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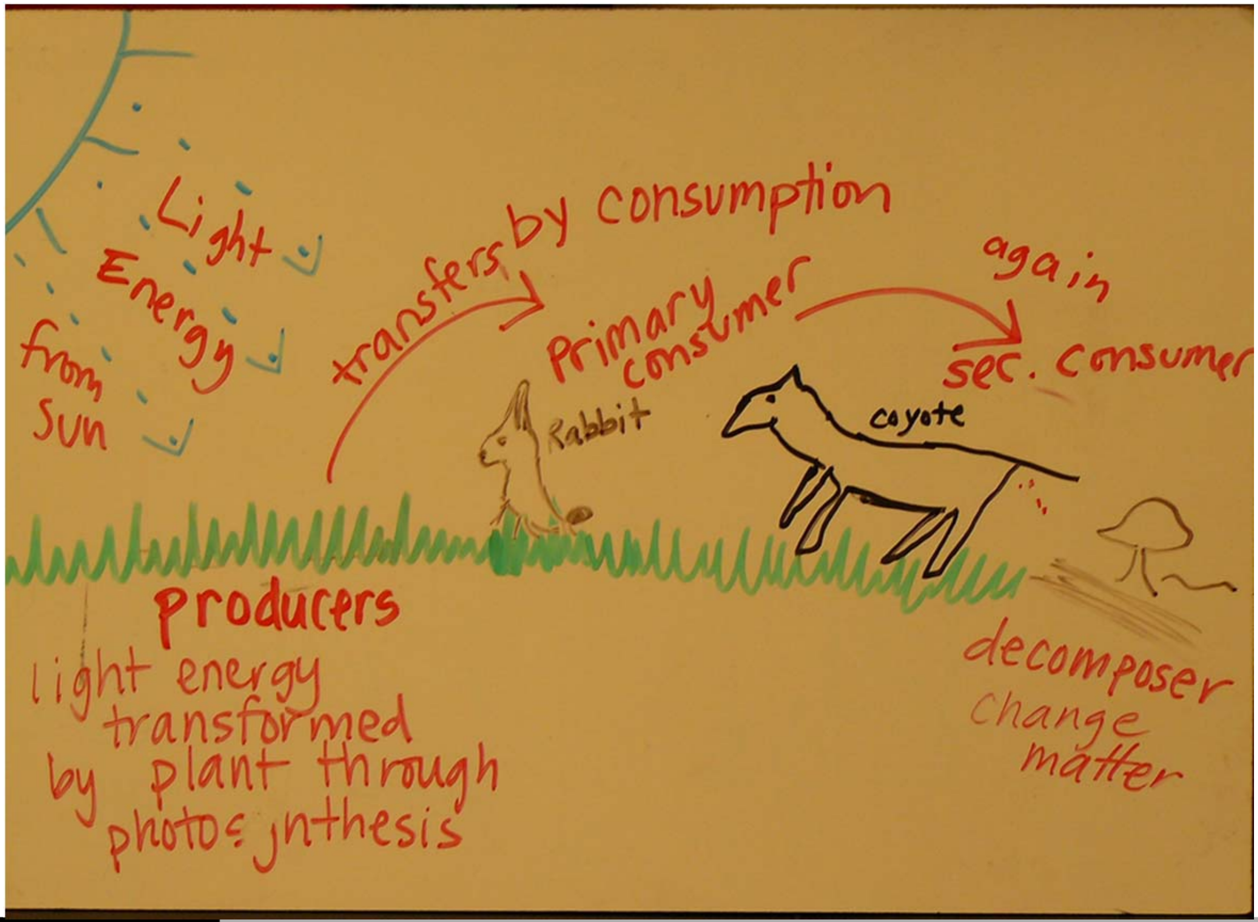

Assessing with Learning Progressions in Science

STC Ecosystems and FOSS Environments

Photo by Joanne Johnson

Content Professional Development Tools| **Contributors: Val Mullen and Cliff Palmer**

Northwest Educational Service District 189
Together We Can

Skagit Valley College
Where Learning Comes to Life

Funding information:
Mathematics & Science Partnership under Title II, Part B
Program Code: 62
CFDA 84.366B

Learning Progression

Ecosystems & Environments

Prerequisite skill:
Definition of matter
Definition of energy
Laws of conservation of matter and energy

Learning Target:

Photosynthesis and cell respiration share an intimate relationship in the transformation and transfer of energy and matter. It all starts with the sun.
Basic Processes

Success Criteria:
I can…
- What is food for plants and how do they get it?
- What is food for animals and how do they get it?
- What does food supply to plants and animals?
- Identify ultimate source of energy.

Formative Assessment:
- Ident. Food checklist (probe whiteboard)
- Talking Heads – Where does the energy come from?
- Exercise – Von helmonts

Learning Target:

Biome formation and location are instrumental in ecosystem formation, location, and function.

System Aggregation

Success Criteria:
I can…
- Ident. Different biomes and locations
- Describe process of biome formation
- Describe characteristics of different biomes
- Ident relationships btwn biomes and photosynthesis and cellular respiration rates

Formative Assessment:
- Pre-Fill in map of global / regional / climate / weather, vegetation
- Post-Fill in map again based on formation process and terminology

Learning Target:

Ecosystems are functional units, comprised of biotic and abiotic components, that function as matter and energy transfer systems.

Refining Systems

Success Criteria:
I can…
- Define biotic and abiotic
- Break down biome into subset of ecosystems
- Ident energy and matter transfer in that ecosystem
- Recognize that ecosystems can exist at different scale
- Human defined concept / boundary

Formative Assessment:
- Categorize abiotic and biotic cards
- Whiteboard showing transfer between ecosystems of two different scales (two groups)
- Cycle 1 content

Learning Target:

Food chains, food webs, and trophic pyramids direct energy and matter transfer through ecosystems.

Systems Interaction

Success Criteria:
I can…
- Ident levels of trophic pyramid
- Create food web, ident chains within web
- Relate trophic pyramid levels with food web members
- Autotrophs and heterotrophs (producers and consumers)
- Ident energy transfer efficiency (inefficiency)

Formative Assessment:
- Cycle 5 (bio111) assessments
- EcoBreaker_Keystone Pred.

Learning Target:

Matter is recycled within the biosphere via biogeochemical cycles. Energy is lost to space.

Climax Level Interactions and Dispersal

Success Criteria:
I can…
- ID three biogeo cycles
- Implications of energy (heat lost to space)
- Implications of human influences on cycles.
- Carbon sequestration and release (hydrocarbon balance).

Formative Assessment:
- Whiteboard of implication of human influences
- Talking heads of human effect

Big Idea:

Flow of energy and matter through system

Ecosystems are part of a biospheric flow of energy and matter

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Math Science Partnership
File Name: C_ESEV

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LT-#1

FOOD FOR ANIMALS AND PLANTS PROBE

Which of these is food for plants? Food for animals? Place a P next to the word if you think this is food for plants. Place an A next to the word if you think this is food for animals.

Water ________________ **Pop** ________________

Vitamins ________________ **Cereal** ________________

Oxygen ________________ **Butter** ________________

Carbon Dioxide ________________

Meat ________________ **Soil** ________________

Sunlight ________________ **Glucose** ________________

Air ________________

Explain your thinking: ____________________________________

____

____

____

____

____

Name ______________________________ *Date* ______________

Plant Food

Archeological evidence suggests that people have been growing plants for food since before 7000 BC, so we can guess that people have been wondering about how plants grow for at least that long. One thing most people know is that plants require something in the soil for good growth. After all, that is why we fertilize our lawns and put compost in our gardens. What may be less clear is exactly what plants are getting from soil, how they are using it, and whether it can be considered as food for plants.

