ECOLOGY

A Comprehensive Unit Plan

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EDFI 611

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Rationale / Research

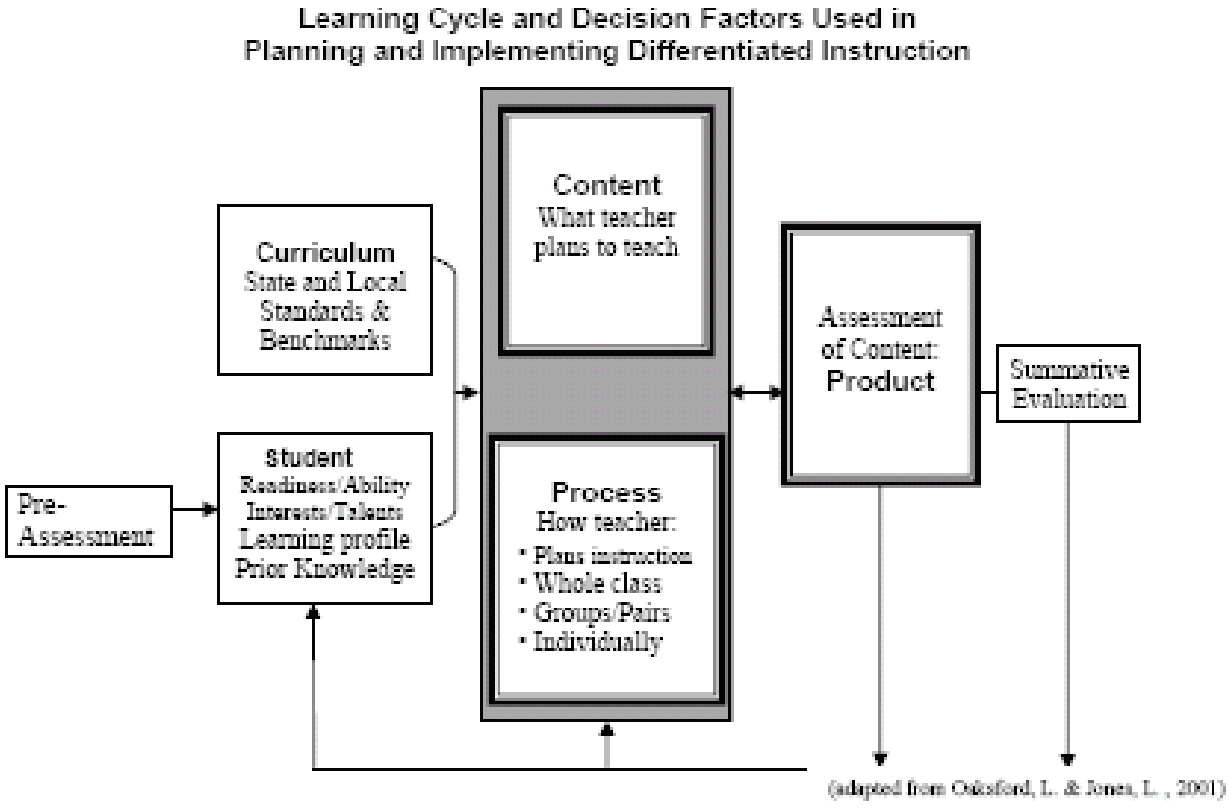
For my course project I am designing a set of materials focused around an Ecology Unit for a high school Biology course. The rationale behind my decision is two fold, first students have a difficult time understanding the cycling of materials, energy, and food within an ecosystem. Students have misconceptions about how organisms obtain food; they believe it is taken directly from the environment, as we do. In order to better understand the flow of energy students must be able to understand that organisms obtain food in a variety of ways and this concept is directly related to how energy flows through and ecosystem.

Second, as district we are focusing on varying instruction which is closely related to differentiated instruction. We are working to develop all of our lessons around the idea that all students learn differently, thus we are developing lessons and projects that allow students to have a variety of presentations and activities that focus on a wide range of learning abilities. All of the lessons developed will be focused around the student learning objectives and standards set forth by the Ohio Department of Education. (Ohio Department of Education Center for Curriculum and Assessment, 2003).

Differentiated instruction can be defined as, " as a process to approach teaching and learning for students of differing abilities in the same class, the intent of differentiating instruction is to maximize each student's growth and

individual success by meeting each student where he or she is, and assisting in the learning process". (Hall, 2002). The idea behind differentiated instruction not only allows for students to decide what is the best activity or project for themselves but it allows the student to fell some sense of entitlement and control over how they learn.

As presented by Oaksford and Jones, the differentiated lesson plan that the Elyria City Schools Science Department has adopted models the following flow chart.



We are looking to develop all students on a variety of levels while giving them the opportunity to choose how they learn. The lesson plans throughout this unit will model the previous flow chart and will address a variety of learning as well as multiple types of assessments. The final assessment within the unit will be the district assessment, developed by the Elyria City Schools Science Department; this assessment will be found at the end of the Unit Plan. Many of the lesson plans throughout this unit will have a variety of presentation materials and activities to focus on all learning styles. For those students who are "ahead" of the class or w ho seem to get the material very quickly, there are enrichment activities and many reading activities to supplement each lesson. A lesson plan which uses a variety of teaching techniques, in my opinion, has been found to develop all students and focuses on the varying interests, abilities, and achievement levels of all students it can be found as a valuable tool for the development of the student's population.

Bibliography

Hall, Tracy. (June 2002) *Differentiated instruction, effective classroom practices report*, Wakefield, MA: National Center for Assessing the General Curriculum. http://www.cast.org/system/galleries/download/ncac/DiffInstruc.pdf

Oaksford, L. & Jones, L. (2001) *Differentiated instruction abstract*. Tallahassee, FL: Leon County Schools.

Ohio Department of Education Center for Curriculum and Assessment. (2003). *Academic content standard K-12 science*. Columbus, Ohio: Ohio Department of Education

Explanation of Unit Set-Up

Each of the lessons in this unit plan will begin with the lesson plan format developed by the Elyria City Schools Science Department, shown below.

Title of Lesson Plan	
Grade Level	
ODE Standard:	**Benchmark:**
GLI(s)	
Anticipatory Set	**Prior knowledge/Preassessment/Motivation**
Explanation	**Your presentation**
Guided Practice	**"we do it" teacher assessment**
Opportunities to Relearn	**"re do it"**
Independent Practice	**"I do it"**
Assessment/Evaluation	
Enrichment	
Closure	
Materials (include websites)	

Within each lesson plan you will find:

1. Title – basic idea or concept that will be covered in the lesson
2. Grade Level – what grade is the lesson intended for
3. ODE standard – from the Ohio Department of Education
4. GLI – from the Ohio Department of Education
5. Anticipatory Set – a pre-test, short video clip, or activity to either assess prior knowledge or to motivate the students
6. Explanation – the lecture or notes component of the lesson
7. Guided Practice – this is going to be an activity that the class does together (can be interactive video, lab, or activity)

8. Opportunities to Relearn – this is going to be a supplement to the concept being covered (student will complete basic assessment, or correct previous work – then we go over the material)
9. Independent Practice – generally a lab followed by assessment questions, graphs, or journaling
10. Assessment / Evaluation – because evaluations are done throughout the unit, this going to be tied into what was previously done, in most cases. This will always conclude with the district assessment at the end of the unit.
11. Enrichment – generally an article related to the concept and its relationship to the students. This will be supplemented with a writing assignment or learning activity.
12. Closure – review what was done in the lesson and how it will relate to where we are going
13. Materials – for this unit, the materials will be imbedded in the paper, this will also include a reference page at the end of the unit with all websites used for pictures and graphs.

In addition to the previous lesson plan, I will also imbed all the materials for the lesson into the paper.

Lesson One: Who's Who in an Ecosystem

Title of Lesson Plan	**Who's Who in an Ecosystem?**
Grade Level	**10**
ODE Standard:	**Explain the structure and function of ecosystems and relate how ecosystems change over time.**
GLI(s)	**Describe how matter cycles and energy flows through different levels of organization in living systems and between living systems and the physical environment.** **Explain how some energy is stored and much is dissipated into the environment as thermal energy (e.g., food webs and energy pyramids). (1992/LS - 9).** **Relate how distribution and abundance of organisms and populations in an ecosystem are limited by the ability of the ecosystem to recycle materials and the availability of matter, space and energy. (1999/LS - 16)**
Anticipatory Set	**Show the beginning scene from The Lion King. Prior to showing clip, give students the 5 questions to think about while watching (found in the share folder (Lion King Intro). Discuss with the students the possible answers to the questions posed.**
Explanation	**Notes: "Who's who in an Ecosystem"**
Guided Practice	**Practice built into presentation, variety of internet practice and questions.**
Opportunities to Relearn	**Revisit the Lion King: answer questions related to movie**
Independent Practice	**"The Price of Butter Depends on the Number of Old Maids"**
Assessment/Evaluation	**Final product from the Independent practice and district assessment.**
Enrichment	**United Streaming Video: Food Chains and Webs**
Closure	**Write down the 3 most important things you learned from the lesson. These ideas will then be shared with the rest of the class.**
Materials (include websites)	**At the end of the Unit plan: reference page.**

Anticipatory Set

Lion King: Introduction to Ecology!!

1. List some living and non-living factors.
2. How are the living and non-living factors related/what is their relationship?
3. What types of organisms are in the greatest number?
4. What organisms are smallest in number?
5. Create a basic food chain based on one of the organisms found in the movie.

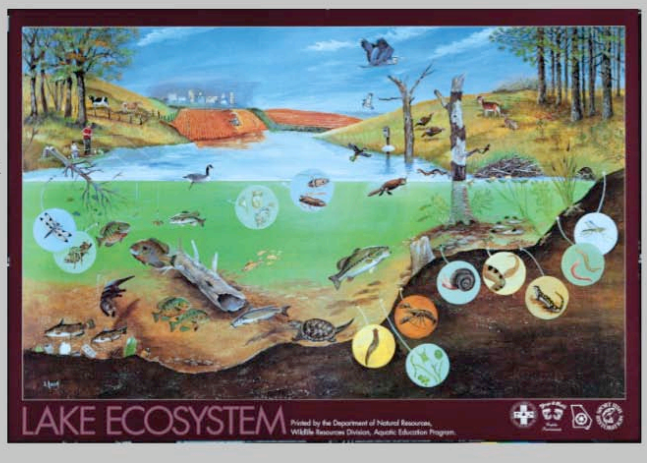
http://www.jamesweggreview.org/reviews/filmdvdvideo/lock_up_your_sons.html

Explanation - teacher guided notes with imbedded interactive activities.

WHAT IS AN ECOSYSTEM?

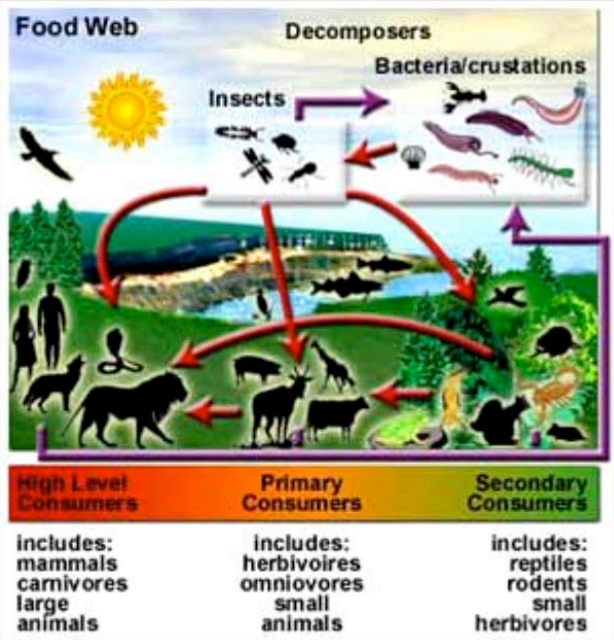
- INTERACTING GROUPS OF SPECIES AND THEIR PHYSICAL ENVIRONMENT

- BIOTIC FACTORS
  - LIVING THINGS
    - EX. TREE, BIRD, TIGER
- ABIOTIC FACTORS
  - NON LIVING THINGS
    - WATER, OXYGEN, ROCK



ENERGY IN AN ECOSYSTEM

- ALL ENERGY COMES FROM THE SUN!
- HOW IS IT CONVERTED TO USEFUL ENERGY????



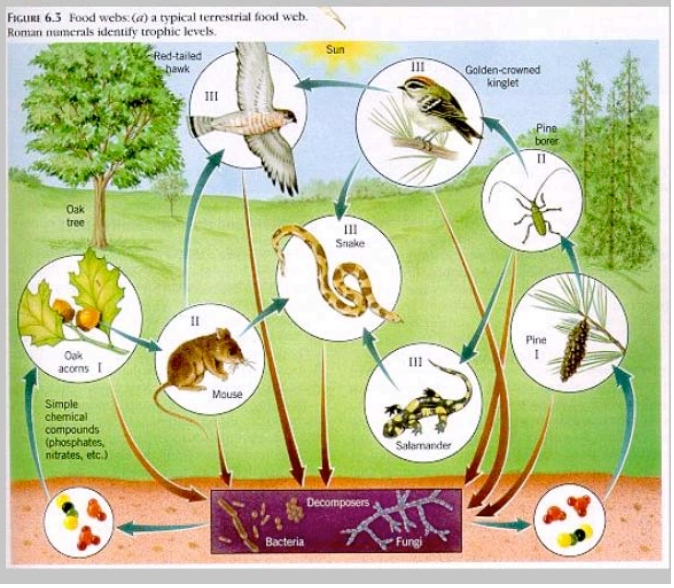
PRODUCERS

- AUTOTROPHS
- MAKE THEIR OWN FOOD
- Ex. Grass, flowers, trees
- USE THE SUN! (PHOTOSYNTHESIS)

Where are the Producers found??

CONSUMERS

- HETEROTROPHS
- CAN'T MAKE THEIR OWN FOOD
- MUST "EAT"
- DEPEND ON PRODUCERS FOR ENERGY!



TYPES OF CONSUMERS

- **HERBIVORES**
- PRIMARY CONSUMERS
- EAT ONLY PLANTS
- EX. RABBIT

- **CARNIVORES**
- SECONDARY AND TERTIARY CONSUMERS
- EATS OTHER ANIMALS

- **OMNIVORES**
- EAT BOTH PLANTS AND ANIMALS

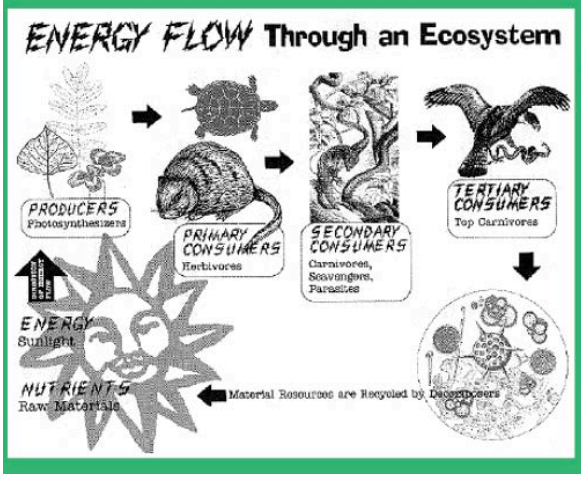
DECOMPOSERS

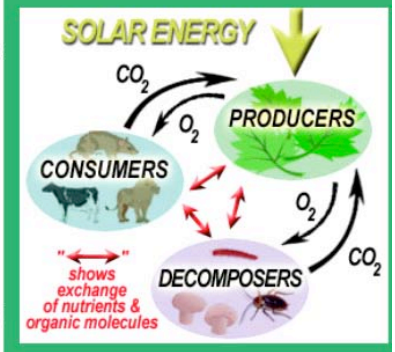
- RETURN ORGANIC MATERIALS TO ENVIRONMENT BY BREAKING DOWN DEAD ORGANISMS
- EX. BACTERIA, FUNGI, WORMS

http://techalive.mtu.edu/meec/module10/Decomposition2.html

ENERGY IN AN ECOSYSTEM

ENERGY ONLY GOES THROUGH AN ECOSYSTEM ONE TIME!!





LAW OF THERMODYNAMICS

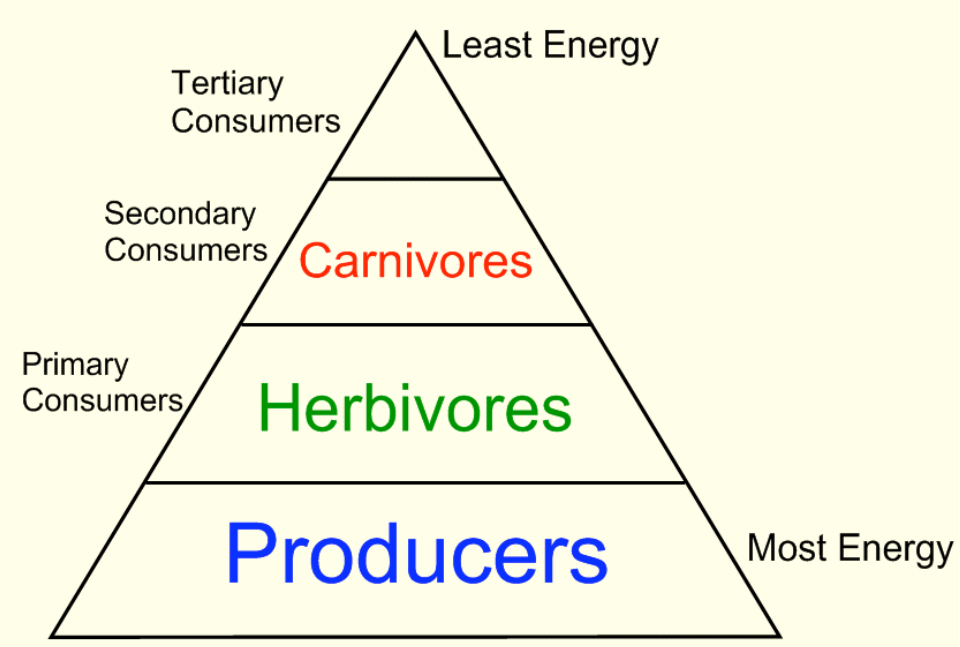
- 1ST LAW – ENERGY CAN'T BE CREATED OR DESTROYED…ONLY CONVERTED.

- (FROM THE SUN TO USEFUL ENERGY)

2ND LAW

- WHEN ENERGY IS CONVERTED SOME USEFUL ENERGY IS LOST

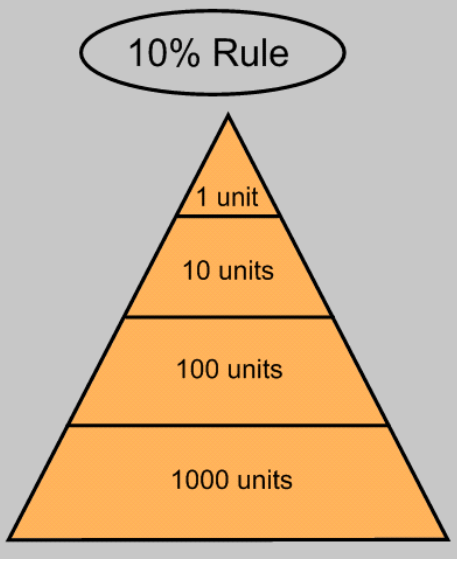
- AS ONE ORGANISM EATS ANOTHER ONLY SOME OF THE USEFUL ENERGY IS TRANSFERRED.



*REMEMBER: 2nd law- some useful energy is lost as it is passed from one Level to the next.

How much energy is lost??

- As an organism lives, they use energy to breathe, move, reproduce, etc.
- Therefore, all of the energy they received cannot be passed on to the next level.
- Only 10% of the energy actually makes it to the next level.



What unit are we using?

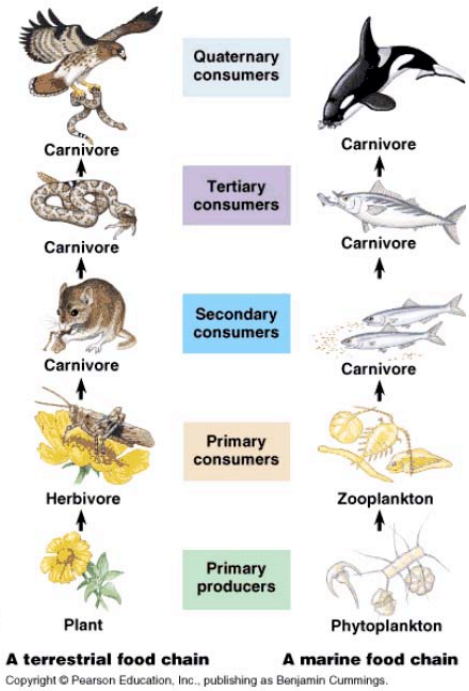
- It's difficult to measure energy, therefore we measure BIOMASS.
- Biomass is the weight of each trophic level. (usually in grams of kg)

Using the example →

1. If we start with 10,000 units of energy in the terrertrial chain, how much energy will remain for the quarternary consumers?

2. In the marine food chain, if there are 500 units of energy available for the secondary consumers, how much energy is available for the other levels in the food chain?

3. Based on what you already know about animal popluations, what could you predict about this food chain?



Guided Practice – this is built into the presentation

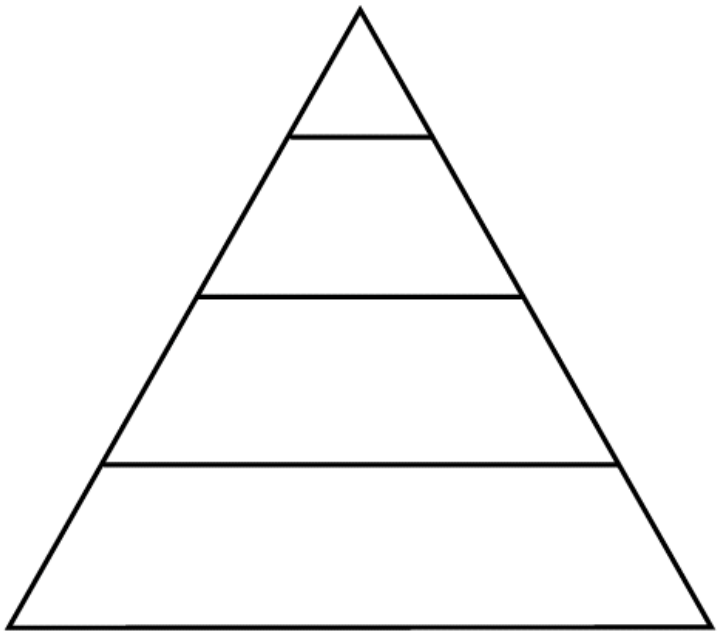
Opportunities to Relearn – revisit The Lion King and complete the following activity.

Name: _____ Period: _____

The Lion King

For the following questions, use the characters from the movie Lion King to correctly form relationships, fill in charts, or answer questions.

1. Name a producer from the movie:
2. Name an herbivore:
3. Name a carnivore:
4. Identify two decomposers:
5. Put the following characters into a trophic pyramid. Label the pyramid with the appropriate levels. (Timon, Simba, Zazu, Scar, Rafiki, Pumba, Hyenas, Gazelles, elephants, rhinos, Nala, zebras, grass, trees, grubs, Mufasa).



6. Give two examples of predator/prey relationships from the movie.
7. The grass has 1000 units of energy. Simba ate the grass and Scar at Pumba. How much energy did Scar get?

