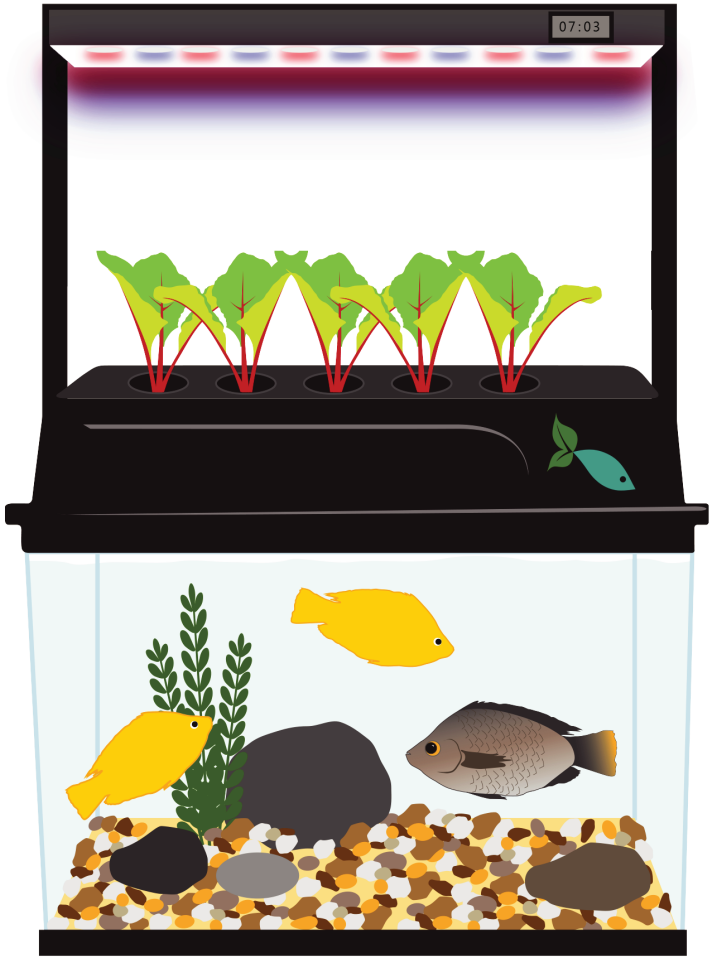
ECOLIFE aquaponics®

6–8

ECO-CYCLE CURRICULUM

What is the ECO-Cycle Aquaponics Kit™?



The ECO-Cycle Aquaponics Kit™ provides students and teachers with an interactive, hands-on tool for learning. The kit may be used to demonstrate concepts such as:

- **Plant and animal anatomy**
- **Photosynthesis and respiration**
- **Living systems**
- **The Nitrogen Cycle**
- **The role of bacteria in ecology**
- **The function of water in ecology**
- **The science of sustainable agriculture**
- **Climate change and ecological issues**

and many others, all while caring for fish and plants, germinating seeds, and harvesting vegetables.

The curriculum is designed around the ECO-Cycle. Once it is assembled and running (see assembly instructions included with the kit), the following lessons may be implemented.

Grades 6 - 8 Lesson Plans

ACTIVITY #1: FISH TANK OPTICS

NGSS: MS-PS4-2

OBJECTIVE:
Students learn and understand how light (a form of energy) travels and moves. Students will see how light travels through certain materials and what happens when light hits certain materials. Students will observe how light is used in the ECO-Cycle Aquaponics Kit.

CONCEPTS:
Students learn and understand how light moves through or bounces off different materials in different ways.

PRINCIPLES:
Light moves in waves
Light waves can often travel through a material or medium
When light waves hit a medium, light will either reflect or refract

FACTS:
Light travels fast or slowly, depending on its power and on the material it passes through
Light moves more slowly through thicker and darker materials
Light is reflected off of some materials
Light is bent or refracted by some materials
Light is absorbed by materials
Light waves can scatter when they bounce off rough surfaces

SKILLS:
Observing
Making Inferences
Drawing Conclusions

MATERIALS:
- Different sizes of flashlights
- ECO-Cycle filled with clean water
- White and dark paper
- Large can or another non-floating object

ROOM PREPARATION:
Place the ECO-Cycle on a table so students can stand around it comfortably, see clearly, and participate in the activity.

QUESTIONS FOR DISCUSSION:
Today, we will observe light waves and how light interacts with materials. Light moves in waves, which can bounce off or go through materials. How does light travel? What happens when light hits or moves through different objects?

ACTION:
Have students shine flashlight beam through their hands. We can see that flesh and bone won't allow light to pass through. The hand turns pink, evidence that light is bouncing off. This bouncing of light off a surface is called reflection.

Shine flashlight beam through the tank of water. Hold dark paper at outside end of tank to see evidence that light is coming through the tank. Look down into the water and see reflection in it. Experiment with different sizes of beams and flashlights and document what you see.

Put the can or other object in the middle of the tank. Shine light through tank and observe what happens when the beam passes through water and hits an object. Do light waves pass through the object or bounce (reflect) off of it?

Next, place dark sheets of paper along the sides and end of the tank. Focus a beam on the far end of the tank and observe how light shining in at one end hits mostly, but not entirely, on the other end. Refraction causes some light waves to bend and pass through the sidewalls.

Shine light through the air in the tank (top of the tank above the water). Observe that light has no reflection or refraction because the medium is just "air," so there is no material to reflect or refract the beams.

