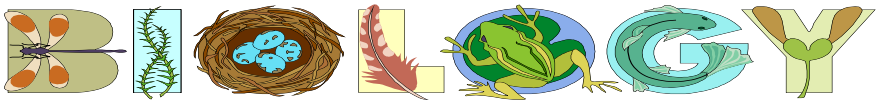


@ NEW SMYRNA BEACH HIGH SCHOOL

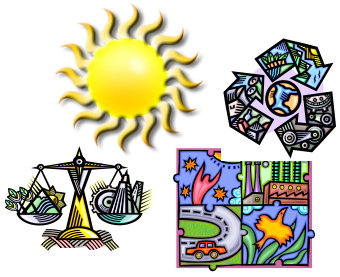
Accept our connectedness to events. It is not unknown forces that cause our problems. We are the cause and the cure. We create our own reality and we can change it.

STANDARD 2

The Ecology of Life

a.k.a. The Circle of Life!

'No man is an island, entire of itself; every man is a piece of the continent, a part of the main'



1. Principles of Ecology
2. Energy & BioGeoChemical Cyles
3. Changes in an Ecosystem
4. Human Impact on Ecosystems

New Smyrna Beach High School

Working together with parents, school personnel and community members, New Smyrna Beach High School students will graduate with the knowledge, skills and values to be positive contributors to society.

STANDARD 2, The Ecology of Life

Key Terms = "Ticket to Test"

KNOWLEDGE	INFORMATION
1- Principles of Ecology 1. Ecology	
2. Ecosystem	
3. Abiotic vs. Biotic	
4. Community	
5. Aquatic	
6. Topography	
7. BioDiversity	
2. Energy & BioGeoChemical Cyles 8. Autotroph=Producer	
9. Heterotroph=Consumer	
10. Decomposer	
11. Food Chain vs. Food Web	
12. Primary vs. Secondary vs. Tertiary Consumer	
13. Herbivore vs. Carnovire vs. Omnivore vs. Detritovore	
14. Trophic Level Pyramid	
15. Joule(s)	
16. Water Cycle vs. Carbon Cycle	

STANDARD 2, The Ecology of Life

Key Terms = "Ticket to Test"

KNOWLEDGE	INFORMATION
3- Changes in Ecosystems 17. Habitat	
18. Niche	
19. Competition	
20. Predation	
21. Symbiosis: Mutualism vs. Commensalism vs. Parasitism	
22. Population Density	
23. Immigration vs. Emigration	
24. Succession	
25. Invasive Species vs. Non-Native Species	
26. Exponential Growth vs. Logistic Growth	
27. Carrying Capacity	
3- Human Impoact on an Ecosystem 28. Smog	
29. Acid Rain	
30. Greenhouse Effect	
31. Global Warming	
32. Fossil Fuels	
33. Indicator Species	
34. BioMagnification vs. BioAccumulation	
35. Habitat Fragmentation	

STANDARD 2: Ecology = The Circle of Life

Reading Comprehension Worksheet .... NonNegotiable!

Part 1, Principles of Ecology*: *Chapter 13.1

The first part of Unit 3 introduces you to many of the basic introductory terms for the unit.

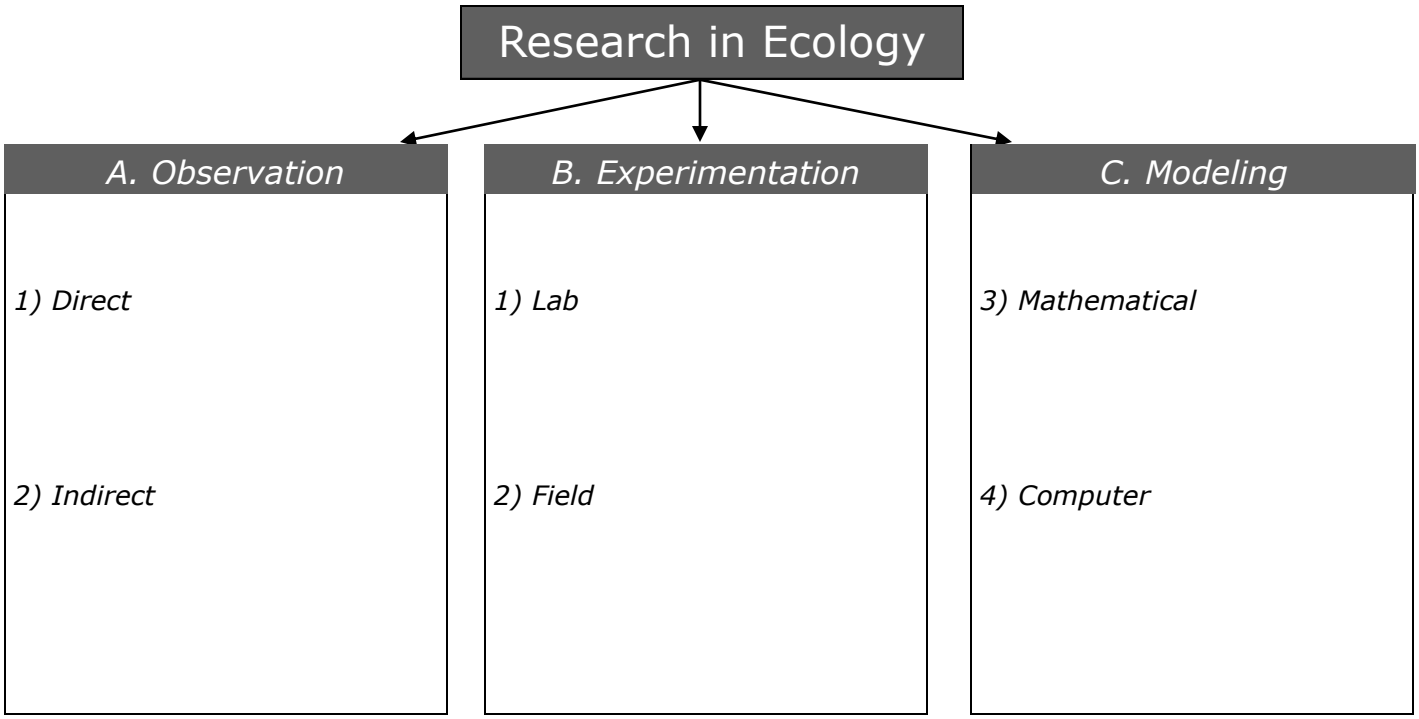
1. **Ecology** is the study of the _____between organisms and their _____.

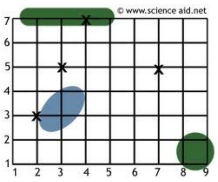
2. The Levels of Organization show the complex relationships in nature. Review Figure 13.2. Describe those levels below:

ECOLOGICAL LEVELS OF ORGANIZATION

- **A.**
- **B.**
- **C.**
- **D.**
- **E.**

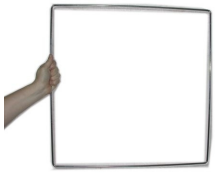
3. Ecological research methods include observation, experimentation, and modeling. Describe each below:





Quadrat Sampling

Sampling Quick Lab, textbook page 399



CHAPTER 13 | QUICK LAB

Quadrat Sampling

Ecologists often use quadrats—square or rectangular grids—to collect data about population numbers in an ecosystem. In this lab, you will use a quadrat to collect data on three "species."

MATERIALS

- quadrat = 12m of string
- meterstick
- calculator
- objects to count

PROCESS SKILLS

Sampling

Problem

What is the population size of each species?

Procedure

1. Obtain a quadrat frame. Measure, calculate, and record the area of the quadrat.
2. Stand at the edge of the area you will sample and randomly throw your quadrat.
3. Move your quadrat so that it does not overlap with any other quadrat. Each different object represents a different species. Count how many individuals of each species are in your quadrat and record your data in a data table. Repeat this procedure three times.
4. Combine your data with that of your classmates. Find the average number of each species for all of the samples. Obtain the area of the sampling plot from your teacher. Calculate how many quadrats would fit in the area of the sampling plot. Multiply this by the average number of each species found in one quadrat to estimate the population of each species.

Analyze and Conclude

1. **Analyze** Compare your population estimate for each species to the actual number that your teacher provides. Is the estimate accurate? Why or why not?

2. **Evaluate** How can you ensure that your estimate of population size will be as accurate as possible?

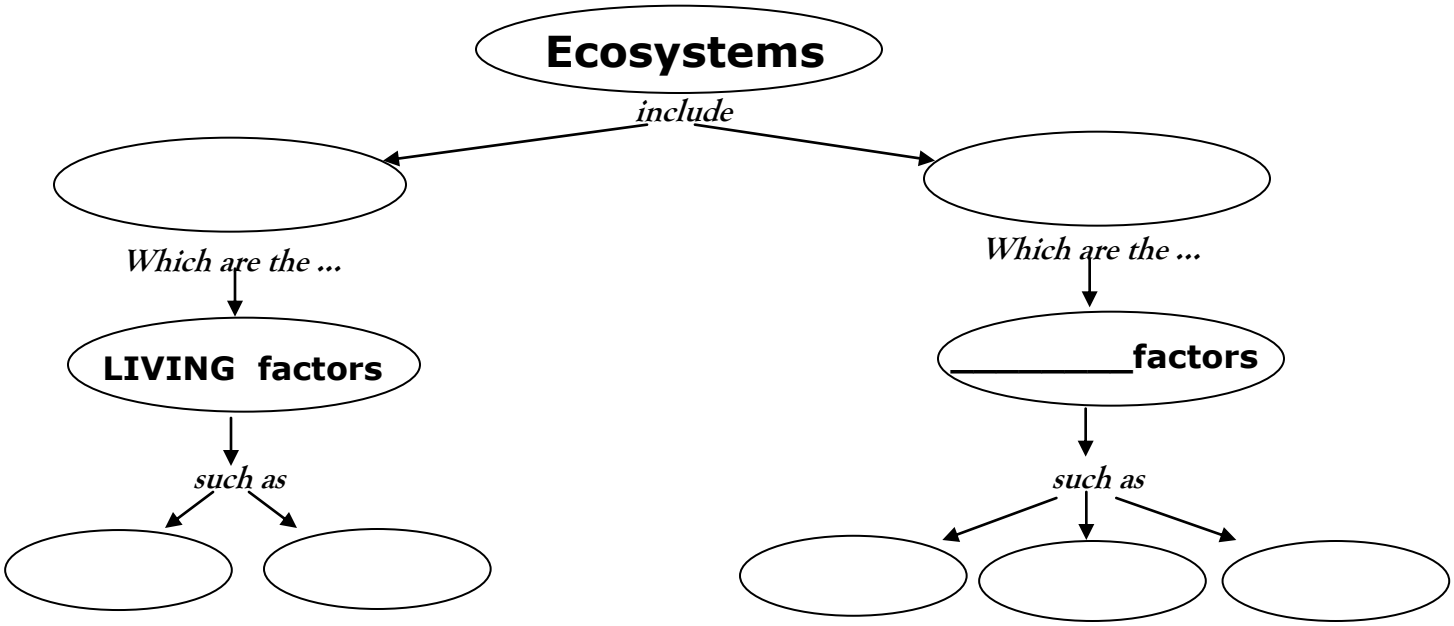
STANDARD 2: Ecology = The Circle of Life

Reading Comprehension Worksheet .... NonNegotiable!