One idea that many people have is that plants take something from the soil that helps them build their structures. One of the first people who investigated this idea was a Belgian doctor named Jean Baptiste van Helmont who lived from 1577-1644. In addition to being a doctor, van Helmont did experiments with plants. In 1642, he did a famous experiment to test the idea of whether soil is food for plants.

INITIAL IDEAS

Suppose a child was given a plate with 20 pounds of food to eat as quickly as they could. Predict what would happen to the weight of that child as he or she ate the food. Would the child's weight go up, go down, or stay the same? What would happen to the weight of the food as the child ate it? Would the weight of the food go up, go down, or stay the same? Write your predictions in the table below.

TABLE 3-2

PREDICT: EVENTUAL WEIGHT OF CHILD	PREDICT: EVENTUAL WEIGHT OF FOOD ON PLATE

Now think about a young tree planted in a bucket of soil. Would the tree's weight go up, go down, or stay the same? Would the weight of the soil go up, go down, or stay the same? Record your predictions in the table below.

TABLE 3-3

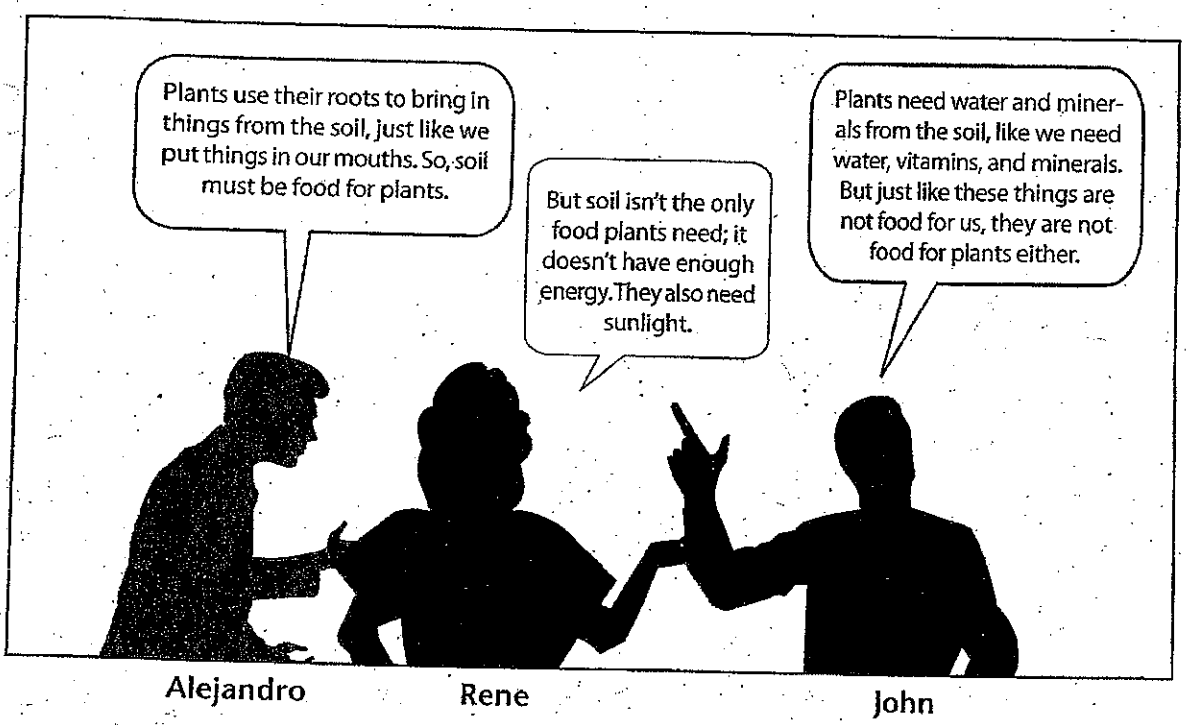
PREDICT: EVENTUAL WEIGHT OF TREE	PREDICT: EVENTUAL WEIGHT OF SOIL

[1]Adapted from Roth, Kathleen J., 1991, Student-focused curriculum materials development: The "Food for Plants" story. AAAS Conference on Developing Textbooks that Promote Science Literacy, February 27-March 2, 2001. AAAS, Washington, DC

3. Based on Van Helmont's experiment, do you think water is food for plants? What is your evidence?

4. Are minerals in the soil food for plants? What is your evidence?

5. Three students are discussing the role of water and soil in plant growth:



Which student has the best understanding of the plant's use of soil? Explain your reasoning.

Name ______________________ *Date* ______________

Food for Plants

Open Cycle 3, Homework 2 as directed by your instructors, read the essay, then answer these questions.

1. Joseph Priestly did experiments with mice and green plants inside of a Bell jar. Make a diagram below and indicate the gases that were exchanged between the mouse and the green plant.

2. If the bell jar containing the mouse and the plant were placed in the dark, what do you think would happen? Why do you think so?

3. The reaction for photosynthesis can be represented as follows:

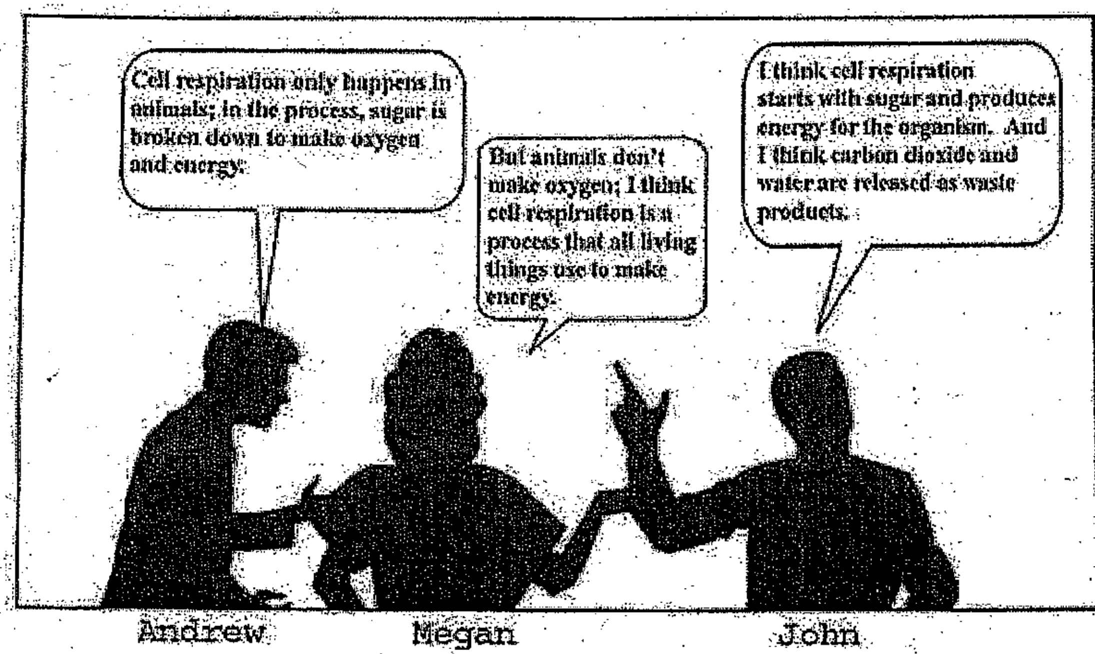
$$6CO_2 + 6\ H_2O \longrightarrow C_6H_{12}O_6 + 6\ O_2$$

Compare the structure of carbon dioxide and glucose. What is present in the glucose molecule that is missing in the carbon dioxide molecule? Given the reaction for photosynthesis, from where does this missing component seem to come?

4. Do the experiments of deSaussure support or contradict your answer in #3? Explain your reasoning.

Post Assessment

Three students were discussing the process of cell respiration. (See image below). Do you agree with any (or all) of the students? Explain your reasoning.