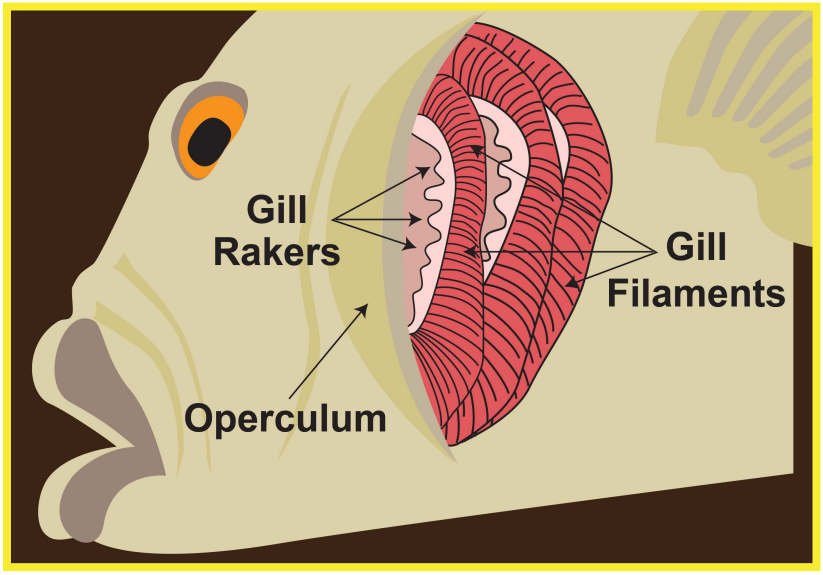
FURTHER DISCUSSION:
What happens when light moves through or hits different materials? How does the light of a flashlight compare to the light from the sun? Share what we have learned and observed. Have students demonstrate, draw, or tell how light waves travel through air, water, paper, glass, their hands, etc. Listen for evidence that the students understand reflection and refraction.

SWIMMING DEEPER:
Ask students to explain what they have learned about light and it's importance to plant growth. What do they know so far from the study of the ECO-Cycle Aquaponics Kit? What have they learned so far from the lights on the kit replicating that of the sun?

ACTIVITY #2: HOW DO FISH GET OXYGEN?

NGSS: MS-LS1-4

OBJECTIVE:
Explain the basic method in which fish get oxygen, how they breathe underwater and understand the structures of the fish body that aide breathing and the exchange of oxygen and carbon dioxide.



MATERIALS:
Description of how fish get oxygen, teachers choice of materials for a sample model of how fish get oxygen.

BUILDING BACKGROUND:
During observations in previous lessons, students should have a clear understanding that while fish move around an aquarium, they continually open their mouths. This is an easy “show me how fish open and shut their mouths” demo to conduct at the beginning of the lesson.

Explain in this lesson, students will plan and create a small model demonstrating how fish get oxygen. The teacher can direct the simplicity or complexity of student models, types of materials to use, steps of completion, in class or homework assignment, etc. Have students work in groups (determined by class size).

SIMPLE CLASSROOM DEMONSTRATION:
Place a small amount of ground coffee onto a coffee filter. The ground coffee represents anything that could be floating in water, including oxygen molecules. The filter represents a gill filament. Have a student or two hold the filter flat above a large bowl and pour warm water through the coffee grounds. Have students look at the water in the bowl. Although there are no solid pieces of coffee, the water is not clear. The brown in the water is what the water took away from the coffee grounds. For purposes of this demonstration, the brown color in the water is caused by the oxygen that moved through the gill, or coffee filter, and into the fish's lungs.

ACTIVITY #3: FLOWER ANATOMY & DISSECTION

NGSS: MS-LS1-4

OBJECTIVE:
Students will investigate and understand basic plant anatomy and life processes. Key concepts include: The structures of typical plants (leaves, stems, roots, and flowers).

MATERIALS:

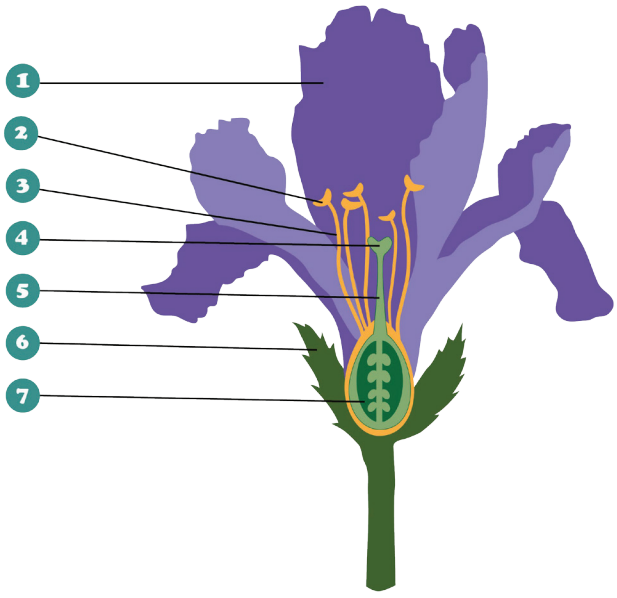
- Hibiscus flower
- Small plant
- Tweezers
- Paper towel
- White drawing paper
- Pencils

ACTION:
Student led observations. Students can draw flowers and label with sticky notes or pass out flower and plant diagram worksheets.

Pass out flower, small plant, tweezers, paper towel to students. Using tweezers, students will dissect (with teacher modeling) their plant, identifying the basic parts including the leaves, stems, roots, and flowers.

Students will draw, label, and color parts of a plant on drawing paper. Students will add to the diagram to show what the parts of the flower do in the environment to stay alive.

FURTHER DISCUSSION:
Ask the students if they can find the same anatomy on flowering plants such as daffodils, amaryllis, or other bulbs.



1. PETAL
2. ANTHER
3. FILAMENT
4. STIGMA
5. STYLE
6. SEPAL
7. OVARY

SWIMMING DEEPER:

Use a variety of different flowers like lilies, carnations, roses, hibiscus and a variety of different small plants. Ask groups of students to dissect more than one type of flower. While labeling the different parts of the flower, ask students to list the function of each part as well as the name.