Part 2, Energy & BioGeoChemical Cycles in Ecosystems: Chapter 13.2

This part of Unit 1 discusses things like food chains, food webs, and the biogeochemical cycles. Additionally, this section discusses energy transfer through ecosystems.

1. All ecosystems are made up of living and nonliving components; these are referred to biotic & abotic factors:



2. An ecosystem undergoes changes constantly—all in order to fall into balance, which is called _____ _____. Changing one factor—*either biotic or abio*tic— can affect other factors. The variety of biotic factors in an ecosystem is referred to as _____.

   A. It has been found that increased species can promote **stability** and **productivity** in a community because communities that have more species contain more links between species and these links *spread out the disturbances* and lessen the **disruption** of the community.

   B. Think what would happen to a pine forest when a hurricane hits…. Would a pine forest with more or less living things be more adversely affected? _____. Explain: _____
   _____
   _____

   C. Explain how a change in an abiotic factor like sunlight would affect biodiversity. _____
   _____
   _____

   D. Explain how a change in an biotic factor like a panther would affect the biodiversity of a pine forest.
   _____
   _____

Abiotic Lab

Abiotic Factors & Plant Growth, textbook page 405

Many factors affect plant growth. Is it possible to test some in a laboratory setting? In this investigation you will choose an abiotic factor and attempt to test how (or if) it affects the growth of radish seedlings.

Problem

How do abiotic factors affect plant growth?

Procedure

1. Choose an abiotic factor to test on the growth of radish seedlings. Possible factors include amount of sunlight, amount of water, soil type, light color available to plants, or amount of fertilizer.
2. Determine a way to vary the factor you have chosen. Be sure to include at least three different settings of your variable and to keep all other factors constant. Write out a procedure for your investigation below.

Abiotic factor:

_____

Procedure:

_____

_____

_____

_____

_____

_____

_____

_____

_____

MATERIALS

- 4 radish seedlings
- 4 labels
- marker
- 4 cups
- ruler
- cheesecloth
- sand
- gravel
- potting soil
- household-plant liquid fertilizer
- plastic wrap in a variety of colors
- graduated cylinder

PROCESS SKILLS

- Designing Experiments
- Collecting Data

3. Obtain 4 plants. Label one "Control" and the remaining three "A," "B," and "C."

4. Measure the height of your control and variable plants over a period of seven days. Use the same method to repeat measurements each day. Be sure to keep plants watered.

5. Record all data you generate in a well-organized data table.

Analyze and Conclude

1. **Operational Definitions** On the basis of your procedure, how are you defining plant growth?

_____

_____

_____

2. **Identify Variables** What are your independent and dependent variables? What are your constants? What is your control?

_____

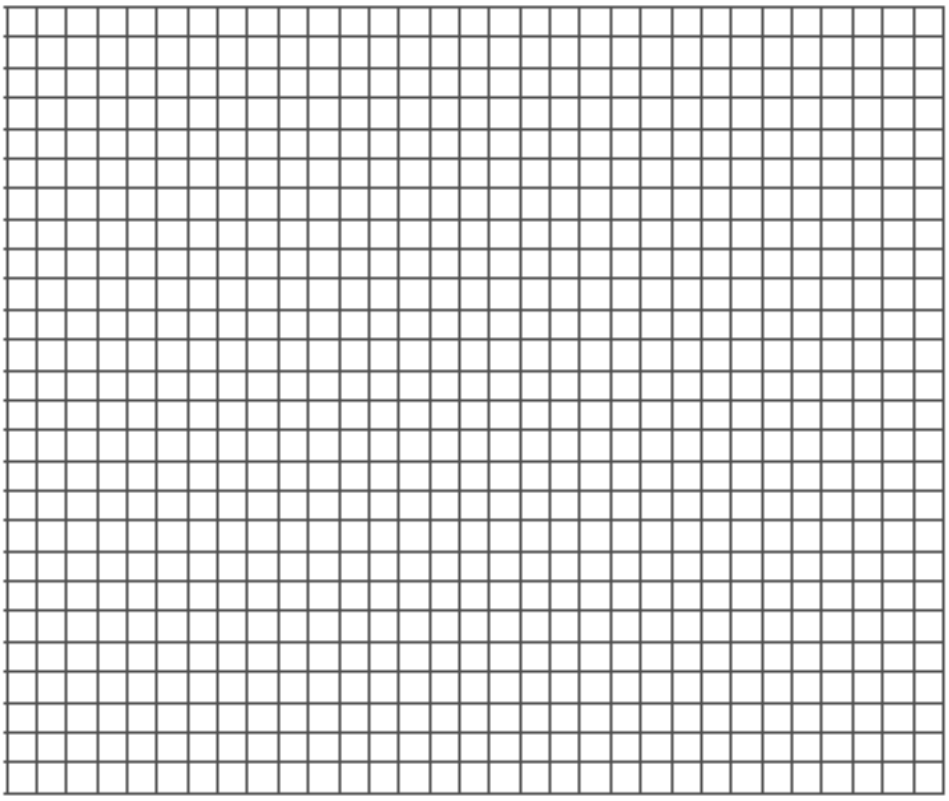
_____

_____

_____

_____

3. **Graph Data** Make a bar graph to present the data you obtained on plant growth.



4. **Conclude** By studying your data, what can you conclude about how (or if) you variable affects the growth of the plants?

_____

_____

5. **Conclude** Is your experiment a failure if your variable did not apparently affect the growth? Explain _____

_____

_____

6. **Experimental Design** What possible sources of error may have taken place in your experiment? Why might they have occurred? _____

_____

_____

STANDARD 2: Ecology = The Circle of Life

Reading Comprehension Worksheet .... NonNegotiable!

Part 2, cont. Energy in Ecosystems: Chapter 13.3

This part of Unit 3 discusses the flow of energy through food chains, food webs.

3. All organisms have a source of energy in order to survive, but not all of them obtain energy by eating other organisms. Energy in an ecosystem moves from producers TO consumers —> describe them below:

Type:	***Also called:***	***Description:***	***Example:***
A) PRODUCERS			
B) CONSUMERS			

4. Describe the probable effects on an ecosystem **if all the autotrophs were to die.** _____

_____

What **if all the decomposers were to die?**_____

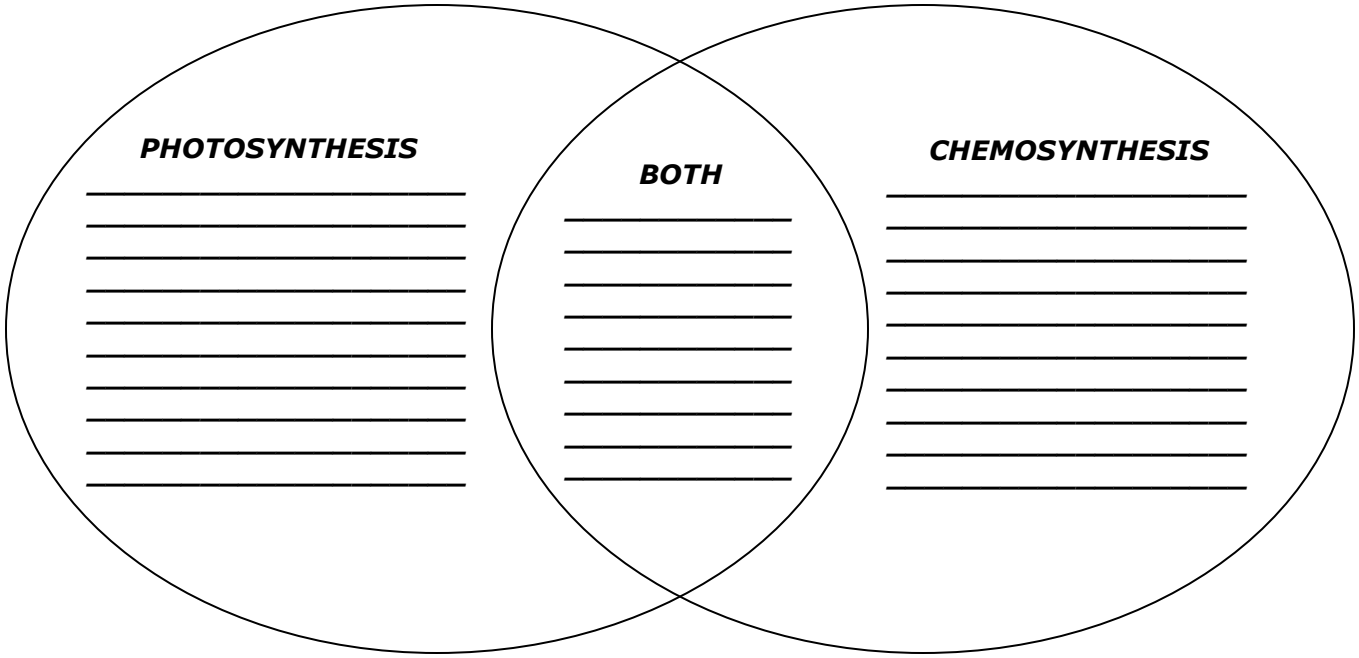
_____

5. Why is **sunlight important** to producers and consumers in an ecosystem? _____

_____

6. Almost all producers use sunlight as their energy source. Those that do not have access to sunlight use another source. Compare those two processes below:

Processes by Which Producers Obtain Energy



STANDARD 2: Ecology = The Circle of Life

Reading Comprehension Worksheet .... NonNegotiable!