Independent Practice

Name: _____ Period: _____

The Price of Butter Depends on the Number of Old Maids

"The price of butter depends on the number of old maids in the area, because old maids keep cats, cats eat mice, mice eradicate bees, bees pollinate clover, cows eat clover, the more clover there is, the less it costs the farmer to produce milk, butter is made from milk, therefore…"

- adapted from Charles Darwin *ORIGIN of SPECIES*: Chapter 3 – *Struggles for Existence*

Using the statement above, answer the following questions:

1. This sentence is a good illustration of what science?
2. Which of the above organisms is a good example of an **omnivore**?
3. Which is a **producer**?
4. Which is a primary **consumer**?
5. Which organism is the **gamete** transporter?
6. Which substance is the **lipid**?
7. Which organism is the **autotroph**?
8. Which organism is the **carnivore**?
9. Which is an **insectivore**?
10. List the above organisms which produce **carbon dioxide**?
11. Which of the above organisms use **food**?
12. Which of the above organisms is at the top of the **food chain**?
13. Which organism is a good example of a **secondary consumer**?
14. Which of the above is a good example of an **herbivore**?
15. Construct a **trophic pyramid** using the organisms above.

http://www.accessexcellence.org/AE/ATG/data/released/0512-TrumanHoltzclaw/index.html

Lesson Two: Food Webs and Chains

Title of Lesson Plan	**Food Chains and Food Webs**
Grade Level	
ODE Standard:	**Explain the structure and function of ecosystems and relate how ecosystems chan**
GLI(s)	**Describe how matter cycle and energy flows through different levels of organizatio systems and between living systems and the physical environment. Explain how s is stored and much is dissipated into the environment as thermal energy (e.g., food energy pyramids). (1992/LS-9)**
Anticipatory Set	**Food Chain Pre-Asses (in Ecology Folder)**
Explanation	**Food Chain Smart notes**
Guided Practice	**Practice with a variety of different websites (found below or on Smart presentation)** http://www.ecokids.ca/pub/eco_info/topics/frogs/chain_reaction/index.cfm http://teacher.scholastic.com/activities/explorer/ecosystems/be_an_explorer/map/line_exp http://www.gould.edu.au/foodwebs/kids_web.htm http://www.harcourtschool.com/activity/food/food_menu.html
Opportunities to Relearn	**Food Chain and Web wkst**
Independent Practice	**Galapagos Food Web (information is in Ecology Folder w/ instructions**
Assessment/Evaluation	**Food web construction from Independent Practice and District Assessment**
Enrichment	**Students can create a food web based on the plants and animals they eat. United S video "You and the food Web"**
Closure	**Ask students to write down one thing that they enjoyed and one thing that could be Then have a feedback session with the entire class.**
Materials (include websites)	**At the end of the Unit plan: reference page.**

Anticipatory Set

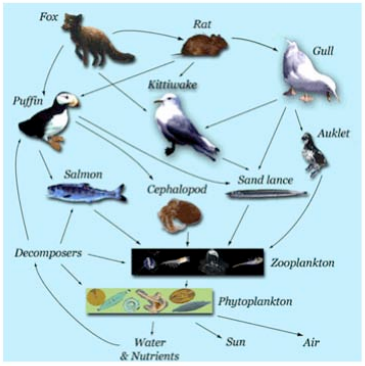
Name: _____ Period: _____

Pre-Assessment Food Chains, Food Webs, and Food Pyramids

Circle the correct answer.

1. Energy (increases, decreases, stays the same) as you move through a food chain.
2. The ultimate source of energy is (the sun, plants, animals).
3. Producers are organisms that (makes their own food, obtain energy from non-living matter, or obtain food from other organisms).
4. Consumers are organisms that (makes their own food, obtain energy from non-living matter, or obtain food from other organisms).
5. Decomposers are organisms that (makes their own food, obtain energy from non-living matter, or obtain food from other organisms).

Identify the food chain, food web, and food pyramid from the following diagrams.



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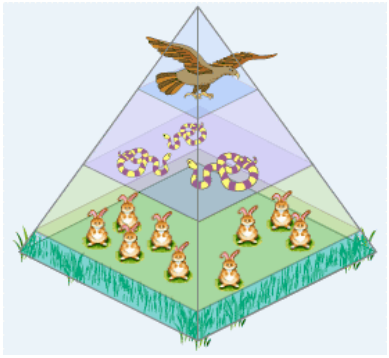

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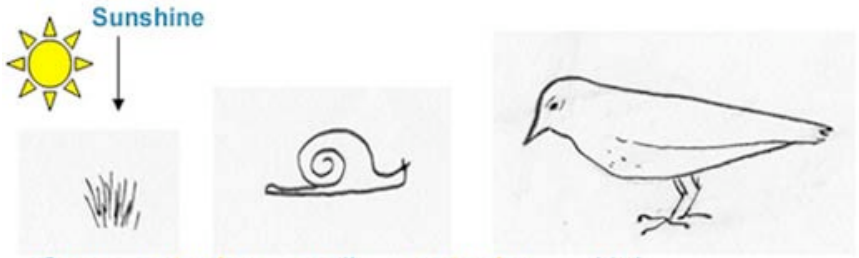


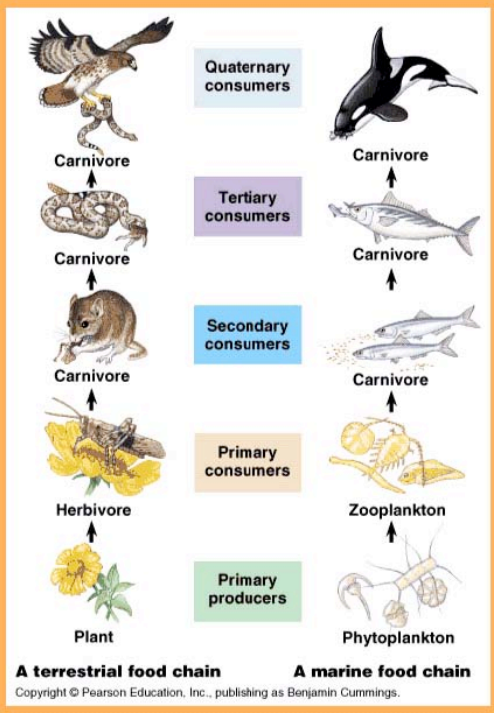
_____

9. Where would you find humans to be on a food pyramid? _____
10. Energy can move through an ecosystem (only once, more than once).

Explanation

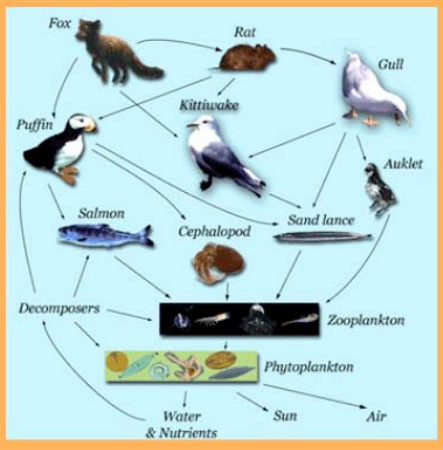
Food Chain

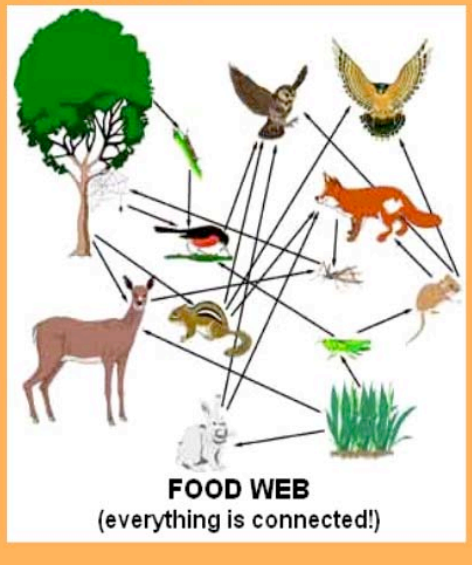
- Single pathway of feeding relationships among organisms in an ecosystem that results in energy transfer



Food Web

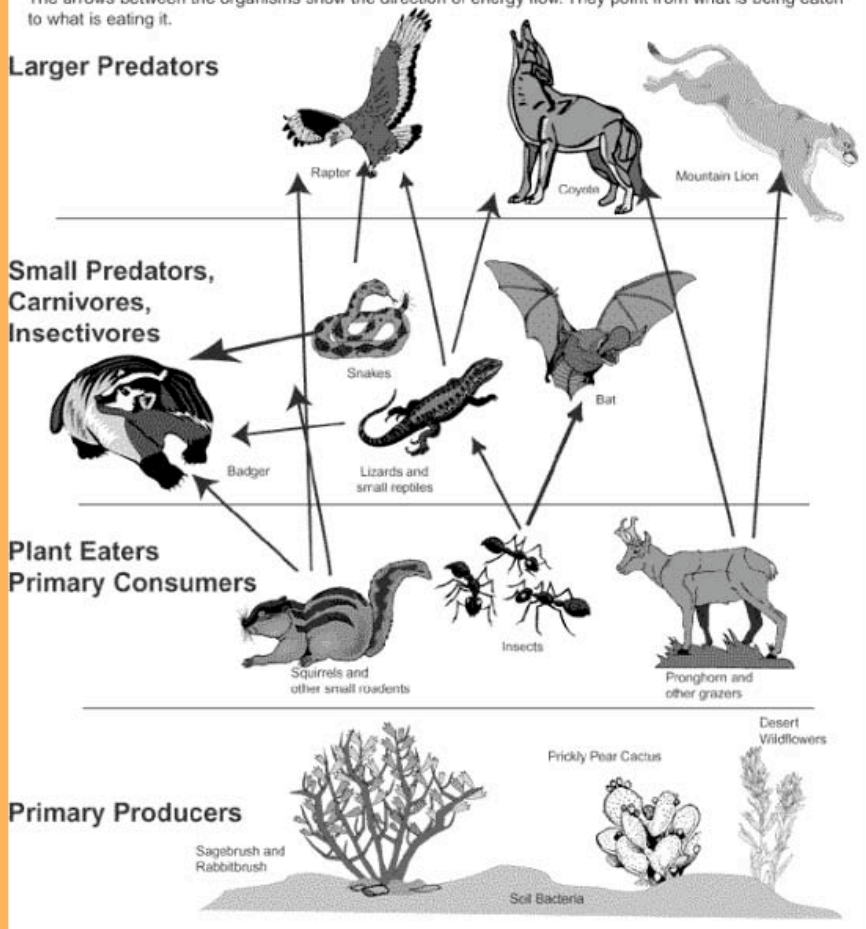
- Interrelated food chains in an ecosystem.

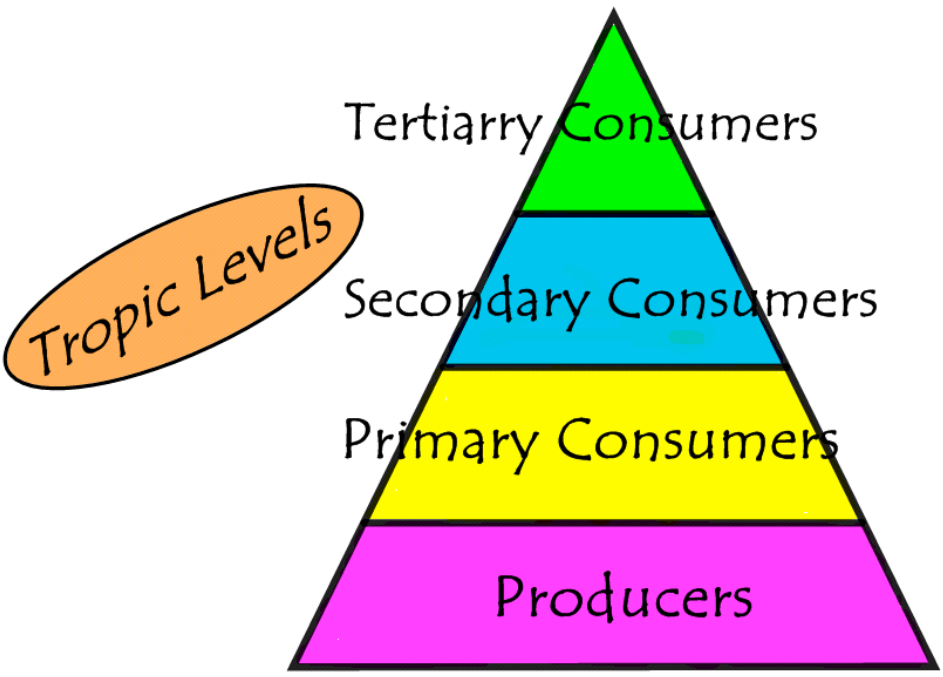




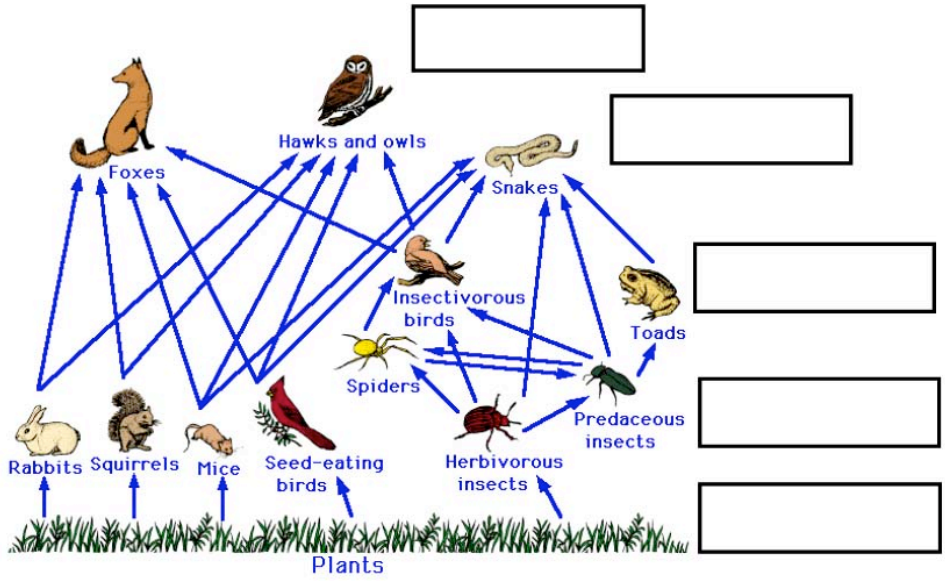
Food Web in the Sagebrush-Steppe Ecosystem

A food web is a model that shows how energy is passed in the form of food from one organism to another. The arrows between the organisms show the direction of energy flow. They point from what is being eaten to what is eating it.





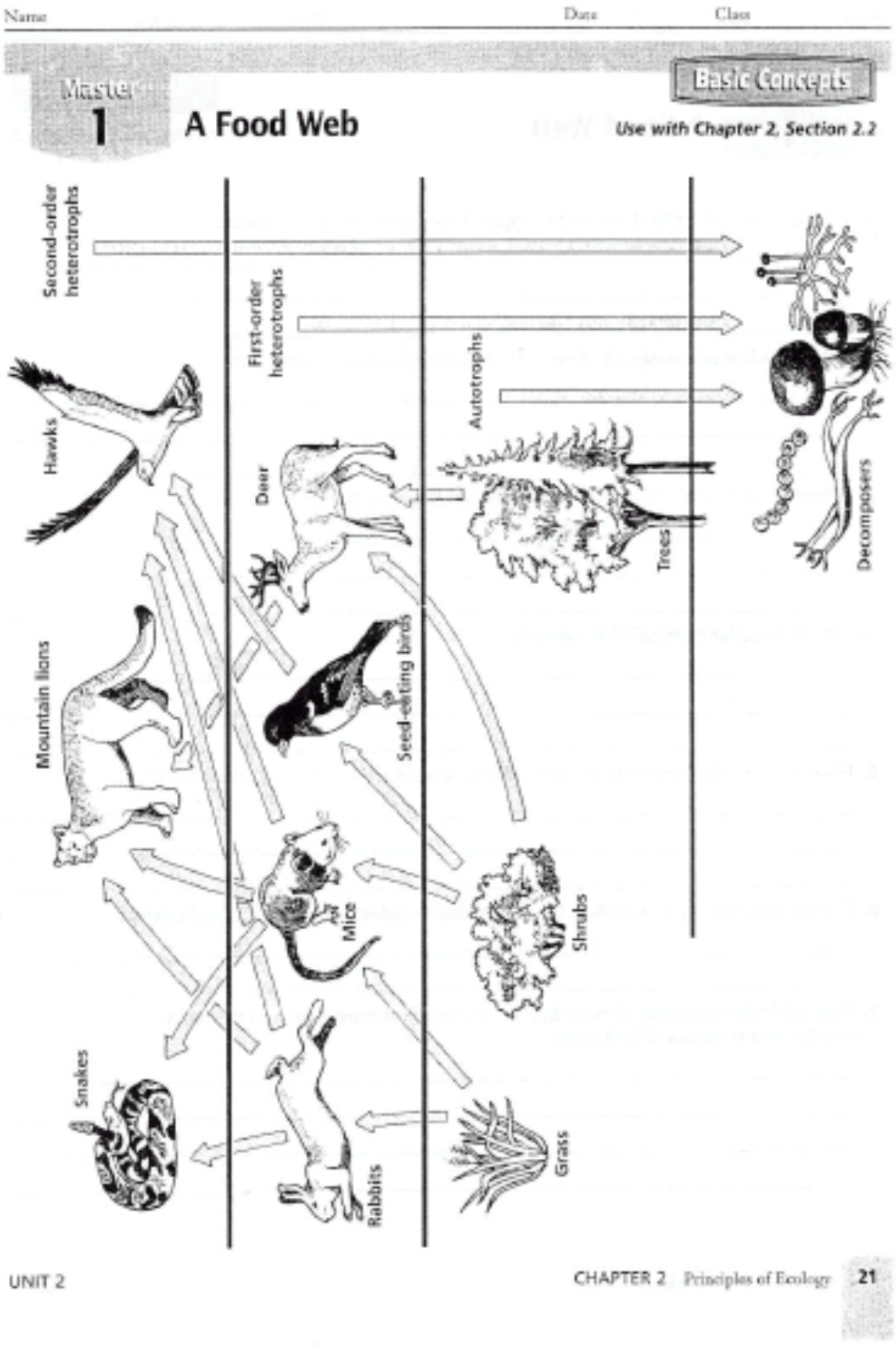
Identify the Tropic Levels...




Let's Practice...Food Chains and Food Webs!!!
http://www.ecokids.ca/pub/eco_info/topics/frogs/chain_reaction/index.cfm
http://teacher.scholastic.com/activities/explorer/ecosystems/be_an_explorer/map/line_experiment14.swf
http://www.gould.edu.au/foodwebs/kids_web.htm
http://www.harcourtschool.com/activity/food/food_menu.html

Guided Practice – imbedded in presentation

Opportunities to Relearn



Name Date Class

Worksheet 1

A Food Web

Basic Concepts

Use with Chapter 2, Section 2.2

1. At which level of the food web is the supply of energy the greatest? Explain.

2. Which feeding relationship do first-order heterotrophs have in common?

3. Which feeding relationship do second-order heterotrophs have in common?

4. Explain why plants are called autotrophs.

5. Food webs and food chains both involve multiple trophic levels. How do they differ?

6. Use the transparency to describe a food chain that includes a mountain lion and a shrub.

7. How might the organisms pictured in the food web be affected if most of the mouse population was destroyed by disease?

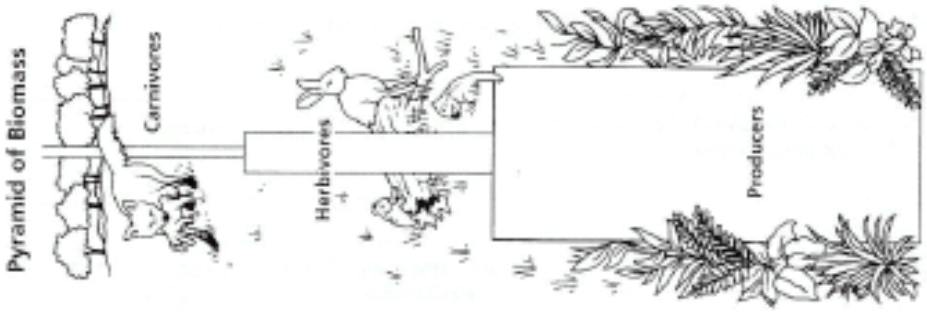
Name Date Class

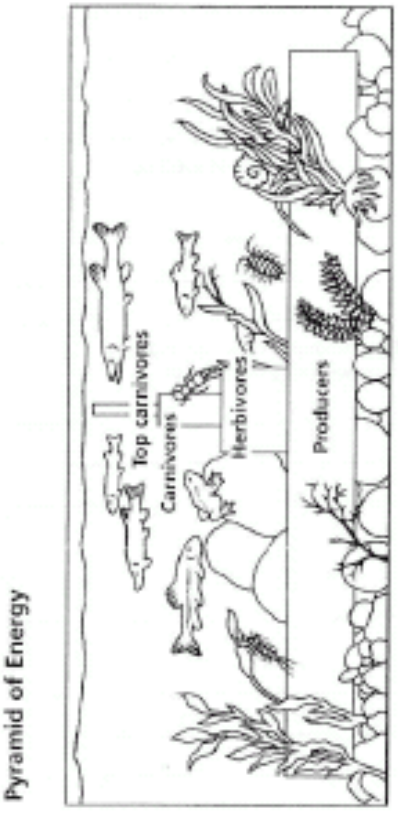
Master 2

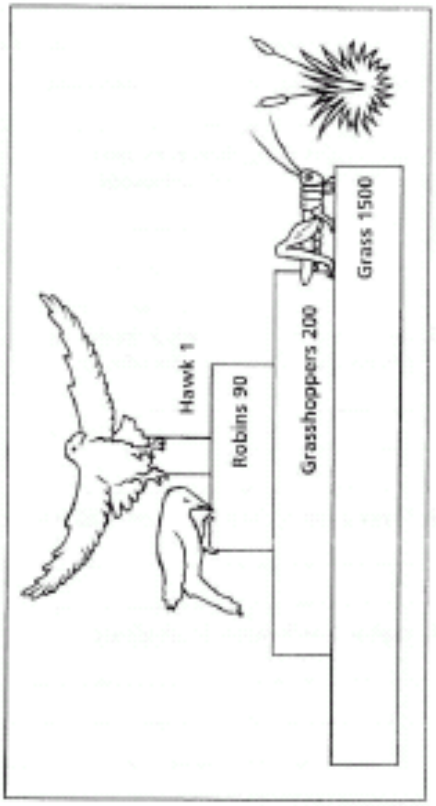
Ecological Pyramids

Basic Concepts

Use with Chapter 2, Section 2.2







Name Date Class

Worksheet 2

Ecological Pyramids

Basic Concepts

Use with Chapter 2, Section 2.2

1. What is the source of energy for all of the ecological pyramids shown in the transparency?

2. In general, what kind of organism makes up the base of the pyramid of energy? Provide some specific examples.

3. Examine the pyramid of energy shown in the transparency. Explain why only about 10% of the energy available at one trophic level is transferred to the next higher trophic level.

4. How is the energy loss from one trophic level to the next reflected in the pyramid of numbers shown in the transparency?

5. Suppose an ecosystem has a greater number of individual herbivores than individual producers. How would this affect the shape of the ecosystem's pyramid of numbers?

6. What quantity does a pyramid of biomass express?

7. Explain how biomass is calculated.

Independent Practice and Assessment

You and your group will be constructing a Food Web of the Galapagos Islands.