Try growing flowering plants in your ECO-Cycle!

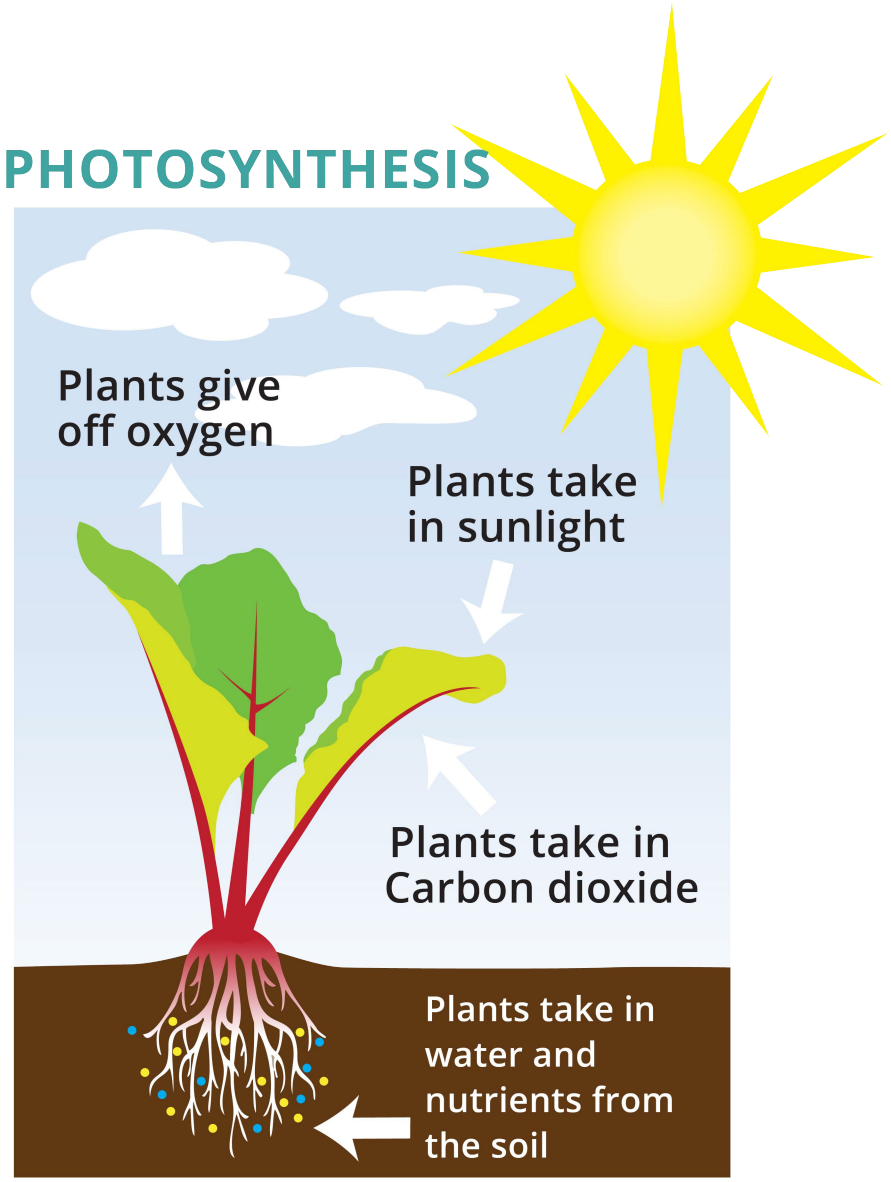
ACTIVITY #4: PHOTOSYNTHESIS

TEACHER PREPARATION:

Although plants differ in their shapes and sizes, all plants are alike in one way. They make their own food in a process called photosynthesis. All organisms, or living things, need energy to grow, stay healthy, and reproduce. Plant get the energy they need from the food they make.

During photosynthesis, plants take in sunlight (the lights in your ECOLIFE ECO-Cycle Aquaponics Kit supplement that of natural sunlight), water (H_2O), and a gas in the air called carbon dioxide (CO_2). Plants use these three ingredients to make sugar, which is a plant's source of food and energy.

Plants have a material called chlorophyll that helps them take in sunlight. Chlorophyll is the material that gives plants their green color. With the help of chlorophyll, plants take in energy from the sun and use it to produce sugar. Energy from the sun is called solar energy.

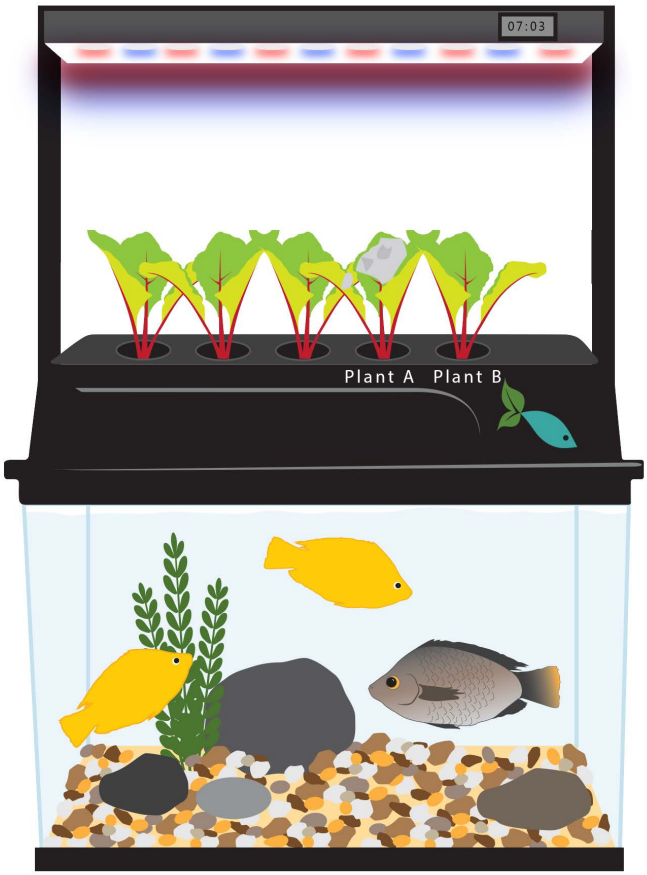


ACTIVITY #5: LET THERE BE LIGHT!