Part 2, cont. Energy in Ecosystems: Chapter 13.4

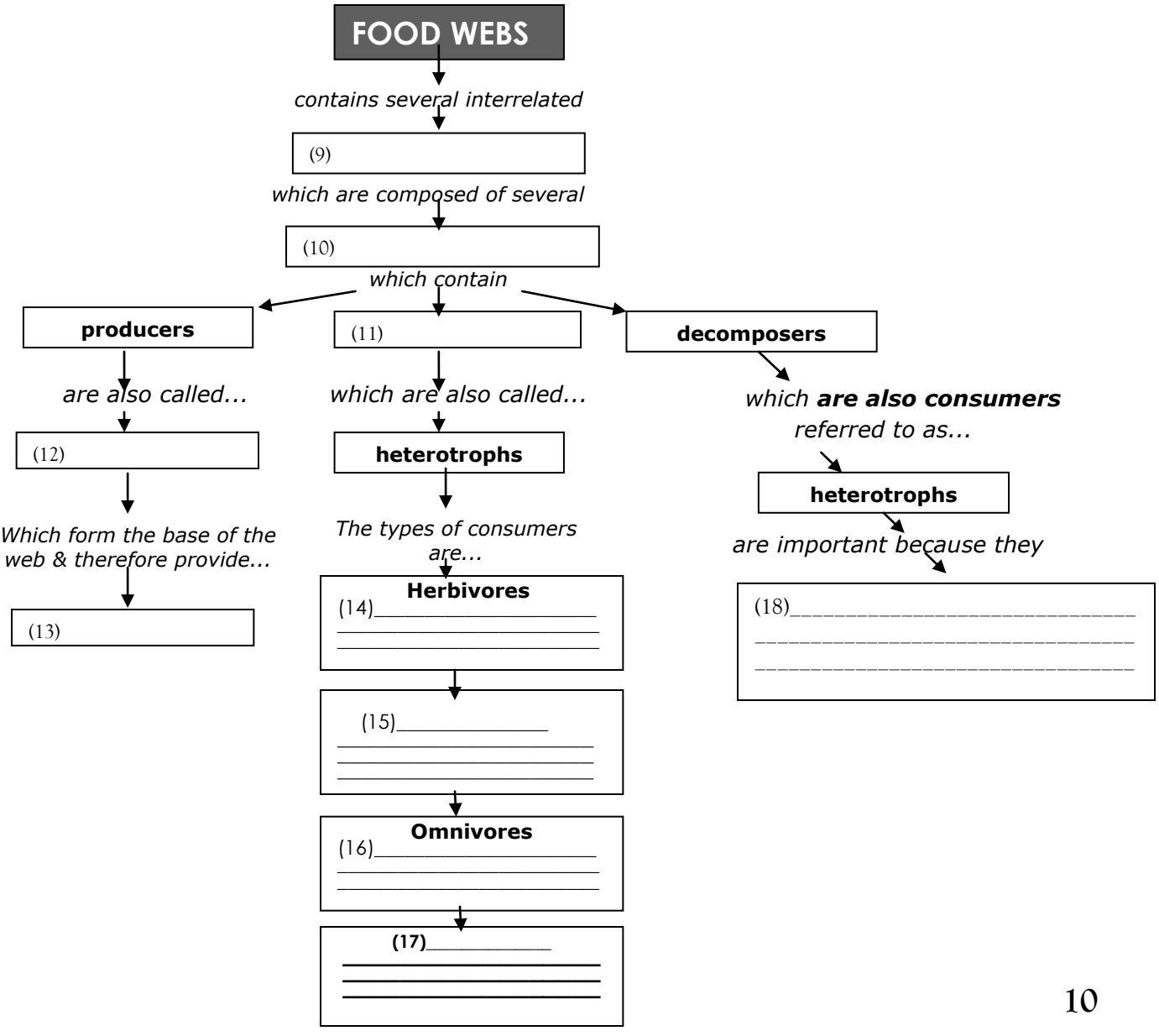
In the previous section, we saw that energy flows through ecosystems in one direction —> from PRODUCERS to CONSUMERS. Food chains and food webs are used to show the relationships from the many producers to the many consumers

7. What is a **food chain**?_____ It is the simplest way to look at energy flow—it only shows the connection between _____ producer and a _____ chain of consumers.

   A. Which of the following **food chains** is correct?
      1) Killer whale —> Leopard seal —> Cod fish —> Shrimp —> Algae
      2) Algae —> Shrimp —> Cod fish —> Leopard seal —> Killer whale

8. **Food webs** show a _____ _____ of feeding relationships.

- **Use the following terms to complete the concept map below:** Food chains, trophic levels, consumers, break down dead & decaying organisms, autotrophs, , carnivore, detritivore



Part 2, cont. Cycling of Energy AND Matter: Chapter 13.4 & 13.5

9. The stability of any food web depends on the presence of _____, because they form the basis of any food chain or food web.

10. Food webs are complicated and show multiple feeding relationships, and thus multiple energy flow from one organism to the next. So, what do you think would happen to the flow of energy if a new predator were introduced into a food web?_____
_____

11. It's not just energy that cycles through an ecosystem… Matter changes form, but does NOT _____: It can be used over and over again —> *Remember the Law of Conservation…???*
    A. The **Law of Conservation of Energy** states that energy cannot be created or destroyed, but can change its form. (Potential —> Kinetic; Light —> Heat)
    B. The total quantity of matter and energy available in the universe is a fixed amount and never any more or less.

12. Briefly describe the cycles below:

Hydrologic Cycle
aka Water Cycle

_____
_____
_____
_____
_____
_____

So if water cycles & the total amount does not change, why are there such concerns about global freshwater shortages? Use facts from text to answer!

_____
_____
_____
_____

Oxygen Cycle

_____
_____
_____
_____
_____
_____
_____

Sooo, explain how deforestation might affect the oxygen cycle.

_____
_____
_____
_____

Carbon Cycle

_____
_____
_____
_____
_____
_____
_____

So why is carbon so important?.

_____
_____
_____

Nitrogen Cycle

About _____% of the Earth's atmosphere is made of Nitrogen gas. But nitrogen can't be used unless it is FIXED or "fastened" into a compound that <u>can</u> be used. It has strong bonds & so it is un-reactive unless it is FIXED. _____ does the fixing & they live freely in the soil. Nitrogen released by _____ —> taken up by Plants —> _____ eat the plants —> Nitrogen returns to soil by _____ when they break down dead animals.

STANDARD 2: Ecology = The Circle of Life

Reading Comprehension Worksheet .... NonNegotiable!

Part 2, cont. Energy in Ecosystems: Pyramid Models: Chapter 13.6

So far you have seen that ecosystems have structure with large numbers of producers supporting several layers of consumers. This section will look at the Trophic Level Pyramid models ecologists use to represent this structure.

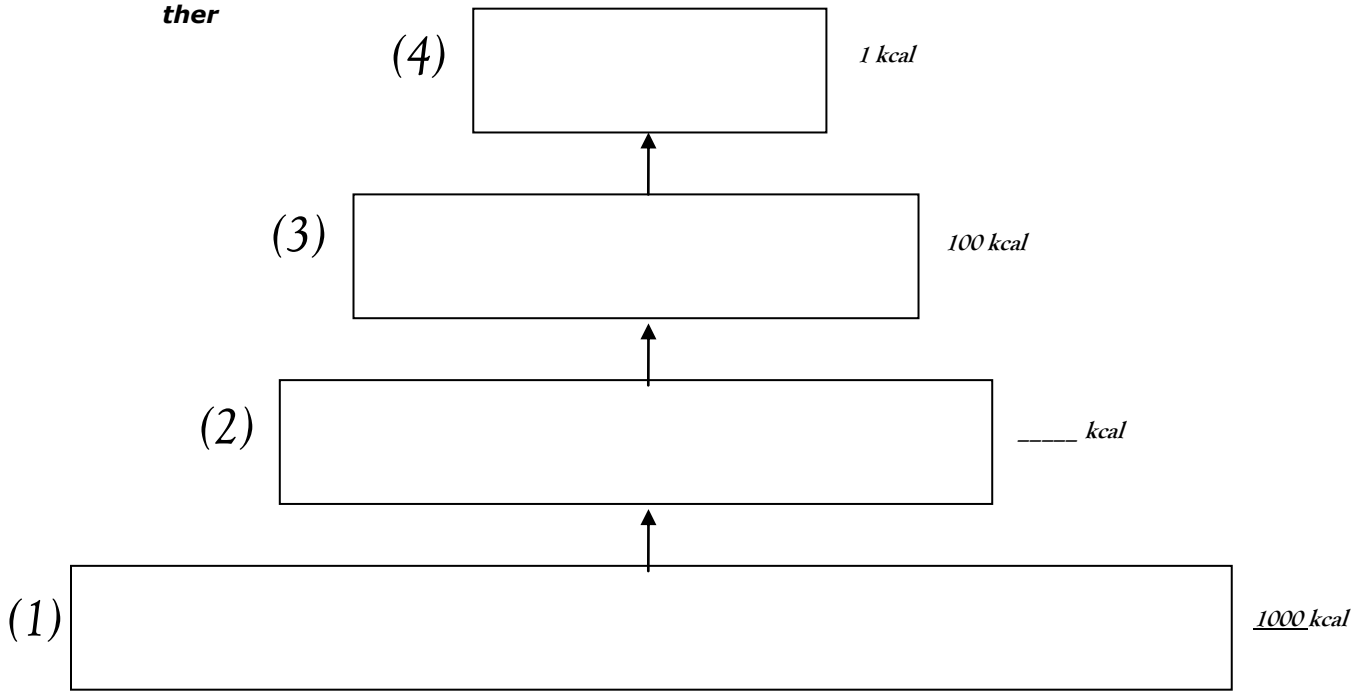
13. An energy pyramid show the distribution of _____ among trophic (=feeding) levels.