Clipart: Microsoft,

Post Assessment

In a unit on photosynthesis, students make several statements.

a. John says, "plants convert light directly into sugar." Do you agree or disagree? Explain.

b. Melody says, "sugar is the only product of photosynthesis." Do you agree or disagree? Explain.

c. Tyler says, "light is not the only thing that plants need to photosynthesize. They also need water and carbon dioxide." In the space below, indicate whether you agree or disagree and explain your thinking.

For LT 4, Food chains, webs, trophic pyramids

Simulation:
http://simbio.com/products-college/EcoBeaker

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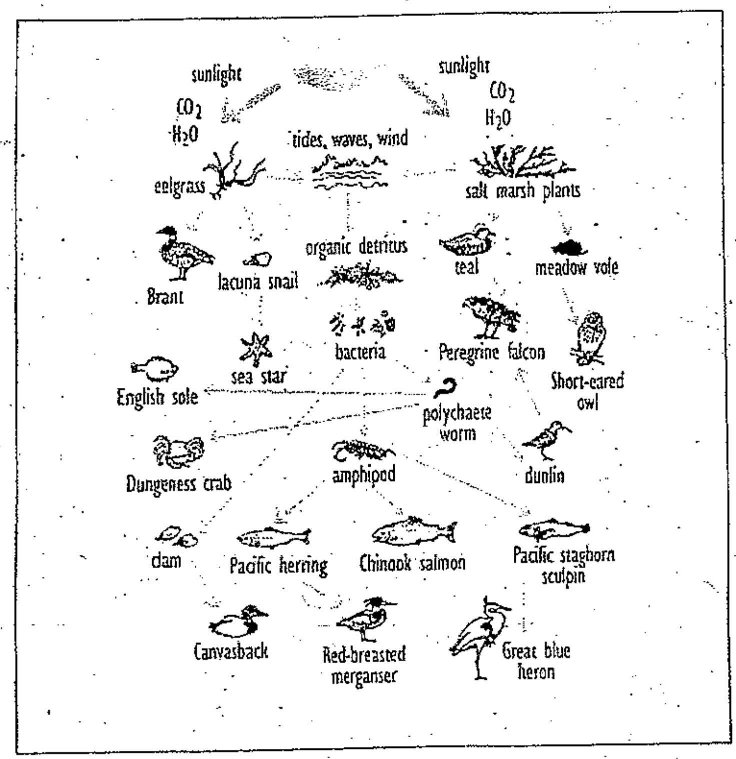
Your ideas about the living components of an ecosystem

The following information and diagram come from the Department of Ecology, State of Washington (http://www.ecy.wa.gov/programs/sea/pugetsound/species/detritus.html). It depicts the coastal food web in Puget Sound. Please read the information, study the diagram and answer the following questions regarding ecosystems.



IDEA 1

Many species feed directly on eelgrass or salt marsh vegetation. Many of these species are in turn preyed upon by other creatures. The meadow vole, for example, feeds on salt marsh plants such as Lyngby's sedge. The short-eared owl and the great blue heron then hunt the vole.

IDEA 2

Decaying salt marsh plants and eelgrass are vital to the food web. At the end of the growing season, bits of dead plants and animals combine with a rich array of microorganisms such as bacteria to form "detritus." Small invertebrates, such as worms and snails, feed on detritus and are in turn eaten by fish, birds, and amphibians.

1. Draw the two food chains described in Ideas 1 and 2. Label the producers, consumers and decomposers in each food chain. (Remember that decomposers break down dead organic matter into inorganic matter, such as phosphorus and nitrogen, which is later used by plants as nutrients; remember also that decomposers can be eaten dead or alive and hence provide matter, such as carbon, and energy).

2. Compare and contrast the two food chains you have drawn. How are they the same? How are they different?

3. What do you think would happen to the coastal ecosystem (page 231) if the following were suddenly removed? Give a detailed answer.

- Peregrine falcons:

- Eelgrass:

- Clams:

- Bacteria:

LT#5

ACTIVITY 3: HOMEWORK

Name ______________________________ *Date* ______________

Comparing the Class Consensus and Scientists' Ideas

During the previous activity, the class developed ideas about the consequences of the transfer of energy and matter in food webs, including its effects through time. These ideas should have been described in your written responses to the Summarizing Questions at the end of the activity.

As you can imagine, over many years scientists have also reflected on this concept and developed many different ideas about food webs and natural selection. Take a few minutes to review the ideas in *Scientists' Ideas: Transfer of Energy and Matter in Food Webs*, and determine if they correspond to the ideas that the class has developed. In the space below each of the scientists' ideas make a note of any evidence or examples you have seen in this cycle that supports each idea.

SCIENTISTS' IDEAS

Transfer of Energy and Matter in Food Webs

The amount of matter and energy available to each trophic level is determined by the amount of biomass produced by producers and by the efficiencies with which food is converted to energy and building blocks at each link of the food web. The percentage of energy in food that is transferred from one organism to the next is generally 5-20%. This loss of energy with each transfer can be represented by a pyramid in which the trophic levels are larger at the bottom (producers) and smallest at the top (highest level consumers). One important consequence of the low transfer efficiencies is the existence in most ecosystems of a biomass pyramid, in which the lowest levels (producers) have the largest biomass and the highest levels (tertiary consumers) have the smallest biomass..

IDEA 1

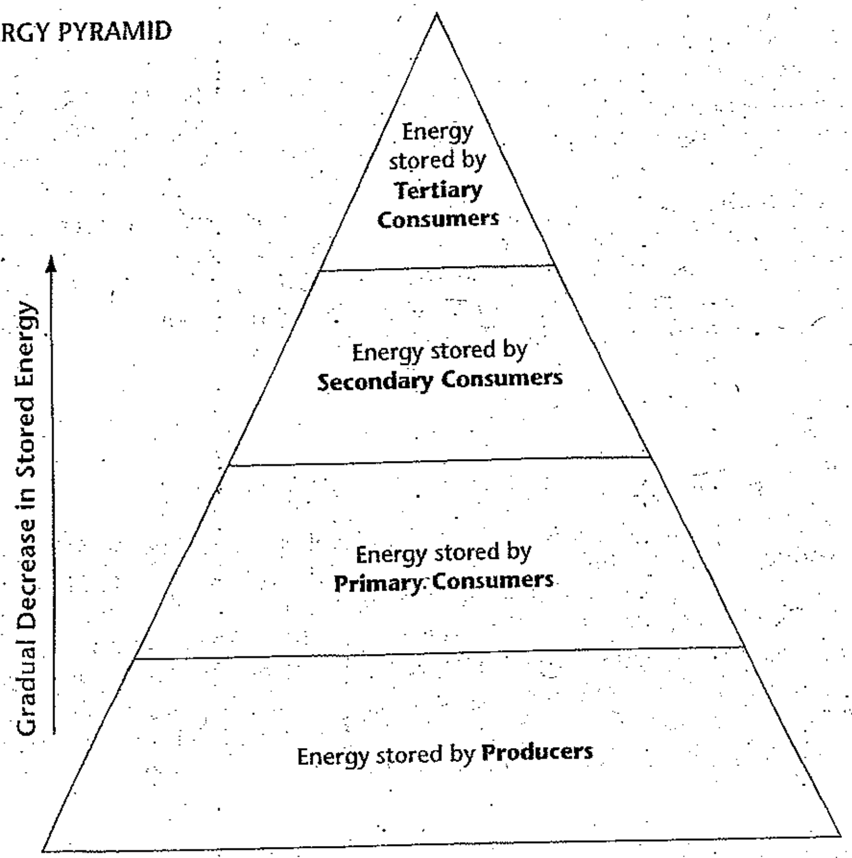
Food is inefficiently converted into energy and building blocks from one organism to another.