You will be given a set of papers that contain Organisms within the food web and information regarding the Trophic Levels they belong to.

Be sure to read all the information given and take note of what the organsims feed on (this is in the reading).

You will have to work as a team and be sure to lay all organims out before gluing them down.

In addition you will need to connect these organisms, showing all aspects of the food web.

Remember: work quickly and work together.

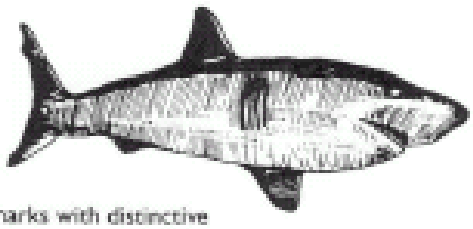
Ecology and Evolution: Islands of Change

By: Richard Benz

GALÁPAGOS MARINE ORGANISMS

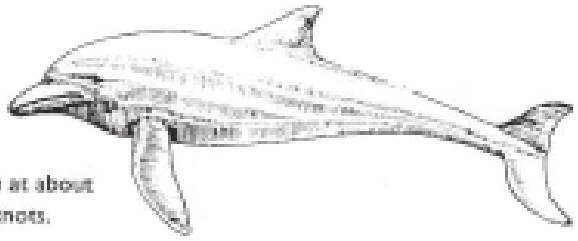
TROPHIC LEVEL 6

Killer whales can reach lengths of 6.5 m. They are toothed whales that eat fur seals, sea lions, dolphins, young humpback whales, and large and medium-sized fish. Killer whales have no natural enemies. Their population size is limited by disease and food supply.

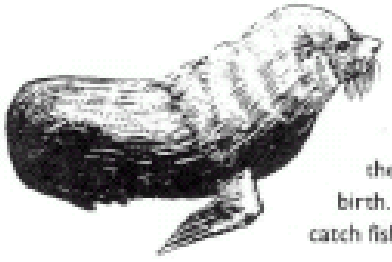


Galápagos sharks are large gray sharks with distinctive uniform coloration and reach 3 to 4 m in length. Their triangular upper teeth are sharp and serrated like steak knives. To satisfy their large appetites, they eat medium- to large-sized fish, and sometimes eat sea lions, fur seals, sea turtles, flightless cormorants, and occasionally marine iguanas. When human divers are in the water the sharks are very curious and approach them at close range, but usually are not aggressive. A large adult shark can be twice the size of a human diver. Only other large sharks (including cannibalistic members of their own species) prey upon them.

TROPHIC LEVEL 5



Bottlenose dolphins got their name because of their short, protruding snouts. As mammals, they must come to the surface to breathe air. Bottlenose dolphins are sociable animals, traveling in pods of about six or seven. Adults grow to approximately 2.5 m and feed on fish and squid. Their streamlined bodies allow them to swim at about 10 knots, darting in short bursts of speed to almost 20 knots. Killer whales prey upon the dolphins.

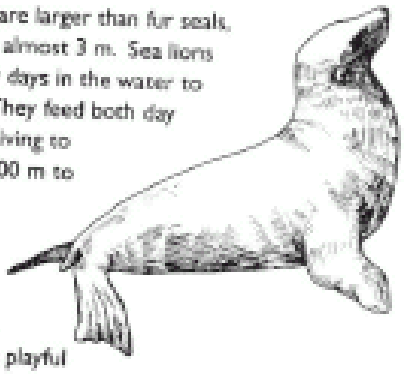


Fur seals found in the Galápagos are the smallest of all known fur seal species. Adult males grow to approximately 2.5 m and weigh about 70 kg; females are smaller, averaging about 35 kg. They live in colonies on rocks with shaded overhangs that protect them from the daytime sun, and there they breed and give birth. At night fur seals feed offshore, diving to about 30 m to catch fish and squid. Sharks and killer whales eat fur seals.

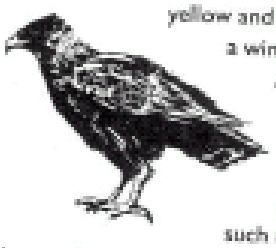
ACTIVITY 10: GALÁPAGOS MARINE FOOD WEB

GALÁPAGOS MARINE ORGANISMS

TROPHIC LEVEL 5

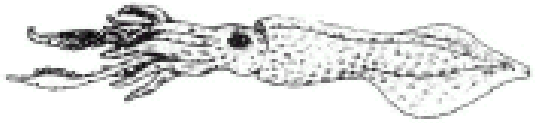


Sea lions are larger than fur seals, growing to almost 3 m. Sea lions spend their days in the water to stay cool. They feed both day and night, diving to depths of 200 m to catch fish. Adults are aggressive toward humans, but juveniles are playful and curious. Sharks and killer whales prey upon them.

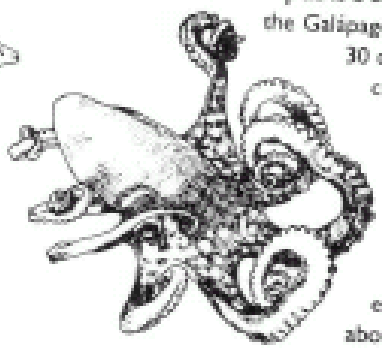


Galápagos hawks belong to the category of birds known as raptors: birds of prey. Their feathers vary in color from white and brown to a brilliant yellow and black, and they may have a wingspan of nearly 1.5 m. Aided by their keen eyes, they are the principal native predator in the islands. In addition to land animals such as marine iguanas, they also eat the young of other seabirds, such as boobies and flightless cormorants. Galápagos hawks are also scavengers, feeding on virtually any dead animal. These birds have no native natural enemies.

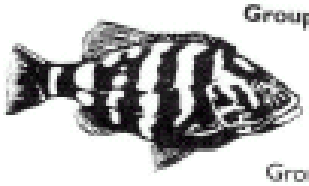
TROPHIC LEVEL 4



Squid are bottom-dwelling carnivores that, like octopi, can change the color of their skin to blend in with their surroundings. Squid are also known for their ability to squirt a potential predator with "ink" and escape backwards by forcing water from a siphon near the head. Unlike their octopus relatives, squid are not solitary creatures. They swim in schools and will frequently follow the schools of fish on which they feed. Shark, fur seals, sea lions, and sea birds such as penguins prey upon squid.



The **octopus** is a bottom dweller that, in the Galápagos, can grow to about 30 cm. They can change color quickly to blend with the background and are difficult to see. Their untidy dens are easy to locate, however, because they leave empty seashells strewn about after eating. They eat small fish, crabs, and shellfish. Octopi are eaten by cormorants and groupers.

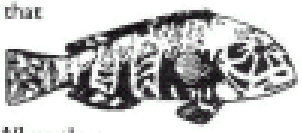


Groupers can grow to more than 1 m in length. They prey upon small and medium-sized fish, crabs, and crustaceans such as shrimp and lobsters. Groupers are eaten by sharks.

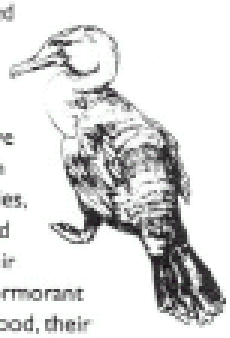
GALÁPAGOS MARINE ORGANISMS

TROPHIC LEVEL 4

Hieroglyphic hawkfish feed on small fish and crustaceans such as Sally Lightfoot crabs. They are medium-sized, shy creatures that tend to hide in coral reefs. From the coral, they use their pectoral fins to "sit up" and watch for prey. When they spot their prey, they swoop down and devour it quickly. The name *hawkfish* comes from this swooping hunting behavior. These hawkfish are blue-black with a camouflage of bluish stripes and brownish bands that look like hieroglyphics.



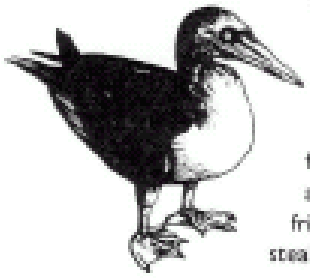
Flightless cormorants have very small wings and cannot fly, but they have thick, muscular legs adapted for swimming. They chase and catch octopus and small schooling fish that live within 10–15 m from shore. Like the boobies, they nest on land, and hawks prey upon their chicks. If the adult cormorant cannot find enough food, their chicks die. Sharks sometimes prey upon the adults.



Galápagos penguins, which grow to about 36 cm tall, nest in holes along the shoreline. They cannot fly in the air, but seem to "fly" in the water using their greatly modified wings like paddles. Their swift underwater swimming allows them to catch small schooling fish. Food supply regulates the population of penguins in the Galápagos; when schooling fish or crustaceans are scarce, juvenile penguins cannot survive. Occasionally penguins are eaten by sharks, fur seals, and sea lions, but most die of starvation.

Frigate birds, when fully grown, are about 1 m long with a 2 m wingspan, but weigh only a little over 1 kg. The frigate bird can use its long, pointed wings and forked tail to make sharp spiral turns and dive at great speeds through the air. Because of their habit of stealing fish caught by boobies and other birds, these graceful birds are sometimes described as parasites. They occasionally do their own fishing, however. Their population size is regulated by food supply.

Blue-footed boobies are excellent fliers that feed on fish from the near-shore waters to a few km offshore. They frequently catch fish by folding their wings and diving down into the ocean from great heights. Their nests are on land, and hawks prey upon the chicks. When offshore fish are scarce, many young chicks die from lack of food. The adults are harassed by the frigate bird, which tries to steal their fish.

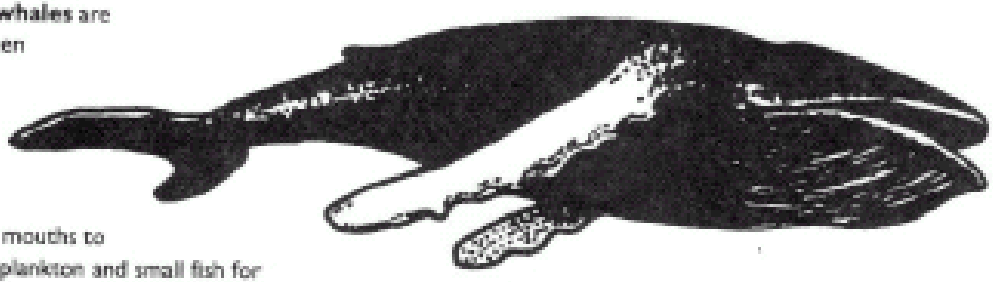


ACTIVITY 10: GALÁPAGOS MARINE FOOD WEB

GALÁPAGOS MARINE ORGANISMS

TROPHIC LEVEL 3

Humpback whales are toothless baleen whales. They gulp in huge quantities of seawater, using baleen plates in their mouths to strain out zooplankton and small fish for food. Humpbacks winter in subtropical waters, where they breed, and summer in cooler waters. They prefer coastal waters and shallow banks. When they travel from summer to winter grounds, they swim in herds led by a large male. The humpback can grow to 15 m in length and weigh more than 900 kg. The killer whale is its natural enemy, preying upon its young.



Triggerfish have characteristic dorsal spines. When a triggerfish is chased into a rock or reef crevice by a larger, predatory fish, it opens its spines to wedge itself in place. The open spines not only make it difficult for the predator to dislodge the triggerfish, but also make the prey painful to swallow. Triggerfish eat sea urchins, algae, coral, crabs, and starfish.

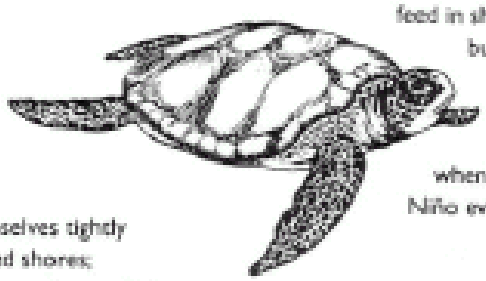
Red-lipped batfish have broad, flat heads and slim bodies and are covered with hard lumps and spines. They grow to approximately 36 cm long and are characterized by their vivid red lips. Batfishes are poor swimmers. Instead of swimming, they usually use their thickened, limb-like fins to walk on the sandy bottom. Batfishes have a long "snout" with whitish bumps. They use this bumpy protrusion as "bait" to catch prey such as small fish, small mollusks, clams, and worms.

Anchovies and **sardines** are small fish that normally live in the open ocean. They feed on zooplankton. When the zooplankton drift close to shore, these fish follow their food into shallow waters. Anchovies and sardines are food for some large fish species, penguins, and boobies.

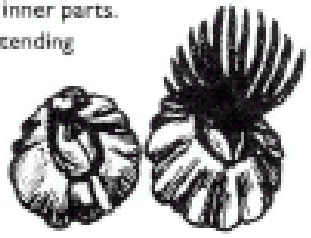
GALÁPAGOS MARINE ORGANISMS

TROPHIC LEVEL 3

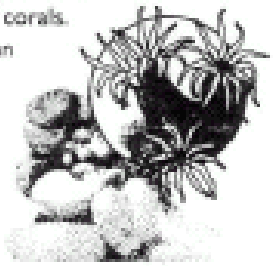
Sea turtles are air-breathing reptiles that come ashore to reproduce, but spend most of their lives at sea. They feed in shallow coastal waters, foraging for ulva, but also eating jellyfish and crustaceans. They sometimes migrate great distances in search of ulva beds. Like marine iguanas, green turtles starve when ulva becomes scarce during an El Niño event. Sharks prey upon green turtles.



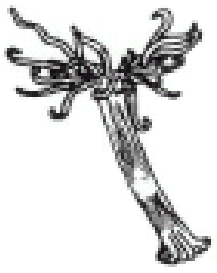
Barnacles cement themselves tightly to rocks on wave-pounded shores; sometimes they attach themselves to living whales. By attaching themselves to whales, they are easily transported to new food areas. Barnacles are small, ranging from 1 to 3 cm in diameter. The barnacle's hard outer shell is made up of overlapping calcium plates around a central opening, which can be closed tightly to protect their soft inner parts. Barnacles feed by extending appendages out of their shell and waving them about to trap small animals and fragments of food; they filter zooplankton and small food particles from the water. Birds prey on barnacles.



Coral polyps, organisms that look like tiny sea anemones, secrete a hard, calcareous skeleton. Coral reefs are made up of colonies of corals. In the Galápagos, a coral head can be as small as a golf ball or as large as a house. Coral polyps use their tentacles to reach out and capture zooplankton for food. Symbiotic algae, called *Zooxanthelae*, live in the tissue of the polyps and benefit the coral by producing additional food as well as oxygen for the polyps to use. One type of sea urchin and a number of fish feed upon the coral polyps.



Sea anemones are entirely soft-bodied animals that attach themselves to rocks. They resemble flowers or miniature palm trees because of the circle of waving tentacles that surrounds their central stalk. Anemones have a symbiotic relationship with juvenile damselfish. They live within the anemone's tentacles, which offer protection to the fish. The damselfish's bright colors attract other fish to the anemone, which it then kills. The anemone and the damselfish both eat the captured prey. Anemones are active carnivores that wave their tentacles to attract and capture zooplankton. Fully extended, anemones in the Galápagos reach 6 cm in height and 3 cm in diameter.



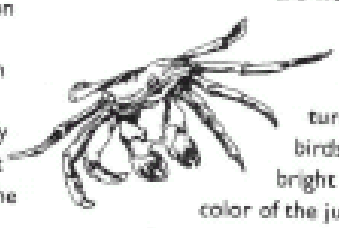
ACTIVITY 10: GALÁPAGOS MARINE FOOD WEB

GALÁPAGOS MARINE ORGANISMS

TROPHIC LEVEL 2

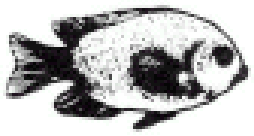
Marine iguanas live on the rocky shores, but dive in the near-shore water to depths of about 10 m to dine on the green seaweed ulva. When the ulva become scarce after an El Niño event, the marine iguanas try eating ceramium. Many iguanas starve because the ceramium does not fulfill their nutritional needs. Galápagos hawks prey upon marine iguanas on land, and occasionally sharks eat them in the water.

Sally Lightfoot crabs, so named because of their speed and agility, live on shoreline rocks both above water and to depths of about 1 m. Their flat bodies are well adapted to living in a high wave area. These small crabs feed on algae and in turn are eaten by some birds and fish. Adults are bright red, but the black color of the juveniles provides them somewhat greater protection from predators.

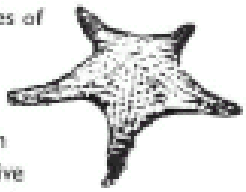


Parrotfish, so named because of its blue-green color and parrot-like beak, grows up to 1 m in length. It uses its beak to bite off and crush chunks of coral from reefs. Parrotfish are herbivores because although they "eat" coral, in fact they only digest the algae coating on the coral, passing the broken remains of the coral through their digestive systems. They also eat ulva and ceramium. Despite their powerful beaks, they are gentle fish and creatures of habit that swim in schools along set feeding routes. They are food for larger predatory fish and sharks.

Damselfish grow 7–25 cm long and are sometimes described as "algal gardeners" because of the way they stake out and defend their home territories. The males chase away other herbivorous fish, including other damselfish. They also pick up herbivorous sea urchins and move them away from the algal mats. They eat different types of algae including ulva and ceramium. Juvenile damselfish have a symbiotic relationship with sea anemones, and they use the anemones' tentacles to protect themselves from their predators: larger fish and seabirds.



Sea stars and **sea urchins**, relatives of the crab, move about in large numbers over the submerged rocks and corals, searching for coral polyps and attached algae, such as ceramium, to eat. Sea stars have five rays (arms) arranged around a central mouth that is located on its underside. Tube feet help them hold onto rocks and move about in the water. Calcareous algae are their preferred food. Sea urchins have thick spines encasing and protecting their bodies. Like sea stars, they have mouths on the underside and tube feet. Predatory fish, such as triggerfish, eat both.

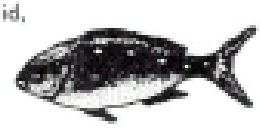


GALÁPAGOS MARINE ORGANISMS

TROPHIC LEVEL 2

Surgeonfish, notable for their beautiful color, grow to 25 cm in length and have one or two sharp spines on their sides. They swim together in small schools, aggressively chasing other herbivorous fish away from their territory. They feed on algae within a set area and predatory fish eat them.

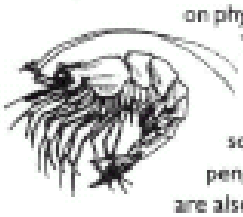
Five-spotted anthias are small gray fish with up to five white spots on the side. They travel in large schools and feed on plankton. They are eaten by other fish, squid, or birds such as the penguin or flightless cormorant.

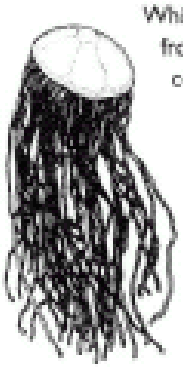


Zooplankton are animals that float or swim very weakly. Some zooplankton, like copepods, krill, and some jellyfish, remain as floating plankton all their lives. Others, like tiny **fish larvae**, eventually outgrow their early planktonic stage. As they drift, the zooplankton feed on phytoplankton and other zooplankton. Zooplankton are eaten by many organisms from higher trophic levels.

Copepods, at approximately 0.5–2 mm in length, are a smaller relative of crabs and lobsters and the most abundant group among marine **zooplankton**. The copepods found in the Galápagos are parasites that feed on the host tissue of almost every major animal group, including sponges, corals, fish, and mammals. Copepods, in turn, are a food source for many species of fish that eat zooplankton.

Krill are shrimp-like **zooplankton** that range in size from 8 to 60 mm. Most are bioluminescent (emit light), making them visible at night. These planktonic crustaceans feed on phytoplankton. They are a primary food source for penguins and are also eaten by various fish, birds, and whales.





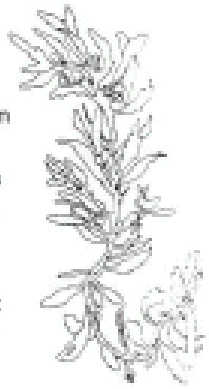
While adult **jellyfish** in the Galápagos range in diameter from about 2 to 40 cm (though some species are considerably larger, with diameters of up to 2 m), until they reach their adult size, juvenile jellyfish are microscopic and sometimes considered part of **zooplankton** because they are microscopic, free-floating animals. Some jellyfish filter-feed on phytoplankton and zooplankton, while others eat small fish that they catch in their tentacles. The tentacles have stinging cells (nematocysts) that poison and paralyze captured prey. Large fish and sea turtles feed on jellyfish.

ACTIVITY 10: GALÁPAGOS MARINE FOOD WEB

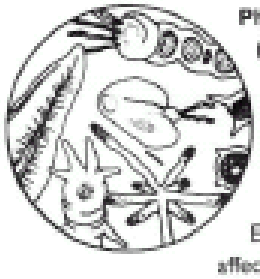
TEACHER SECTION

TROPHIC LEVEL 1

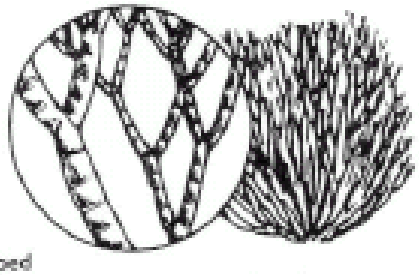
Ulva is a fast-growing green algae found from the shoreline to depths of about 8–10 m. When fully grown, ulva looks like seaweed or loosely arranged lettuce leaves; it is often called "sea lettuce." Ulva is the favorite food of the marine iguana and an important food for turtles, as well as for damselfish and many other herbivorous fish. Thus ulva is usually found in the Galápagos looking more like mowed grass than like lettuce. The herbivores keep it cropped to about 2 cm. Warm water and a lack of nutrients during the El Niño almost wiped out the ulva population, depriving many herbivores of their primary food.



Sargassum is a brown seaweed averaging about 15 cm in length. It has characteristic air sacs that support it in the water. Although it is abundant, many organisms do not eat it because it contains toxic substances.



Phytoplankton are the very abundant but tiny (less than 1 mm) algae and plant-like organisms that drift in the ocean. Phytoplankton live near the surface, using sunlight, carbon dioxide, and water to produce food and oxygen. When they are deprived of nutrients, however, as they are in El Niño years, their numbers decrease, affecting the entire food web. Phytoplankton provide food for zooplankton and other, larger, organisms.



Ceramium is a small (5 mm) filamentous red algae that provides food for damselfish, surgeonfish, parrotfish, some sea stars, and snails. When ulva are almost wiped out by an El Niño, marine iguanas start eating ceramium, but these red algae do not provide all the nutrients the iguanas need.

Lesson Three: Ecological Interactions

Title of Lesson Plan	**Interactions**
Grade Level	**10**
ODE Standard:	**Explain the structure and function of ecosystems and relate how ecosystems change over time.**
GLI(s)	**Explain how living things interact with biotic and abiotic components of the environment (e.g., predation, competition, natural disasters, and weather) (1998 LS - 15)**
Anticipatory Set	**Jeff Corwin: Hyena video (first 20 minutes) Discussion questions prior to viewing in the video and questions to answer after viewing the video can be found in the share drive. (Jeff Corwin Intro doc.)**
Explanation	**Notes: Interactions**
Guided Practice	**The Far Side Gallery, Interactions**
Opportunities to Relearn	**Predator Prey Lab with paramecium and didinium.**
Independent Practice	**How are Predator and Prey Related? - concluding with a graph in the end.**
Assessment/Evaluation	**Predator Prey Enrichment: District assessment**
Enrichment	**Using Predators to Manage Populations**
Closure	**Interactions Concept Map**
Materials (include websites)	**At the end of the Unit plan: reference page.**

Anticipatory Set – Jeff Corwin Hyena Video, first twenty minutes. Use the following document.