14. Ecosystems get their energy from _____ which provides the energy for photosynthesis. Producers use energy from the sun to make _____ —> Herbivores eat the plants, but burn some energy in the process —> the energy is given off a _____ —> then _____ eat the herbivores & again lose some energy as _____ —> each level in the food chain contain _____ energy that the level below it.

15. Each box below represents a **trophic level**:

   *A. Each level in the pyramid below identifies one or more **traits of the trophic levels**. Use the following terms to label each level in their proper order: **secondary consumer, primary consumer, producer, tertiary consumer***

   B.** Place the following living things on the correct trophic levels above—each level **may** have more than one answer: **grass, hibiscus flower, grasshopper, rabbit, hawk, snake, Florida panther



C. What do the **small arrows** connecting each trophic level represent?_____

D. What does the **decreasing width** of each box mean in terms of available matter and energy at each level? _____

E. Only about _____**%** of the energy available at one trophic level is transferred to the next level, so there is **not enough energy** available to support more levels!

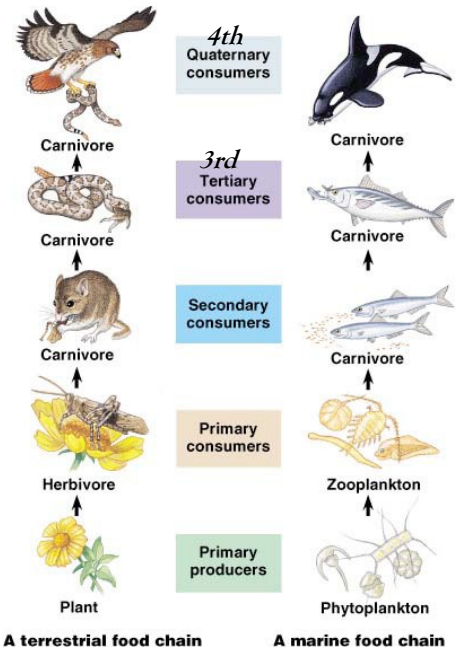
F. Sooooo, if each level in a food chain loses 90% of the energy it takes in, and the producer level

Food Chains & Energy in Ecosystems

A Laboratory Exercise

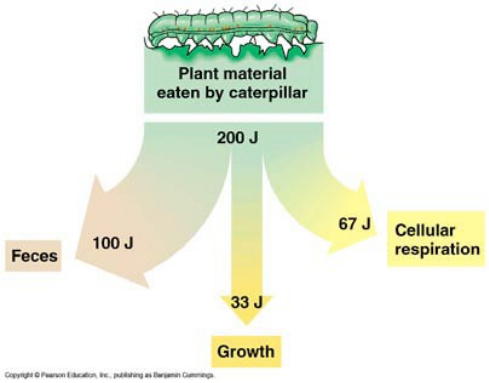
PART 1: BACKGROUND:

- All organisms need an input of energy and nutrients to live. For animals, both of these come from the food they eat. For plants the source of energy is the sun — they produce their own food through photosynthesis — and their source of nutrients is the soil.

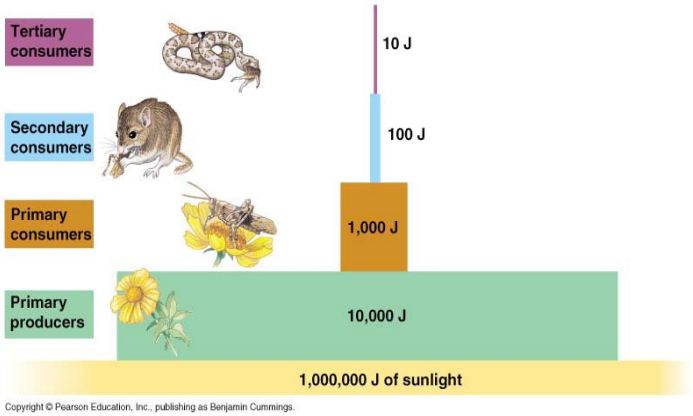


- The feeding relationships between organisms forms a **FOOD CHAIN:**
  - **Producers** (plants, or **autotrophs**) capture the sun's energy and absorb nutrients from the soil to make their own food.
  - **Primary consumers** (animals, **heterotrophs**, or **herbivores**) eat the plants and capture their energy and nutrients.
  - **Secondary consumers** (animals, **heterotrophs**, or **carnivores**) eat the herbivores and capture their energy and nutrients.
  - Third and fourth level consumers continue this chain by eating the lower level carnivores.
  - Then finally **decomposers** breakdown waste and dead organisms recycling the nutrients back into the ecosystem, so they are available for another generation of plants and animals.

- When a consumer eats another organism, only a small fraction of the energy taken in is used for growth. About 50% of the food is not digested or absorbed and is passed out as waste. About 40% of the energy of the food is lost from as heat or used by the organism for cellular respiration — making energy for daily life. **Only about 10% of the food eaten is used for growth** and is therefore available as energy to the next trophic level in the food chain. This produces a pyramid of energy and a pyramid of numbers in an ecosystem. The **greatest amount of energy** and the largest population is at the base of the pyramid with the producers. The **least amount of energy** and the smallest population is at the top of the pyramid in the top level consumers. Only about 10% of the energy from the food eaten is used for growth. Because of the loss of energy moving up the food chain, each trophic level can support fewer organisms. The different levels of organisms in a food chain are called **trophic levels**.



Only about 10% of the energy from the food eaten is used for growth.



Because of the loss of energy moving up the food chain, each trophic level can support fewer organisms.

PART 2: PROCEDURE

1. On the accompanying sheets is a collection of organisms from a food chain:
    A. grass
    B. grasshoppers
    C. mice
    D. snakes
    E. hawks

2. You also have been provided with a food chain pyramid chart.

3. Cut out the organisms and organize them at the appropriate trophic level. Start by gluing **all the grass** (10,000 blades of grass) onto your ecosystem pyramid.

4. Now calculate the correct amount of each of the animals that can be supported at their trophic level, given the following rules: (you may NOT have to use all the pictures you cut out!)
    A. It takes 10,000 blades of grass to feed 1,000 grasshoppers.
    B. It takes 1,000 grasshoppers to feed 100 mice.
    C. It takes 100 mice to feed 10 snakes.
    D. t takes 10 snakes to feed 1 hawk.

5. Glue the **correct number** of animals onto the food chain pyramid at their proper trophic level.

6. Record the number of organisms at each trophic level on the line to the left of the pyramid.

7. Calculate the amount of energy available at each level…. Assuming you begin with 5,000,000 Joules (a unit of energy)

8. Correctly label each trophic level:
    A. 1st level = producer
    B. 2nd level = primary consumer
    C. 3rd level = secondary consumer
    D. 4th level = tertiary consumer = primary predator
    E. 5th level consumer = secondary predator

9. Answer the Conclusion Questions.

PICTURES for ENERGY PYRAMID

1

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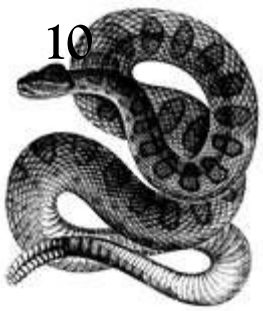

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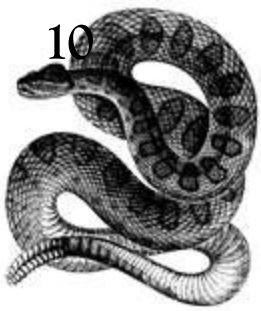

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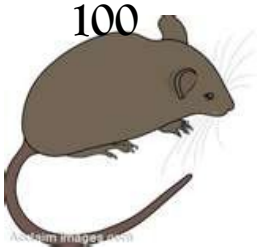

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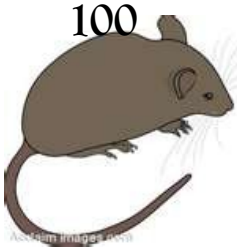

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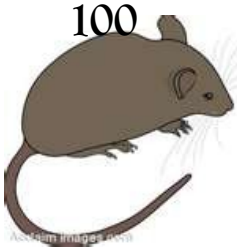

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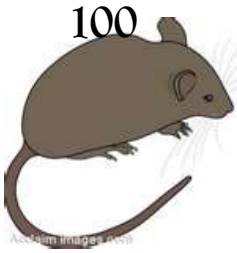

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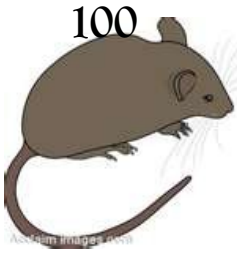

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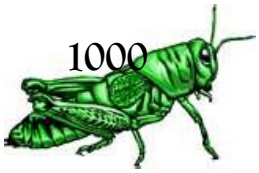

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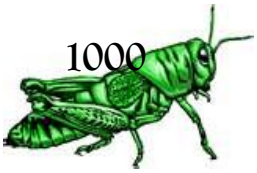

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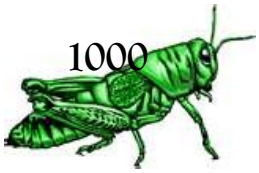

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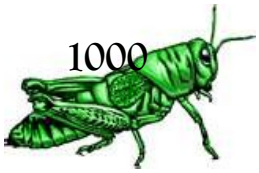

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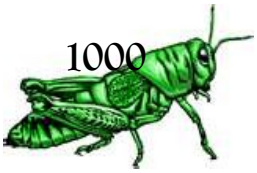