NGSS: MS-LS1-6

MATERIALS:

- Two mature plants
- Tin foil
- Water
- Your ECO-Cycle



ACTION:
Label two identical plants "Plant A" and "Plant B". Wrap each leaf of Plant A with aluminum foil. Keep the leaves of Plant B uncovered. Each plant should receive the same amount of light and water.

PREDICT:
What do you think will happen to each plant?

OBSERVE:
Uncover Plant A after four days. Record your observations about each plant in a chart.

INFER:
Why do Plant A and Plant B differ after four days?

DRAWING CONCLUSIONS:
How can you tell plants need light to grow?

SWIMMING DEEPER:

- Have students use different plants, different locations, both indoors and out with various materials to cover leaves (copy paper, newspaper, magazine pages, card stock paper, wax paper, parchment paper, etc.
- Group students and fill the entire ECO-Cycle with a variety of plants. Ask students to compare and discuss why some plants might need more light then others.
- Students discuss the variations in what they observe at the conclusion of the experiment time and why they observed those variations, if any.

ACTIVITY #6: 'LEAF' IT BE! MATH IN SCIENCE

NGSS: MS-LS2-1

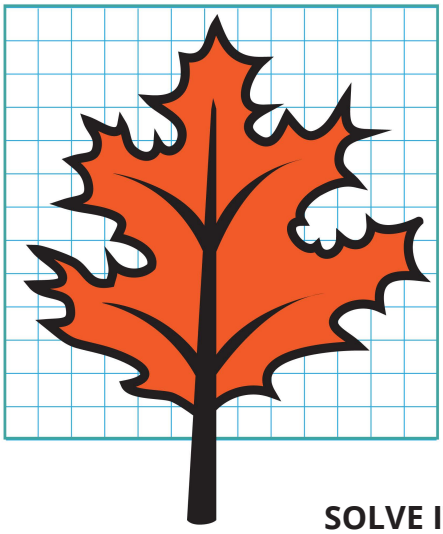
OBJECTIVE:
Have your students learn and understand how to find the area of an irregular shape. Students may have already learned and understood how to find the area of a regular shape such as a rectangular (maybe a garden bed in your school garden) or the shape of the ECO-Cycle fish tank. Perhaps it is a square bed, but students will learn that all objects can be measured for area.

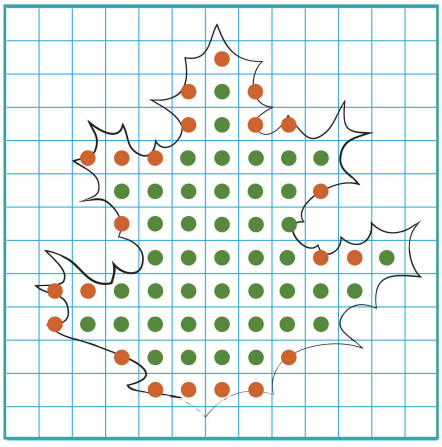
Some leaves, like the fine pine needle, barely have any surface area. Others, like the very large banana plant leaf, have a very large surface area. The surface area of leaves is directly connected to the amount of sugar and oxygen they produce. One could assume that a single pine needle does not produce as much sugar and oxygen as a banana leaf.

CALCULATE THE AREA OF AN IRREGULAR FIGURE:

1. Trace the figure on graph paper
2. Count the number of whole square units
3. Count the number of partial square units and divide this number by 2
4. Add the two numbers together

● Whole Squares	+	● Partial Squares/2	=	Area
44	+	22/2	=	Area
44	+	11	+	55





SOLVE IT

1. Find a leaf.
2. Calculate the area of your leaf.
3. Compare the area of your leaf to the area of the leaf above.
4. Which produces more sugar and oxygen?
5. Why are there bigger leaves in rainier/shady places and smaller leaves in hot/dry places?

ACTIVITY #7: LEAVES, CARBON DIOXIDE & OXYGEN

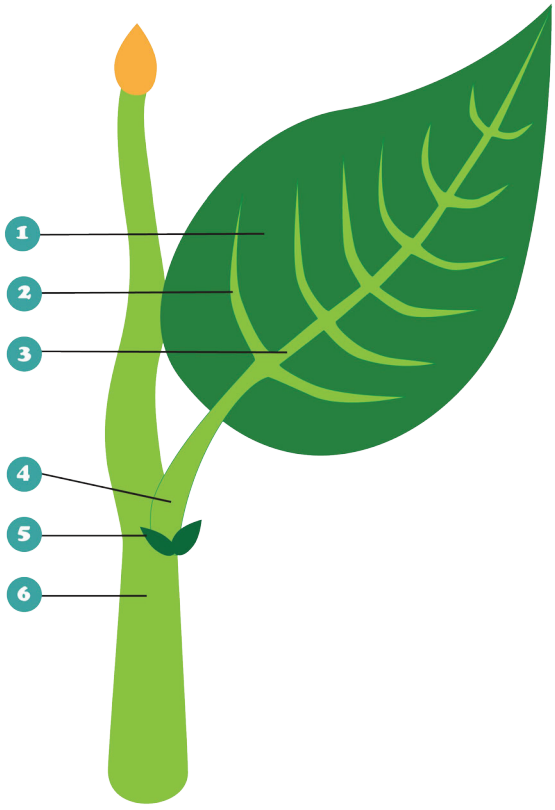
NGSS: MS-LS1-7

MATERIALS:

- Small plant with multiple leaves
- Petroleum jelly
- Q-tips or small paint brush
- Magnifying glass
- Drawing paper
- Colored pencils or crayons

ACTION:
Observe the leaves of the plant, both the top of the leaf and the bottom of the leaf. Use the drawing paper to draw, color, and label the top and bottom of the leaf.