Evidence/examples:

IDEA 2

The amount of available energy in the organisms of an ecosystem can be represented by an energy pyramid, Figure 5-1, in which the trophic levels are larger at the bottom (producers) and the smallest at the top (highest level consumers).

FIGURE 5-1 ENERGY PYRAMID

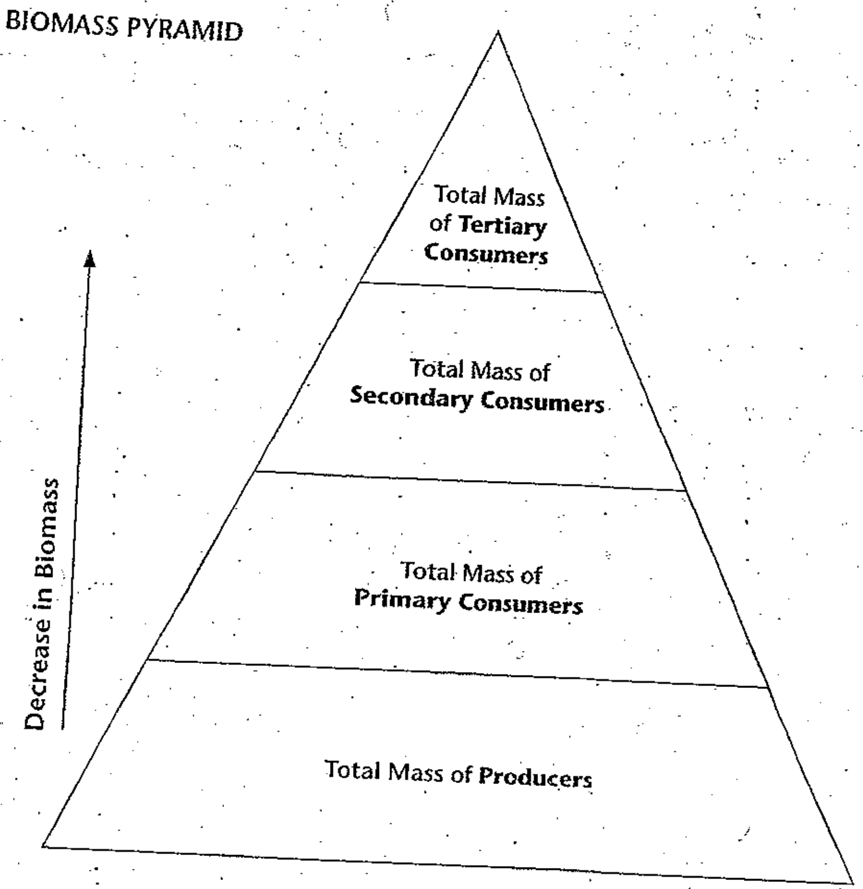


Evidence/examples:

IDEA 3

In most ecosystems, biomass diminishes in successive trophic levels. Hence, the trophic level producers have the largest biomass and the trophic level top consumers have the lowest biomass. This can be represented by a biomass pyramid (Figure 5-2).

FIGURE 5-2 BIOMASS PYRAMID



Evidence/examples:

Cycle 5 Big Ideas

Look through Cycle 5 and list the big ideas and the evidence/example(s) that support the big ideas. Be thorough and complete.

The big ideas should be in the form of a statement and should explain an important concept learned from the cycle. Headings and subheadings from the cycle cannot be used as your big ideas.

Evidence and examples should be taken from class activities and/or homework. Include a reference to the cycle activity or homework that supports the big idea. Evidence / examples should be explained in detail. See **Cycle 1 Big Ideas** for example. Use the format below.

CONCEPT 1

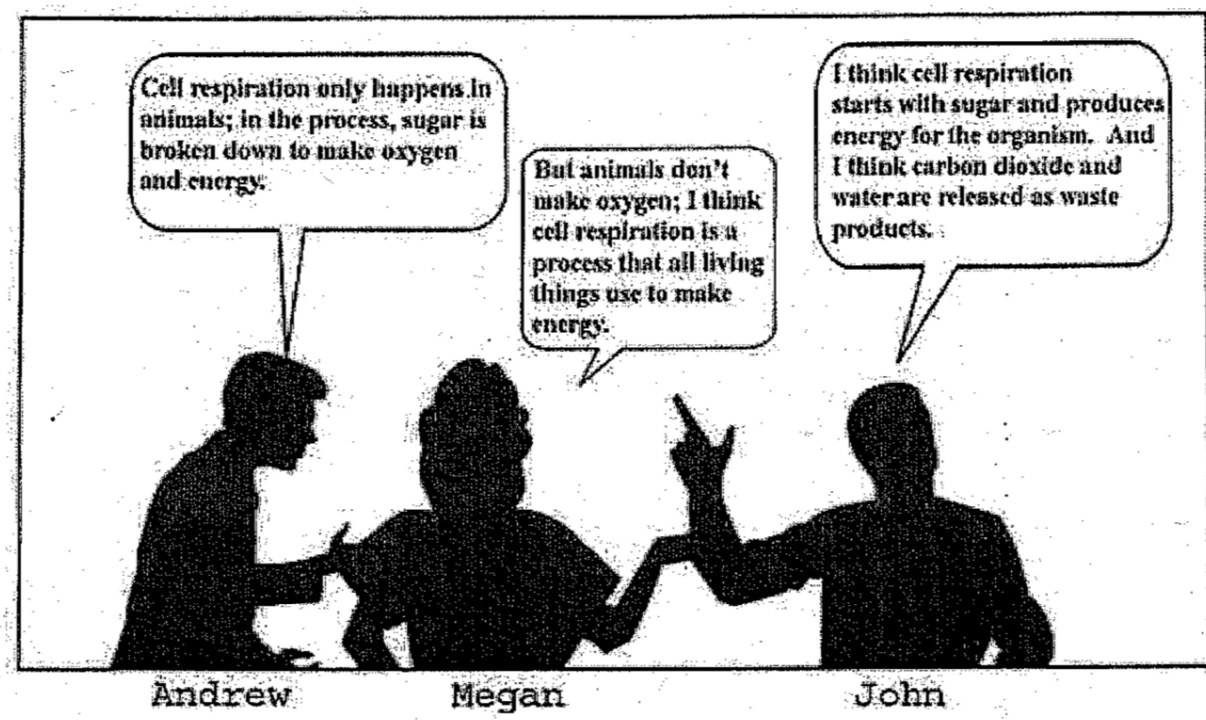
Evidence/Examples:

CONCEPT 2

Evidence/Examples:

Post Assessment

Three students were discussing the process of cell respiration. (See image below). Do you agree with any (or all) of the students? Explain your reasoning.



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Post Assessment

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c. Tyler says, "light is not the only thing that plants need to photosynthesize. They also need water and carbon dioxide." In the space below, indicate whether you agree or disagree and explain your thinking.

LTH5

ACTIVITY 3: HOMEWORK

Name ______________________________ *Date* ______________

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IDEA 1

Food is inefficiently converted into energy and building blocks from one organism to another.

Evidence/examples:

____

____

____

IDEA 2

The amount of available energy in the organisms of an ecosystem can be represented by an energy pyramid, Figure 5-1, in which the trophic levels are larger at the bottom (producers) and the smallest at the top (highest level consumers).