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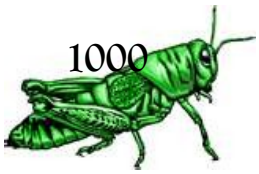

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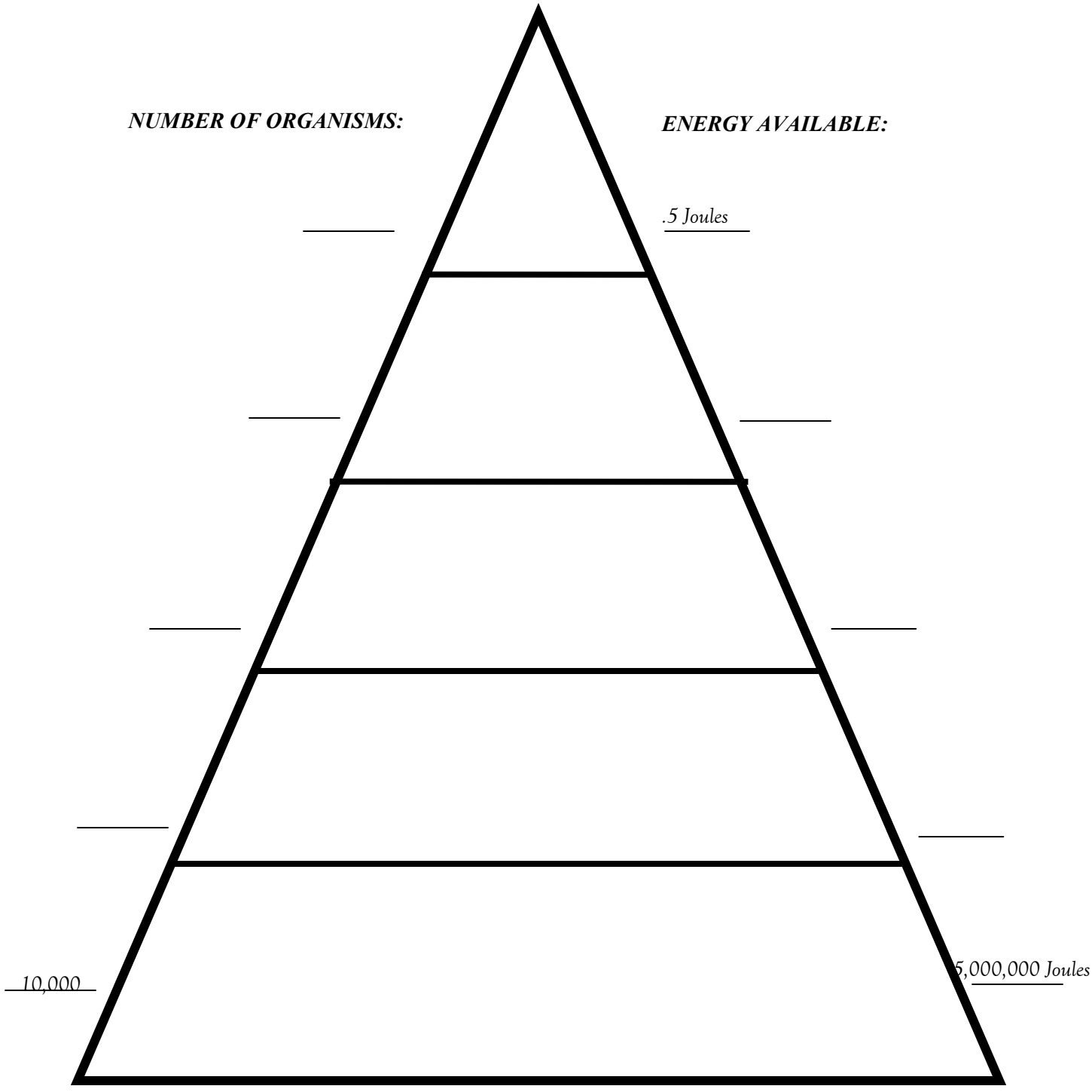
ENERGY / POPULATION SIZE PYRAMID



PART 3: CONCLUSION:

1. Complete the chart below:

Trophic level	Name of organism	Autotroph or Heterotroph???
1st level = Producers		
2nd level = Herbivores = Primary consumers		
3rd level = Secondary consumers		
4th level = Tertiary consumers = Primary Predator		
5th level = Secondary Predator		

2. What **trophic level** is not represented in your pyramid?_____ Write some examples on the pyramid page.

3. What **energy source** used by this ecosystem is not shown in the pyramid? _____

4. What is the **energy source** for all food chains? _____

5. One day the people living in houses on the edge of this ecosystem spray a general purpose insect pesticide to kill a wide range of insects on their property. The wind carries the insecticide onto the field and it kills many of the grasshoppers. Discuss the possible effects on this ecosystem from the loss of the grasshoppers.

_____
_____
_____

6. Even though all of the grasshoppers weren't killed, they all were exposed to the insecticide, so when the mice eat them, they are also ingesting pesticide.
   a. How much pesticide will each mouse take in compared to each grasshopper? To each snake? To each hawk? Explain.

      _____
      _____
      _____

   b. Considering your answers to the previous question, explain what happens to environmental poisons as you move up the food chain.

      _____
      _____

7. The grass necessary to support this ecosystem needs 10 acres to grow. But this field has been reduced to 5 acres because a developer has built houses on the other 5 acres. Explain what the result of this development will be on each of the trophic levels in this ecosystem.

_____
_____
_____

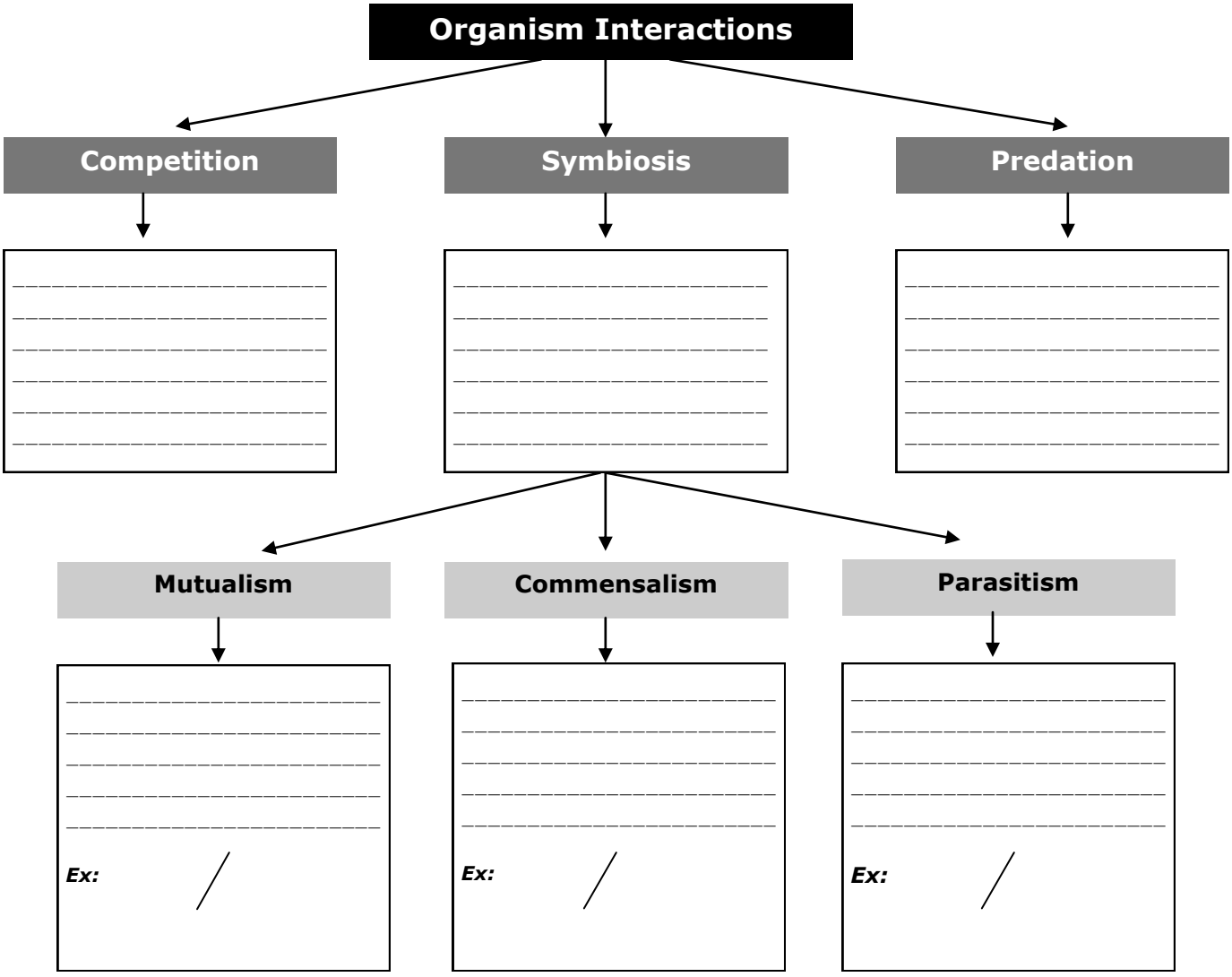
Part 3, Changes in Ecosystems: *Chapter 14.1—14.2*

All populations affect each other because all organisms are interrelated. To understand what individuals, populations, and communities need to survive, ecologists must study the interactions—and thus CHANGES—among and between species!

1. All the biotic and abiotic factors in an ecosystem make up what is called an organisms _____

2. In an ecosystem, each living thing has its own ecological _____ which are all the things that a living thing needs to survive. Name some of the things that make up a niche: _____
_____

3. There are many things that affect communities: competition, predation, symbiosis



4. There are BILLIONS of microorganisms that live on and in our body (mites, bacteria, fungus). They are referred to as the **"normal flora"** of the human body. It is possible that there are more bacterial cells in your body that there are body cells! Would you refer to this relationship as mutualism or parasitism? Explain. _____
_____
_____

Modeling Predation Lab

Textbook page 435

In this lab, you will model predation and the effects of changes in the environment on organisms. Blue herons are large birds that live in aquatic habitats and feed on fish, frogs, salamanders, lizards, small snakes, and dragonflies. You will model a blue heron feeding in a lake filled with fish.