1. LAMINA
2. VEIN
3. MIDRIB
4. PETIOLE
5. STIPULE
6. STEM



- Cover the top of one leaf with petroleum jelly.
- Cover the bottom of one leaf with petroleum jelly.
- Leave at least one leaf with no petroleum jelly.

PREDICT:
What do you think will happen to each leaf?

OBSERVE:
Observe the leaves over several days. Record observations about each leaf in a chart.

INFER:
How do the leaves differ after four days?

DRAW CONCLUSIONS:
Where on a plant does photosynthesis take place? How can you tell?

ACTIVITY #8: WATER MOVEMENT IN PLANTS

NGSS: MS-LS2-1, MS-ESS2-1

OBJECTIVE:
Students will learn how water moves in and out of plants and understand the importance water plays in survival for plants. Students will learn the important role water plays in plant and fish health in the ECO-Cycle.

TEACHER DISCUSSION:
Plants need water to survive. Without water, plants wilt and eventually die. How do plants lose water? Plants lose water through transpiration, the evaporation of water from the leaves. As water evaporates, it pulls water from the roots up through the xylem tissue. The rate of transpiration can change depending on a number of variables. How does the amount of light a plant receives affect its transpiration rate? Write your answer as a prediction in the form "If the amount of light a plant receives is increased, then the rate of transpiration..." Show the students that in the ECO-Cycle we use grow lamps as our light source, which takes the place of the sun. As a reminder, we should be using the timer for both the plants and fish so both can simulate the normal cycle of the sun daily life.

MATERIALS:

- Four annual bedding plants in pots
- Water
- Four plastic bags
- String
- Spray bottle
- Light source (sun or lamp)
- Scale or metric balance

ACTION:
Students create their own experiment using the materials provided. Example below.

1. Using the spray bottle, water four plants the same amount.
2. Place all of the plants' in a plastic bag and use string to tie the bag around the stem of each plant.
3. Weigh all four plants using the scale or metric balance. Record their masses.
4. Use Variables – Place two of the plants under the light source. Place the other two plants away from the light source.
5. Record Data – After 10 minutes, weigh all four plants again. Record their masses.
6. Return the plants to their original locations.
7. Repeat step five every 10 minutes for 30 minutes.

DRAW CONCLUSIONS:
What is the independent variable in the investigation?

Analyze Data – Did the mass of any of the plants change? Did your data show a correlation between the transpiration rates and the amount of light?

Did your results support your hypothesis? Why or why not?

FURTHER DISCUSSION:
What other variables could have changed the rate of transpiration in these plants? What if the plants sat in full sun? How would partial sun have changed the rate of transpiration? Could wind and partial light make any difference in the rate of transpiration?

ACTIVITY #9: DO PLANTS SWEAT TOO?

NGSS: MS-LS2-1

OBJECTIVE:
To teach students about transpiration and how it occurs and takes place in a plant.

VOCABULARY:
Transpiration- The passage of water through a plant from the roots through the vascular system to the atmosphere.

QUESTION FOR DISCUSSION:
Why do plants sweat? How can you see the plant sweat? Would the ultra violet lamps above the grow trays increase the amount of sweating found in a plant? Can we measure the amount of water being sucked through the plants root system by measuring the amount of water removed from the fish tank?

MATERIALS:

- Two plants of Russian Red Kale (great to grow in the ECO-Cycle)
- Small sandwich or plastic bag
- A twist tie
- Pencils
- Paper

BUILDING BACKGROUND:
The stomata are a structure on the plant's leaves that allow for movement of moisture in and out of a leaf. As noted in the classic experiment done with celery stalks students will see the rate of transpiration with food dye colored water as it is traveling up through the celery.

ACTION:

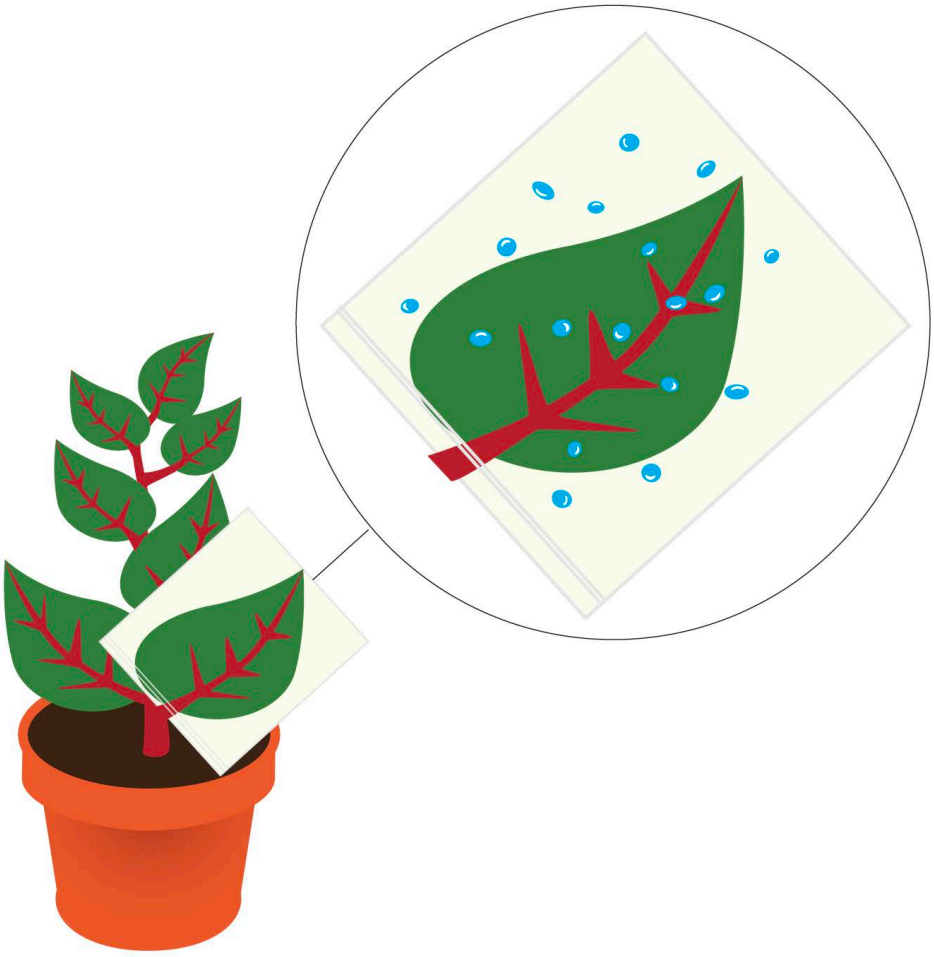
1. Place a plastic bag over the green leaves of the red kale. Since typical transpiration occurs in normal sunlight we will measure the rate of transpiration between a traditional setting of a red kale plant in a window sill and one found on the ECO-Cycle Aquaponics Kit.
2. Use a twist tie to seal the bag.
3. Make observations between the two plants every 30 minutes. Observe what is happening inside the bag and records any observations.

Does one plant sweat more than the other? Would either raising or lowering the sunlamps over the kale cause an increase or decrease in the amount of cellular respiration from the leaves of the plant?

WRAP UP:
Would there be any other variables that could increase or speed up the rate of transpiration in either of the two plants? While the students are discussing what they think would help to speed up transpiration, guide them to the understanding of testing variables. The example here would have been the close proximity of the grow lamps verses the sun in the window and also leaving lamps on for 24 hrs where the 2nd Kale plant was in the dark for part of the day.

SWIMMING DEEPER:

- What evidence did we have that cellular respiration took place?
- Compared to the stomata, which parts on our bodies act similar to that of a plant's stomata?
- How does this fit into the water cycle?



ACTIVITY #10: TAKE A HIKE - JOURNEY THROUGH SOME ECOSYSTEMS

NGSS: MS-LS2-3

OBJECTIVE:
To understand the differences in abiotic and biotic parts of ecosystems using your ECO-Cycle and school.

MATERIALS:

- Construction paper
- Regular paper
- Markers
- Pen or pencil

BUILDING BACKGROUND:

Ecosystems are both simple and complex, depending on where an observer is and what they may be observing. In order for an ecosystem, and all organisms in that ecosystem to survive and thrive, there needs to be both *biotic* and *abiotic* parts to the ecosystem.

TERMS TO KNOW AND REMEMBER:

- **Biotic** - describes a living or once living component of a community. The best example is organisms, such as plants and animals.
- **Abiotic** - The non-living parts of an ecosystem
- **Ecology** - the study of the interaction of organisms and their environment OR the study of the interaction of biotic organisms with abiotic organisms
- **Ecosystem** - a system formed by the interaction of a community of organisms with their environment

1. Discuss with students what they believe biotic and abiotic mean. Also discuss what ecology means and how the terms biotic and abiotic fit into their definition of ecology. Write student ideas on the board.

2. Think-Pair-Share preparation: Have each student make two columns on their paper, one labeled Biotic and one labeled Abiotic. Refer to the ECO-life Aquaponics system for observation and have students write down what they believe all Biotic and Abiotic organisms are. Once they are finished, have them pair up and share with a partner. Bring students together and discuss their answers.

3. Share with the students the correct definition of abiotic, biotic, ecology and ecosystem. Have them write this down on the same paper they folded, placing the correct definition in the correct column where the term can be found.

4. Take the students on a walk around school. Visit different locations (athletic fields, swimming pool, cafeteria, main quad area) and have the students conduct the same observations, identifying the biotic and abiotic organisms in a specific area. Allow students to discuss with each other as they observe and record. Remind students of simple things that can go over looked, such as their role in this particular ecosystem, trash, planters, bicycles, benches, etc.

5. Upon returning to class or for homework, have students describe the role of each abiotic organism they listed (i.e. a bench is where an organism can rest and regain its strength so that it may continue surviving in this ecosystem)

ACTIVITY #11: WHAT'S YOUR ROLE? THE ECOSYSTEM PLAY

NGSS: MS-LS2-3

OBJECTIVE:
To understand the role of all organisms, abiotic and biotic in various ecosystems.