Introduction to Ecological Interactions

The Jeff Corwin Experience: Hyenas

- The video looks at the life of the hyenas focusing on the interactions that the hyenas have with other organisms (lion).

Previewing Questions:

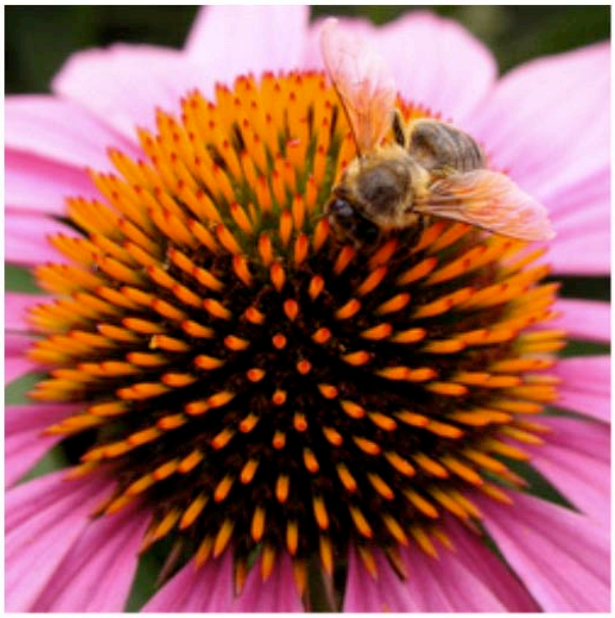
1. What do you know about lions and hyenas?
2. Do these two organisms interact in any ways, if so, how?

Watch the first 20 minutes of this video, focus on answering the following questions:

1. What type of relationship exists between lions and hyenas?
2. After seeing the video segment, how do these two organisms interact?
3. Why are hyena's so successful in their environment?

Explanation

ECOLOGICAL INTERACTIONS



Symbiosis

- Relationships between organisms
- (*Sym* – Together, *bios* – Life, & *symbiosis* – Living Together)

Commensalism

One organism benefits & the other is not harmed Ex: Barnacles/Whales

Commensalisms

Mutualism

- Both species benefit
- Ex: Clownfish/Anemone

Mutualism

Density Dependent Limiting Factors

- Operate when a population is both large and crowded.

- **A. Competition – Struggle for food, water, space, sunlight, or other essentials of life**
- Intraspecies competition – between members of the same species

- Interspecies competition – between members of different species

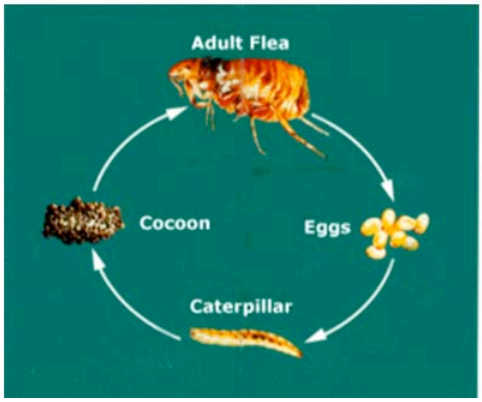
- **B. Predation – Predator/Prey relationships**
- Usually one organism benefits and the other is killed.

- **C. Parasitism – A parasite lives off a host.**
- Usually one organism benefits while the other is harmed.

- **D. Crowding & Stress – Organisms need space to avoid territoriality**

Predator-Prey

Parasite-Host



Mimicry

Danaus plexippus male

Limenitis archippus

Density Independent Limiting Factors

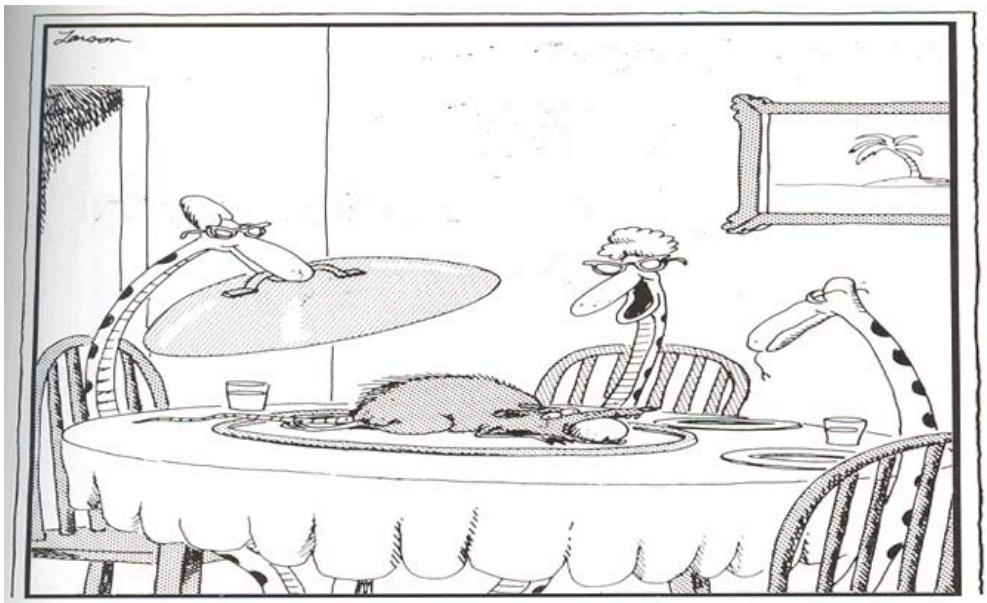
- Population Density does not matter!!! (These will occur no matter how many organisms live in the environment)

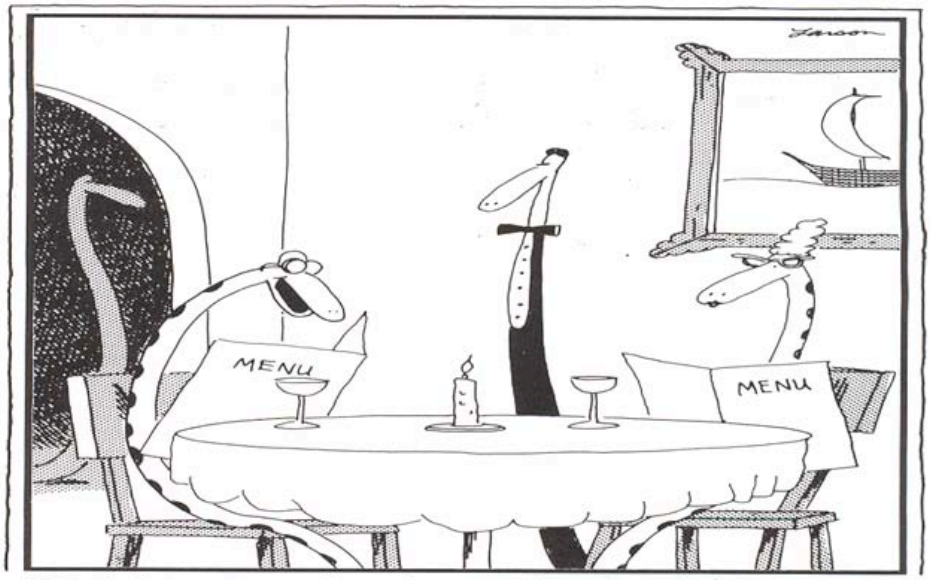
- Ex: Natural disasters – hurricanes, tornadoes, forest fires, etc.

Guided Practice – Far Side Interactions Power Point

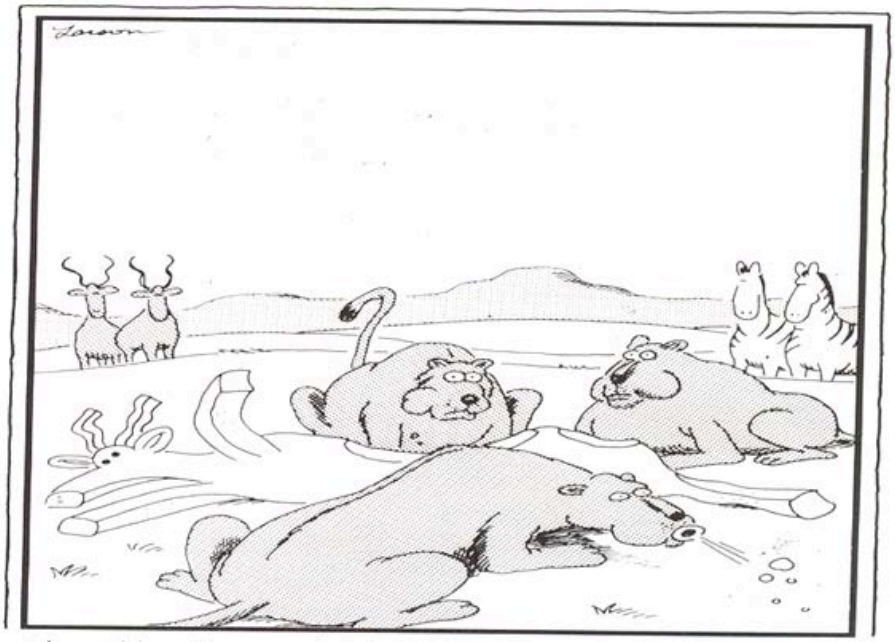
THE FAR SIDE GALLERY 4

BY
GARY LARSON

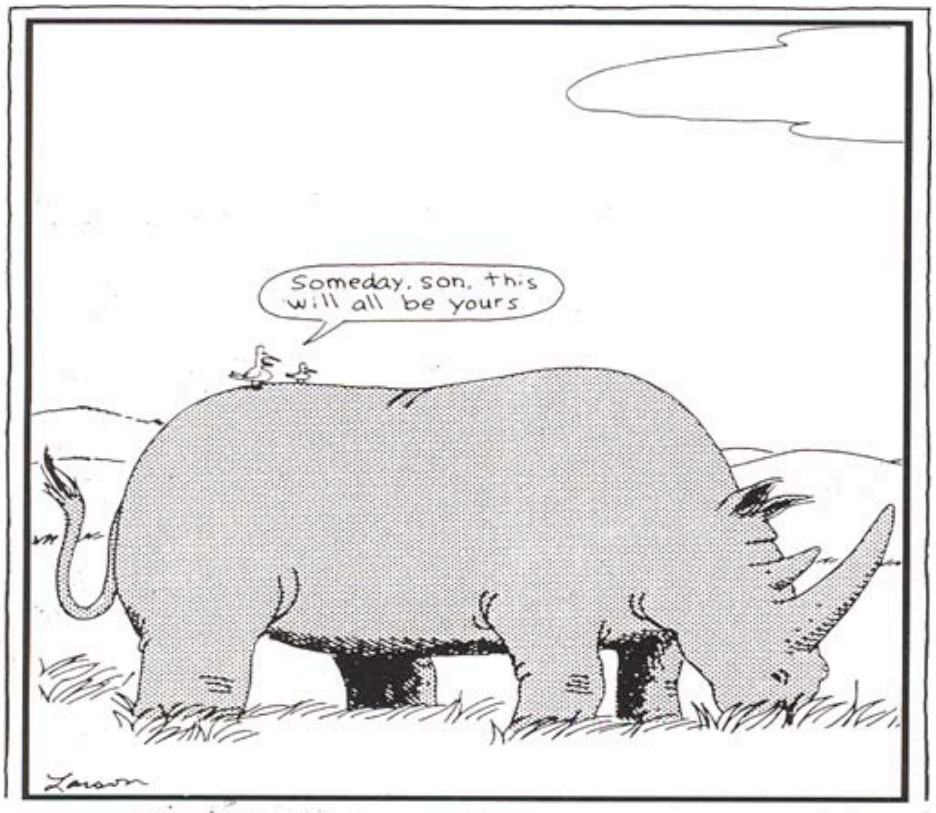


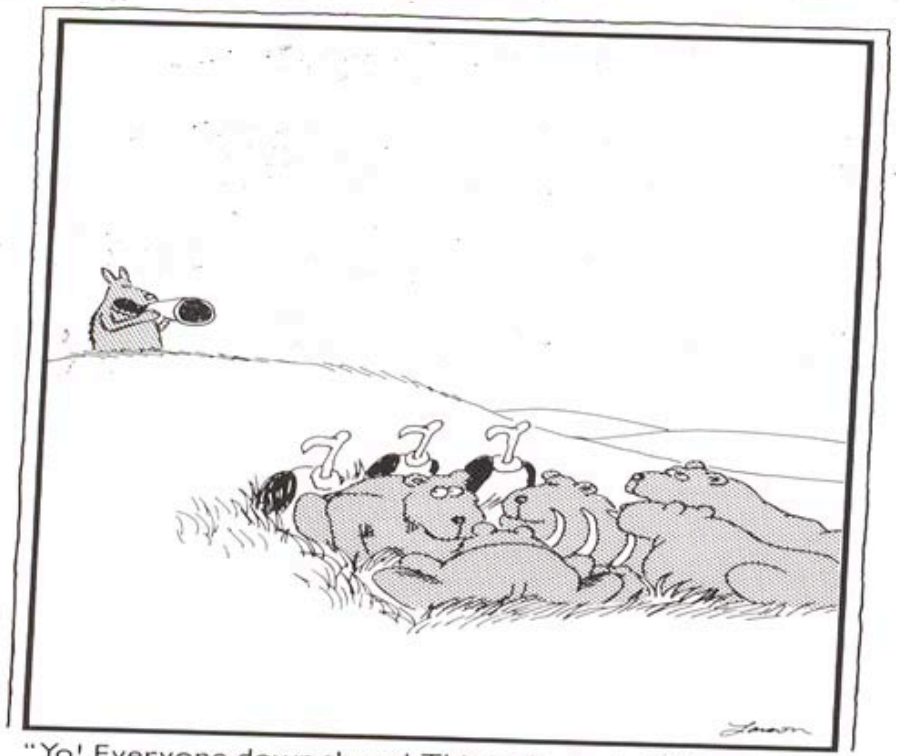


"Well, this may not be wise on a first date, but I just gotta try your garlic wharf rats."

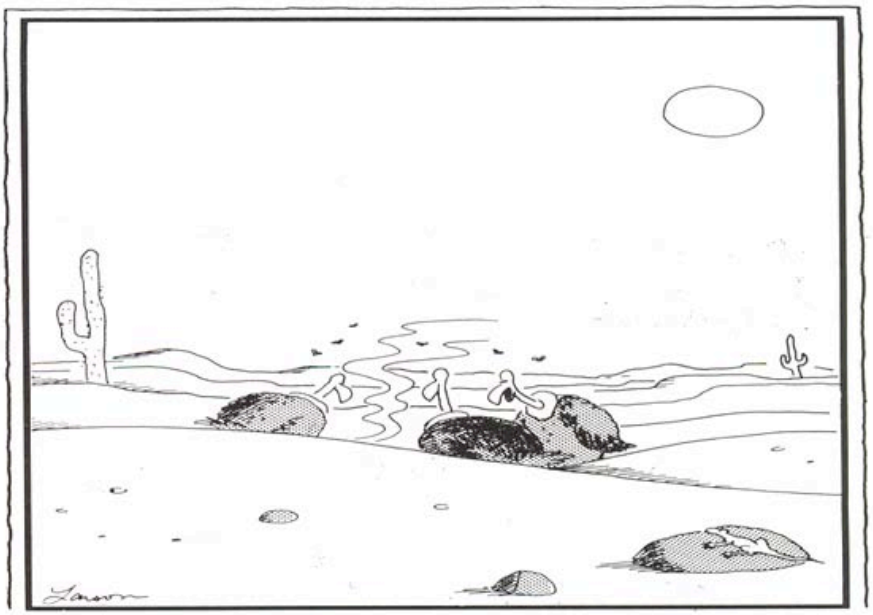


In sudden disgust, the three lionesses realized they had killed a tofudebeest—one of the Serengeti's obnoxious health antelopes.

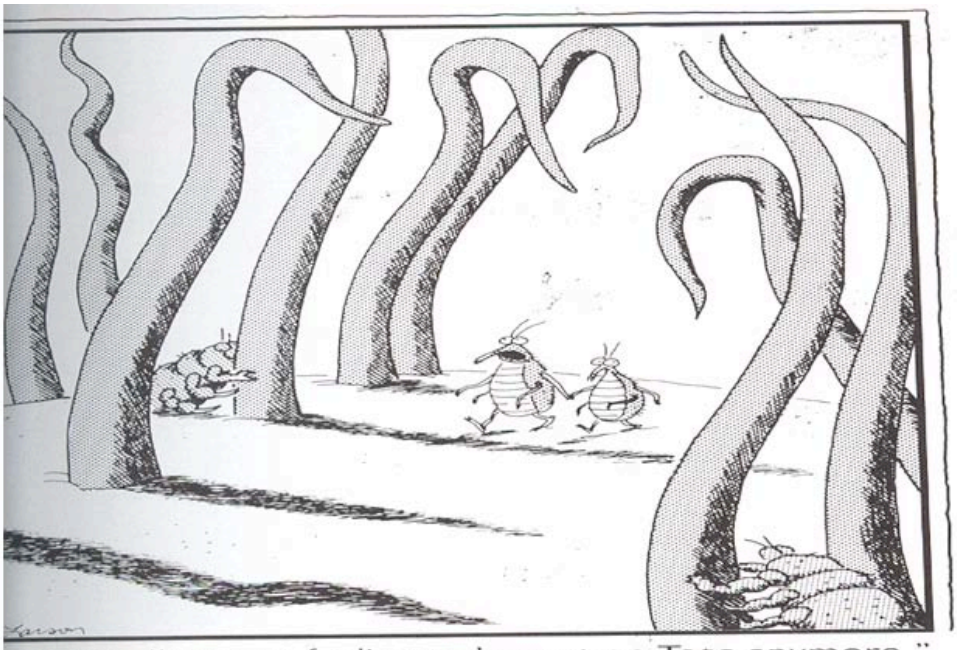




"Yo! Everyone down there! This is the jackal! I'm tired of slinking around in the shadows! ... I'm coming down to the kill! Is that gonna be cool with everyone! ... I don't want trouble!"



"Oooooooweeeeeee! This thing's been here a looooooooong time. Well, thank God for ketchup."

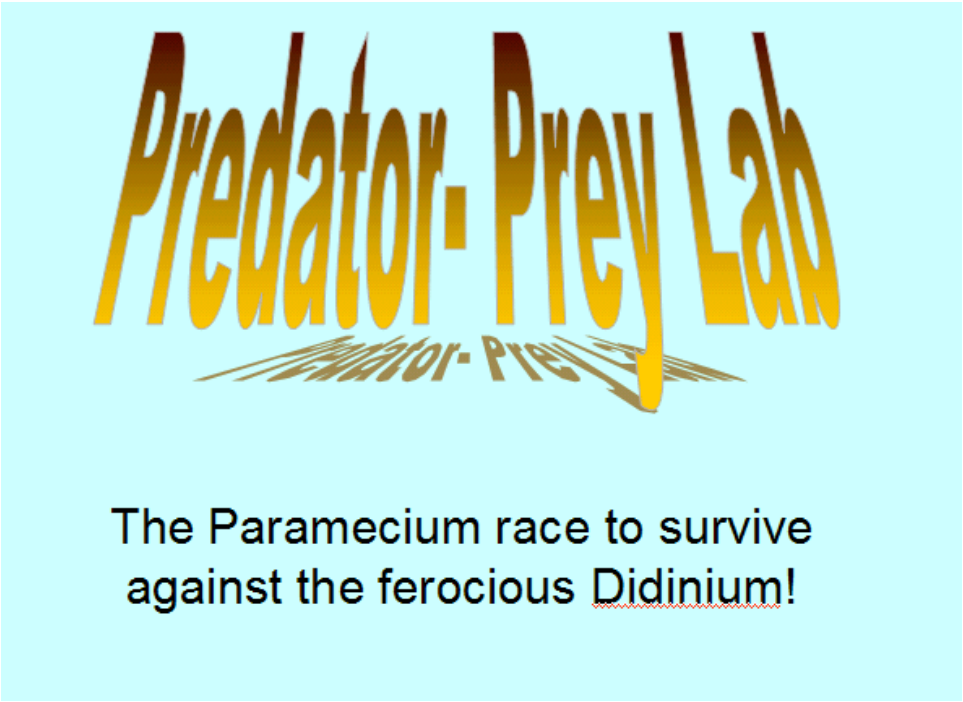


"Frances, I've got a feeling we're not on Toto anymore."

Homework!!!!!

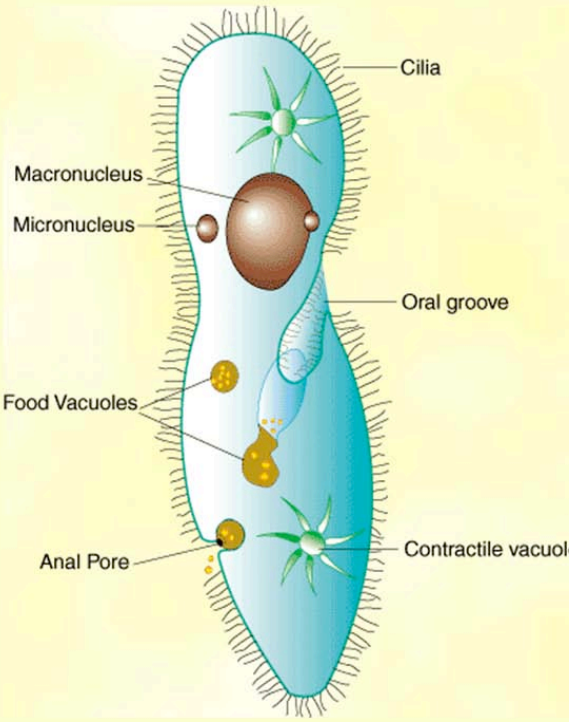
- How are humans……
  - » **predators?**
  - » **prey?**
  - » **hosts?**
  - » **parasites?**
  - » **intraspecific competitors?**
  - » **interspecific competitors?**
  - » **commensalists?**
  - » **mutualists?**

Independent Practice – Predator Prey Lab



THE PREY

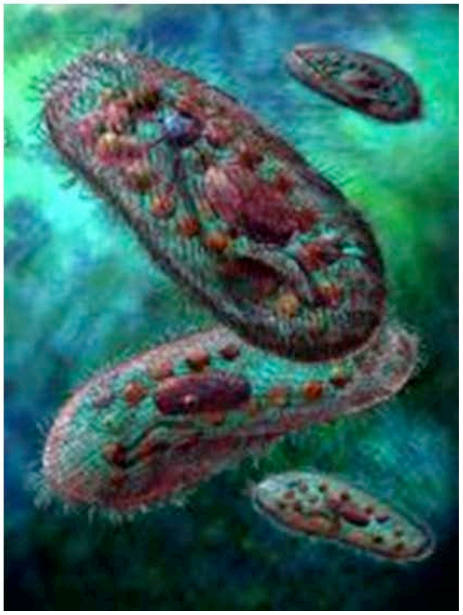
PARAMECIUM



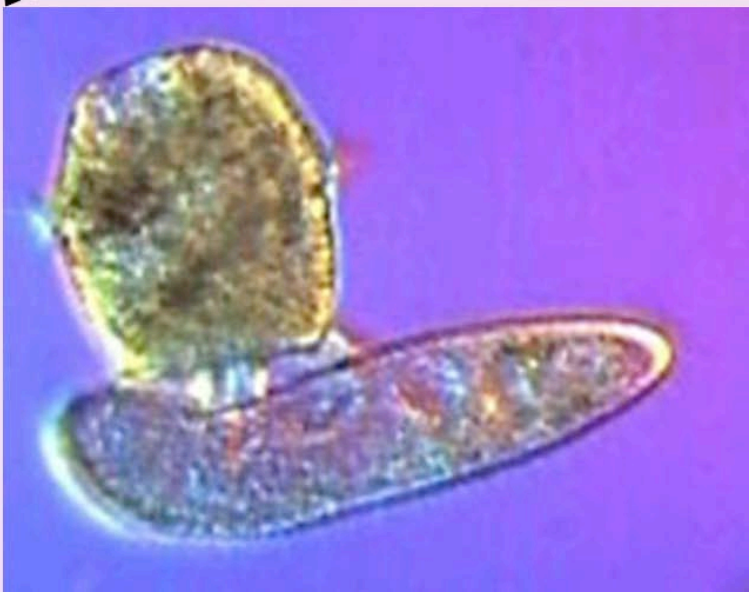
Paramecium

- Slipper shaped
- Found in aquatic environments
- Feed on bacteria and algae
- Agile, capable of bending back on itself and contorting in many ways

What do they look like under the microscope?