MATERIALS
- 21 × 27 cm^2 grid paper
- 400 uncooked rice grains
- toothpick

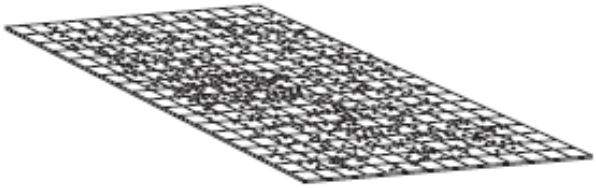
PROCESS SKILLS
- Modeling
- Analyzing Data

Problem

How do changes in environmental factors affect the predation habits of the blue heron?

Procedure

1. Spread 200 rice grains over the grid. The grid represents the lake from which the heron feeds, and the rice grains represent fish.



2. A blue heron will catch an average of two fish per hour during daylight. To model the heron hunting for fish, close your eyes and lower the end of the toothpick slowly down onto the grid.

3. Remove the grains that are in the square where the toothpick touched. Count the grains.

4. Rearrange the remaining grains on the grid, and repeat steps 2 and 3 five more times to model one day's worth of feeding for the heron. Count the total number of grains removed, and record this number in the data table below.

5. Repeat steps 2–4 five more times to represent six total days of feeding by the heron.

TABLE 1. NUMBER OF FISH CAUGHT PER DAY

Day	1	2	3	4	5	6
No. of Fish Caught						

6. Return all of the removed rice grains to the grid. Runoff containing large amounts of nitrates causes an algal bloom in the lake. When the algae die and decomposition occurs, the oxygen level in the lake becomes very low, causing fish to die. Remove 150 grains from the grid. Repeat steps 2–5. Record this data in the table below.

TABLE 2. NUMBER OF FISH CAUGHT PER DAY OF ALGAL BLOOM

Day	1	2	3	4	5	6
No. of Fish Caught						

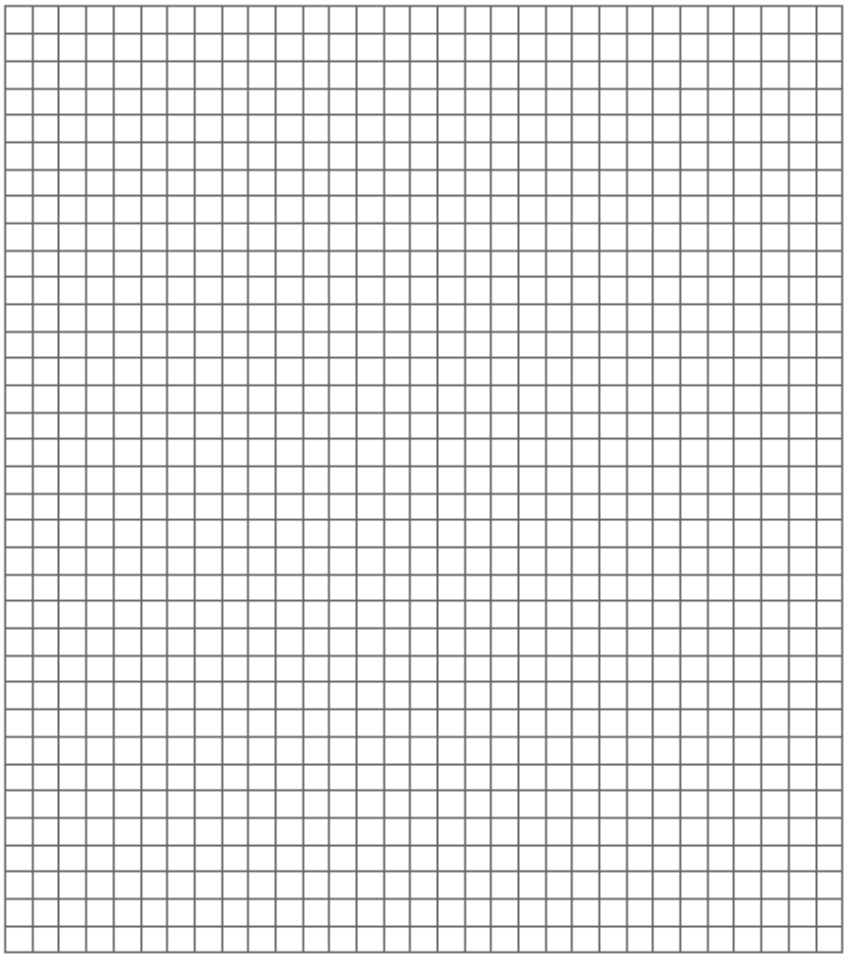
7. Return all of the removed grains to the grid. The fish in the lake spawn during the spring. To model this, add another 200 grains to the grid. Repeat steps 2–5. Record this data in the table below.

TABLE 3. NUMBER OF FISH CAUGHT PER DAY IN SPAWNING SEASON

Day	1	2	3	4	5	6
No. of Fish Caught						

Analyze and Conclude

1. **Graph Data** Construct a graph to represent your data.



2. **Analyze** How was the amount of food caught by a heron related to changes in biotic and abiotic factors?

3. **Infer** How might abundant amounts of food allow herons to reproduce more often?

4. **Predict** How would the populations of amphibians and small reptiles be affected if the fish population in the lake remained low for an extended period of time?

Part 3, cont. Changes in Ecosystems: *Chapter 14.3 & 14.4*

All populations affect each other because one population can affect another. This section focuses on what we can learn from populations.

4. A **population** is described as all of **the individuals of a species** that live in the same area. What is **population density**? _____
   A.) Scientists want to help keep populations healthy. What can cause a change in population density? _____

5.

Describe Four Factors That Affect the Size of a Population
1._____
2._____
3. _____
4. _____

6. Populations grow and change and are affected by the surrounding environment.
   A) If a population steadily increases due to abundant resources, it shows a growth curve known as an _____ growth curve.

   B) A more realistic model is the _____ growth curve because it takes into account available resources & competition between organisms.

   C) Draw AND label the graphs that represent these growth curves:

EXPONENTIAL GROWTH	*LOGISTIC GROWTH*

7. What is **carrying capacity**? _____

8. What happens to the growth rate **when a population is below carrying capacity**?_____
   Above carrying capacity?_____

9. The Earth's human population is over 6 billion. Do you think there should be concern that we have passed the **carrying capacity** of our planet? _____ Do you see how our carrying capacity affects the carrying capacity of other living things?_____ Can you see how a change in one aspect of a population or ecosystem can affect another part of the population or ecosystem?_____

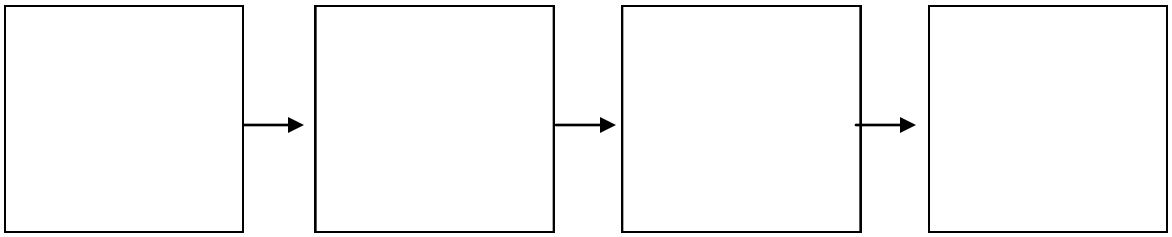
Part 3, cont. Changes in Ecosystems: ***Chapter 14.5***

Populations change, but so does the land a population inhabits. A clean room becoming cluttered is a gradual process, much like the process that rebuilds a damaged ecosystem.

10. Ecosystems change over time. You can see early stages of progression in vacant lots, along roads, and even in sidewalks or parking pots where weeds are pushing up though cracks in the concrete. The sequence of changes that regenerate a damaged area or creates a community is called _____

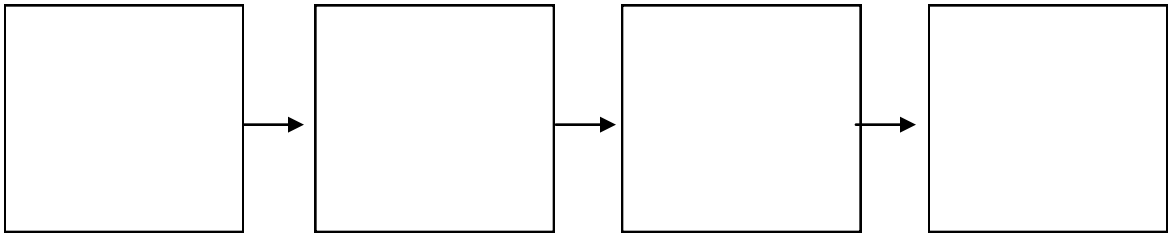
11. Ecologists recognize **two types of succession**—Define & sketch each step:

A) Primary Succession is _____
_____



_____ _____ _____ _____

B) Secondary Succession is _____
_____



_____ _____ _____ _____

8. The **first organisms to predominate a new habitat** early in succession are called_____

9. **Immigration** is moving INTO an area, whereas **Emigration** is moving OUT OF an area…. How do you think plants & animals moving into or out of an area can affect a population? _____
_____
_____

10. **Native species** are those that naturally live in an area; whereas **Invasive species** are those that are not natural to the area but use the resources of the native species & do not have natural predators. Examples of invasive species are the Cuban Tree Frog and the Brazilian Pepper. How would a population be affected by an Invasive species? _____
_____
_____

LLCCC Reading Exercise

Introduced Species i.e. Non-Native Species

The Threat to Biodiversity & What Can Be Done

Almost half of the native species in America are endangered because of invasive species!

There are many ways in which the introduction of non-native or exotic species negatively affects our environment and the diversity of life on our planet. The statistics are startling and more attention must be paid to the problem and devising a solution before the cost is more than we can bear.