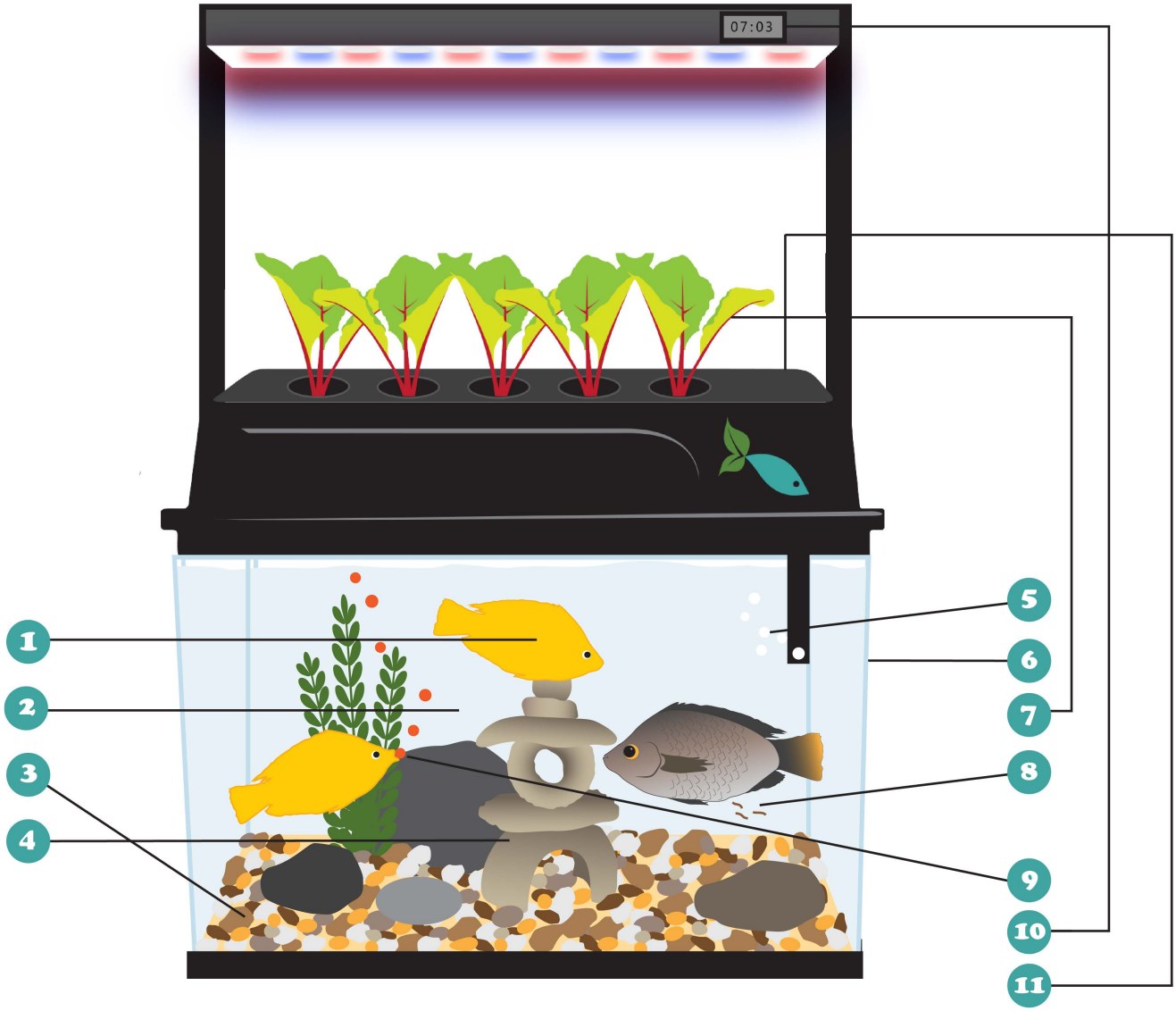
MATERIALS:
Any appropriate materials determined by teacher and students to complete the activity.

BUILDING BACKGROUND:
Our world is made up of a variety of different ecosystems. An ecosystem is a biological community of interacting organisms and their physical environment and the specific types include: Desert, Jungle/Tropical, Grassland, Forests, Ocean/ Freshwater.

The ECO-Cycle is a small version of a freshwater ecosystem. In this activity, students will be assigned an ecosystem to research and will write a 5-10 minute “play” where all students in a group will have at least one speaking part. The “roles” will be all of the organisms that make up and ecosystem.

For example: The “roles” in the “play” called the ECO-Cycle would include the following:

- Fish
- Water
- Gravel
- Decor
- Oxygen
- Fish tank
- Plants
- Fish waste
- Fish food
- Light
- Filters



key terms

1. FISH
2. WATER
3. GRAVEL
4. DECOR
5. OXYGEN
6. FISH TANK
7. PLANTS
8. FISH WASTE
9. FISH FOOD
10. LIGHTS
11. FILTERS

ACTION:

1. Write the name of each of the ecosystem on a small piece of paper. Each slip of paper should be folded once and placed in a hat or basket. Divide the class into groups and ask a representative from each group to come forward and pick an ecosystem out of the basket.
2. Explain to students that they are to make a list of all the "roles" in their ecosystem, abiotic and biotic. After they complete their list, students should determine who will play each of the roles in their ecosystem play. If there are more roles that students, students should take on a second and perhaps even a third role in the play.
3. Once students know what role they will be playing, they should research their own role and determine between 3 and 6 statements that they should make about their role in the ecosystem. At east one statement should include identifying their part of the ecosystem as abiotic or biotic (see below) in their lines for the play.
4. Teachers should be sure to check that all ecosystems are represented, by organisms found to how each works together. See editable worksheet at the end of this activity.
5. Allow time in class for each ecosystem play. Focus of movement of matter/energy. Pass along the energy to the...
6. Ask student audience to discuss each play or run the presentations as if they were acts in a play and conduct a class discussion at the conclusion of all the ecosystem acts.

NAME: _____

PLAY TITLE: _____

My groups play is about the _____ ecosystem.