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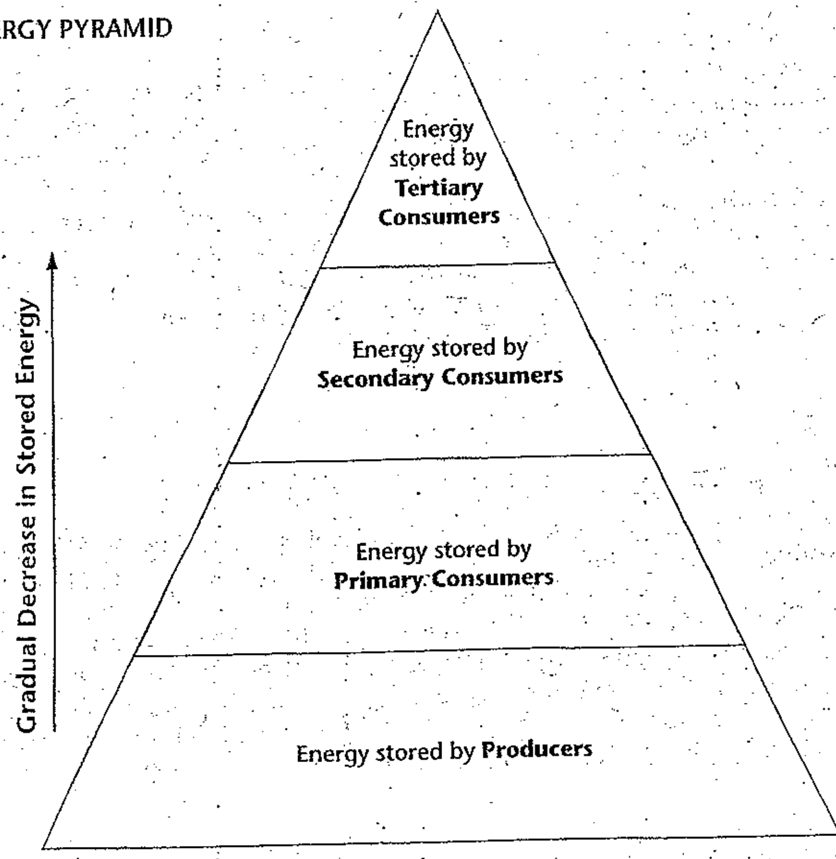

Evidence/examples:

IDEA 3

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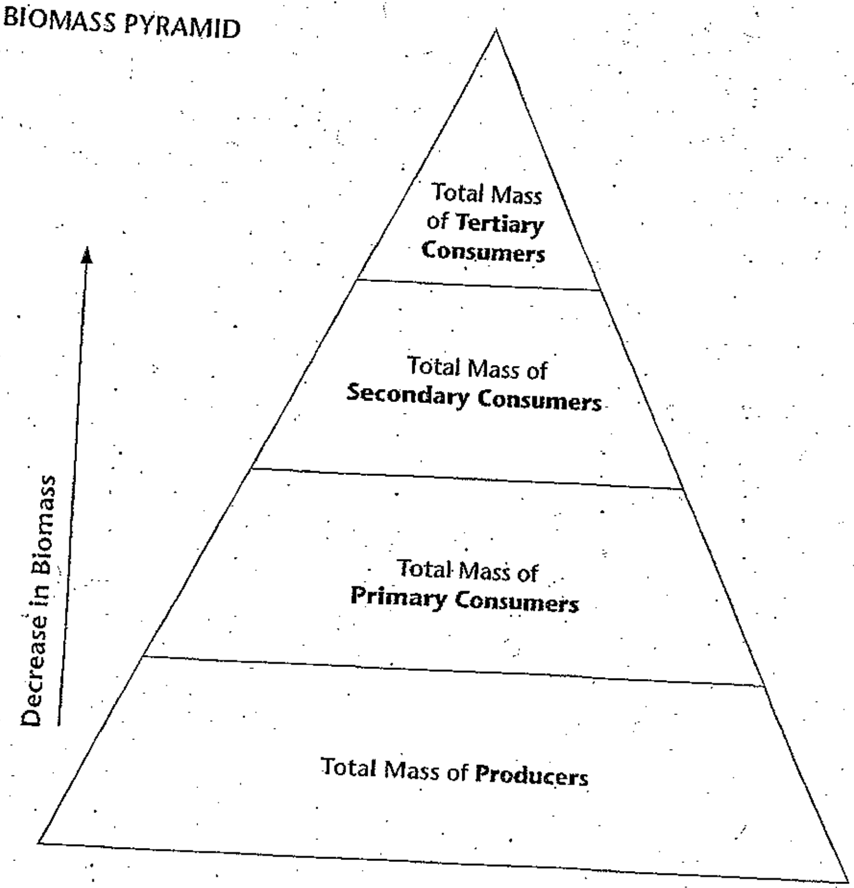
FIGURE 5-2 BIOMASS PYRAMID



Evidence/examples:

Cycle 5 Big Ideas

Look through Cycle 5 and list the big ideas and the evidence/example(s) that support the big ideas. Be thorough and complete.

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Evidence and examples should be taken from class activities and/or homework. Include a reference to the cycle activity or homework that supports the big idea. Evidence / examples should be explained in detail. See **Cycle 1 Big Ideas** for example. Use the format below.

CONCEPT 1

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Evidence/Examples:

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CONCEPT 2

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Evidence/Examples:

LT-3

How do we study connections among living and non-living things?

OVERVIEW

Imagine a scene along the coast of Washington near one of the San Juan Islands. There are birds flying over the ocean that are just coming in to roost on some rocks on a tiny offshore island. On the same island are a couple of seals basking on the rocks in the warm sun. Several hundred meters off the island are large schools of fish swimming along the western coast of one of the larger islands. A little further offshore is a rather large pod of killer whales. The water in this area is teeming with tiny shrimp-like organisms (1-3 cm long) called krill. In the upper oxygen rich surfaces of the water are also an abundance of microscopic single-celled green organisms called algae. Several miles off shore a humpback whale is just starting to breach and breathe.

To the inquisitive, several questions might come to mind. Are all these organisms that occupy this bit of ocean and the tiny island interconnected in some manner? Are there fundamental processes that link these organisms to themselves and to their environment? If so, are the processes that link these organisms the same as those that link organisms that occupy areas that are solely on land? Another line of questions might be: Are the types of organisms living in this area today the same as were living in a similar environment a million years ago? How, if at all, are these organisms related to each other? And perhaps most importantly, what investigative approach might we use to try and find answers to these provocative questions?

Finding answers to the above and related questions will be the focus of our study this quarter. The answers to these generally complex questions are not always easy and straight forward. We will therefore tackle the questions in a very systematic and carefully constructed manner.

In Cycle 1 we will begin to try and answer the first an perhaps most straight forward of all the questions: *Are all organisms that live in a particular area of land or water interconnected in some manner? We will also explore how scientists investigate questions like these.*

INITIAL IDEAS

On the list below, place a checkmark next to all of the things that you think are alive.

_____ sun	_____ fish	_____ whale
_____ birds	_____ rocks	_____ air
_____ water	_____ krill	_____ seals
_____ oxygen	_____ algae	_____ shell

Describe any rules you used to decide if the thing was alive.

____

____

____

____

Group Discussion

Share your ideas about living organisms with your group. On your whiteboard write your group's ideas about what characteristics all living things have.

Class Discussion

Your instructor will now lead a class about your initial ideas about the characteristics of living things.

ACTIVITY 1 *How can you tell if something is alive or not?*

You will need:
- candle
- matches

PURPOSE

In this activity we will consider the living things we are familiar with, as well as meet other living and non-living things that may challenge our ideas about what life really is.

EXPERIMENT 1

PROCEDURE

Light the candle and observe the flame. Is it alive? For that matter, what is life? How can you determine whether something is alive, never alive, or once was alive? Complete the table below based on your observations.