- Compared to other threats to biodiversity, non-native species that become invasive rank second only to habitat destruction, such as forest clearing.
- Of all 1,880 imperiled species in the United States, 49% are endangered because of introduced species alone or because of their impact combined with other forces.

Invasive species cause more damage than some pollutants!

- In fact, introduced species are a greater threat to native biodiversity than pollution, harvest, and disease combined.
- Further, through damage to agriculture, forestry, fisheries, and other human enterprises, introduced species inflict an enormous economic cost, estimated at $137 billion per year to the U.S. economy alone.
- Of course, some introduced species (such as most of our food crops and pets) are beneficial. However, others are very damaging.

The Cuban Tree Frog is an invasive species in southeast USA, competing with smaller native species.

<u>Introduced species are not good guests</u>

Florida's fires are fueled by a tree imported from Australia!

The greatest impact is caused by introduced species that change an entire habitat, because many native species thrive only in a particular habitat.

•When the Asian chestnut blight fungus virtually eliminated American chestnut from over 180 million acres of eastern United States forests in the first half of the 20th century, it was a disaster for many animals that were highly adapted to live in forests dominated by this tree species- ten moth species became extinct.

•Similarly, the Australian paperbark tree has replaced native plants, such as sawgrass, over 400,000 acres of south Florida, because it has a combination of traits (for example, spongy outer bark and flammable leaves and litter) that increase fire frequency and intensity. Many birds and mammals adapted to the native plant community declined in abundance as paperbark spread.

The invasive zebra mussel is depleting the food of marine natives.

•In similar fashion, aquatic plants such as South American water hyacinth in Texas and Louisiana and marine algae such as Australian Caulerpa in the Mediterranean Sea change vast expanses of habitat by replacing formerly dominant native plants.

•The zebra mussel, accidentally brought to the United States from southern Russia, transforms aquatic habitats by filtering prodigious amounts of water (thereby lowering densities of planktonic organisms) and settling in dense masses over vast areas. At least thirty freshwater mussel species are threatened with extinction by the zebra mussel.

The Zebra Mussel is an invasive species that has taken over beaches, docks, boats, and other mussels.

•Other invaders, though they do not change a habitat, endanger single species or even entire groups of them in various ways:

•The predatory brown tree snake, introduced in cargo from the Admiralty Islands, has eliminated ten of the eleven native bird species from the forests of Guam.

•The Nile perch, a voracious predator introduced to Lake Victoria as a food fish, has already extinguished over one hundred species of native cichlid fish.

•A parasite can be similarly devastating. The sea lamprey reached the Great Lakes through a series of canals and, in combination with overfishing, led to the extinction of three endemic fishes.

The Brown Snake is an invasive species .

•The European parasite that causes whirling disease in fishes, introduced to rainbow trout in a hatchery in Pennsylvania, has now spread to many states and devastated the rainbow trout sport fishery in Montana and Colorado.

•Herbivores can wreak great damage. The first sailors to land on the remote Atlantic island of St. Helena

Some impacts of invaders are subtle but nonetheless destructive to native species:

•North American gray squirrels are driving native red squirrels to extinction in Great Britain and Italy by foraging for nuts more efficiently than the native species. Such competition for resources is not easy to observe, but the end result is the loss of a native species.

Trout fishing is almost nonexistent in some American states because of a foreign parasite.!

•Hybridization, or cross-breeding, of introduced species with natives is an even subtler impact (no lineage goes extinct), but it is insidious because it leads gradually to the extinction of many native species, as their gene pools inevitably evolve to become those of the invader. Introduced mallards, for instance, are driving the native Hawaiian duck to a sort of genetic extinction by breeding with them.

•Of 26 animal species that have gone extinct since being listed under the Endangered Species Act, at least three were wholly or partly lost because of hybridization with invaders. One was a fish native to Texas, eliminated by hybridization (reproducing with) with introduced mosquito fish.

•Rainbow trout introduced widely in the United States as game fish are hybridizing with five species listed under the Endangered Species Act, such as the Gila trout and Apache trout.

Some alien species eliminate native species by breeding with them, altering the gene pool!

•The endangered, endemic Hawaiian duck is being lost to hybridization with North American mallards introduced for hunting.

•The rarest European duck (the white-headed duck) is threatened by hybridization with the North American ruddy duck, which was originally kept as an amenity in a British game park. The ruddy duck escaped, crossed the English Channel, and spread to Spain, the last stronghold of the white-headed duck.

Invasion meltdown: when an invasive species triggers destructive traits in another

Often invaders interact with one another to generate a problem where either species alone would be harmless. For example, ornamental fig trees in the Miami area for over a century stayed where planted, in people's yards, because they were sterile. Each fig species requires a particular wasp to pollinate it, and the wasps were absent. About fifteen years ago, the pollinating wasps for three fig species arrived independently in the region, and now these fig species are reproducing. At least one has become invasive, with seedlings and saplings being found many miles from any planted figs. More cases of this phenomenon, termed "invasion meltdown," are likely to arise as more species are introduced and have the opportunity to interact with each other.

Warding off the Intruder

Ballast water, packing material, and gardening plants: transportation for invasives.

Keeping potentially damaging invaders out is the most cost-effective way to deal with introduced species. Targeting common pathways by which invaders reach our shores can slow or stop their entry. Ship ballast water, wooden packing material, and horticultural plants are three prominent pathways for invasion that could all be monitored or treated more rigorously. A species that is introduced despite precautions can sometimes be eradicated, especially if discovered quickly. In the United States, a Giant African snail population was eliminated by a long campaign in Florida, and a federal-state cooperative effort is currently underway in California to attempt to eradicate the recently discovered Caulerpa alga invasion. Even if eradication fails, several technologies often can control invasive species at acceptably low levels. No method is a magic bullet, each can have drawbacks if misused, and each has failed when used against certain invaders, but each also has successes to its credit.

•Biological control entails introducing a natural enemy usually from the native range of the introduced pest.

Biological, chemical, and mechanical control of invasives have had limited success.

•For example, prickly pear cactus from the Americas is well controlled on hundreds of thousands of square miles of Australian rangeland by caterpillars of a moth introduced from South America. A disadvantage of biological control is that some agents attack nontarget species, and it is very difficult to remove a troublesome introduced natural enemy once it is established.

•Chemical control involves using a pesticide, such as an herbicide or insecticide. Although chemicals can effectively control some species (such as water hyacinth in Florida), they may have nontarget impacts, they are often expensive, and pests can evolve resistance to them.

•In mechanical control, hand pulling or various kinds of machinery are employed. For example, volunteer convict labor is used in Florida to cut paperbark trees and in Kentucky to rip out Eurasian musk thistle. However, some invaders cannot be easily found for mechanical removal or occupy a habitat (for example, the marine benthos) that is not readily accessible.

•The newest technology for managing invaders is ecosystem management, in which the entire ecosystem is subject to a regular treatment (such as a simulated natural fire regime) that tends to favor adapted native species over most exotic invaders. Because it is so new, the specific ways in which ecosystem management can be employed must be determined in each type of habitat.

Addressing the Problem

The numbers of introduced species are growing in the United States and elsewhere because of increased trade and travel, but the situation is not hopeless.

- Internationally, the Rio Convention of Biological Diversity (1992) recognized the threat and called for action to limit it.
- A Global Invasive Species Program, formed by the United Nations and other international organizations, is beginning to answer this call with a series of programs designed to deal with particular sorts of introduced species.

In the United States, a Presidential Executive Order in 1999 called for the formation of a Federal Invasive Species Council to render the federal response to introduced species more effective, and to foster cooperation among federal agencies, state agencies, and other stakeholders such as conservation organizations and private landowners. The Council has formulated a Management Plan that includes many activities to slow the influx of invasive introduced species and to deal with them more effectively once they are present.

International cooperation and management is the best solution!

If all these policies (or global measures) and weapons are used in the battle against invaders, there is every reason to think that most native species and ecosystems can be protected against this threat. If our interest or support falters, the current wave of invaders will surely become a flood, leading to massive habitat change and extinction as much of the earth undergoes a massive biotic homogenization.

Questions:

1. In the 2nd bullet on page one, what do you think the word 'imperiled' means?
   - A. Dangerous
   - B. Extinct
   - C. Endangered
   - D. Dead

2. What is the greatest threat to native biodiversity?
   - A. Introduced species
   - B. Pollution
   - C. Harvest
   - D. Disease

3. What is the greatest impact of invasive species?
   - A. They cause pollution
   - B. They change the native species limited habitat
   - C. They eliminate natural habitats
   - D. They develop stronger species and there is really nothing to worry about

4. When an invasive species reproduces with a native species, called hybridization, it can
   - A. Make the genes stronger
   - B. Alter the natural gene pool
   - C. Enable the native species adapt
   - D. Cause the nonnative species to alter its DNA, just in case it needs to

5. The most prominent pathways for invasion, that could all be monitored or treated more rigorously, is by
   - A. Ship ballast water
   - B. Wooden packing material
   - C. Horticultural plants
   - D. A, B, and C

5.

6. One way that the international community has worked to save the native species is to
   - A. Increase the impact of nonnative species
   - B. Slow the influx of invasive species
   - C. Not worry about non native organisms until they reach a specific area
   - D. Use weapons to kill the invasive species

7. Share some of your thoughts regarding invasive species. _____

_____

_____

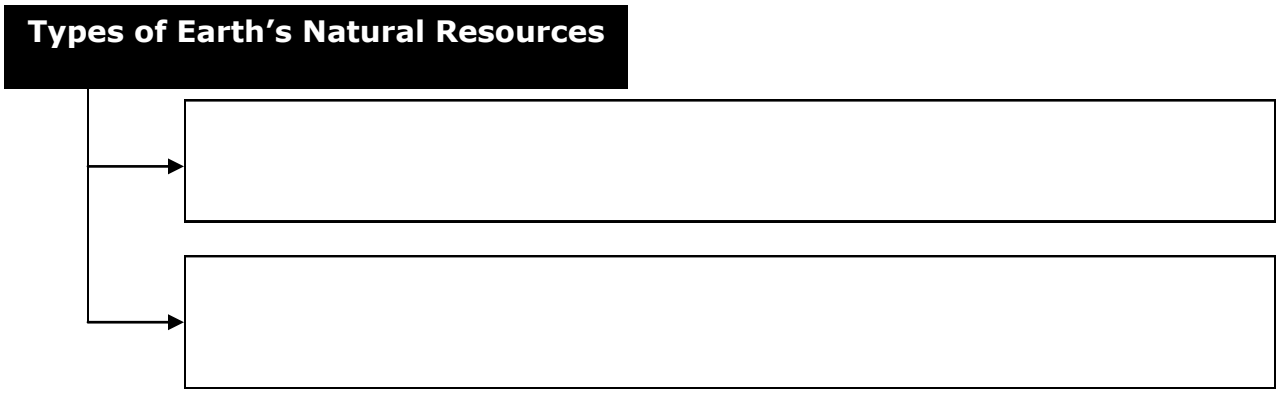
_____

_____

***Part 4, Human Impact on Ecosystems*: Chapter 16.1, 16.2, 16.3**

We live on an interconnected planet. Like all other organisms, humans depend on their environment for food, water, air, shelter, clothes. etc. HOWEVER, the overuse of resources and production of waste can disrupt the energy & nutrient cycles of the Earth.

1. The growing population exerts pressure on Earth's natural resources; describe & give examples of each:



2. How could a renewable resource like water become a nonrenewable resource?_____

_____

3. Why is our **ecological footprint** important? _____

_____

A) What region of the world has the biggest ecological footprint?_____

1) How does that region's footprint compare to its population?_____

_____

4. Name several reasons fossil fuels are so important to us._____

_____

5. As we use fossil fuels, we can negatively affect our ecosystem. Define each of the affects below:

A) Pollution _____

_____

B) Smog_____

_____

C) Acid Rain_____

_____

D) Greenhouse Effect_____

_____

E) Global Warming_____

_____

6. What we do to our water affects the ecosystems. Some of the pollutants we put in the water are: _____

_____

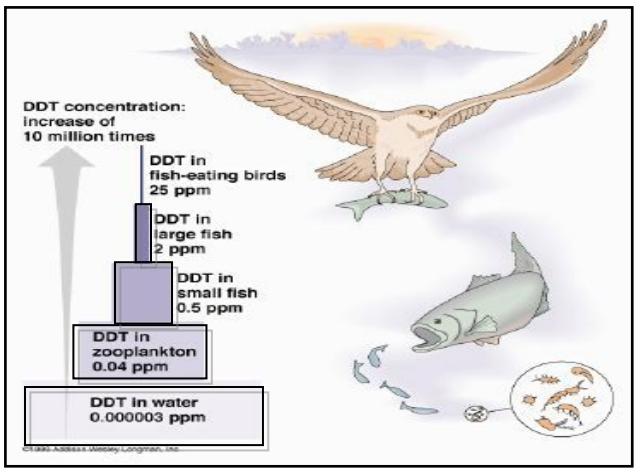
7. One way that scientists can determine the health of an ecosystem is through the study of **indicator species.** An indicator species is:_____

_____

A) If an indicator species population is increasing, what might you infer about the conditions of the ecosystem? _____

***Part 4, cont. Human Impact on Ecosystems*: Chapter 16.3, 16.4, 16.5**

8. Some chemicals/molecules can move from one organism to another in a process called _____ This process, also called **biomagnification,** causes the pollutants to accumulate in _____ con centrations.
   A) The spraying of pesticides is a good example of biomagnification. Draw an arrow from low to high concentration:



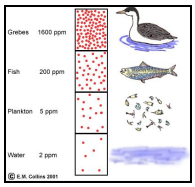
   B) Why would tertiary consumers have higher concentrations of toxins like pesticides than primary consumers?
   _____
   _____
   _____
   _____
   _____
   _____
   _____

9. What is **biodiversity**?_____
   A) A decrease in biodiversity will have a ripple effect the our entire ecosystem —> What are the many areas this ripple effect will affect? _____
   _____
   _____

10. Describe the…….. ***Threats to BioDiversity***

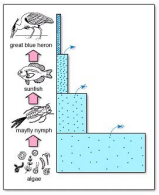
Habitat Fragmentation:	***Introduced Species:***
_____	_____
_____	_____
_____	_____
_____	_____
*Effects:*_____	*Effects:*_____
_____	_____
_____	_____

11. **Sustainability:** Using resources w/o depleting them— recycling, replanting; crop rotation; ability to survive the ability to survive, to endure, to be productive over time; So how can we and the plants and animals live and be productive when WE are affecting the balance of our planet so much?! How can we protect our planet?
    - _____
      _____
    - _____
      _____
    - _____
      _____
    - _____
      _____



Biological Magnification

Quick Lab, textbook page 496



CHAPTER 16 | QUICK LAB

Modeling Biomagnification

In this lab, you will model biomagnification. Small cups represent smelt, a fish that feeds on zooplankton. Medium-sized cups represent trout, which feed on smelt. The large cup represents an eagle, which feeds on trout.

Problem

How are contaminants magnified up the food chain?

MATERIALS

- 4 small paper cups
- 2 medium paper cups
- 1 large paper cup
- marker
- sharpened pencil
- 10 cm masking tape
- 400 mL salt
- 16 beads
- 500-mL beaker

PROCESS SKILLS

Modeling

Procedure

1. Label the cups, smelt, trout, and eagle according to size. Punch holes in the bottom of each cup with the pencil. Cover the holes with masking tape.
2. Fill each of the cups halfway with salt. Add 4 beads to each small cup.
3. Hold each of the small cups over the beaker and remove the tape. Allow the salt to flow through the holes into the beaker.
4. Pour the remaining contents of two small cups into one medium cup. Pour the contents of the other two small cups into the second medium cup. Repeat Step 3 with the medium-sized cups.
5. Pour the contents of both of the medium cups into the large cup.

Analyze and Conclude

1. **Modeling** What do the beads represent in this model of biomagnification?

_____

_____

2. **Evaluate** Why is the following statement true: "Carnivores at the top of the food chain tend to be most affected by pollutants released into the environment"?

_____

_____

_____

_____

_____

Oil Spill Laboratory Exercise!

What is the Best Way to Clean Up Our Ocean?

Purpose: To gain an understanding of what happens in an oil spill and to develop a greater awareness of taking responsibility for the environment.

Background: What causes an oil spill? (Tankers running aground, oil platform accidents) Have you ever seen oil on the street, garage, or in a parking lot? Actually, oil tanker accidents only contribute 11% of the oil in our oceans. More than 54% comes from runoff and leaks from storage facilities. A lot of oil—at least 40% comes from cars. Cars use oil to run and after so many mile, that oil needs to be changed. People who change their own oil may not be careful and allow some of that oil to spill or don't fix their cars when it leaks. Even if they change the oil correctly, they may not dispose of it properly. It should be taken to a gas station where it is picked up by a waste management company to be recycled or burned. If it isn't and instead emptied into landfills, storm drains, or back yards, it will carry toxins contaminants into ground water, streams, and lakes. What happens to the water and to animals if oil spills? If an accident occurs, how can it be cleaned up?

Materials:

- Foil pan + beach sand
- Oil mixture (2 tbs oil + 1 tbs cocoa))
- "Cleaning supplies" - cotton balls, panty hose, string, paper towels , liquid detergent, plastic cup, spoon, feathers

Procedures:

1. Fill the foil pan half full of water.
2. In a cup, mix the vegetable oil and cacao powder. This is your "oil spill" oil. (DON'T POUR IT IN YET)
   A. Record your prediction —> What will happen when the oil is poured into the water? Will the oil sink to the bottom of the pan, float on top of the water, or mix with the water? _____
   _____
3. From a height of about 1cm above the water's surface, pour the oil very slowly into the water.
   A. Describe how the oil spill interacted with the water. _____
4. Simulate wind and waves by gently blowing along the water's surface.
   A. Record your prediction —> What effect will wind and wave action have on the oil spill? _____
   _____
   B. Describe how the oil spill reacted to wind and waves. _____
7. Dip a feather in the oil spill.
   A. Describe how oily feathers might affect birds' behavior. _____
8. Using the different clean-up materials, one at a time, **you** try to clean up the oil spill.
   A. Describe how effective **each** material was in cleaning up the oil spill.
   _____
   _____
   _____
   _____
9. Add 5 drops of liquid detergent (represents a chemical dispersant) to the oil spill.
   A. Record your prediction —> What will happen when the detergent is dropped on to the oil spill? _____
   B. Stir and blow on the surface to simulate wind —> Describe what happens to the oil spill_____
   _____
   C. In the ocean, where do you think the oil in a real oil spill would go? _____
   _____

STANDARD 2, The Circle of Life = Ecology!

Study Guide = "Ticket to Test"

1. What is an ecosystem?	
2. Differentiate between biotic & abiotic factors AND give several examples of each.	
3. Differentiate between autotrophs (producers) & heterotrophs (consumerd) AND give several examples.	
4. What is the purpose & advantage of decomposers?	
5. Differentiate between food chains & food webs.	
6. What happens to energy as it flows through the ecosystem? Explain.	
7. Draw AND label a trophic level pyramid.	
8. What are biogeochemical cycles AND why are they important to ecosystems?	
9. Describe 3 types of symbiosis.	
10. Differentiate between a species, a population & a community.	

Study Guide, cont. = "Ticket to Test"

11. Differentiate between immigration & emigration AND their effects on a community.	
12. What is the significance of carrying capacity? Draw an example of a graph that shows carrying capacity.	
13. Differentiate between renewable & nonrenewable resources AND give examples of each.	
14. What causes acid rain?	
15. What are indicator species AND what happens if they die?	
16. What is biological magnification AND how does it affect food chains? Draw a diagram that indicates a poison magnifying itself in a food chain.	
17. What is the significance of non-native and invasive species?	
18. Why do we want to preserve biodiversity?	
19. Define sustainability AND how can YOU help promote the sustainability of freshwater?	