ABIOTIC roles in this play _____

BIOTIC roles in this play_____

I will play _____ in our _____
ecosystem play.

Facts about my role:

_____
_____
_____

My lines for our ecosystem play :

_____
_____
_____

ACTIVITY #12: WATER CONSERVATION VS. SOIL CONSERVATION - WHAT IS THE CONNECTION?

NGSS: MS-ESS3-3

OBJECTIVE:
To gain a better understanding of both water conservation and soil conservation without bias to either; to understand how both conservation efforts effect people, either negatively or positively; to better understand the role of aquaponics can play in both water and soil conservation.

MATERIALS:
Presentation materials as determined by student groups, internet or library access for topical research.

BUILDING BACKGROUND:
Conservation in general is a topic of many discussions around the globe. Water conservation and soil conservation are specific areas discussed regularly. The ECO-Cycle represents both conservation efforts. For instance, aquaponics only uses 10% of the amount of water that it takes to water an acre of land. Soil erosion can be caused by over watering land and regular windy conditions. Conservationists can work together to reduce the waste of both soil and water.

ACTION:

1. Divide students into groups, depending on the size of the class. Four groups is ideal, with two representing soil conservation and two representing water conservation.
2. Explain to students that while two groups will research soil conservation and two group will research water conservation, the two groups with each topic will come together and work as one large group eventually.
3. Give students time to research soil conservation and water conservation. Each group should list 10-15 facts or statements about their topic. Remind students to incorporate industries like aquaponics in their research.
4. Resources at the school library should be considered. Remind students when using the internet to use reputable websites, not Wikipedia. There are several internet sites available with reliable information. Here are a few resources:
    a. http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/
    b. http://www.swcs.org/
    c. http://soils.usda.gov/

5. After each of the groups has completed their list, bring the various groups together to form two large groups, either soil conservation or water conservation. Both large groups should compare their lists and create one large list that represents their conservation subject.

6. After having time to make their list of facts, have one student from each group alternate making a statement to the class about their conservation effort topic. (One student from soil, then one student from water, one student from soil, one from water, and so on). In between, have students write down their own thoughts on how, if they are in the water group, the soil fact overlaps with their list. Some items will be obvious, while some will need prompting to understand the overlap.

7. Continue until all statements have been made and all assessments have been completed by students.

Glossary

Ammonia – The Nitrogen/Hydrogen compound (NH 3) excreted from the gills of fish and the decay of organic matter such as plants, fish waste, and excess fish food.

Aquaponics – the system or the development of a system that is beneficial to both plants and aquatic animals and bacteria in a recirculating environment where all can thrive and grow; a sustainable food production system that combines a traditional aquaculture (raising aquatic animals such as fish in tanks) with hydroponics (growing plants in water) in a symbiotic environment

Bacteria – any of the smallest kinds of microorganisms; one-celled living things that do not have a nucleus

Biome – a place with certain kinds of living and nonliving things

Chloroplast – a part of a plant cell that uses energy from sunlight to make food

Consumer – a living thing that eats other living things

Decomposer – a living thing that breaks down dead plants and animals

Ecosystem – all the living and nonliving things working together in an area

Food chain – the path of energy in the form of food going from one living thing to another

Fresh water – an environment that has water with little or no salt in it

Germination – the development of a plant from a seed or spore after a period of dormancy

Nitrate – Nitrate is an ion produced as the last step in the Nitrogen Cycle and is only toxic to fish at high levels, above 160 ppm. Nitrate is removed from the water and used by plants for growth.

Nitrite – Nitrite is an ion produced as the second step in the Nitrogen Cycle. Nitrite is toxic to fish and will kill them quickly if levels are high. An ideal level of nitrite in a cycled system is 0 ppm.

Nitrifying Bacteria – Bacteria that plays a role in the Nitrogen Cycle. The first set of bacteria in your system converts ammonia into nitrite. The second set of bacteria in your system converts nitrite into nitrate. Nitrifying bacteria thrive in environments that are rich in oxygen, with no UV light and warm temperatures.

Nitrogen Cycle – The Nitrogen Cycle is the process in which nitrogen moves through an environment, taking different forms and interacting with different organisms.

Nonvascular – any plant that soaks up water from the ground directly into its cells

Nutrients – a substance that provides nourishment essential for growth and the maintenance of life

Phloem – tissue that moves food (sugar) from the leaves to other parts of a plant

Photosynthesis – the way plants use sunlight to make food; how a plant changes raw materials into food in the presence of sunlight Pistil – the part of a plant where seeds are made

Pollen – a powdery material that flowers need to make seeds

Pollination – the movement of pollen to the seed-making part of a flower

Producer – any living thing that makes, or produces, its own food

Respiration (in cells) – the release of energy from food

Seed – an undeveloped plant with stored food inside a protective coat

Stamen – the part of a plant where pollen comes from

Stomata – tiny holes in the bottom of a leaf that allow gases in and out

Symbiotic – a mutually beneficial relationship of animals and plants

Transpiration – the evaporation of water from the leaves of a plant

Vascular – any plant that has tubes for moving water and other materials to where they are needed

Xylem – tissue that moves water and minerals up from the roots

Next Generation Science Standards

MS-PS4-2 : Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
MS-LS1-4 : Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
MS-LS1-6 : Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
MS-LS1-7 : Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
MS-LS2-1 : Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS-LS2-3 : Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem
MS-LS2-5 : Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
MS-ESS2-1 : Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
MS-ESS2-4 : Develop a model to describe the cycle of water through the Earth's systems driven by energy from the sun and the force of gravity.
MS-ESS3-3 : Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MATH

Differentiate between, and use appropriate units of measures for, two- and three-dimensional objects (i.e. find the perimeter, area, surface area, volume)

WRITING

All standards across all grade levels