Observations leading you to think the fire is living	Observations leading you to think the fire is NOT living

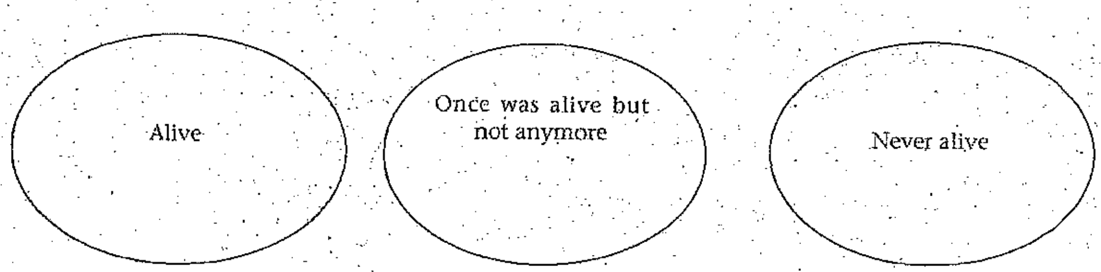
What tests or experiments would you do with the flame to help make a more informed decision?

EXPERIMENT 2

PROCEDURE

To begin developing a list of characteristics that all living things share and to begin figuring out how to classify living things into meaningful groupings, it is helpful to try and sort through a wide variety of different things, both living and non-living. Your instructor will provide you with 100 cards, each with the name of a different item.

With your group: Group your items into the following 3 categories.



Describe the rules or reasoning your group used to decide which category each item belonged to.

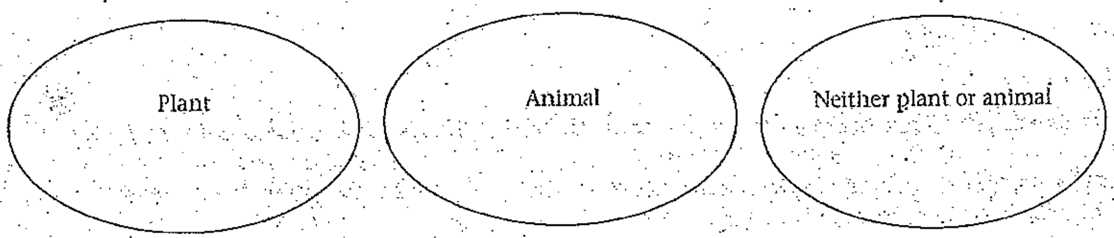
Were there any items that you had difficulty deciding where they belonged? Which items were they? Explain why these items were so difficult to categorize.

____

____

____

With your group: Focus on the items in the "Alive" category. Group these items into the following 3 categories:



Describe the rules or reasoning your group used to decide which category each item belonged to.

____

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____

Were there any items that you had difficulty deciding where they belonged? Which items were they? Explain why these items were so difficult to categorize.

____

____

____

Divide your white board in half. One one half, summarize the rules or reasoning that your group used for deciding whether an item was alive, never alive, or once alive but not anymore. On the other half, summarize the rules or reasoning that your group used for deciding whether an item was plant, animal or neither. Be prepared to share your group's ideas with the rest of the class.

Your instructor will now lead a short whole-class discussion about this card sorting activity. Be prepared to explain your group's ideas and to write down ideas and comments from other groups that you find interesting.

ACTIVITY 1

Name ______________________________ Date ____________________

Characteristics of Life List

Consider the discussion today in the context of all that you have learned in this course so far. What characteristics do all living things share? Stated another way, how would you complete the sentence: "All known living things..." Start a list of the characteristics of life here:

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________
11. ______________________________
12. ______________________________
13. ______________________________
14. ______________________________
15. ______________________________
16. ______________________________

ACTIVITY 2 *Are all organisms that live in a particular area of land or water interconnected in some manner?*

COLLECTING AND INTERPRETING EVIDENCE

PURPOSE

Biologists can conduct laboratory experiments to investigate the interactions between living things and their environment. The power of experiments like these is their ability to control many variables so that they can focus on the effects of just a few. However, many biologists seek to understand how living things behave in the natural world and these types of questions cannot be fully answered in the laboratory. Biologists who study ecology seek to understand how living things interact with each other and their environment, and the factors that affect the abundance and distribution of living things.

INITIAL IDEAS

What are some types of connections that you already know between living things and between living things and their environment? Give some examples here.

____

____

____

In this activity, your instructor will direct your attention to an image of an ecosystem.

YOU WILL NEED

3 X 5 index cards in three different colors
post-it notes
large paper and tape to tape cards onto your poster
markers for writing on paper

PROCEDURE

With your group: Look at the image and think about the following questions: Which of the things you see in the area are living and which are not? Which of the things that you might have listed as nonliving were actually living at one time and which were never living? In what ways might the living things be interconnected with each other? In what ways might the living things be interconnected with the nonliving things?

Make a list in the space provided below of nonliving (never were alive), nonliving (once were alive), and living things.

NONLIVING (never-lived) (Abiotic)	NONLIVING (once-lived)	LIVING (Biotic)

Use the space below to write down any ideas you have about how different things in the natural area might be interconnected:

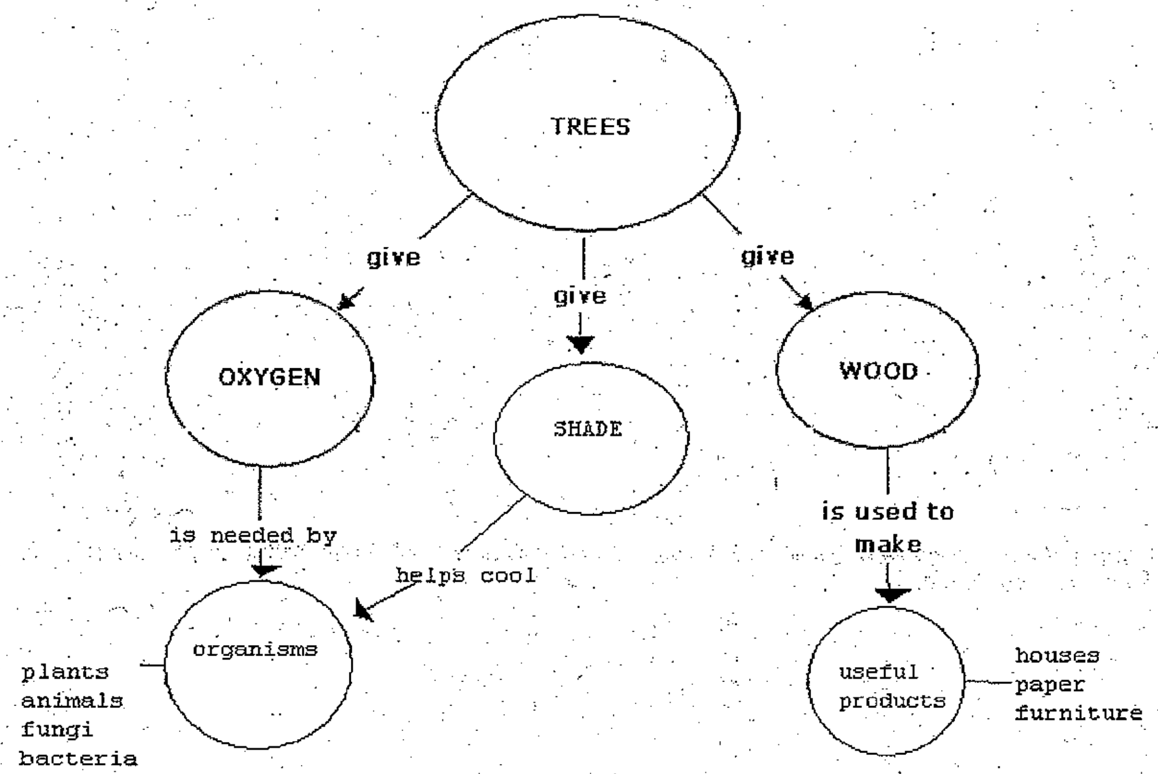
Return to the classroom.