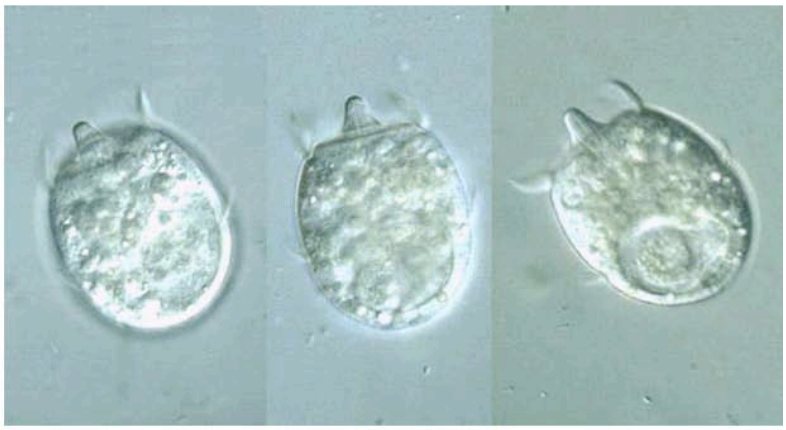


THE PREDATOR

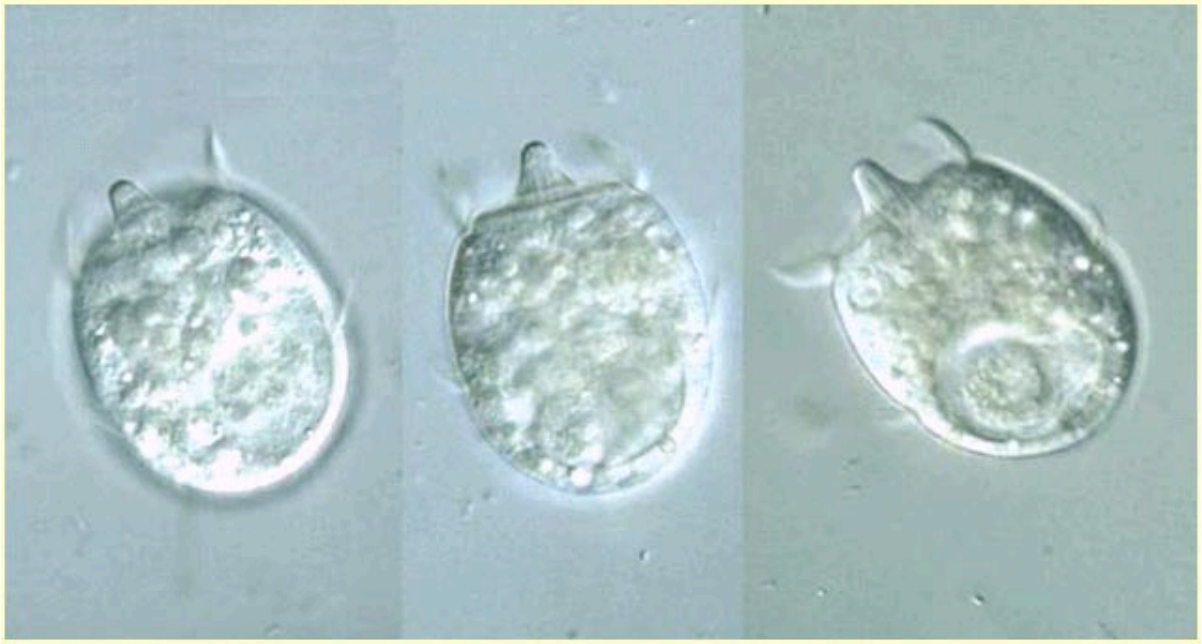


What does Didinium look like?

- Rounded
- Cell body equipped with a short cone-shaped snout

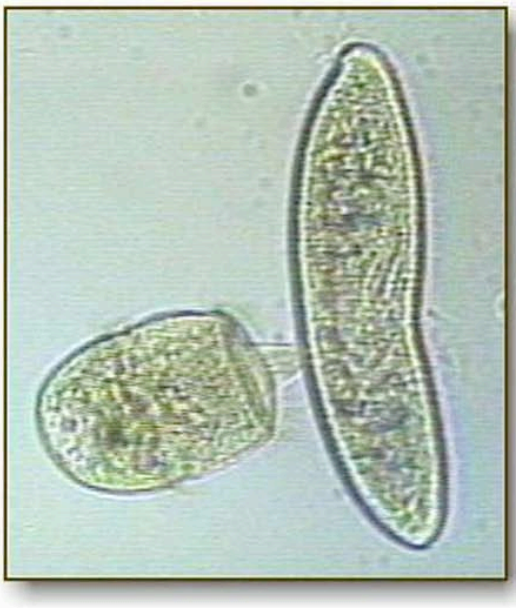


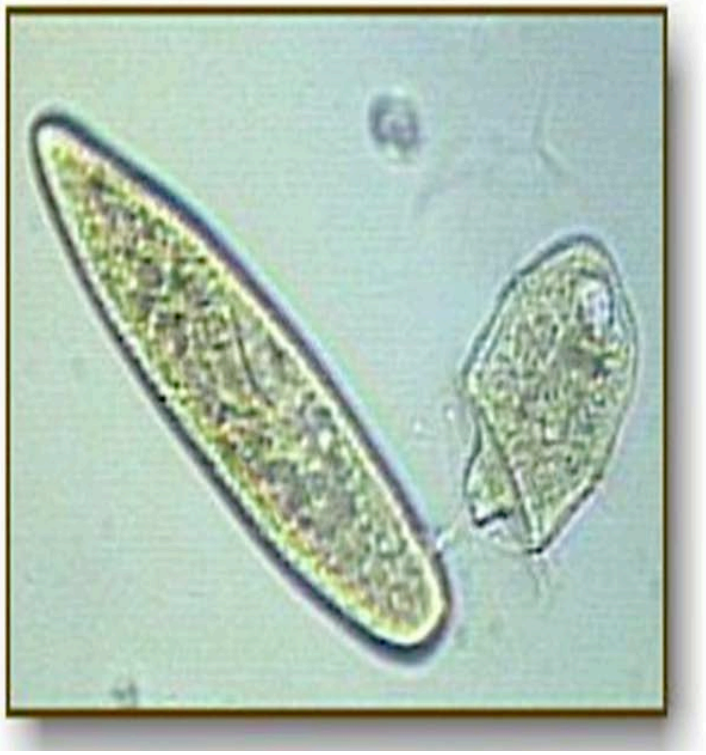
HOW WILL I RECOGNIZE THEM UNDER THE MICROSCOPE?



How do they eat?

- Didinium are fast moving carnivores that feed on live Paramecium.
- When its "nose" (shown at top) strikes a Paramecium it latches on with a threadlike trichocyst. Once captured and paralyzed, the didinium devours the Paramecium whole.





- Like it just caught a huge fish, the Didinium reels in the Paramecium. Amazingly, it will stuff this entire Paramecium totally inside its body!

Independent Practice

How are Predators and Prey Related??

Name: _____ Period: _____

Objective: Students will simulate the predator prey interactions, the number of predator and prey within their ecosystem will be recorded and graphed.

Materials Needed:
Each group will receive 200 small squares cut out of index cards (1 inch squares). The small squares represent the prey population. Each group will receive 50 large squares (index cards cut in half). The large squares represent the predator population.

Instructions:

1. Place 3 prey on the table.
2. Toss 1 predator onto the table and attempt to make the card touch as many prey as possible. In order to survive, the predator must capture at least 3 prey. It will be impossible for your predator to survive at this point.
3. Remove a prey captured and record your data for the 1st generation.
4. The prey population doubles each generation. Count how many prey you have left on your table, double that number and add prey card to the table. Record the number in the data table under 2nd generation. It should be 2x the number you have under the prey remaining for generation 1.
5. Your predator died during the first round, but that is okay, a new predator moves in for the second round. If your predator died, out 1 in the "number of predator" for generation 1 to represent the new arrival. Repeat the tossing procedure and record your data for the 2nd generation.
6. Again, number of prey doubles, if your predator didn't capture 3 prey, it died. But a new on moves in for the next round. Keep going, adding to the number of prey each round.
7. Eventually your predator will be able to capture enough prey to survive. Guess what happens? The number of predators double. Add to your predator population by adding predator cards. Now when you toss your predators, you will be tossing more than one. Don't forget to remove any captured prey.
8. Continue to record your data through 20 generations.

	Generations																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
# of Predators																				
# of Prey																				
# of Predators remaining																				
# of Prey remaining																				

Construct a Graph – On the x-axis, put generations 1 through 20, on the y-axis you will have the population numbers for each generation (number of predators, number of prey). Use one line for the predator and one line for the prey. Remember to Title your graph.

Enrichment

USING PREDATORS TO MANAGE POPULATIONS

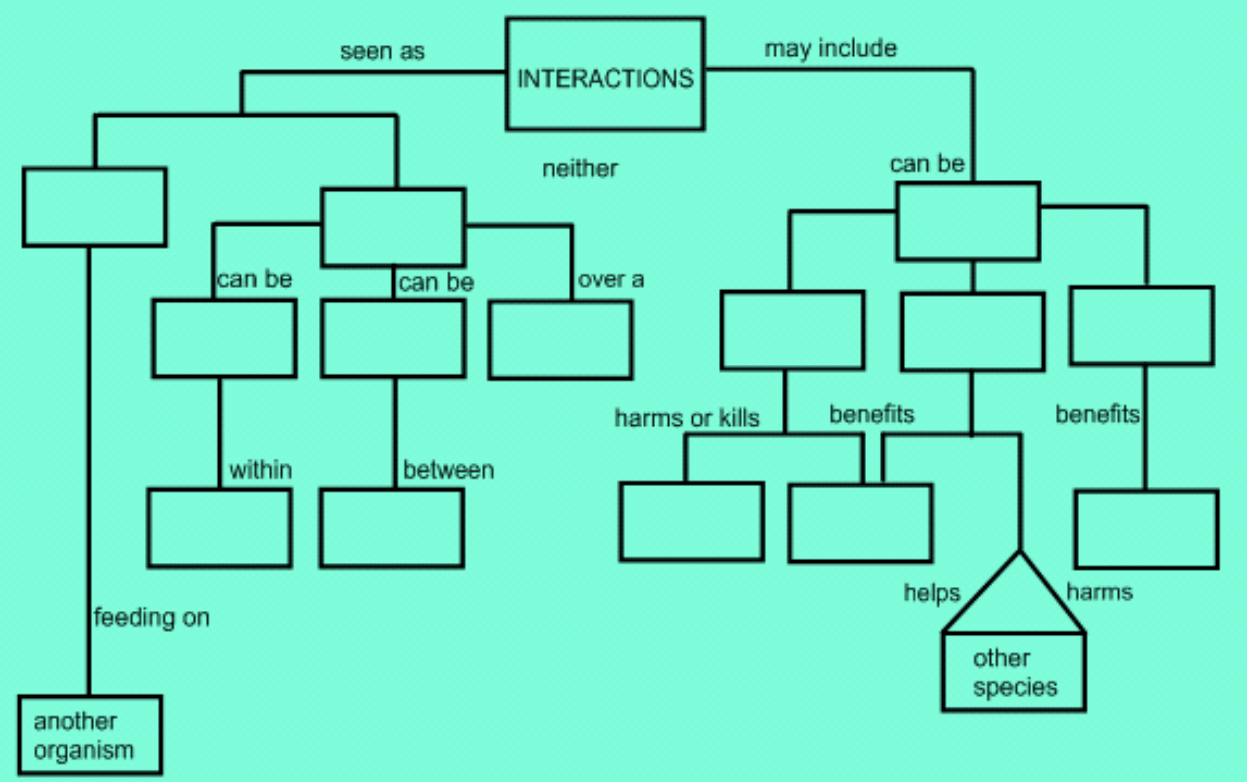
In 1970, the deer population of an island forest reserve bout 518 square kilometers in size was about 2000 animals. Although the island has excellent vegetation for feeding, the food supply obviously had limits. Thus the forest management personnel feared that overgrazing might lead to mass starvation. Since the area was too remote for hunters, the wildlife service decided to bring in natural predators to control the deer population. It was hoped that, eventually, natural predation would eliminate the weakest deer, thereby preventing the herd from becoming too large and, at the same time, increasing the quality of the herd. In 1971, 10 wolves were flown in to the island. The results of this natural predator program are presented in the table below.

Year	Wolf Population	Deer Population	Deer Offspring	Predation	Starvation	Population Change
1971	10	2000	800	400	100	+300
1972	12	2300	920	480	240	+200
1973	16	2500	1000	640	500	-140
1974	22	2360	944	880	180	-116
1975	28	2244	996	1120	26	-150
1976	24	2094	836	960	2	-126
1977	21	1968	788	840	0	-52
1978	18	1916	766	720	0	+46
1979	19	1952	780	760	0	+20
1980	19	1972	790	760	0	+30

1. On a separate sheet of paper, plot the fluctuations in the deep and wolf population on a graph for the 10 year study period.
2. Would it have been better for the ecosystem if more wolves had been introduced in 1971? Why?

Adapted from Holt Biology.

Closure



Use the following words to complete the concept map: both species, commensalism, comptetition, host, interspecific, intraspecific, united resources, mutualism, one species, parasitism, predation, same species, sybiosis, two different species.

Lesson Four: Water Cycle

Title of Lesson Plan	**Biogeochemical Cycles (Water)**
Grade Level	**10**
ODE Standard:	**Explain the structure and function of ecosystems and relate how ecosystems change over time.**
GLI(s)	**Describe ways that human activity can later biogeochemical cycles (e.g., carbon dioxide and nitrogen cycles) as well as food webs and energy pyramids (e.g., pest control, legume rotation crops vs. chemical fertilizers) (1982 ES-7)**
Anticipatory Set	**Poems about water cycle: Attached**
Explanation	**Notes on Energy Movement: Water Cycle**
Guided Practice	**Video embedded in presentation**
Opportunities to Relearn	**The Incredible Journey**
Independent Practice	**Water Cycle Worksheet**
Assessment/Evaluation	**Explanation of Incredible Journey (what did you learn)**
Enrichment	**Article: How we are affected by water cycle. Read article and complete reading activity attached. Video: Water to the Last Drop**
Closure	**Discussion of Ohio's water cycle article. Video: Water to the Last Drop**
Materials (include websites)	**At the end of the Unit plan: reference page.**

Anticipatory Set

Read the following poem. Using the poem create your own diagram of the water cycle. Take all ideas into consideration.

Water

Water, water everywhere, water all around,
Water in the ocean, water in the ground.

Water in a river, water in a creek,
Water in a faucet with a drip-drip leak!

Water in a fountain, water in a lake,
Water on a flower, as day begins to break.

Water from a waterfall, rushing down from high,
Water from a dark cloud, raining from the sky.

Water boiling hot, water frozen ice,
Water in a blue lagoon, clean and clear and nice.

Water at a fire, gushing through a hose,
Water in a garden, so every flower grows.

Water for the animals swimming in the sea,
Water, water everywhere for you and for me!

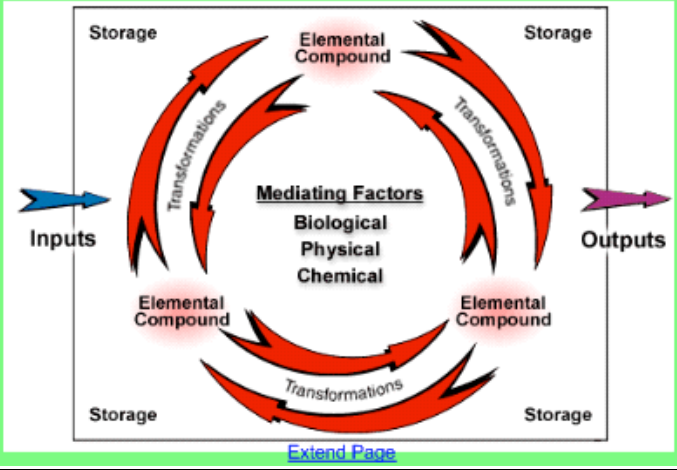
by Meish Goldish, 101 Science Poems & Songs for Young Learners, Instructor Books

Explanation

Biogeochemical Cycles

How does energy move...

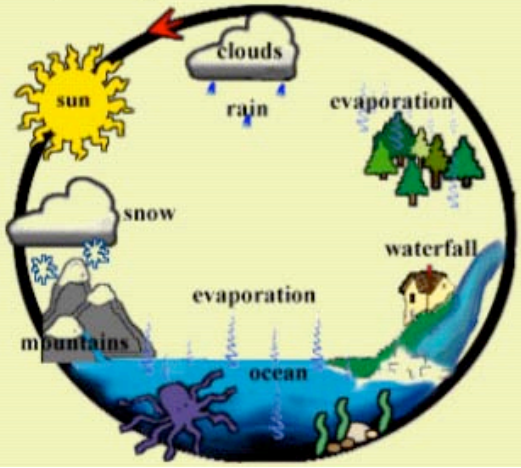
- Moves in a one way direction, nutrients are recycles.
- Biogeochemical Cycles
  - Nutrients move through the biosphere in a series of physical and biolgical process.
  - May be used over and over again.



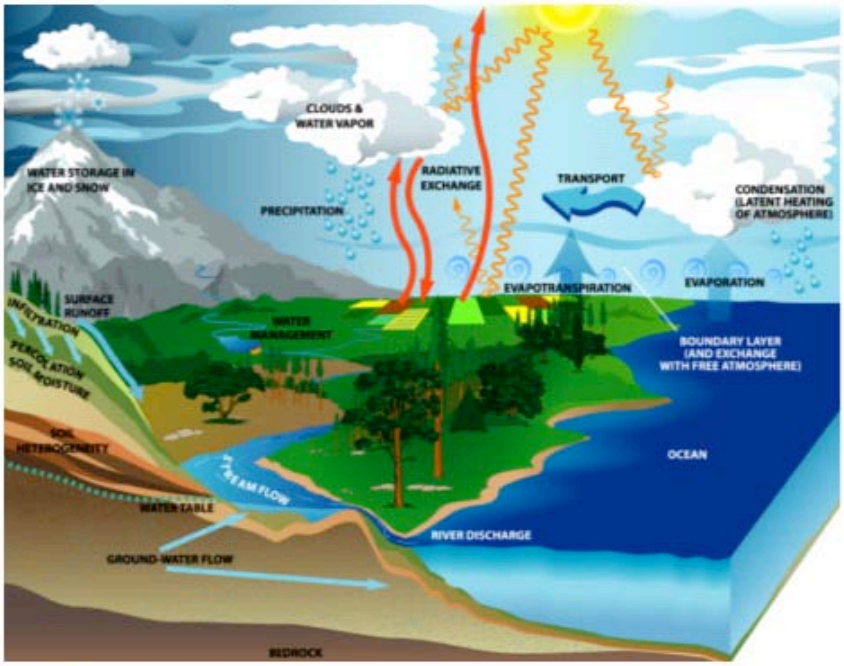
Extend Page

Water Cycle

- Water enters air by evaporation (oceans and bodies of water).
- Condenses in air.
- Returns to earth as precipitation.
- Water will move until it reaches a large body of water.
  - Ground water, the upper surface of groundwater = water table.



Steps in the Water Cycle



http://www.epa.gov/safewater/kids/flash/flash_watercycle.html

Opportunities to Relearn

Teacher Notes: http://www.in.gov/dnr/soilcons/wet/images/pwdice.pdf

You will need to make up the dice for this activity.

Soil Station Cube
- 2 sides- clouds
- 1 side - rivers
- 1 side - plants
- 1 side - groundwater
- 1 side - stay
- *STAY means the water droplet stays at the station*

Plant Station Cube

- 4 sides - clouds
- 2 sides - stay

River Station Cube

- 1 side - animals
- 1 side - lakes
- 1 side - groundwater
- 1 side - oceans
- 1 side - clouds
- 1 side - stay

Lake Station Cube

- 2 sides - stay
- 1 side - clouds
- 1 side - oceans
- 1 side - groundwater
- 1 side - lakes

Cloud Station Cube

- 1 side - soil
- 1 side - lakes
- 1 side - glaciers
- 1 side - stay
- 2 sides - oceans

Ocean Station Cube

- 2 sides - clouds
- 4 sides - stay

Animal Station Cube

- 2 sides - soil
- 3 sides - clouds
- 1 side - stay

Ground water Station Cube

- 3 sides - stay
- 2 sides - lakes
- 1 side - rivers

Glacier Station Cube

- 1 side - groundwater
- 1 side - clouds
- 1 side - rivers
- 3 sides - stay

You will also need to make signs to hang around your room that indicate where each station is. The templates for the dice follow the activity.

THE INCREDIBLE JOURNEY

Background:

While water does circulate from one point of state to another in the water cycle, the paths it can take are variable.

Heat energy directly influences the rate of motion of water molecules. When the motion of the molecule increases because of an increase in heat energy, water will change from solid to liquid to gas. With each change in state, physical movement from one location to another usually follows. Glaciers melt to pools which overflow to streams, where water may evaporate into the atmosphere.

Gravity further influences the ability of water to travel over, under, and above Earth's surface.

One of the most visible states in which water moves is the liquid form. Water is seen flowing in streams and rivers and tumbling in ocean waves. Water travels slowly underground, seeping and filtering through particles of soil and pores within rocks.

Although unseen, water's most dramatic movements take place during its gaseous phase. Water is constantly evaporating, changing from a liquid to a gas. As a vapor, it can travel through the atmosphere over Earth's surface. In fact, water vapor surrounds us all the time. Where it condenses and returns to Earth depends upon loss of heat energy, gravity, and the structure of Earth's surface.

Water condensation can be seen as dew on plants or water droplets on the outside of a glass of cold water. In clouds, water molecules collect on tiny dust particles. Eventually, the water droplets become too heavy and gravity pulls the water to Earth.

Living organisms also help move water. Humans and other animals carry water within their bodies, transporting it from one location to another. Water is either directly consumed by animals or is removed from foods during digestion. Water is excreted as a liquid or leaves as a gas, usually through respiration. When water is present on the skin of an animal (for example, as perspiration), evaporation may occur.

The greatest movers of water among living organisms are plants. The roots of plants absorb water. Some of this water is used within the body of the plant, but most of it travels up through the plant to the leaf surface. When water reaches the leaves, it is exposed to the air and the sun's energy and is easily evaporated. This process is called transpiration.

All these processes work together to move water around, through and over Earth.

Procedure:

1. You are a water molecule moving through the water cycle.
2. You can move through nine different stations: Clouds, Plants, Animals, Rivers, Oceans, Lakes, Ground Water, Soil, and Glaciers.
3. You will be assigned to an initial station where you will form a line. At the cloud station form a single line, at all other stations line up in pairs.
4. Roll the dice at the station to determine where in the cycle you will go next. When you move as a liquid you will grab the person next to you and take them with you representing many water molecules in a water drop. When you move to clouds (evaporate), you will separate from your partner and move alone as an individual water molecule.

HYPOTHESIS: Where in the water cycle do you think you, a water molecule, will spend the most time?

_____

_____

5. Record data in Table 1. Under # of times at location, tally how many times you are at each station. Under Total, count up the tally marks and record the total number.
6. When you get to the next station go to the end of the line.
7. Continue until told to stop.

Conclusion:

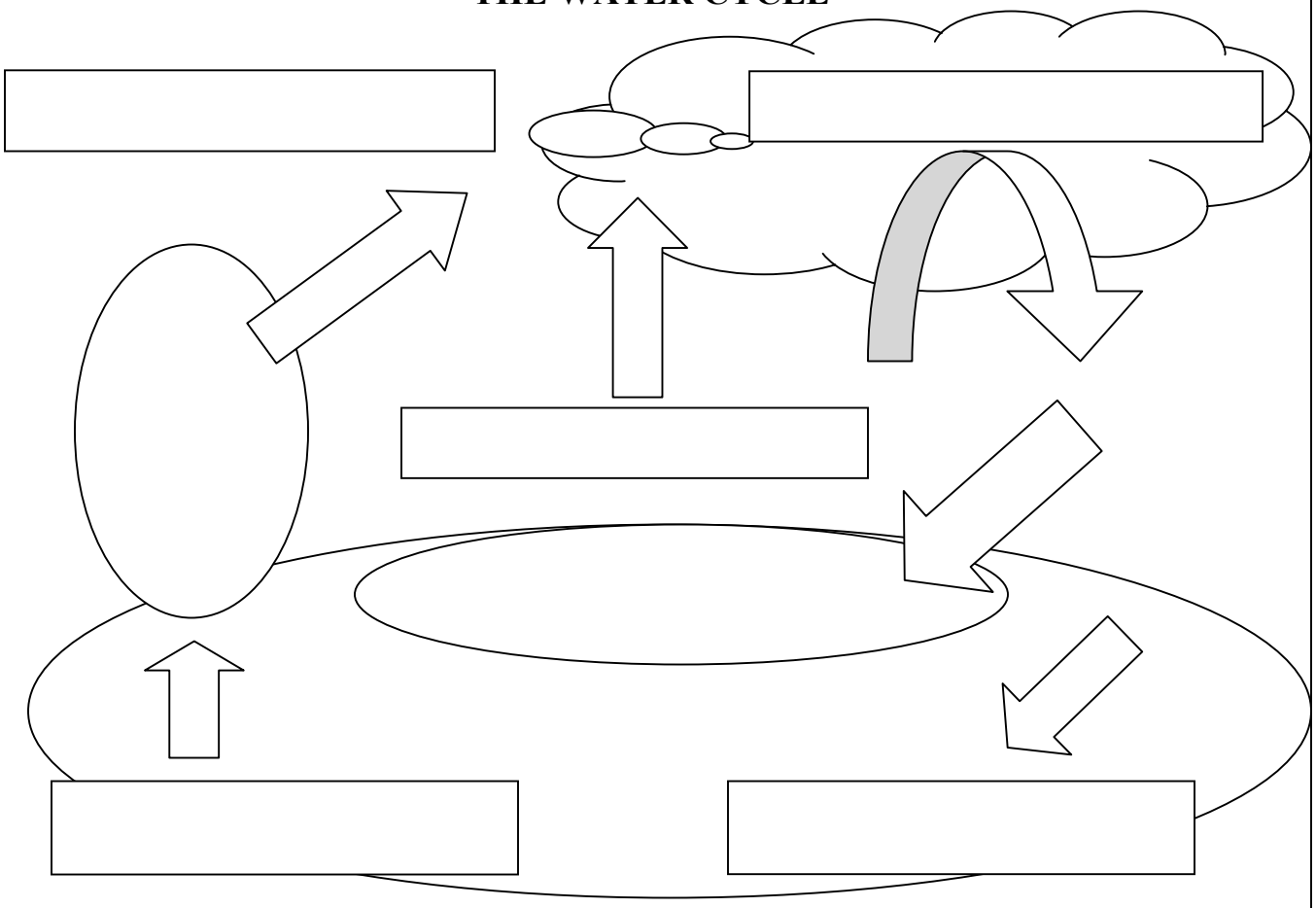
1. Where did you spend the most time? The least time?
2. Discuss any *cycling* that took place (returning to the same place).
3. Write a story describing all of the places you have been as a water molecule. Include what state you were in (solid, liquid, gas).

STATION	# OF TIMES AT LOCATION	TOTAL
CLOUDS		
PLANTS		
ANIMALS		
RIVERS		
OCEANS		
LAKES		
GROUND WATER		
SOIL		
GLACIERS		

Table 1

Independent Practice

THE WATER CYCLE



1. How does water come from the atmosphere to the Earth?

_____

2. What happens to water once it reaches the Earth?

_____

3. How does water leave the earth and return to the atmosphere?

_____

4. Is it runoff water or groundwater that evaporates?

_____

5. What happens to the groundwater?

_____

Enrichment: Article that follows in addition to the questions pertaining to the article.

Ohio State University Extension Fact Sheet

Food, Agricultural and Biological Engineering

Ohio's Hydrologic Cycle

AEX-461-94

Larry C. Brown

Water is Important!

Recent estimates indicate that Ohioans use approximately 11,700 million gallons of water per day (MGD) for various purposes. Over 9,000 MGD of the 11,700 MGD is for thermo-electric use. This water is supplied by our state's abundant water resources, which include surface- and ground-water supplies (see Table 1). Surface-water resources, such as ponds, lakes, reservoirs, streams and rivers, supply water to about 55 percent of the state's population. These resources include 43,900 miles of streams and 2,200 lakes. The remaining 45 percent of the population is served by ground water, which is extracted from water-bearing geologic formations beneath the Earth's surface. These formations, called aquifers, are of two types in Ohio: unconsolidated deposits and sedimentary bedrock, which are confined or unconfined.

Table 1. Water Facts for Ohio [1]

Water Resource	Estimated Percent of the Total Population Served		Estimated Percent Totals	Estimated Water Use (MGD)[2]
	From Public Supply Systems	From Rural Water Self-Supplied Systems		
Surface Water	54.4	0.3	54.7	932.7
Ground Water	29.1	16.2	45.3	534.8
Totals	83.5	16.5	100.0	1,467.5

1. Abstracted from USGS, 1984; 1985; 1990; 1993
2. Million gallons per day

Water use can be separated into the following supply categories: public, rural (domestic and livestock), industrial, and irrigation. As indicated in Table 2, about 70 percent of the public water supply in Ohio is furnished by surface water, while 98 percent of the rural domestic supply is furnished by ground water. Surface and ground water both play important roles in supplying water for domestic purposes in Ohio.

Table 2. Categories of Water Use in Ohio[1].

	Surface Water[2]		Ground Water	
Category of Use	**Percent of Use Supplied by Surface Water**	**Percent of Total Surface Water Use[2]**	**Percent of Use Supplied by Ground Water**	**Percent of Total Ground Water Use[3]**
Public	70	77	30	60
Rural				
Domestic	2	0.2	98	20
Livestock	76	2	23	1
Industrial	65	20	35	18
Irrigation	73	1	31	1

1. Abstracted from USGS, 1984; 1985; 1990; 1993

2. Offstream use only.

3. Percentages may not add up to 100 percent because of independent rounding errors.

Where does all of this water come from and where does it go? The answers to these questions are important not only for establishing a reliable water source but also for developing an awareness of how human activities can influence the quantity and quality of Ohio's water resources. This publication provides an overview of the hydrologic cycle as it relates to Ohio.

What is the Hydrologic Cycle?

The Earth holds more than 300 million cubic miles of water beneath the surface, on the surface, and in the atmosphere. This vast amount of water is in constant motion in a complex cycle known as the hydrologic cycle.

The hydrologic cycle, illustrated in Figure 1, describes the pathways that water travels as it circulates throughout the world by various processes. The visible components of this cycle are precipitation and runoff; however, other components, such as evaporation, infiltration, transpiration, percolation, ground-water recharge, interflow, and ground-water discharge are equally important.

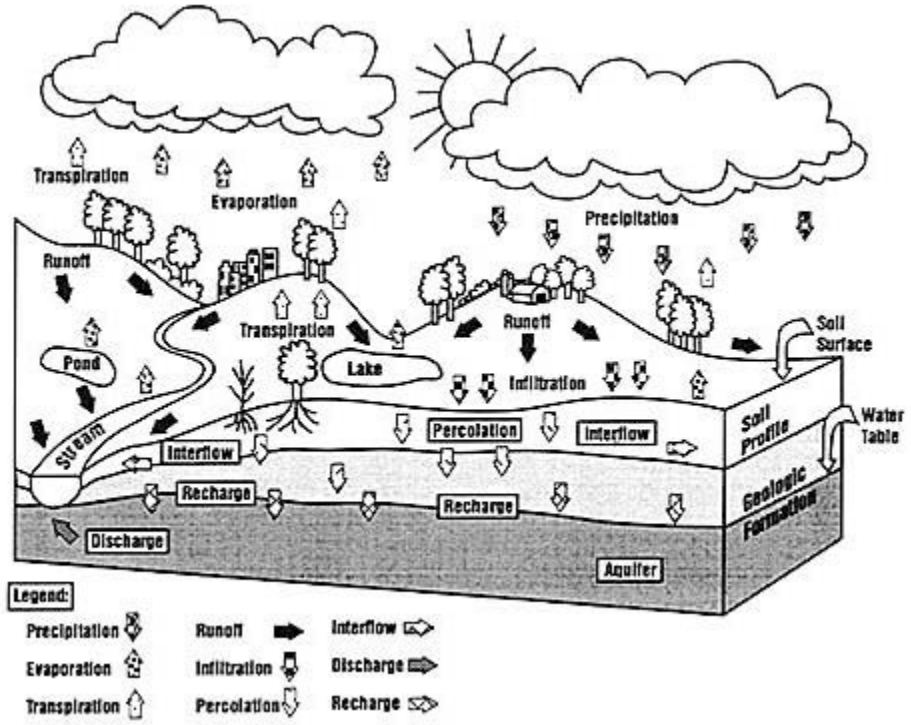


Figure 1. The Hydrologic Cycle. (Modified from What is Groundwater?, 1988)

Adding It Up

As stated earlier, the average annual **precipitation** in Ohio is 38 inches. Of these 38 inches, about 10 inches become **runoff**, which moves immediately to surface-water bodies. Two inches are retained at or near the ground surface and **evaporate** back into the atmosphere in a relatively short period of time.

Twenty-six of the 38 total inches enter the soil surface through **infiltration.** Twenty of these 26 inches go into **soil storage** and later are returned to the atmosphere by the combined processes of **evaporation** and **transpiration (evapotranspiration).** The remaining 6 inches **recharge** the **ground-water** supply. Two of these 6 inches eventually move to springs, lakes, or streams as **ground-water discharge.** The remaining 4 inches either return to the atmosphere by **evapotranspiration** or are withdrawn to supply water needs.

These numbers are averages for Ohio. Values for particular locations will differ according to local conditions.

The Hydrologic Cycle and Water Quality

As water constantly moves from the Earth to the atmosphere and back to the Earth, the constituents dissolved in it and transported by it are modified as a result of natural processes and human activities. Chemicals and particles in dust, smoke and smog in the atmosphere eventually fall back to the Earth with precipitation. Water moving across the soil surface as runoff can detach soil particles and transport them to a stream or lake. Runoff from lawns, pastures, and

agricultural fields can also carry dissolved nutrients and pesticides. Certain chemicals attach to soil particles and also are transported to receiving waters. Runoff from roadways and parking lots wash grit and metal particles directly into storm sewers and streams.

Water that percolates to the underlying aquifer can be polluted by the leaching of chemicals, nutrients and/or organic wastes from the land surface or from materials buried in landfills. Aquifers close to the surface or in porous, unconsolidated strata (sands and gravels) can be very vulnerable to pollution. Deep aquifers are also vulnerable, especially if connected to the surface by fissures or sinkholes in underlying formations as in limestone rock areas. Certainly, surface and underground conditions differ all across Ohio. However, human activities in any part of the state can have a dramatic impact on the quality of our surface- and ground-water resources.

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Skimming and Scanning

Teacher Activities:

1. Students are to work in pairs to skim and scan the assigned reading: look at titles, headings, visuals, boldfaced words, and the first and last paragraph. Discuss with each other what they think the reading will be about.
2. Whole class will compile questions: this is to be placed in the First Impressions column.
3. Examine the first impressions and write down several facts they discovered during their limited reading. Compile the facts in the Fast Facts column.
4. Students are to look at the first impressions and fast facts, to determine what they think the important points or questions that may be answered by the reading.
5. Now they are ready to read the article, answering all questions posed by the pre-reading activity and correcting any fast facts that may be incorrect. After reading they are tom complete the Final Thoughts column, summarizing the article and correcting misconceptions.

First Impressions	Fast Facts	Final Thoughts

Lesson Five: The Carbon Cycle

Title of Lesson Plan	**Carbon Cycle**
Grade Level	**Explain the structure and function of ecosystems and relate how ecosystems change over time.**
ODE Standard:	**Explain the structure and function of ecosystems and relate how ecosystems change over time.**
GLI(s)	**Describe ways that human activity can later biogeochemical cycles (e.g., carbon dioxide and nitrogen cycles) as well as food webs and energy pyramids (e.g., pest control, legume rotation crops vs. chemical fertilizers) (1982 ES-7)**
Anticipatory Set	**Presentations a continuation of Cycles**
Explanation	**Notes**
Guided Practice	**Guided walk through of the Carbon Cycle**
Opportunities to Relearn	
Independent Practice	**Carbon Cycle Worksheet**
Assessment/Evaluation	**RAFT and district assessment**
Enrichment	**Article: Oil Fires and the Carbon Cycle - RAFT**
Closure	**Presentation of Speeches**
Materials (include websites)	**At the end of the Unit plan: reference page.**

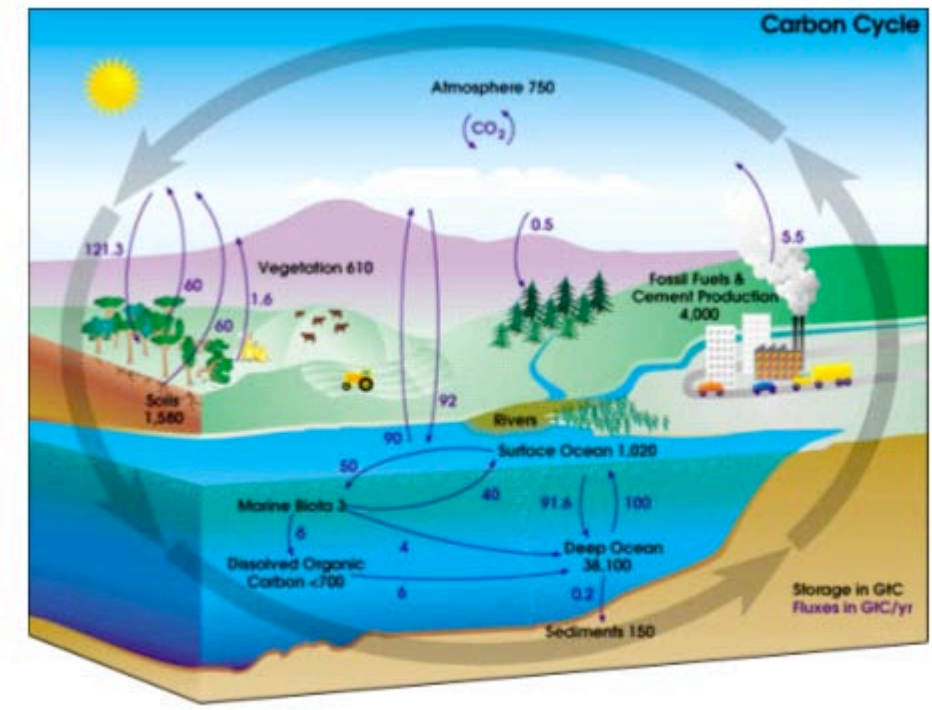
Explanation:

Carbon Cycle

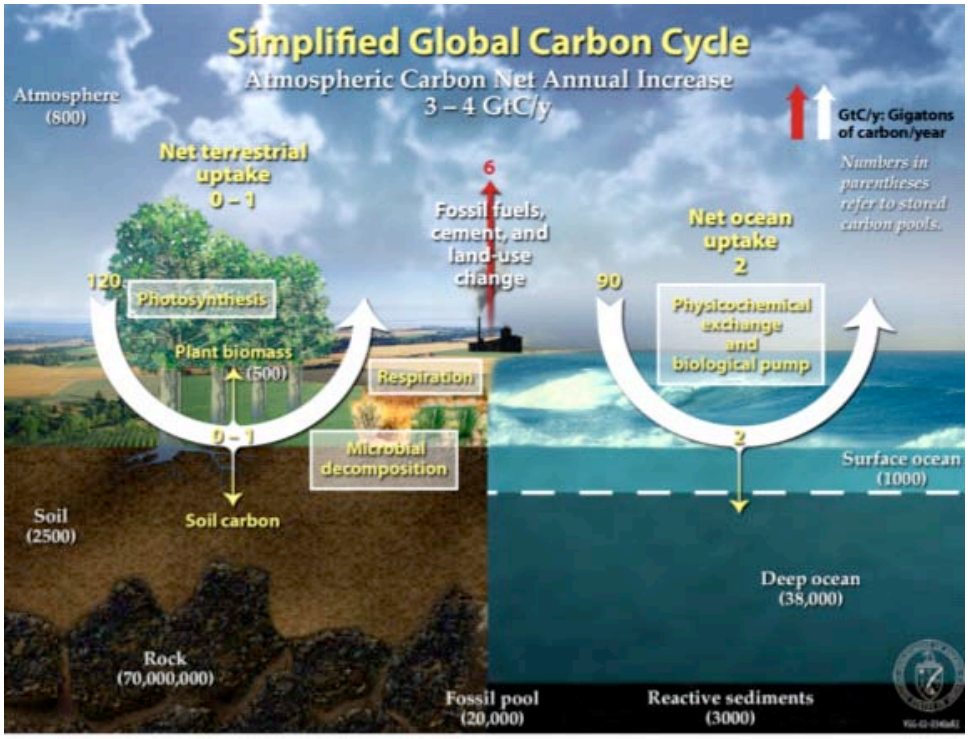
- Photosynthesis, green plants use CO_2 to make glucose.

- Consumers and produceres use glucose in respiration, where they release CO_2 inot the atmosphere.

Let's look at the Carbon Cycle in some more detail...



Explain what is going on in this diagram...



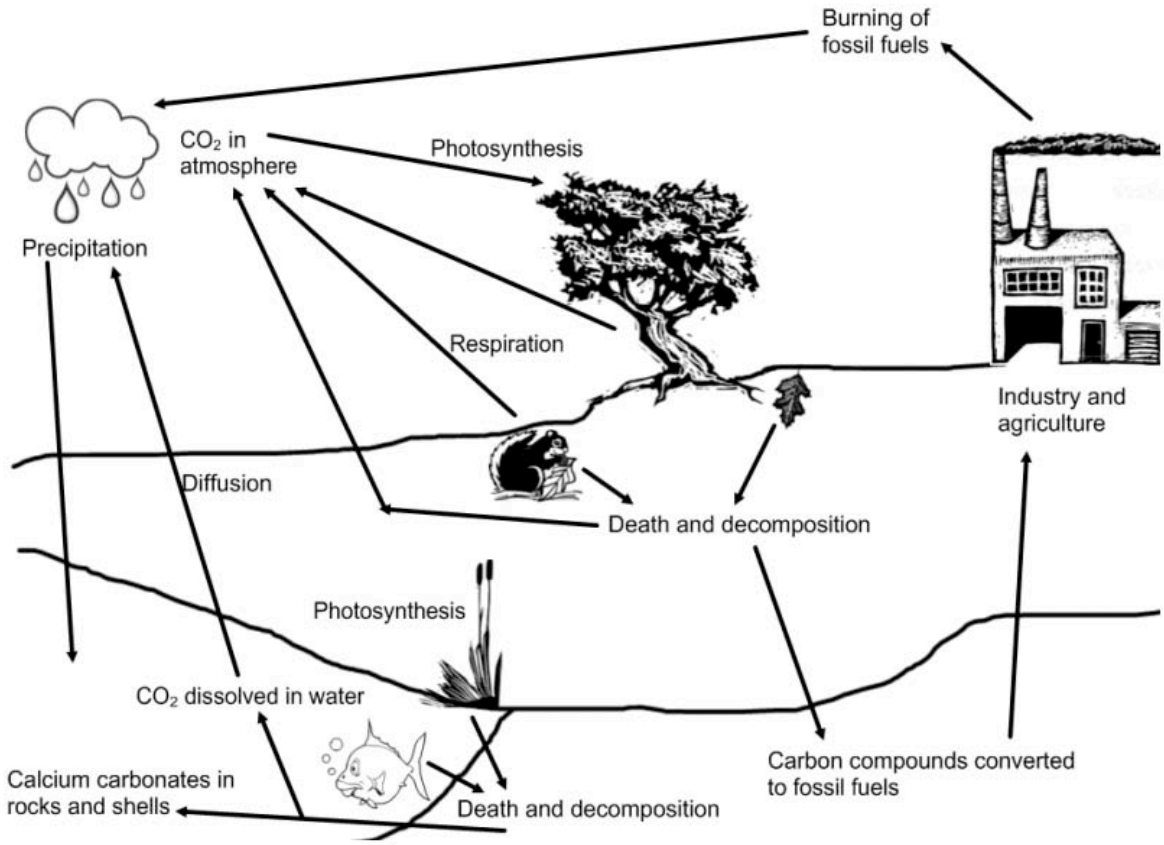
http://epa.gov/climatechange/kids/carbon_cycle_version2.html Kaminski, 2007

Independent Practice

Name: _____ Period: _____

The Carbon Cycle

Use the diagram to answer the questions below.



1. What is the process by which plants convert carbon dioxide into energy-rich carbon compounds?
2. Explain what happens over millions of years to the carbon compounds in organisms that die and decompose.
3. What processes above release carbon dioxide into the atmosphere?
4. Identify two major reservoirs of carbon dioxide on Earth.
5. What are the forms in which carbon is found in the oceans?
6. How do plants and animal help to maintain a balance of carbon dioxide in the atmosphere?
7. Atmospheric carbon dioxide might produce a "greenhouse effect" by trapping heat near the Earth's surface. What human activities might tend to increase the greenhouse effect?

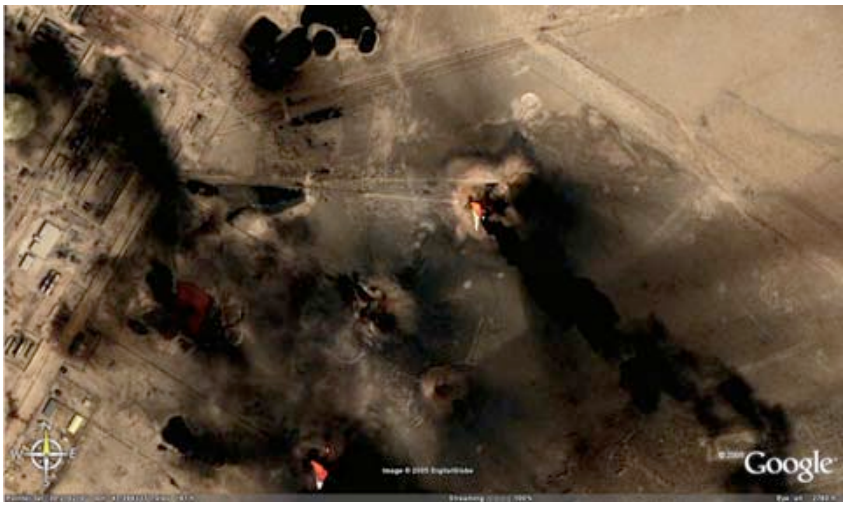
Assessment/Enrichment

RAFT

Role – Environmentalist whose area of expertise is the Carbon Cycle and the human activities that alter the cycle.
Audience – high school science teachers
Format – Speech (you will be writing this out first, them presenting)
Topic – the carbon cycle and the effects of the Middle East oil fires on the environment.

July 27, 2005

Oil Fires and the Carbon Cycle by Stefanie Hamilton

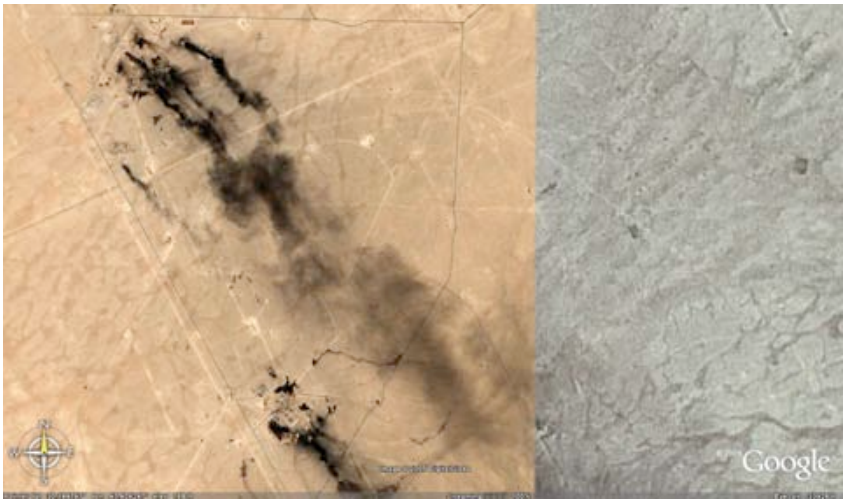


In 1991, and again in March of 2003, oil fires became a serious environmental concern. In 1991, it was the Kuwait oil fields, set ablaze by Sadaam Hussein. In March of 2003, it was the oil fields in Iraq itself, also believed to have been set on fire by Sadaam's people.

This satellite imagery shows some of the burning oil wells of 2003. The intense, black smoke created a litany of environmental and human concerns, one of which focused on the carbon dioxide released by the smoke.

The Carbon Cycle is something every living thing (people included) is part of, but most people have never heard of it. Simply put, the Carbon Cycle is the cyclical exchange of carbons between atmosphere, ocean and biosphere. There are many stores, or "sinks", of carbon, and many ways the sinks exchange carbon. Photosynthesis is the most well known aspect of the carbon cycle, though the process doesn't end with carbon dioxide and water being made into food for plants. From there, the cycle continues. An animal eats the plant. The carbon dioxide, which has been transformed into glucose, is ingested, and the animal becomes part of the cycle. Carbon is then emitted from the animal either through various bodily functions (exhaling, etc.), or through death of the animal (decomposing bodies emit carbon dioxide). So the carbon in released back into the air and the process starts all over again.

An event like the Iraqi oil fires raises concerns because the Carbon Cycle is what's called a closed cycle. In other words, the carbon never goes away, it is merely transferred, in various forms, from one thing to another. So when an abundance of carbon is released into the atmosphere by something like an oil fire, we're stuck with that. Those carbons are now a permanent part of our environment and eco-system.



In a November, 1998 Department of Defense news briefing, Lt. General Dale Vesser (ret.) stated that the effects of the Kuwait oil fires (at least to humans) were negligible.

"….the exposure in Kuwait during the oil well fires…to many of these substances was lower than it was in Houston, Philadelphia, Phoenix or Los Angeles during this same period of time. Now why is that? The oil well fires burned so hot, first of all, much of this material was lofted high. But in addition, much of the material was destroyed, so there were fewer contaminants left after the fire because the fire burned so hot."
Source

Based on this statement, it seems safe to say the effects of the Iraq oil fires were negligible to humans as well. However, long-term effects are still being assessed, and short-term effects were clear: people with asthma and other respiratory conditions found those conditions to be aggravated when exposed to the smoke and soot created by the fires.

There is also concern about something called a polycyclic aromatic hydrocarbon (PAH), which is produced during the incomplete burning of oil, gas, or coal. PAHs are believed to be carcinogenic and have been the cause of reproductive problems and birth defects in laboratory

animals. Some laboratory mice also passed these problems on to their offspring. In addition, PAHs can contaminate the water supply. They don't readily dissolve in water, but rather, sink to the floor of rivers and lakes. Certain types will pass through soil and contaminate ground water, thus becoming a potentially more dangerous part of our eco-system as it can then be absorbed by plants, and eventually by animals and/or people.

Another official government statement claimed that the carbon particles released into the atmosphere were too large to be absorbed into the lungs or skin. Good news for U.S. troops and Iraqi citizens, potentially bad news for the rest of us.

One effect of an increased release of carbons is an intensified "greenhouse effect". Carbon dioxide interferes with the Earth's natural heat radiation. It essentially blocks heat rays, keeping them here on Earth. Consequently, a greater amount of carbon dioxide means more heat is trapped in the Earth's atmosphere.
The Greenhouse Effect, in and of itself, is not a bad thing. The Earth's eco-system was intentionally designed with a certain amount of carbon dioxide in the atmosphere. It's one of the factors that make this planet conducive to life. The problem is that we've been producing more and more carbon dioxide. And remember, the Carbon Cycle is a closed one, so the excess we

produce sticks around. This means that all the additional carbon produced by the Iraqi oil fires hasn't dissipated, and never will. It's now a permanent part of the cycle.

Debates will undoubtedly continue with regards to the true effects the Iraqi oil fires have had, and are having, on people and the environment. Some will claim there were no effects at all, others will make it sound as though the world is coming to end. So we may never know the absolute, untainted truth, but we do know this: excess carbons were released into an environment that's already becoming carbon-heavy, and some of what was released is potentially toxic. And despite the fact that some carbon sinks (like the ocean) absorb more carbon than they release, we find ourselves dealing with an unnatural balance.

http://www.sprol.com/?p=214

Lesson Six: The Nitrogen Cycle

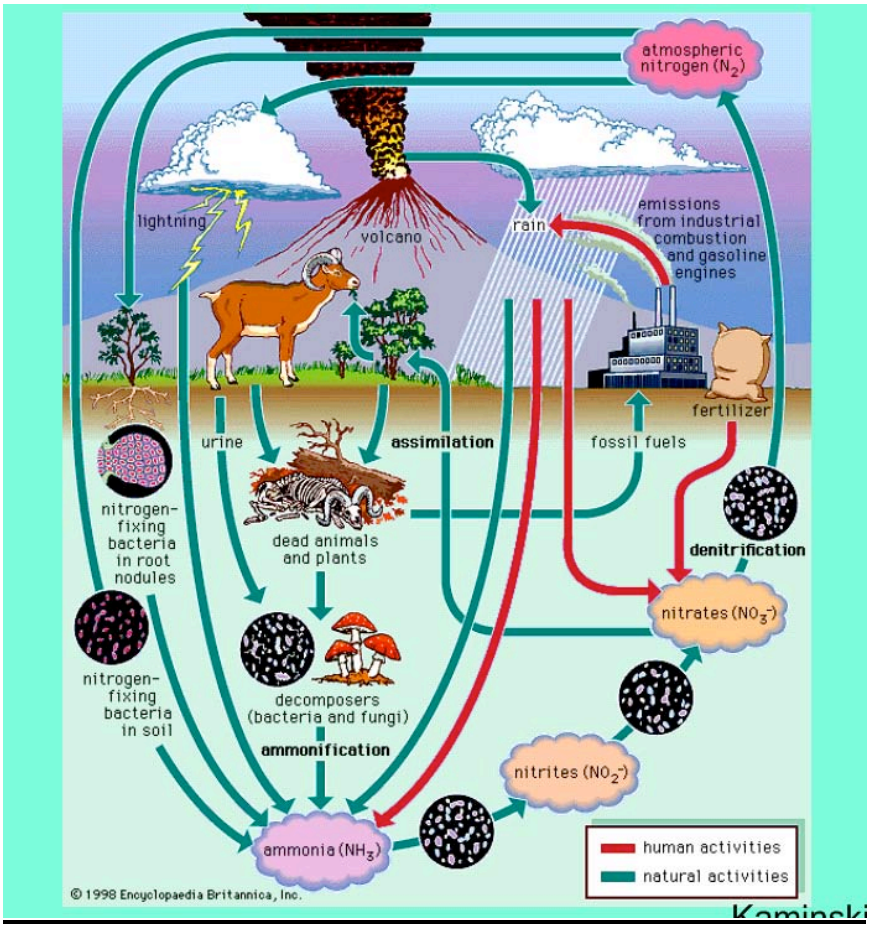
Title of Lesson Plan	**Nitrogen Cycle**
Grade Level	**10**
ODE Standard:	**Explain the structure and function of ecosystems and relate how ecosystems change over time.**
GLI(s)	**Describe ways that human activity can later biogeochemical cycles (e.g., carbon dioxide and nitrogen cycles) as well as food webs and energy pyramids (e.g., pest control, legume rotation crops vs. chemical fertilizers) (1982 ES-7)**
Anticipatory Set	**Continuation of Cycles presentations**
Explanation	**Notes**
Guided Practice	**Walk through the Nitrogen Cycle: embedded in presentation**
Opportunities to Relearn	**Nitrogen, Farms, Fish, Bears, and Salmon**
Independent Practice	**Pesticide Spraying Lab**
Assessment/Evaluation	**Pesticide Spraying Lab: District Assessment**
Enrichment	**Cycle Series: The Nitrogen Cycle Video - United Streaming**
Closure	**Question to discuss in pairs: How are all of the cycles discussed (water, nitrogen, and carbon) all related to some of the environmental and atmospheric issues happening worldwide?**
Materials (include websites)	**At the end of the Unit plan: reference page.**

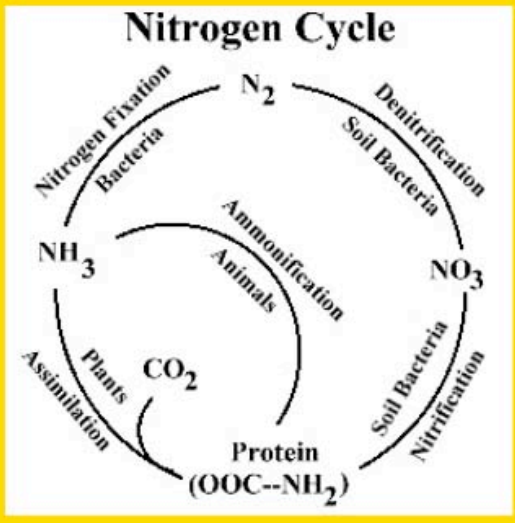
Explanation

Nitrogen Cycle

- Organisms need nitrogen to build proteins.
- Found in wastes

- Nitrogen Fixation
  - Bacteria change free N into N compounds.
  - Now available to plants to produce proteins.
  - Animals eat plants and use to make proteins.
  - Denitrification
    - Bacteria in soil break down N compounds into free N.





Now, let's see how farmers are affected by the Nitrogen Cycle...

http://www.ext.vt.edu/resources/4h/virtualfarm/flash_mov/nitrogencycleintro.swf

Opportunities to Relearn:

Name: _____

Nitrogen, Farms, Fish, Bears, and Salmon

Farmer A has a large farm on which he grows corn. Through his farm flows a small creek which empties into a lake. This farmer sprays nitrogen fertilizer on his crops several times a year. Due to the weather patterns where he lives it often rains within several days of the application of the fertilizer. The lake near him has been a major recreation area with clear water and good fishing. Recently, clear water has become brownish green with mats of algae floating on the surface by late summer, resulting in fish kills. In the fall and winter there are many dead fish floating on the surface of the lake and drifting to shore. Recreation at the lake is coming to a halt because of the murky water and the dead fish.

Farmer B has a similar large farm in which he grows corn one year and soybeans the next. Through his farm also flows a small creek, which empties into a similar lake. This farmer does not spray any nitrogen fertilizer on his crops. He knows that soybeans have bacteria on their roots which take the atmospheric oxygen and convert it into a form of nitrogen that the plants can use. The rainfall is similar to Farmer A's area. The lake near him is and remains a major recreation area. The water is clear and there is good fishing. There is no algae floating in the late summer and there are no fish kills.

Answer the following questions on a separate sheet of paper.

1. What is the most probable cause of the algae growing in the lake near farmer A's farm?
2. Why would increased nitrogen cause the algae to grow?
3. What would cause the fish to die?
4. Why did the algae not increase in the lake near farmer B?

Extended Questions

1. If fossil fuels contain nitrogen what happens to the nitrogen oxide gas (NO) that is produced when they are burned?
2. As human populations increase, more food is needed. To meet the increasing demand crops are grown using fertilizer to increase their yield. What happens to the excess fertilizer?
3. What would happen to the coastal marine fisheries when nitrogen fertilizer follows the rivers to the ocean?
4. Farmers raise cattle, hogs and chickens in large numbers. Their waste contains large amounts of nitrogen. What takes place when that waste enters a water system such as a creek, lake or river?

Independent Practice and Assessment

Name: _____

PESTICIDE SPRAYING

An insect pest has attacked about 20% of the trees in a pure stand of white pine trees, Area A. This area is on the west of the river that runs north to south. In an effort to reduce the economic loss, the owner has the forest crop sprayed every spring with a relatively new pesticide. The species that the farmer is trying to eliminate is normally prayed upon by other insects, a parasite, and blue birds from nearby words, Area B, which is east of the river. To the south of the property and on the east side of the river is a bird sanctuary for rare species of waterfowl and the carnivorous ospreys. The farmer has been assured that natural barriers and the wind direction (west to east) will keep the pesticide out of the wildlife area. The three areas were carefully studied over a five-year period by researchers from a nearby university. Insect populations were estimated fish and bird populations studied, and pesticide concentrations measures in an effort to determine the overall environmental influence of this new pesticide. The results are recorded in Table 1.

Year	Area	Insect Population	Pesticide Concentration in Fish (ppm)	Carnivorous Birds Percentage Nesting Success	Carnivorous Birds Insecticide in egg (ppm)
1985	A	200,000	50		
	B	50,000	50	80	70
	C	50,000	30		
1986	A	4,000	150		
	B	2,000	120	25	170
	C	40,000	100		
1987	A	200	250		
	B	1,000	200	10	240
	C	40,000	150		
1988	A	800,000	400		
	B	80,000	350	4	300
	C	50,000	250		
1989	A	1,400,000	500		
	B	100,000	450	2	400
	C	50,000	300		

QUESTIONS:

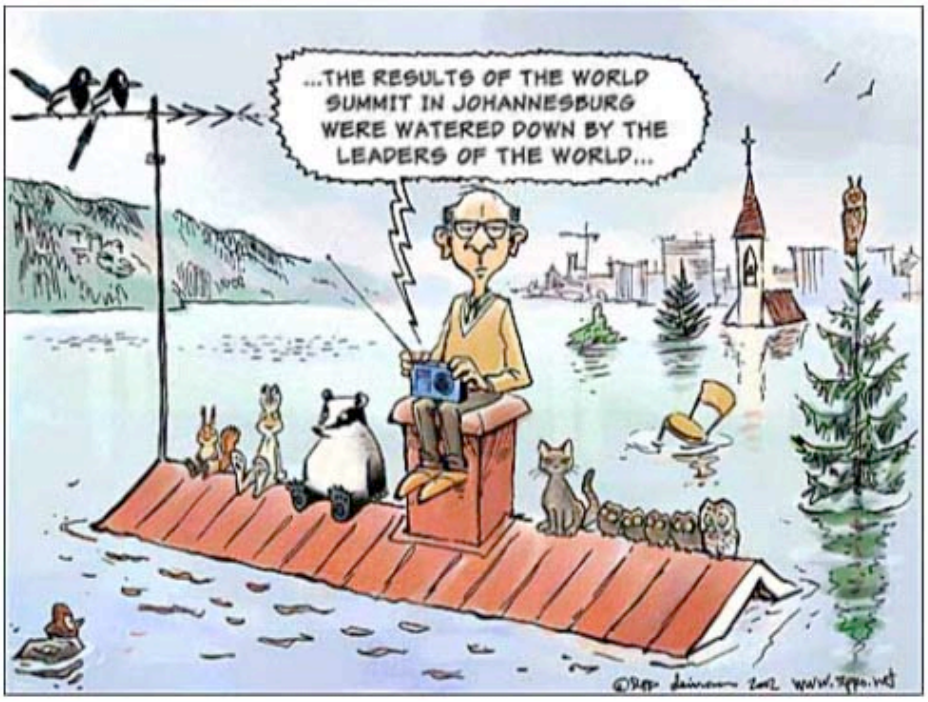
1. Draw pictures of what the area looks like from the reading. Where is each area located in relationship to the other?
2. How has the spraying of pesticide affected the insect population?
3. How has the spraying of the pesticide affected the fish?
4. How has the spraying of the pesticide affected the bird population, both in nesting success and the concentrations in the eggs laid?
5. What can you determine about the effect of the pesticide spraying on the animals in the area (fish and birds)?

Lesson Seven: Atmospheric Issues

Title of Lesson Plan	**Atmospheric Issues**
Grade Level	**10**
ODE Standard:	**Explain the structure and function of ecosystems and relate how ecosystems change over time.**
GLI(s)	**Explain how the acquisition and use of resources, urban growth, and waste disposal can accelerate natural change and impact the quality of life. (1981/EES - 5) Describe ways that human activity can alter biogeochemical cycles (e.g., carbon and nitrogen cycles) as well as food webs and energy pyramids (e.g., pest control, legume crop rotation vs. chemical fertilizers) (1982 ES - 7) Describe advances and issues in Earth and space science that have important long-lasting effects on science and society (e.g., geological time scales, global warming, depletion of resources, exponential population growth). (1983 / ES - 7)**
Anticipatory Set	**Cartoon Motivation: Based on what they know about biogeochemical cycles and previous topics throughout the year students should be able to infer from the cartoon that Global Warming is the main topic. This will lead into a brief introduction to how humans affect biogeochemical cycles and the atmospheric issues associated.**
Explanation	**Notes: Atmospheric Issues**
Guided Practice	**Video: Global Warming (EHS science dept)**
Opportunities to Relearn	**Global Warming Connections**
Independent Practice	**Assessment Questions related to Lab and Video**
Assessment/Evaluation	**Lab and Video Questions; District assessment**
Enrichment	**In order to bring the lessons on cycles and atmospheric issues together students will complete a grafiti on several issues.**
Closure	**Discussion of Enrichment**
Materials (include websites)	**At the end of the Unit plan: reference page.**

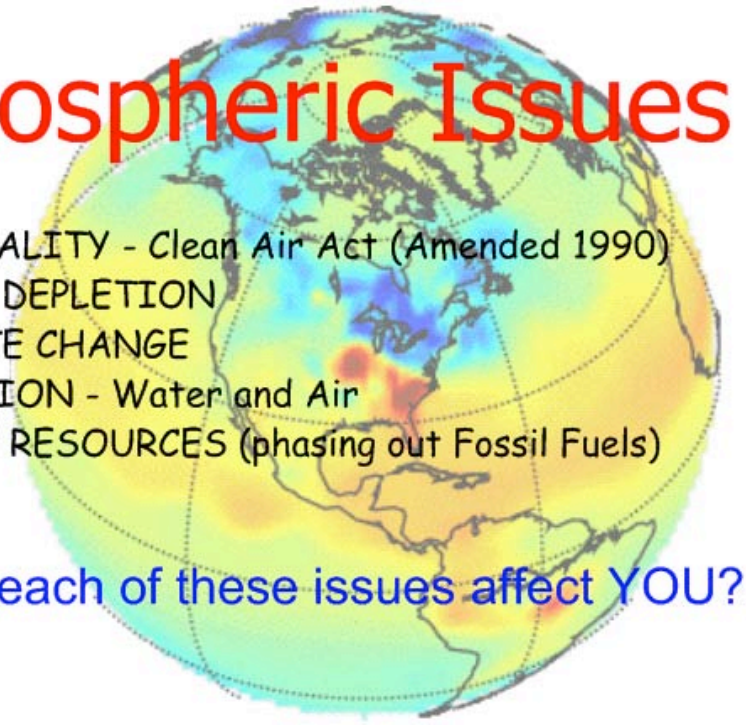
Anticipatory Set:

Look at the cartoon: What do you think they are hinting at in this cartoon?



Explanation:

Atmospheric Issues



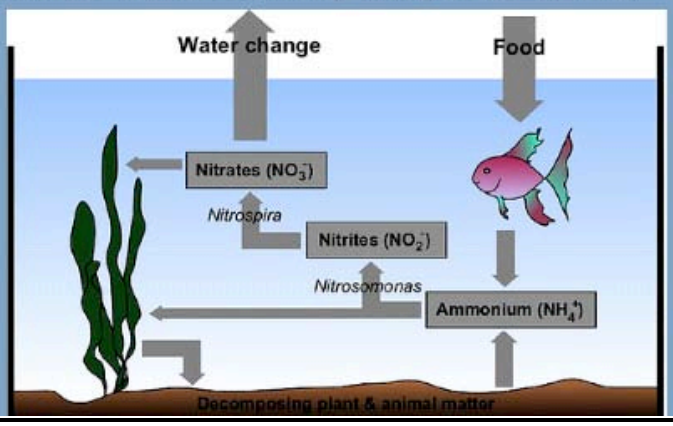
AIR QUALITY - Clean Air Act (Amended 1990)
OZONE DEPLETION
CLIMATE CHANGE
POLLUTION - Water and Air
ENERGY RESOURCES (phasing out Fossil Fuels)

How do each of these issues affect YOU?

Human Activities that Affect the Nitrogen Cycle

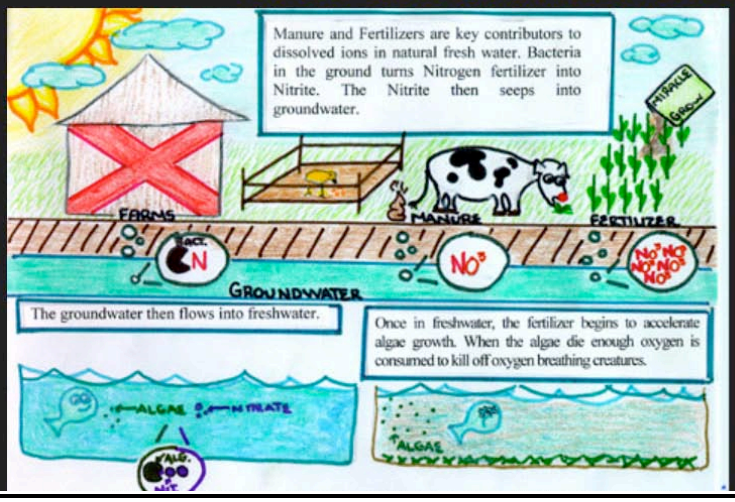
- Human activities cause disruptions in the nitrogen cycle:

- Destroying plant life removes decaying organic matter and the bacteria that return nitrates to the soil and nitrogen gas to the atmosphere
- Planting crops removes nitrates from the soil.
- Farmers maintain soil nitrate levels by using fertilizers and rotating crops.



However…

- Excess nitrates from fertilizer can end up in lakes or other bodies of water.
- This can lead to excess algae growth: *eutrophication*
- The algae uses up O_2 in the water killing off fish and other organisms that need O_2



Why is it considered pollution?

- Promotes excessive plant growth and decay.
- Disrupts normal functioning of the ecosystem.
- Decreases the resource value of rivers, lakes, and estuaries such that recreation, fishing, hunting, and aesthetic enjoyment are hindered.
- Health-related problems can occur where eutrophic conditions interfere with drinking

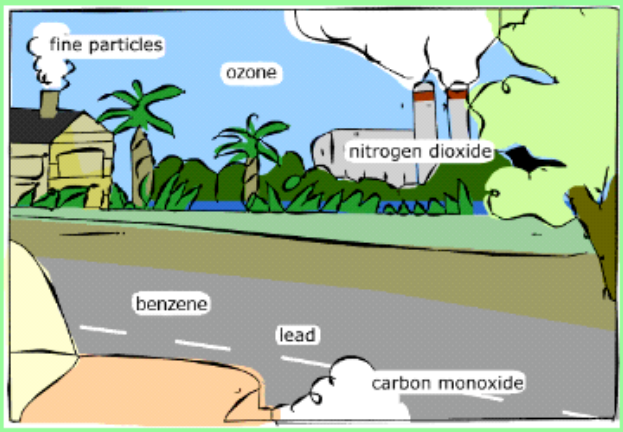
Human Activities that affect...

- Carbon Cycle

- The burning of fossil fuels by cars and industries releases CO_2 into the atmoshpere.
- CO_2 acts like the glass roof of a greenhouse trapping heat close to the Earth=Greenhouse Effect, this leads to global warming- a rise in worldwide temperatures.

Air Pollution

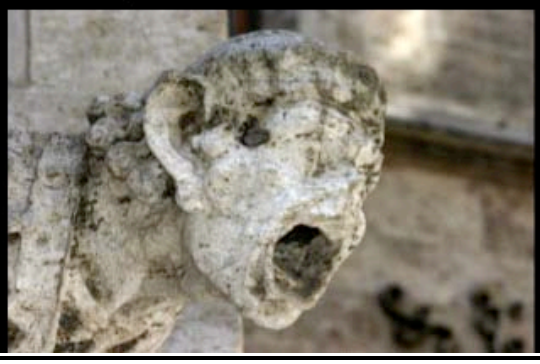
- Harmful to humans, plants, and animals.
- The build-up of pollutants in the atomssphere can cause weather-related problems such as *smog* (a haze formed by pollution in the air reacting with sunlight.
- Smog can cause eye irritation and respiratory ailments and even lead to death.



Acid Rain

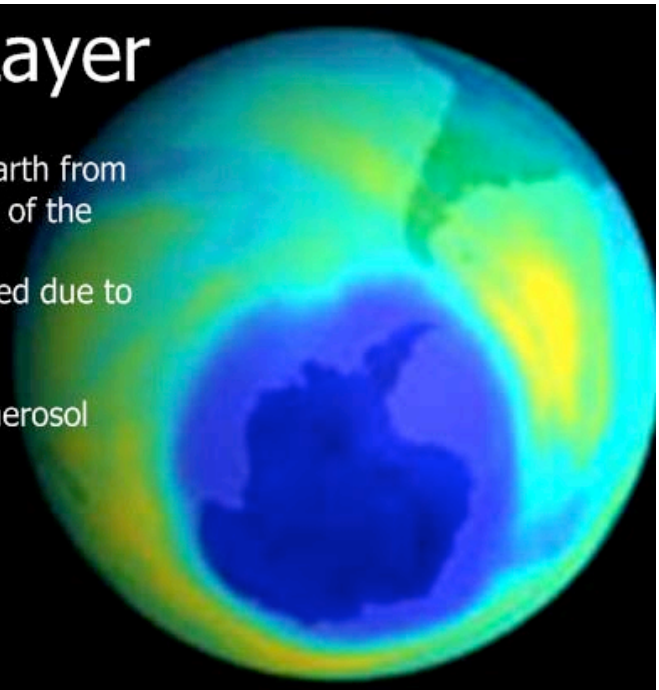
Caused when chemicals in smoke factories and vehicles increase the acidity of water droplets that form clouds.

Victims of acid rain - dead and dying Red Spruce in Maine. Photo by Paul Donahue



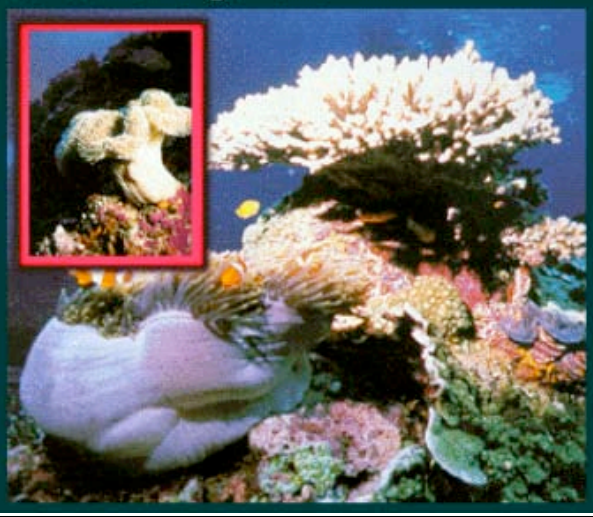
- Poor air quality and high pollution levels have been linked to health problems such as eye irritation, respiratory infections, CO poisoning and cancer.

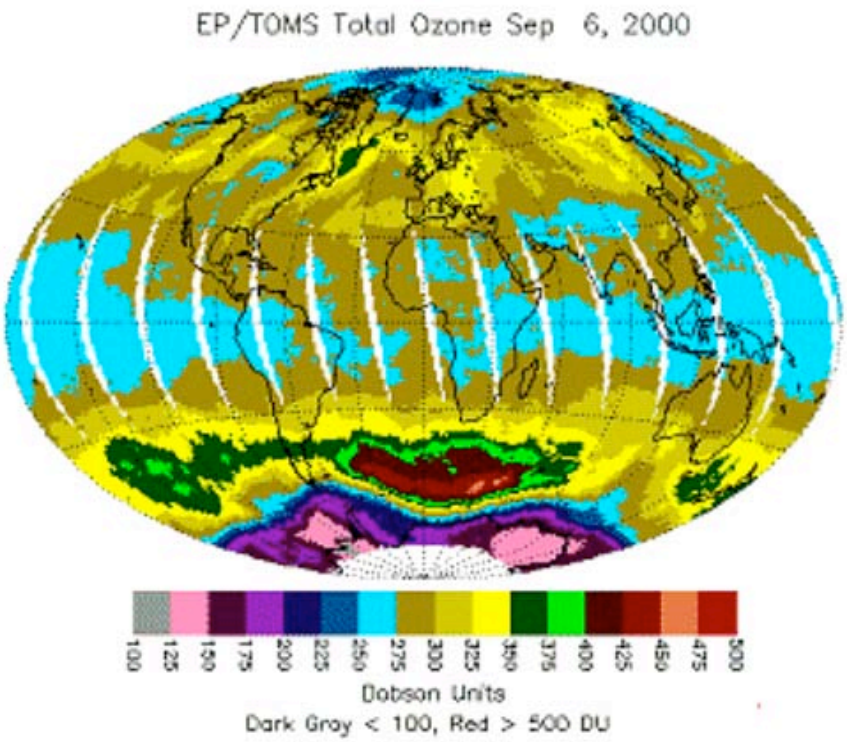
Ozone Layer



- Protects life on earth from the harmful effects of the sun's UV rays.
- It is being depleted due to chemicals found in refrigerators, air conditioners, and aerosol spray cans.

- Oraganisims can be destroyed if they lose its protection. Some frog species have already gone extinct as they are highly sensitive to changes in UV levels.
- Affects can include gene mutations, cancer, the death of cells, even the death of organisms.





Opportunities to Relearn:

Global Warming: Connections

1. Students will sit in a large circle.
2. Index cards will be given to students in the circle.
3. They will create a web to illustrate how the terms are connected.
4. Hand ball of string to student holding a card: ask them to think of one way the term on the card is related to another card.
5. The student is to explain the connection and then holding onto the string pass the ball to that student. This continues until all the terms have been connected.
6. Those who don't have a card are to describe the connections that are NOT in the web.

Terms to be written on note cards:

Global Warming
Greenhouse Effect
Gulf Stream
Ocean water
Sea ice
Glacier
Permafrost
Climate in Western Europe
Polar bear
Large waves
Fossil fuel
Coastline erosion
SUV
Methane
Severe weather events

Name: _____ Period: _____

Global Warming: Connections

1. Why are natural greenhouse gases beneficial?

2. What does the global climate system do?

3. If the polar ice disappears, what problems could result?

4. Is global warming a natural or human-induced event? Explain.

5. Where do most carbon emissions come from?

6. Why is the artic an ideal place to study climate?

7. How do ocean movements control global temperatures?

8. Why is it important to research and study global warming?

Enrichment and Closure:

Atmospheric Issues

Instructions:

You will rotate the "poster papers" around the room, when it gets to your group, you are to use the colored markers given to you and fill in any ideas that you have regarding the topic. You are not to repeat statements.

- The comments or statements do not need to be in complete sentences; you can draw pictures and

keep it simple or as complex as you want. Remember, you cannot repeat ideas.

- When we are finished then we will look for overlapping ideas and look for misconceptions.

1. Carbon Cycle
2. Water Cycle
3. Nitrogen Cycle
4. Pollution
5. Global Warming

Lesson Eight: Biomagnification

Title of Lesson Plan	**Biomagnification**
Grade Level	**10**
ODE Standard:	**Explain the structure and function of ecosystems and relate how ecosystems change over time.**
GLI(s)	**Explain how the acquisition and use of resources, urban growth, and waste disposal can accelerate natural change and impact the quality of life. (1981/EES - 5) Describe ways that human activity can alter biogeochemical cycles (e.g., carbon and nitrogen cycles) as well as food webs and energy pyramids (e.g., pest control, legume crop rotation vs. chemical fertilizers) (1982 ES - 7) Describe advances and issues in Earth and space science that have important long-lasting effects on science and society (e.g., geological time scales, global warming, depletion of resources, exponential population growth). (1983 / ES - 7)**
Anticipatory Set	**Extension of Atmospheric Issues**
Explanation	**Notes: Where do all the toxins go?**
Guided Practice	**Trace the path of mercury through the food web**
Opportunities to Relearn	**Extensions**
Independent Practice	**Biomagnification Project**
Assessment/Evaluation	**Biomagnification Project; District assessment**

Enrichment	
Closure	**Presentation of Project**
Materials (include websites)	**At the end of the Unit plan: reference page.**

Where do all the TOXINS go??

Biomagnification

Bioaccumulation

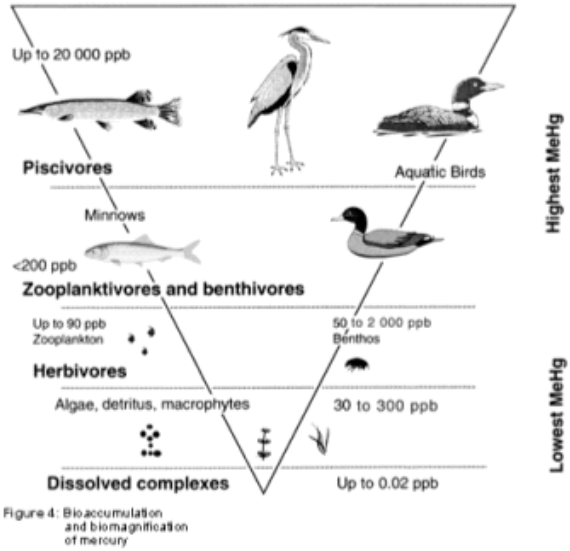


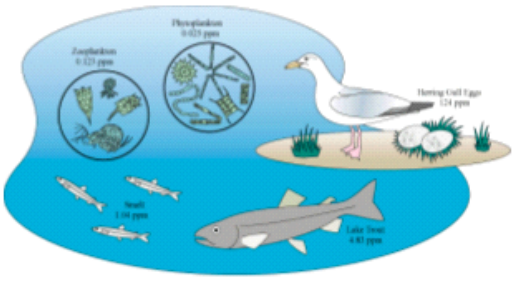
Figure 4: Bioaccumulation and biomagnification of mercury

BIOACCUMULATION

Bioaccumulation is the build- up of chemicals in an organism's body-the longer an organism lives, the more it absorbs. When an older, large lake trout is caught, the concentration of toxins in its body could be a million times that of the original concentration in the water.

BIOMAGNIFICATION

Biomagnification results when toxins become increasingly concentrated as they pass up the food chain. When a fish feeds on zooplankton, for example, the fish takes up toxins in all of the plankton it eats. In the fish, many of the toxins accumulate in its fatty tissues. When a gull or an eagle feeds on the fish, the bird takes up all of the toxins the fish has accumulated from all the contaminated organisms it has ever eaten. Therefore, the higher up an organism is in the food chain, the greater the amount of toxins it is likely to consume.



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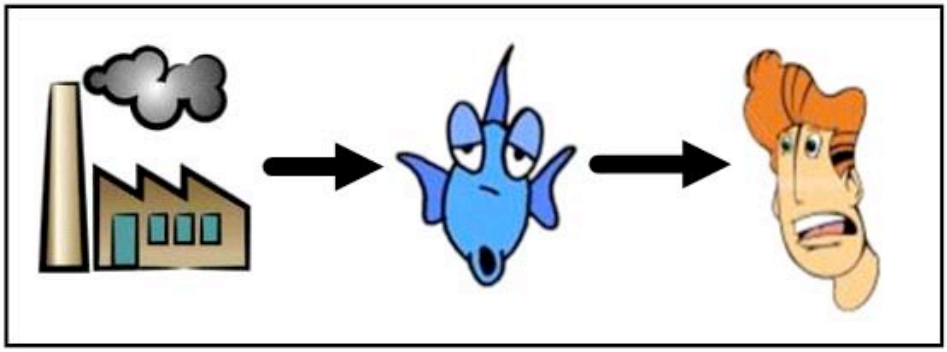
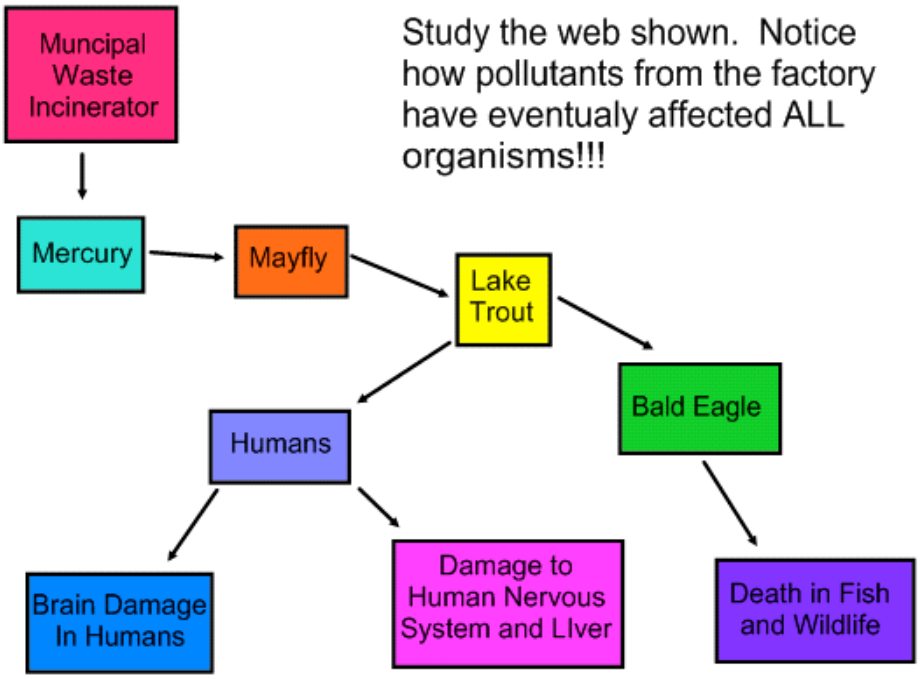


THE CHEMICALS FROM THE FACTORY ARE DEPOSITED IN THE LAKE. WHEN THE HUMAN EATS THE FISH, HE GETS EVEN MORE TOXINS IN HIS TISSUES THAN THE FISH HAD!

HOW DOES THIS HAPPEN?

You are going to view a flow chart which will help you understand how the accumulation of mercury travels through a food chain.



Study the web shown. Notice how pollutants from the factory have eventualy affected ALL organisms!!!

MERCURY

MERCURY is a dangerous toxin that has been increasingly appearing in the environment. COmmon sources include:

- Coal combustion
- Muncipal waste incinerator
- Sewage incineration

It is commonly used in batteries, paints, industrial instruments, and pulp and paper mills.

Mercury affects the nervous system and permanent damage can result.

Fun Fact:

The Mad Hatter from *Alice In Wonderland went insane from mercury poisoning. Mercury was seeping from His hat to his brain.*

Mayfly Nymphs

Mayfly nymphs are one of the benthic organisms that indicate water quality. The presence of them are a sign the water is healthy.

Mayfly nymphs particularly smaller ones live among the aquatic vegetation. Most mayfly nymphs are herbivores. Feeding on algae and diatoms and/or detritus.

Some feed by scraping, others by collecting food in the water.

MAYFLIES IN THE WATER WILL TAKE MERCURY INTO THEIR BODIES.

By the 1930s, people became aware of the diminishing bald eagle population, and in 1940 the Bald Eagle Act was passed. This reduced the harassment by humans, and eagle populations began to recover. However, at the same time DDT and other pesticides began to be widely used. Pesticides sprayed on plants were eaten by small animals, which were later consumed by birds of prey. The DDT poison harmed both the adult birds and the eggs that they laid. The egg shells became too thin to with stand the incubation period, and were often crushed. Eggs that were not crushed during incubation often did not hatch, due to high levels of DDT and its derivatives. Large quantities of DDT were discovered in the fatty tissues and gonads of dead bald eagles, which may have caused them to become infertile.

More than 100,000 bald eagles were killed in Alaska from 1917 to 1953. Alaskan salmon fisherman feared they were a threat to the salmon population.

Putting It All Together

1. Trace the path of the flow of mercury through the food web. Which player will be most affected by the toxin? Explain.

2. Suppose that Lake Trout were found to have high accumulations of mercury in their tissues and were banned from consumption. Predict how that action could affect mayflies, humans, and eagles.

3. The bald eagle became endangered in the early 1930's. How does the information learned in this activity relate to the decline of the bald eagle?

EXTENSIONS

- Research other toxins found in the Great Lakes that probably reached there on air currents. Include a map to determine where these toxins may be originating.

- Choose a city and discuss the human activities that produce airborne toxins and what effects these toxins have on humans and animals.

- References:

http://www.great-lakes.net/lakes/

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ES-EAGLS Great Lakes Environmental Issues

THIS ISN'T YOUR ASSIGNMENT....GO TO THE NEXT SLIDE.

Extend Page

YOU ARE TO CREATE A FOOD WEB THAT WOULD BE FOUND IN OHIO.

THE FOOD WEB COULD BE ONE THATIS FOUND IN:
LAKE ERIE THE BLACK RIVER CASCADE PARK A FARM
A POND YOUR BACKYARD.....!

NOTE: ECOSYSTEMS OFTEN OVERLAP. ANIMALS THAT FLY, FOR EXAMPLE, CAN FIND FOOD IN A VARIETY OF HABITATS AND THUS LIVE IN SEVERAL DIFFERENT ENVIRONMENTS.

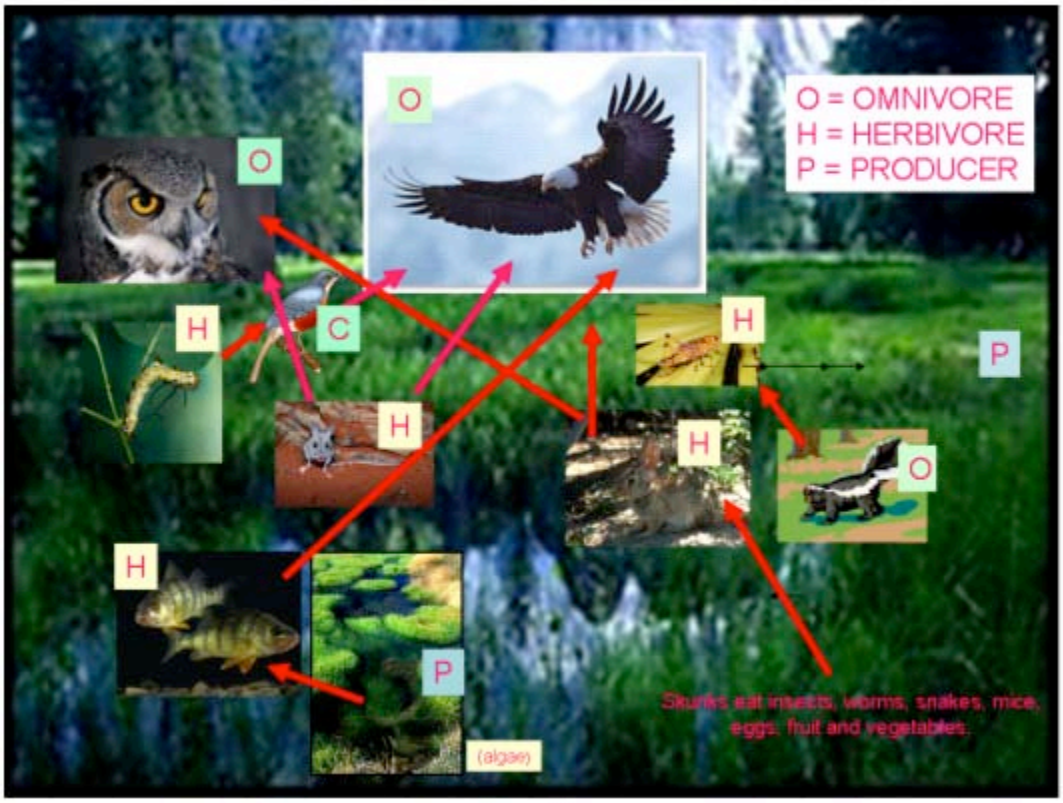
YOU ARE TO MAKE THE FOOD WEB AS A ***SINGLE SLIDE***.

YOU MUST DRAW ARROWS THAT CONNECT THE ORGANISMS TOGETHER AND ***LABEL EACH ONE ACCORDING TO THEIR ROLE. YOU NEED 12 ORGANISMS.***

IT IS EXPECTED THAT YOU WILL COPY AND PASTE PICTURES ONTO YOUR SLIDE BUT YOU MAY NOT COPY AN ENTIRE FOOD WEB AND CALL IT YOURS!

THE LAST PART OF THE PROJECT IS INTRODUCE A HYPOTHETICAL TOXIN INTO ONE OF THE FOOD CHAINS.

EXAMPLE


O
O
O = OMNIVORE
H = HERBIVORE
P = PRODUCER
H
C
H
H
H
P
O
H
P
(algae)
Skunks eat insects, worms, snakes, mice, eggs, fruit and vegetables.

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Who's Who in an Ecosystem

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