With your group:

Create a concept map that shows the things you saw and how you think they connect to each other. A concept map is a graphical way of showing your thinking. It groups concepts based on their relationships to each other. Concept maps typically have three elements:

Concept Words such as "tree," "water," "bird"
Linking Words such as "lives in", "eats," "breaks down"
Connecting Lines that connect concepts and linking words to each other

Many concept maps are structured in a hierarchy with more general, more important concepts at the top and more detailed, less important concepts at the bottom. Here is an example of a simple concept map about trees (Notice that examples can be given off to the side of concept words.):



To create a concept map that represents your thinking about the ecosystem you observed, you will use index cards for your concept words, post-its for your linking words, and marker for your arrows. Don't draw your arrows until you are all done arranging your concepts and linking words!

Write on separate 3 x 5 index cards each of the things you listed above that you observed on your nature walk. Use a different color card for each of the three categories: nonliving things (never-lived), nonliving things (once-lived), and living things.

You may, if you like, add a few living organisms to your list if you have prior knowledge that they could have easily been found in your natural area (at perhaps another time of the day or year).

START WITH LIVING THINGS

1. Examine the living organisms. Think about which of these organisms might be interconnected in some fashion. Group the organisms by how you think they might be interconnected and place these groups on the table.

2. Between any two organisms in a group place a 'post-it' note. On the note briefly explain how you think the two organisms are interrelated.

INCLUDE NONLIVING THINGS

1. Look through your two piles of nonliving things (nonliving once-lived and nonliving never-lived). Do any of these nonliving things interact with living organisms that you have placed in groups on the table? When considering how nonliving things interact with living things, it may be helpful for you to think about what living organisms need to survive. If you have not already, you may choose to include in your list of nonliving things, those non living things in air that you cannot see. Place the nonliving 'things', that you think interact with one or more of the living organisms on the table, next to the organism with which it interacts.
2. Between any nonliving and living thing, place a 'post-it' note that briefly describes how you think the nonliving thing is interconnected to the living thing.

Group Discussion

You may have several groups of interacting 'things' on your table. Pick the group of interacting 'things' that most interests you and ~~draw~~ transfer your index cards and post-its to a large piece of paper to create a map of your ecosystem. Add labels with marker if you desire. Post your ecosystem map on the wall in the classroom and be prepared to present your ideas to your classmates.

Each group should discuss with the class their interconnected "group of things." Be sure to include in the discussion important ways that you think members of the 'group of things' interact.

Class Discussion

Your instructor will now lead a short whole-class discussion about the ideas from each table regarding organisms. Be prepared to explain your table's ideas and to write down ideas and comments from other tables that you find interesting or useful.

SCIENTISTS' IDEAS

Ecosystems

On your own: The idea that in a given area, all organisms are interconnected with themselves and their physical environment ***(abiotic factors)*** is a relatively new concept. (Although the many roots of this idea probably extend back to as long as man has been on the earth.) For several years scientists struggled to come up with a name for this newly developed concept. Finally, the term **ecosystem** was proposed in the 1930s and scientists have been universally using it ever since.

A common textbook definition of an ecosystem is: all the organisms in a given area as well as the ***abiotic*** (nonliving) factors with which they interact. Notice that the definition says nothing about the size of the area of an ecosystem. Scientists have described ecosystems that are as small or smaller than tiny drops of water. By contrast, they have also described ecosystems as large or larger than an entire ocean. Even the entire earth can be considered an ecosystem, for which we use the term biosphere.

The definition of ecosystem also says nothing specific about the nature of the organisms or the environment in which the organisms are living. Regions as environmentally diverse as deserts, rainforests, tropical savannas, and arctic tundra can all be considered ecosystems. Ecosystems need not be restricted to land based (terrestrial) environments. All types of water-based (aquatic) environments such as lakes, streams, ponds, and oceans can also be called ecosystems. Even an area that includes both water and land such as the edge the shore of an ocean can be considered a single ecosystem.. Scientists generally select the size and extent of the area they are calling an ecosystem based on the question they might be asking or the topic of discussion they might be considering.

Given the definition of an ecosystem, could the natural area that you just visited be considered an ecosystem? Explain your reasoning.

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SUMMARIZING QUESTIONS

On your own:

1. Briefly describe an ecosystem other than the one that you just visited. Explain why it is an ecosystem.

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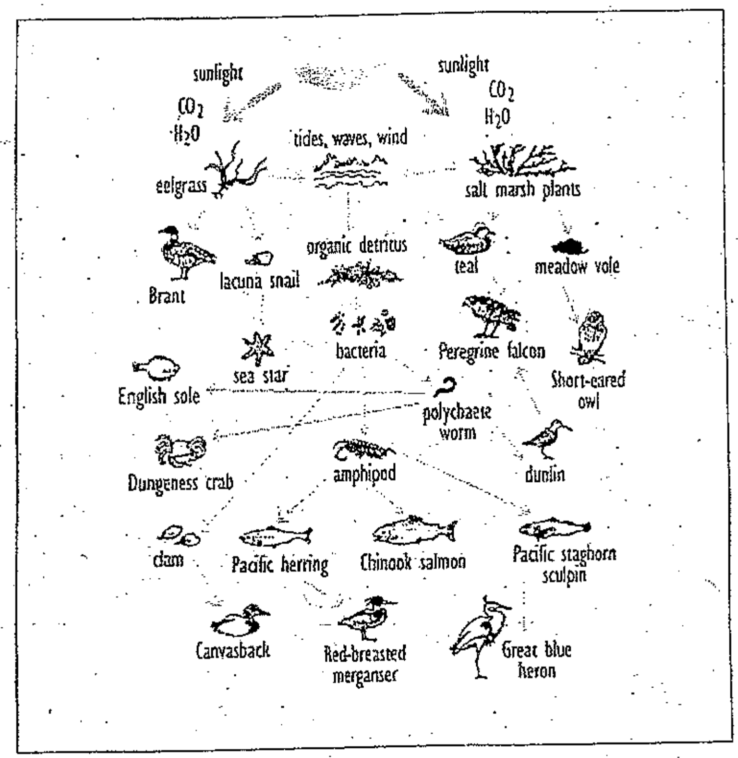
2. Give three examples of how living organisms in the ecosystem you just described might interact with each other.

3. Give three examples how living organisms might interact with nonliving (once-lived) organisms in the ecosystem you described in question #1 above.

4. Justify why the ecosystem that you described (in #1 above) can really be called an ecosystem.

Your ideas about the living components of an ecosystem

The following information and diagram come from the Department of Ecology, State of Washington (http://www.ecy.wa.gov/programs/sea/pugetsound/species/detritus.html). It depicts the coastal food web in Puget Sound. Please read the information, study the diagram and answer the following questions regarding ecosystems.



IDEA 1

Many species feed directly on eelgrass or salt marsh vegetation. Many of these species are in turn preyed upon by other creatures. The meadow vole, for example, feeds on salt marsh plants such as Lyngby's sedge. The short-eared owl and the great blue heron then hunt the vole.

IDEA 2

Decaying salt marsh plants and eelgrass are vital to the food web. At the end of the growing season, bits of dead plants and animals combine with a rich array of microorganisms such as bacteria to form "detritus." Small invertebrates, such as worms and snails, feed on detritus and are in turn eaten by fish, birds, and amphibians.

1. Draw the two food chains described in Ideas 1 and 2. Label the producers, consumers and decomposers in each food chain. (Remember that decomposers break down dead organic matter into inorganic matter, such as phosphorus and nitrogen, which is later used by plants as nutrients; remember also that decomposers can be eaten dead or alive and hence provide matter, such as carbon, and energy).

2. Compare and contrast the two food chains you have drawn. How are they the same? How are they different?

3. What do you think would happen to the coastal ecosystem (page 231) if the following were suddenly removed? Give a detailed answer.

- Peregrine falcons:

- Eelgrass:

- Clams:

- Bacteria:

LT #3

Dog	Algae
Fire	Mildew
Earthworm	Yeast
Cactus	A radish seed
Butterfly	Sand
Bacteria	Salmon
Pencil	Penguin
Glass	Human
Lichen	Pine tree
Potato	Rock
Roasted Peanut	Plastic
Coral	Jellyfish

LT#3

Rose bush	**Mold**
Telephone	**Copepod**
Clock	**Paper**
Cloud	**Air**
Sun	**Ant**
One oak leaf	**An ear of corn**
A blade of grass	**A dead mouse**
Water	**Dirt**
Sea sponge	**Virus**
Crab	**Mushroom**
Wood	**Pollen**
Fern	**Frog**

LT#3

Snake

Moss

Chair

Milk

Yogurt

Blood

Fire

Sea anemone

A fingernail clipping

LT #3

Teacher Key

** DO NOT expect students to correctly categorize these items, even after a group discussion. Keep a list of the items students disagree on and revisit these at the end of the unit when students have mastered the major concepts. **

Alive	Never Alive	Once Was Alive	Not Sure
Dog	Fire	Roasted peanut	Air (The air is full of microbes but the gases that air is composed of is not alive.)
Earthworm	Pencil	Sea sponge (if dried)	
Cactus	Glass	Wood	
Butterfly	Sand	Paper	
Bacteria	Rock	A dead mouse	
Lichen	Plastic	Chair (if wood)	Dirt (Like air, dirt contains many living organisms but the sediments soil is composed of is not alive.)
Potato	Telephone	One oak leaf (It is, or once was, part of a living thing but is not "alive" since it cannot independently reproduce or evolve.)	
Coral	Clock		
Algae	Cloud		
Diatoms	Sun		
Mildew	Water		
Yeast	Chair (if plastic or metal)		Virus (These are generally considered "replicators" rather than alive in the traditional sense since they require a host cell to metabolize, reproduce and evolve.)
A radish seed		Pollen (See oak leaf.)	
Salmon	Fire	Milk (See oak leaf.)	
Penguin		Blood (See oak leaf.)	
Human		A fingernail clipping (See oak leaf.)	
Pine tree			
Jellyfish			
Rose bush			
A blade of grass (if still attached to the root is a whole plant)			
Sea sponge (if still in the ocean)			
Crab			
Fern			
Mold			
Copepod			
Ant			
Ear of corn			
Mushroom			
Frog			
Snake			
Moss			
Yogurt (contains live bacterial cultures)			
Sea anemone			

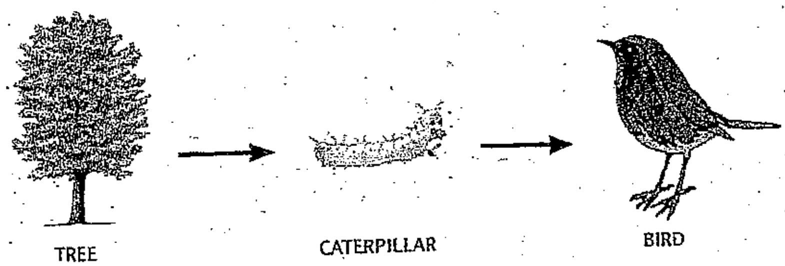
LT - #4

ACTIVITY 2 How can we diagram the complex relationships between organisms in an ecosystem?

PURPOSE

We have seen how producers, consumers and decomposers interact in ecosystems to obtain energy and carbon (matter). To help us study ecosystems, we can create diagrams of these relationships. The diagrams are called **food chains** and **food webs**.

Here is an example of a food chain:



On your own: What does this food chain tell you? What is represented by the arrows? Is the direction the arrow points important? Why or why not?

Imagine you were to draw an energy diagram for this same system. Would the energy diagram be very similar to or very different from the food chain? How would they be the same or different?

Share your answers to the questions with your group members. Listen to their ideas and make revisions to your answers if you deem it necessary.

Your instructor will now lead a short whole-class discussion about the ideas from each table regarding food chains. Be prepared to explain your table's ideas and to write down ideas and comments from other tables that you find interesting or useful.

As you saw in Cycle 5, Activity 1, things get a bit more complicated when we try to show the relationships between all the organisms in an ecosystem. Food chains become interconnected, creating food webs.

To demonstrate the idea of a food web, we will create a food web for the aquatic ecosystem you read about at the very beginning of this course.

YOU WILL NEED

- your trusted brain
- computer with access to the web or a student CD

STEP 1

On your own: Reread the introduction to Cycle 1 that describes a marine ecosystem ( ). Identify the producers and consumers in this ecosystem.

PRODUCERS	CONSUMERS

STEP 2

Use what you know about producers and consumers to construct some possible food chains.

STEP 3

Test your ideas by using the Food Web Matching Game. You can access this game by typing the following URL: ***http://www.bigelow.org/edhab/fitting_algae.html*** and scrolling down to the game. Alternately, you can click "Food Web Game" in the organizer on your student CD. Once you have correctly constructed a food web, draw it below.

Identify the producers on your food web:

Consumers that eat producers are called **"primary consumers."** Consumers that eat primary consumers are called **"secondary consumers."** This naming system continues, with consumers that eat secondary consumers being called **"tertiary consumers,"** and so on.

Identify the primary, secondary and tertiary consumers in your food web:

Think of the prey ingested by the killer whale and of the prey remains left in the water. What happens to matter in those prey remains?

You may have noticed that decomposers are not present in your food web. Remember that decomposers get their energy and building blocks from detritus, that is, nonliving organic matter (feces, dead organisms, fallen leaves, wood). Bacteria are decomposers that would be found in your ecosystem.

Add bacterial decomposers to your food web (step 3, previous page) and include arrow(s) to indicate the appropriate flow of energy.

What happens to the matter that is consumed by decomposers? Where does it go?

SUMMARIZING QUESTIONS

On your own: Review the terrestrial ecosystem you visited at the very beginning of this course (Cycle 1, Activity 2). Draw a food web for that ecosystem.

Observation and classification are two skills employed by scientists. Did you use any of these skills in this activity? If so, how?

Discuss with your group members the answers to the summarizing questions. Together write down on the *white board* the group's ideas regarding the food web of Cycle 1, Activity 2 and the differences between terrestrial and aquatic ecosystems.

Your instructor will now lead a short whole-class discussion about the ideas from each table regarding food webs and science skills. Be prepared to explain your table's ideas and to write down ideas and comments from other tables that you find interesting or useful.

ACTIVITY 2: HOMEWORK

Name ______________________________ *Date* ______________

Ecosystems

An ecosystem consists of all the organisms living in a region as well as all the abiotic factors with which they interact. The boundaries of ecosystems are usually not sharply defined. Ecosystems can range from a microcosm, such as a house aquarium, to lakes and forests. The dynamics of an eco¬system involve two processes: energy flow and matter cycling. Energy is the capacity to move matter against an opposite force; matter is anything that takes up space and has a mass. Energy enters most ecosystems in the form of sunlight. It is then converted to chemical energy by producers, passed to consumers and decomposers in the organic compounds of food, and dissipated in the form of heat. Matter (chemical elements such as carbon and nitrogen) is cycled between abiotic and biotic (living) components of the ecosystem. *Energy flows through ecosystems, while matter cycles within them.*

IDEA 1

Energy flows through ecosystems.

Evidence/examples:

IDEA 2

Organisms (biotic components) and materials (abiotic components) in the environment are similar types of matter, transformable into each other.

Evidence/examples: