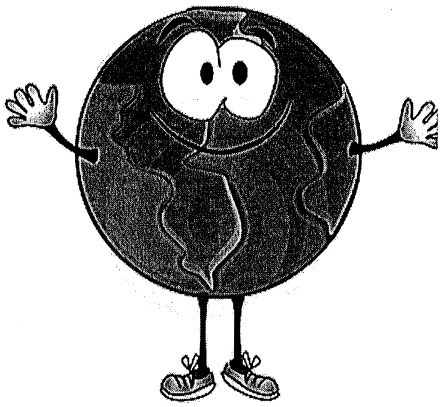
Unit 12 – The Biosphere

Name Notes filled In Hour

OBJECTIVES



_____1. I can identify the levels of organization that ecologists study.

_____2. I can trace the flow of energy through an ecosystem.

_____3. I can describe where all of the energy goes during energy transfers among organisms in an ecosystem.

_____4. I can describe how matter (water, carbon, nitrogen) cycles among the living and nonliving parts of an ecosystem.

_____5. I can explain why nutrients are important in living systems.

_____6. I can describe how the availability of nutrients affects the productivity of ecosystems.

VOCABULARY

Algal bloom
Autotroph
Biogeochemical cycle
Biomass
Biome
Biosphere
Carnivore
Chemosynthesis
Community
Consumer
Decomposer
Detrivore
Ecological pyramid
Ecology
Ecosystem
Evaporation
Food chain
Food web
Herbivore
Heterotroph
Limiting nutrient
Nitrogen fixation
Nutrient
Omnivore
Photosynthesis
Population
Primary productivity
Producer
Species
Transpiration
Trophic level

Unit 12 Warm-Ups

Ecological Sequencing

Ecology is the scientific study of interactions among organisms and between organisms and their environment, or surroundings. To understand relationships on the earth, ecologists ask questions about events and organisms that range in complexity from a single individual to the entire biosphere. Watch the video and write down all of the **living** and **non-living** things you saw.

LIVING	NONLIVING
Bear Grass Tiger Bugs Dead Boar Bird	air mud water dirt weather

Term	What is it?	Example
Individual	one member of a species	Tiger
Population	All members of a species living in one area	Many tigers
Community	All the populations in a given area. (All the LIVING things in one area)	tigers, boars, grass, birds, bugs, ... etc..
Ecosystem	All the LIVING and NON-LIVING things in one area.	boar grass air water birds bugs dirt weather
Biome	A region with specific environmental conditions of climate/elevation/etc.	Tropical Savannah Desert Tundra
Biosphere	All areas of Earth where life exists	Entire Earth

Energy Flow Notes (SECTION 3-2)

To complete this at home go to glscience.weebly.com and click on the link to the online textbook

Producer

- _____is the main source of energy for all life on Earth. Only a small amount of the energy that reaches Earth's surface is actually used by living things. How much? _____
- Some types of organisms rely on the energy stored in _____ _____ _____
- **Autotroph / Producer –**

- Photosynthesis is the process that uses _____ from the sun to power chemical reactions that turn _____ and _____ into _____ and _____
- Who does photosynthesis on land? _____ In the ocean? _____ In tidal flats and marshes? _____.
- Photosynthesis used light for energy, whereas chemosynthesis uses _____ for energy.
- What is one of the molecules that is used as an energy source for chemosynthesis?
- There are many types of bacteria that can do chemosynthesis. We call them _____ bacteria. List three places that chemosynthetic bacteria live: 1.
  2.
  3.

Consumers

- **Heterotrophs / Consumers –**

	Definition	Examples
• **Herbivores**		
• **Carnivores**		
• **Omnivores**		
• **Detritivores**		
• **Decomposers**		

Feeding Relationships

- Energy flows through the ecosystem in _____ _____, from the _____ or inorganic chemical compounds to _____(_____) and then to various _____(_____)
- **Food chain –**
    - Give an example of a food chain that has at least five organisms:
- **Food web –**
- **Trophic level –**
- The Greek root word "trophe" means:
- Who belongs in the first trophic level? _____
- Who belongs in the second trophic level? _____
- Who belongs in the third trophic level? _____

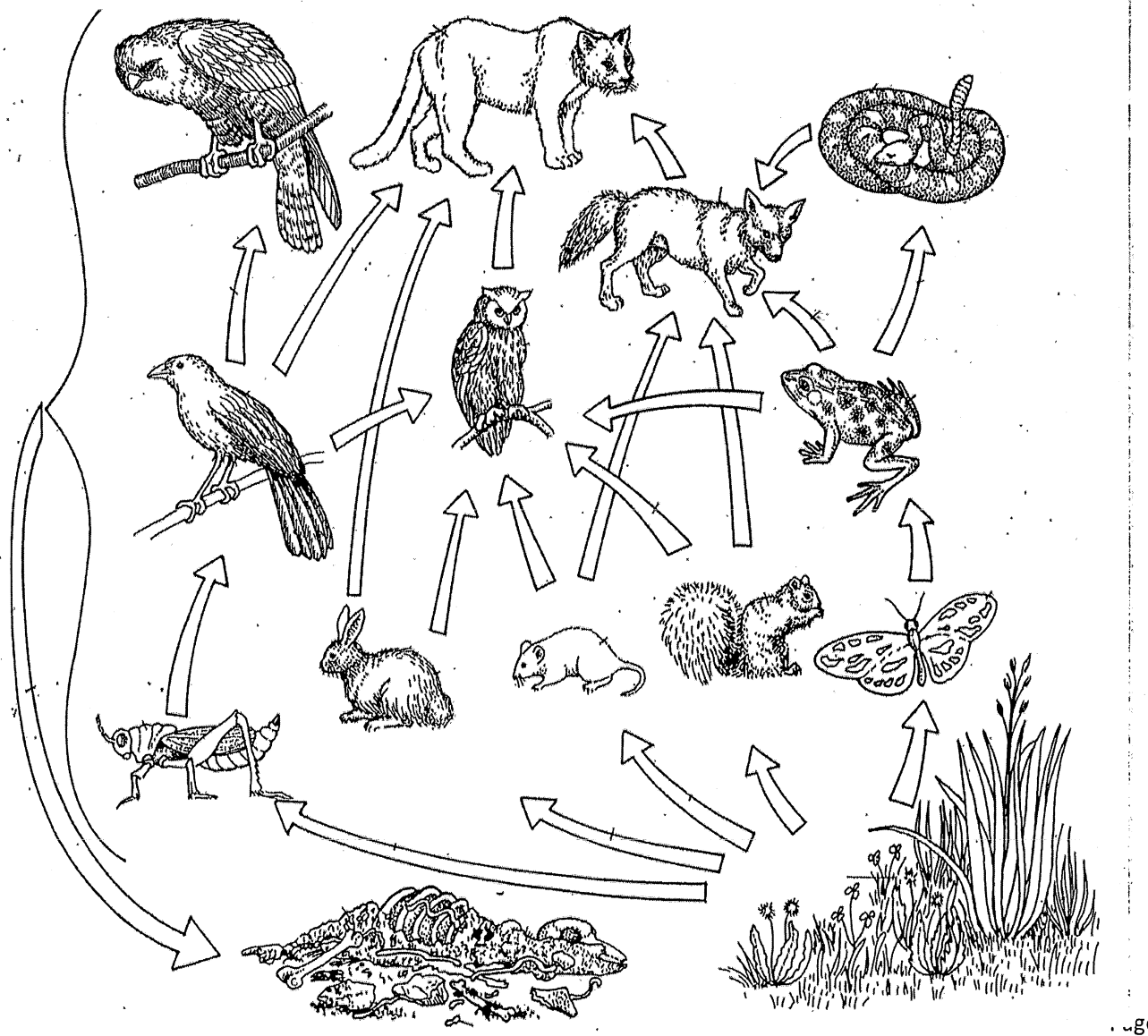
Ecological Pyramids

- **Ecological Pyramid –**
- Only about _____% of the energy available within one _____ _____ is transferred to organisms at the next _____ _____
- **Biomass Pyramid –**
- **Pyramid of Numbers –**

FOOD WEB COLORING

- Your job is to color code the following picture and key. Color the box containing each term the appropriate color and then color the corresponding images that same color.
- Producer (green), Herbivore (yellow), Primary Carnivore (orange), Secondary Carnivore (red), Tertiary Carnivore (purple), Decomposer (brown), Consumption (blue), Decomposition (black).
- NOTE: If an organism can be classified in more than one trophic level, color it both/all the colors that apply. So, carefully analyze each consumer before choosing the color(s).

TROPHIC LEVELS	
Producer	Secondary Carnivore (Tertiary Consumer)
Herbivore (Primary Consumer)	Tertiary Carnivore (Quaternary Consumer)
Primary Carnivore (Secondary Consumer)	Decomposer
FEEDING RELATIONSHIPS	
Consumption	Decomposition

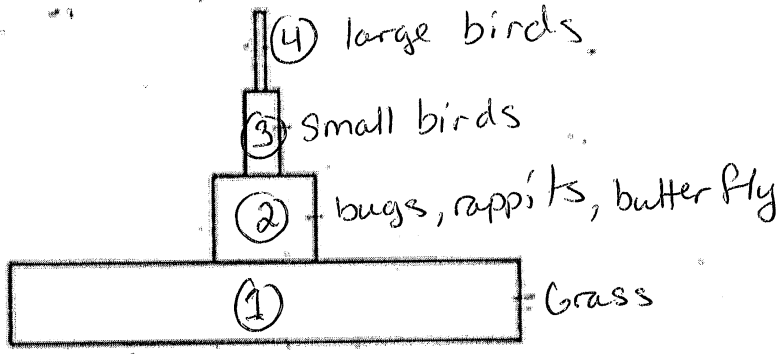


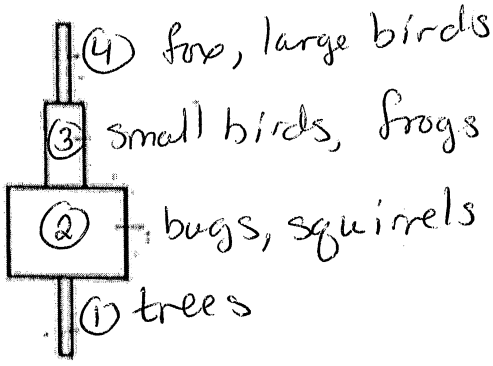
Ecological Pyramid Coloring and Notes

- Color code the following key and pictures based on the colors from the food web. (HINT: The producers always make up the base of the pyramid)

Producers – 1	Primary Carnivores (Secondary Consumers) – 3
Herbivores (Primary Consumers) – 2	Secondary Carnivores (Tertiary Consumers) – 4

PYRAMID OF NUMBERS – tells relative # of individuals at each level

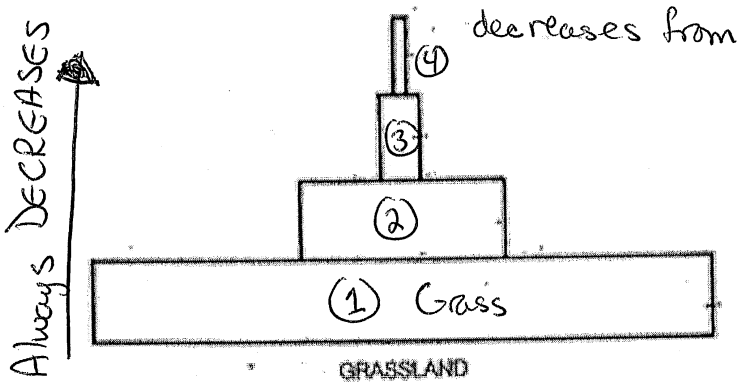


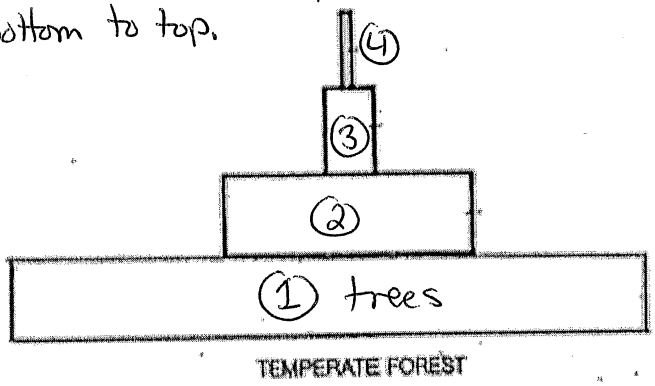


1 grass = small biomass so MANY to support ecosystem

1 tree = huge biomass, so few to support ecosystem

PYRAMID OF BIOMASS – tells the TOTAL mass at each trophic level. Always decreases from bottom to top.



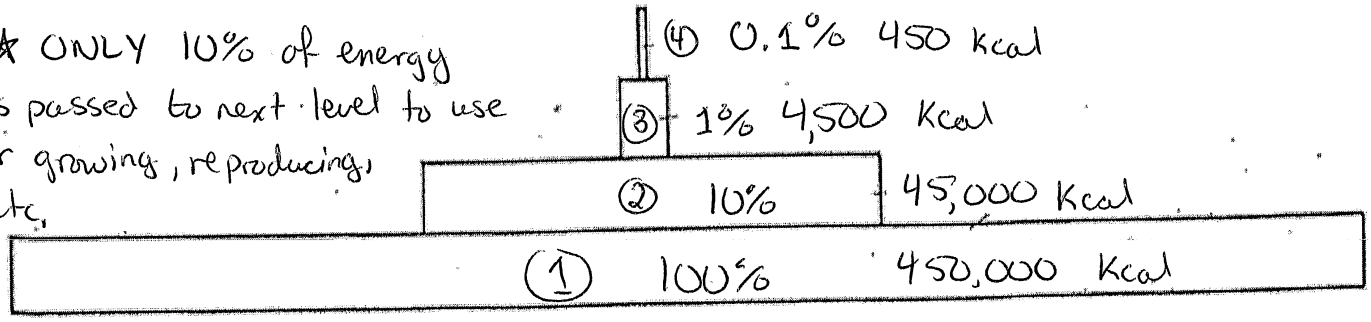


Grass – each is small, but there are billions to make a large biomass

Trees – massive so fewer needed to make a large biomass

PYRAMID OF ENERGY

★ ONLY 10% of energy is passed to next level to use for growing, reproducing, etc.



Sunny Meadows Predictions

Initial explanations and predictions

Organisms eat one another to obtain organic matter and chemical energy. In order for a population of organisms to survive there must be enough food (organic matter) for the population to eat. So all the fox in an ecosystem depend on having enough food—like rabbits—to eat.

Prediction #1: In this investigation you will try to create a **large fox population** by adjusting the number of plants, rabbits, and foxes in the ecosystem. Keep in mind that rabbits eat the plants, and the fox eat the rabbits, so all three organisms are connected.

Plants: _____ Rabbits: _____ Fox: **100**

About how many plants and rabbits do you think you would need to support a large fox population (around 100 foxes)? Try predicting and explaining the number of rabbits and plants you need. Write your numbers above, and explain your reasoning in the space below.

Prediction #2. Unstable populations can lead to the extinction of a species, so you will now try to create an ecosystem that has the **most stable** population after 50 years. How do you think the numbers of grasses, rabbits and foxes will need to change to achieve a very **stable** population?

Sunny Meadows Directions

Directions for the Investigation

1. Go to the following website: http://puzzling.caret.cam.ac.uk/pregame.php?game=6
2. Select the age group 15-18.
3. Click "Play Game".
4. Before playing the game, select "Biomass" in "Choose View" and "4x" in "Game Speed."
5. Now you are ready to play the game:
    a. Use the "+" and "-" keys to set the initial biomass for grass, rabbits, and foxes, the click "start" and watch what happens to the populations until the game stops after 50 years.

b. Click "Reset" to try again with different starting populations. Use the table below to record your starting and final biomass for each trial.
c. Start with your prediction from the previous page (or get as close to it as you can).

Observations during the Investigation

You have **two questions** to investigate in the Sunny Meadows investigation.

1) How can you have the largest fox population at the end of 50 years?
2) How can you have the largest total biomass at the end of 50 years?

	Trial	Start			After 50 Years			Score
		Foxes	Rabbits	Grasses	Foxes	Rabbits	Grasses	
Goal: Largest Fox Population	1							
	2							
	3							
	4							
	5							
Goal: Most Stable Population	6							
	7							
	8							
	9							
	10							

Write down the results for the your BEST attempt at answering each question.

	Start			After 50 Years			Score
	Foxes	Rabbits	Grasses	Foxes	Rabbits	Grasses	
Largest Fox Population							
Most Stable Population							

Sunny Meadows Results

What biomass (relatively speaking) of plants and rabbits were needed to sustain a large fox population during your investigation?

What biomass (relatively speaking) of foxes, rabbits, and plants got you the most stable population?

Why are the plant and rabbit populations always so much larger than the fox population after 50 years?

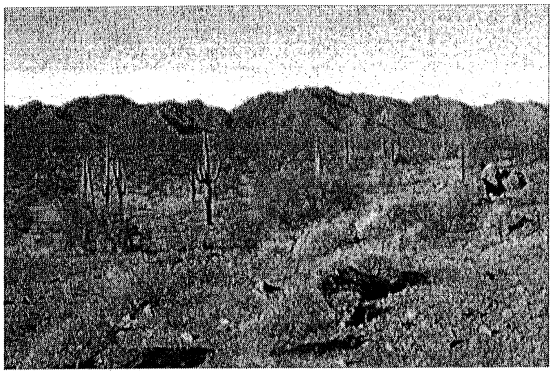
Why do plants contribute so much biomass in an ecosystems?

Reasoning—connecting claims to evidence and scientific principles: Connect what you learned using the simulation, to the number of organisms and the trophic levels at which they exist in the context of your backyard. List the producers, herbivores and primary carnivores that you see in your backyard on a summer day. How many organisms (relatively speaking) are there for each trophic level?

Where Is The Carbon?

Ecosystems are communities of living organisms and their non-living environment. Living organisms can be as small as microscopic bacteria in the soil, or as large as the largest tree in the forest. The organisms you find in an ecosystem depend a lot on where the ecosystem is located on Earth. This changes the average temperatures, rainfall, and hours of sunlight the ecosystem receives, among many other factors. That is why we have many, many types of ecosystems on Earth, from deserts to grasslands to tropical forests.

Look at the two ecosystems below. On the right is a desert ecosystem found in the southwest of the United States, in Arizona. On the left is a forest ecosystem found in the Midwest of the United States, in Michigan.



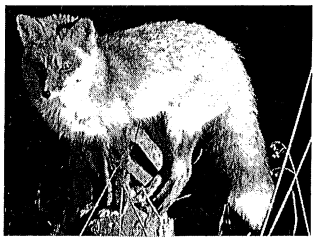
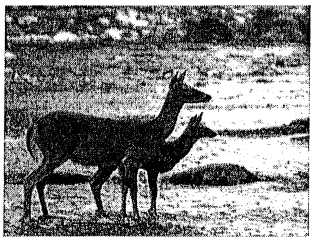
1. Which ecosystem do you think stores the most carbon? Explain why this ecosystem has more carbon than the other ecosystem.

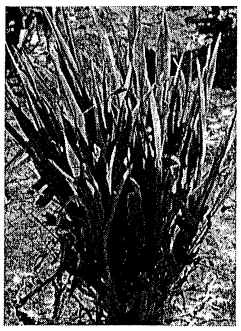
Forest - more trees = (more photosynthesis and more living things that store carbon.)

2. Name all the places where you would find carbon in the ecosystems.

trees
living things
birds
carbon dioxide
grass
fox
Soil (after living thing decompose or poop)

In desert ecosystems and forest ecosystems you can find different species of foxes, deer, rabbits and plants.



Which one of these POPULATIONS of organisms would hold the most carbon in the ecosystem?

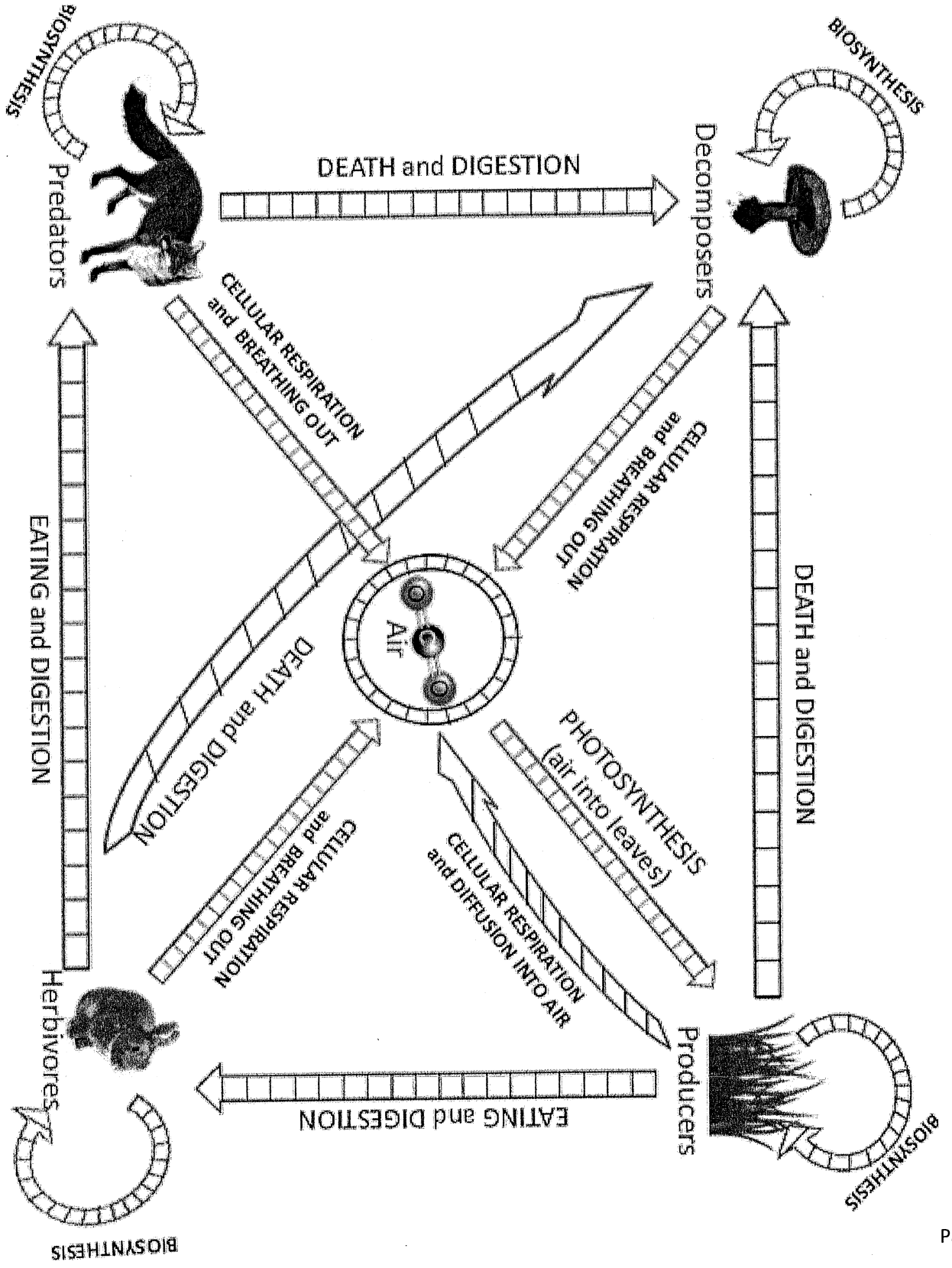
All of the fox populations in the ecosystem	**All of the deer populations in the ecosystem**	**All of the rabbit populations in an ecosystem**	**All of the plant populations in the ecosystem**

3. Explain your choice. Why does that population hold more carbon than the others?

Deer - biggest organism (holds MOST carbon)

Carbon Game Card

Directions: During the game, use the game card on this page to record your data as you play the game. After you play the game, fill in the blanks on the next page.



Carbon Game Analysis

1. I started in the _____ pool.
2. I ended in the _____pool.
3. I was in the AIR pool _____ times. To find the answer, count the number of colored squares in the arrows that point to the AIR pool, and the number of colored squares in the circle around the AIR pool. Add these two numbers together to get your answer.
4. I was in the Producer pool _____ times. To find the answer, count the number of colored squares in the arrows that point to the PRODUCER pool.
5. I was in the HERBIVORE station _____ times.
6. I was in the CARNIVORE station _____ times.
7. I was in the DECOMPOSER station _____ times.
8. I was transformed by PHOTSYNTHESIS _____ times. To find the answer, count the number of colored squares in the arrow labeled photosynthesis.
9. I was transformed by BIOSYNTHESIS _____ times. To find the answer, count the number of colored squares in all of the arrows labeled biosynthesis. These arrows are round; there are 4 of them.
10. I was transformed by DIGESTION _____ times. Note: There are multiple arrows for digestion! Make sure to count them all.
11. I was transformed by CELLULAR RESPIRATION _____ times. Note: There are multiple arrows for cellular respiration, too!
12. When will the game end? _____ Why?
13. Where does a carbon atom spend most of its time?

Biogeochemical Cycles

1. Dissect the vocabulary word biogeochemical cycle
    a. Bio –
    b. Geo –
    c. Chemical –
    d. Cycle –
2. Now that you know the word parts, come up with your own definition this term:

Using the book on pages 75 to 78, read about the way these materials cycle through an ecosystem.

Water

3. Draw a picture of the water cycle including the FIVE major processes

4. What is the difference between evaporation and condensation?

5. How does water directly leave plants and go to the atmosphere?

Carbon

6. Draw a picture to show how carbon goes between the atmosphere, organisms, and the ground.

7. What are some ways that humans are releasing stored carbon into the atmosphere?

STOP – As a class we will listen to the NPR radio clip and answer the following questions:

8. What affect does CO_2 have on ocean waters?

9. Which ocean ecosystems will increased CO_2 affect the most?

10. What conditions are they trying to match in the first tank?

11. What does weighing the coral show?

12. What does the "Do Nothing" tank represent?

13. What kind of living things are present in this tank?

14. What conditions produced the healthiest coral?

15. What two conditions produce poor results?

16. What would humans have to do to keep reefs looking how they do today?

17. How will the destruction of the coral reefs impact humans?

18. What aspect of nature cannot be replicated in the lab?

19. What is the best-case scenario for the natural coral ecosystems?

Nitrogen

20. Draw a picture to show how nitrogen goes between the atmosphere, organisms, and the ground.

21. What do living things need nitrogen for?

22. What is the majority of Earth's atmosphere made of? (name and chemical formula)

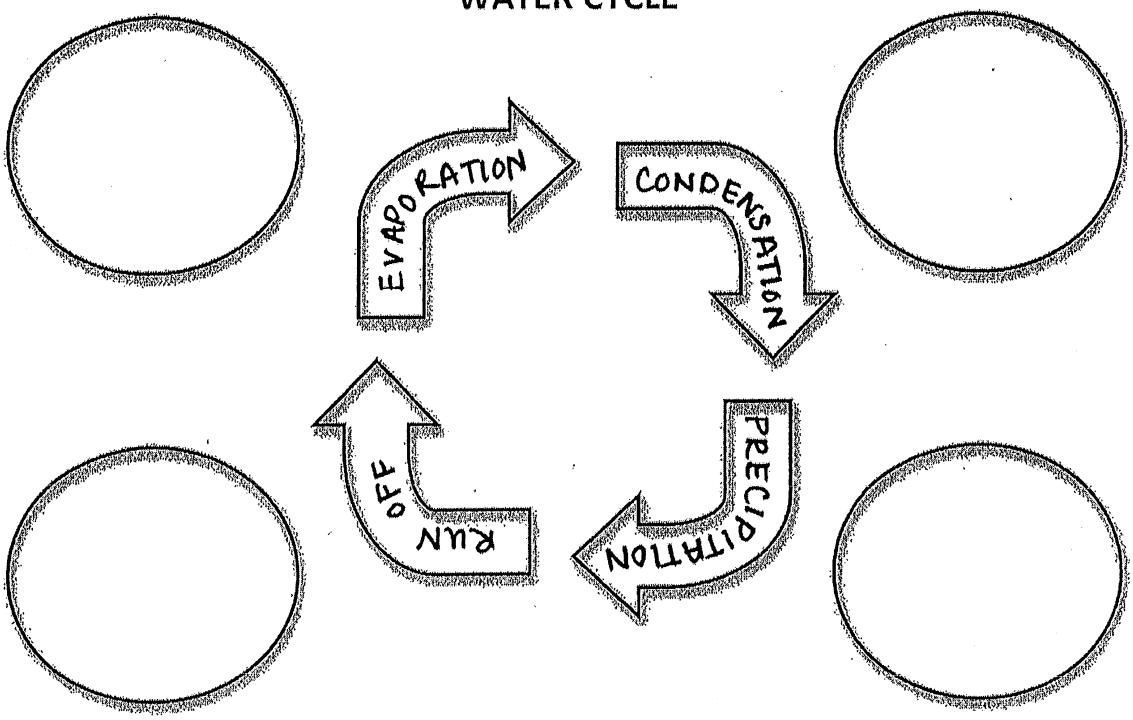
23. Which organisms can use this form of nitrogen directly?

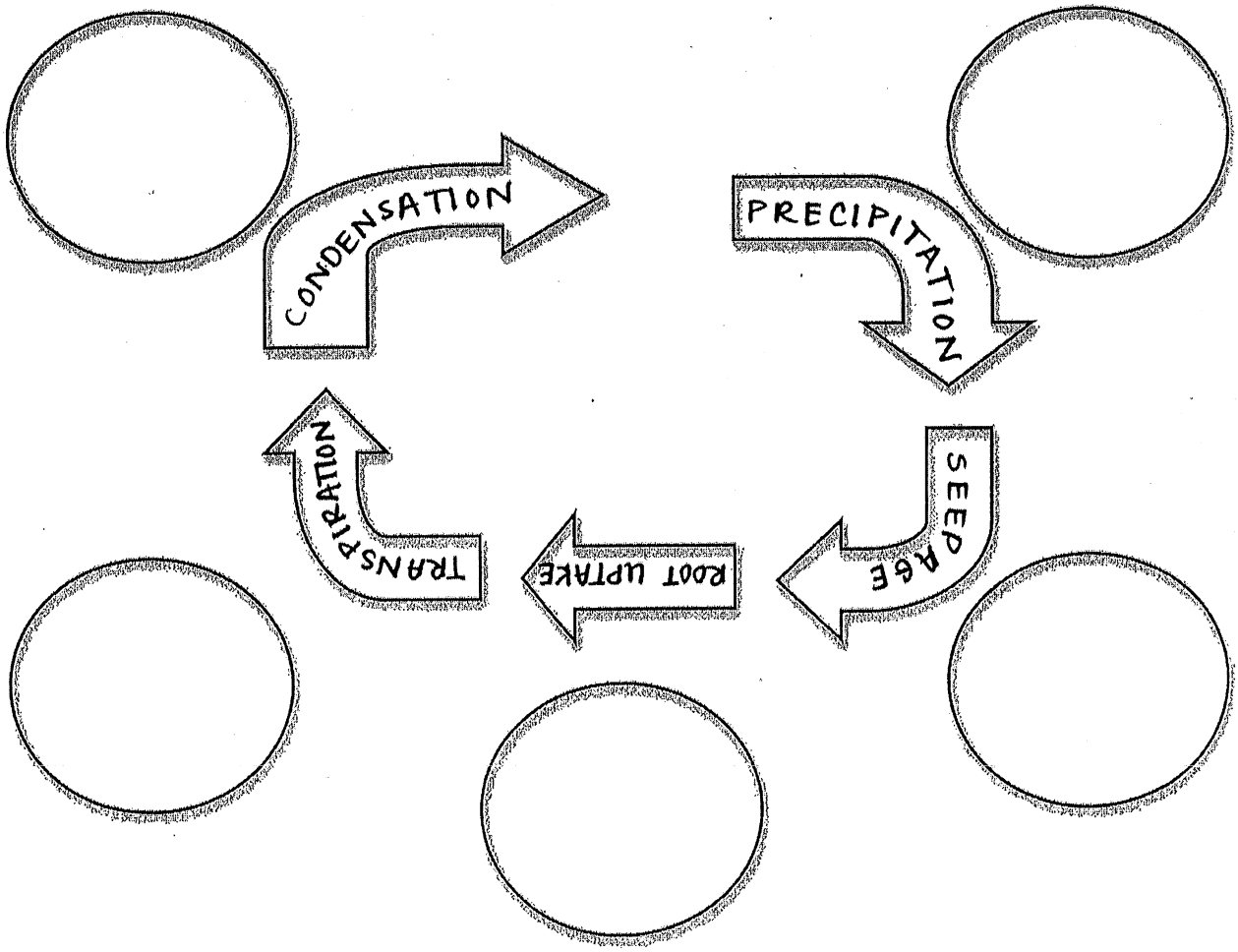
24. Why can't plants and animals use this form directly?

25. In order for plants and animals to use nitrogen, what form(s) does it need to be in?

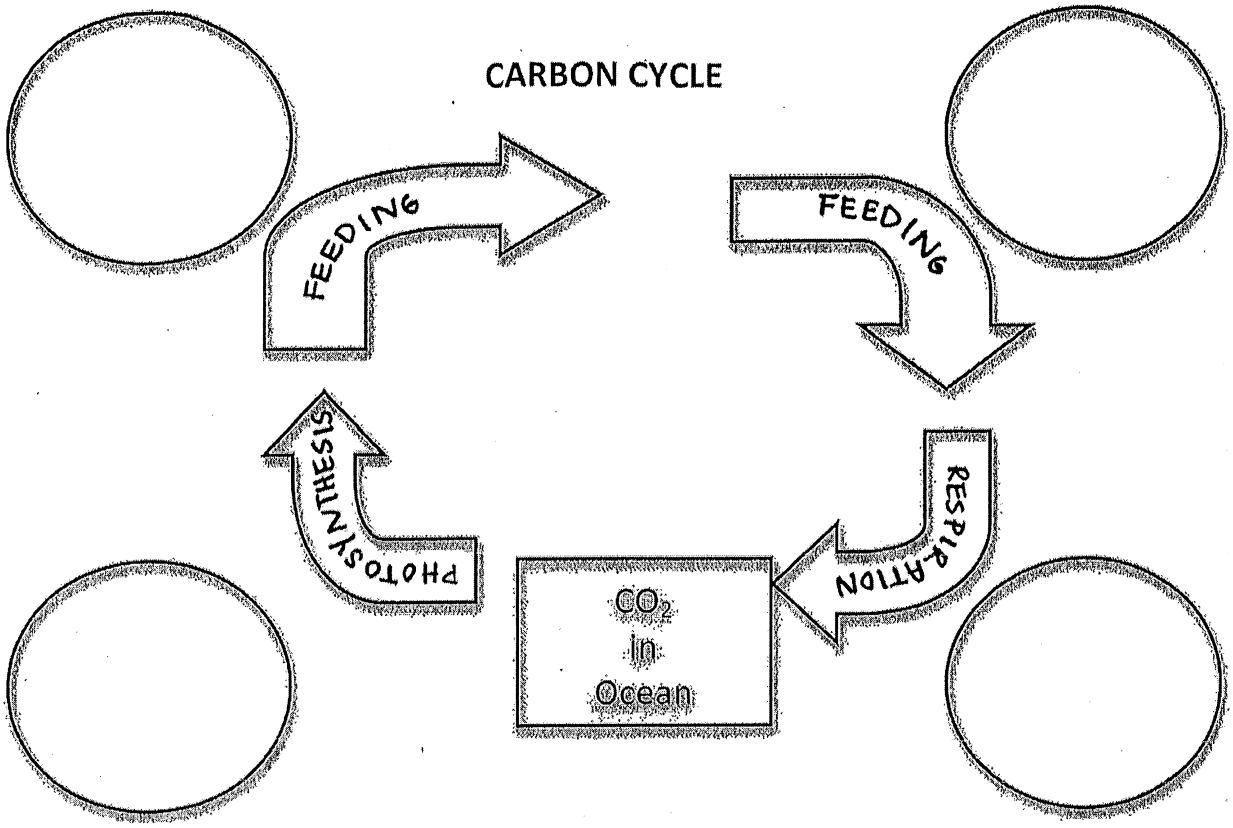
26. How does nitrogen in the atmosphere get converted into the forms we can use?

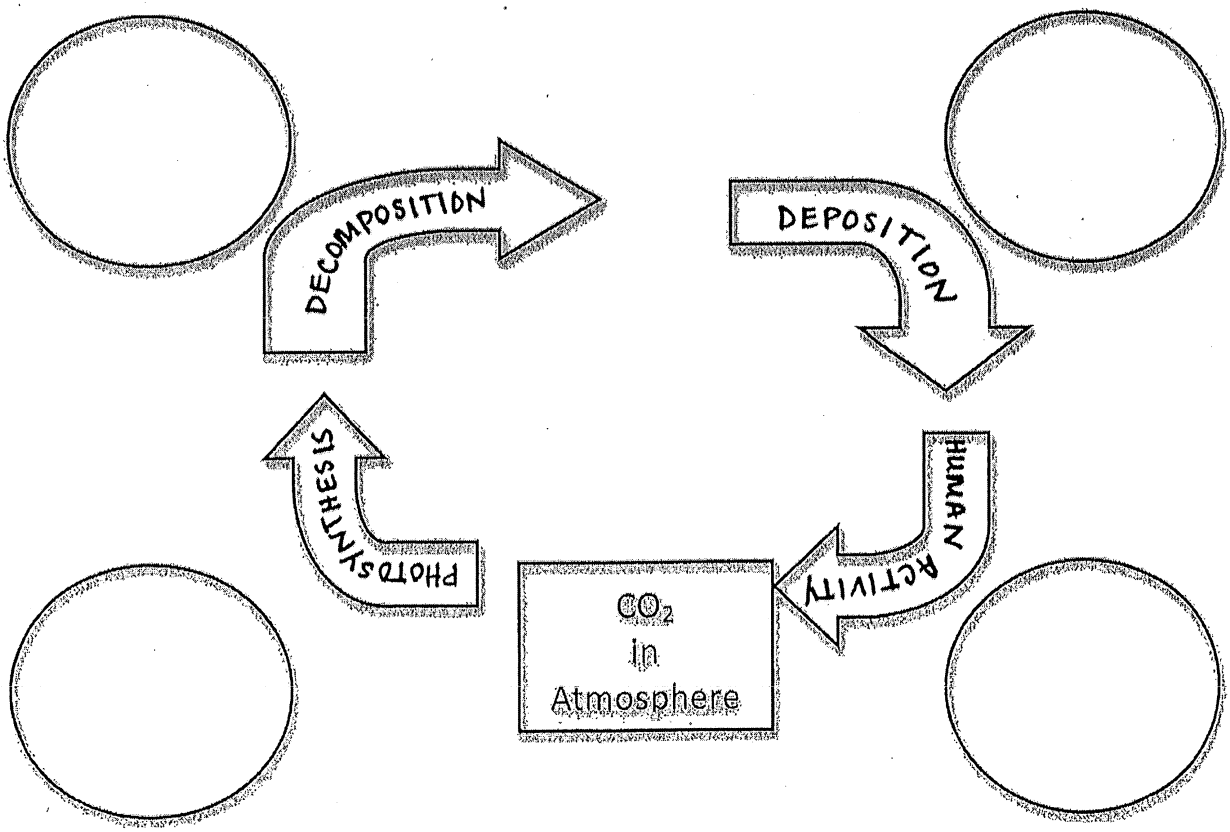
WATER CYCLE


EVAPORATION
CONDENSATION
PRECIPITATION
RUN OFF

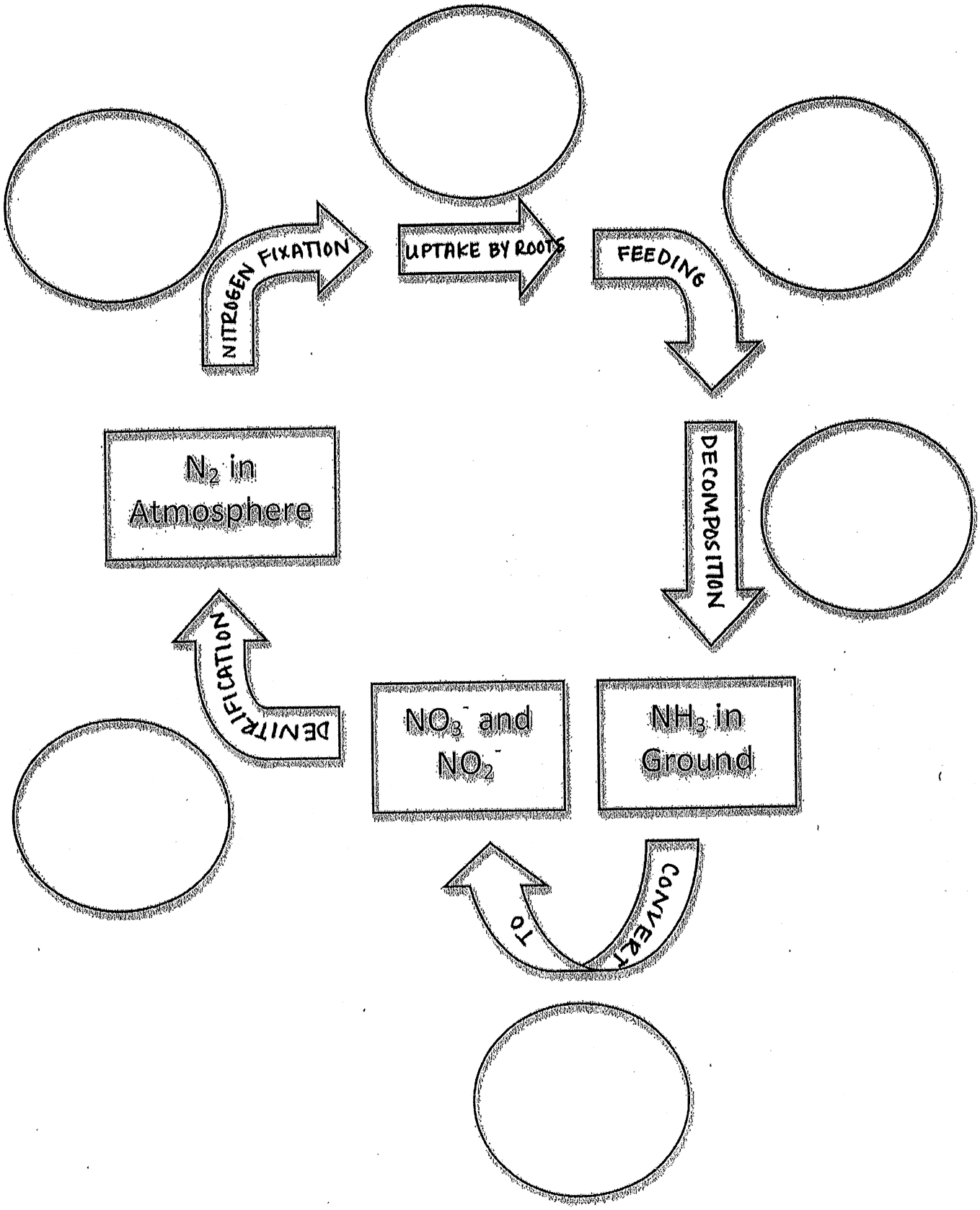

CONDENSATION
PRECIPITATION
SEEPAGE
ROOT UPTAKE
TRANSPIRATION

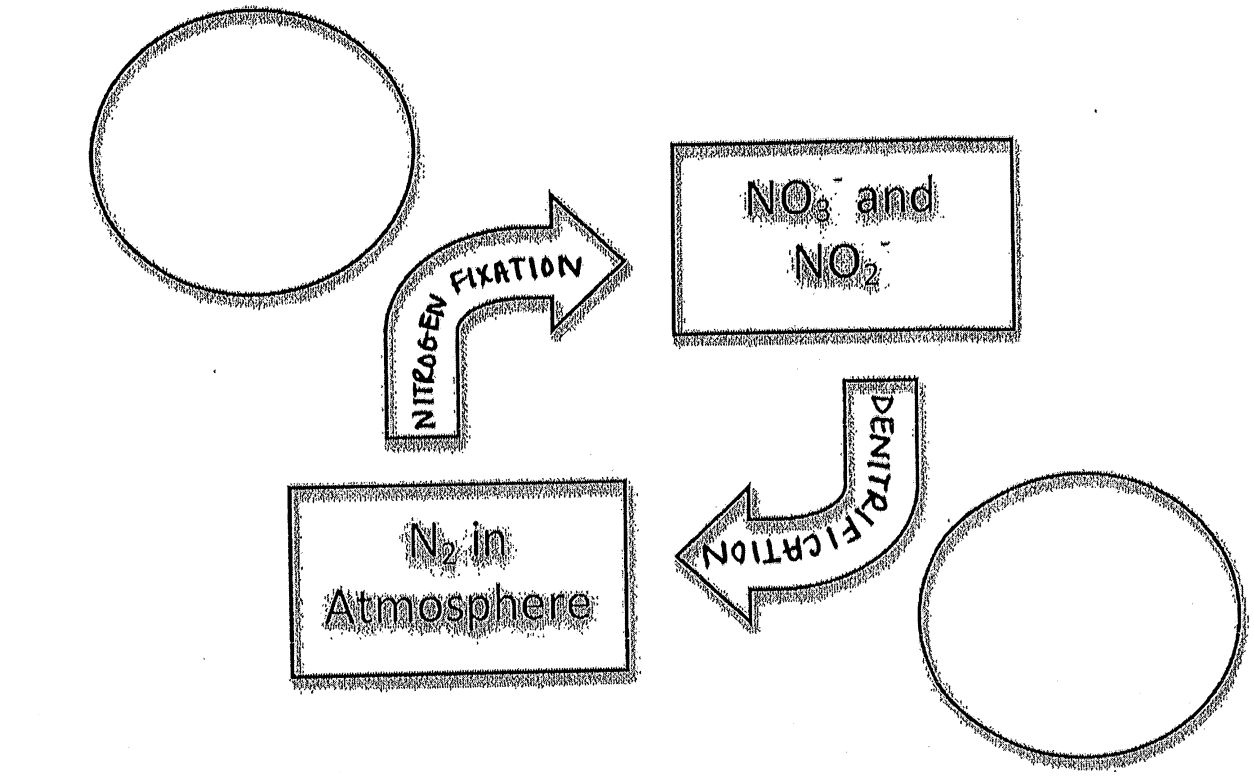
CARBON CYCLE

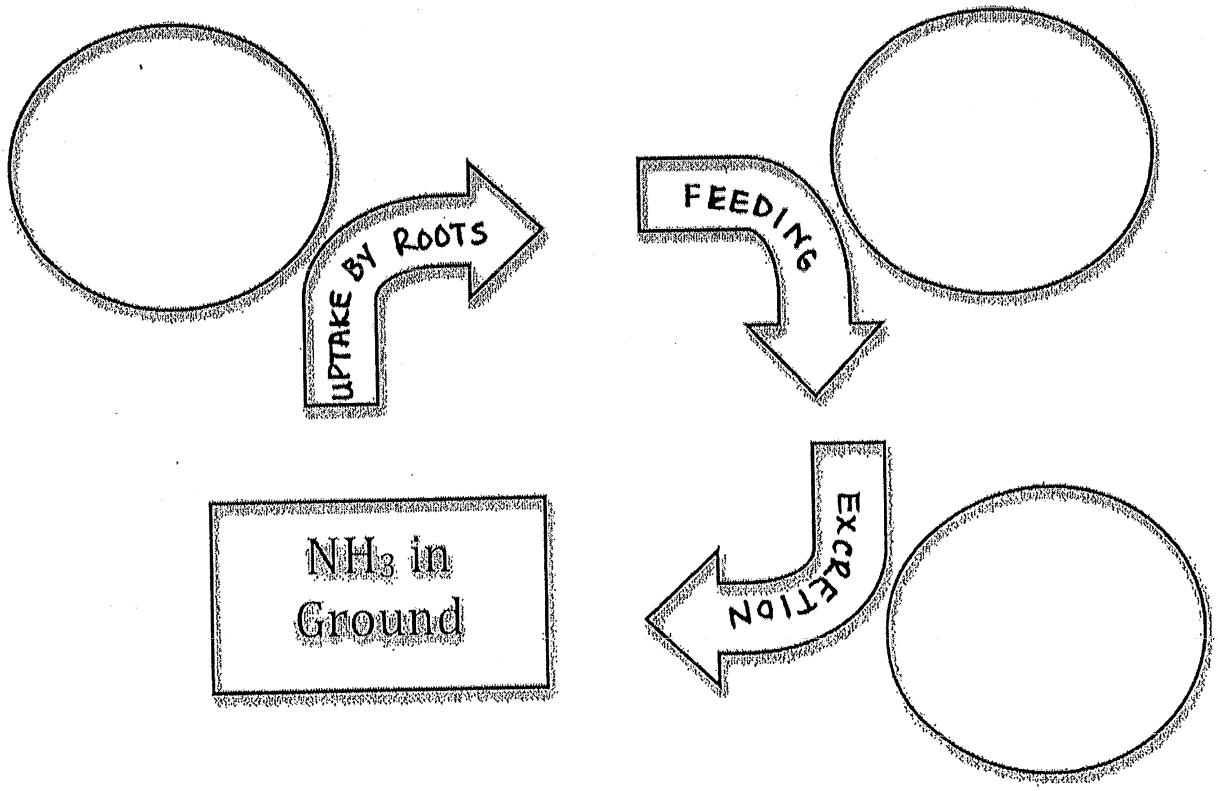




NITROGEN CYCLE




NITROGEN FIXATION
NO_3^- and NO_2^-
DENITRIFICATION
N_2 in Atmosphere


UPTAKE BY ROOTS
FEEDING
EXCRETION
NH_3 in Ground

Limiting Nutrient Notes

Created	Nutrients	Primary productivity
Growth	Phosphorus	Producers
Limiting nutrient	Photosynthesis	Rate
Nitrogen	Potassium	

- Ecologists want to know the Primary productivity of the ecosystem that they are studying. This is the rate at which biomass is created by producers, through the process of photosynthesis. Certain nutrients are needed to do photosynthesis. In ecosystems, rarely will all required nutrients be used up at the same rate. (Think about making smores around the campfire. You never run out of the chocolate, marshmallows and graham crackers at the same time! If you run out of chocolate first, then the chocolate limits the number of smores you can make.) When one nutrient is used up before other nutrients, that nutrient limits the growth of the plants. That nutrient is then considered a limiting nutrient. The most common limiting nutrients are nitrogen, phosphorus, and potassium.
- How do farmers solve the problem of limiting nutrients? Synthetic Fertilizers
- This practice is great for the production of crops, but is it healthy for the entire ecosystem? NO
    - How can fertilizers negatively impact an ecosystem?

      The run off from rain can wash fertilizers into lakes, streams and oceans
- When a limiting nutrient is returned to a lacking environment it jumpstarts primary productivity, meaning _____. Normally algae and aquatic plant growth are regulated, or held in check, by the limiting nutrient. This maintains a healthy balance in the aquatic ecosystem. But when an aquatic ecosystem gets a huge dump of limiting nutrient it can cause an algal bloom.
- How is an algal bloom unhealthy for an ecosystem?

Algae grows fast → not enough fish to eat it → algae dies → algae decays → it burns up the oxygen in water → fish don't get enough oxygen → fish die → ecosystem collapses.

Unit 12 Study Guide

1. List the terms of ecological sequencing in order from smallest to largest and provide an example at each level.

2. What is ecology?

3. Name the two things that must be in common for two areas to be considered the same biome.

4. What type of organisms are able to make their own food? Name two sources from which the energy to make this food come from.

5. What is a trophic level?

6. At which trophic level would you find producers?

7. What is an ecological pyramid?

8. How much of the available energy within one trophic level is transferred to organisms at the next level?

9. Describe an Ecosystem in which a Biomass Pyramid and a Pyramid of Numbers would not look the same. Why are they different?

10. In the Sunny Meadows Investigation we experimented with population numbers to try and find a stable fox population. In the space below, draw the trophic levels that lead to the most stable fox population. Label the appropriate level as fox, rabbits, or plants.

11. What is a food chain?

12. What process do plants undergo that allows them to fix CO_2 into a usable form of energy?

13. List some forms of nitrogen that plants are able to use. What is one form of nitrogen that is not able to be used directly?

14. Why do living things need nitrogen?

15. What is a limiting nutrient? What impact do they have on an ecosystem?

16. Water can enter the atmosphere in many ways. What is the process that occurs when water leaves plants and goes directly to the atmosphere?

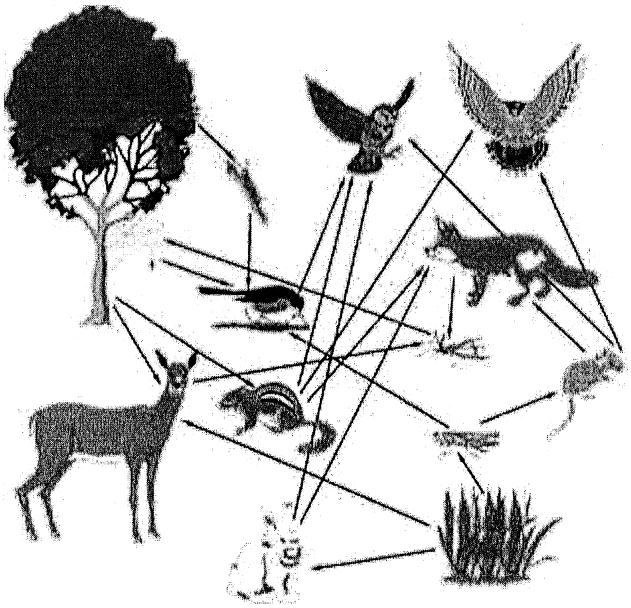
17. What is the difference between an herbivore, omnivore, and carnivore?

18. What is the main source of energy for all life on earth?

19. Which ecosystem would contain more carbon, a forest or desert? Explain.

20. What type of **molecules** can carbon be stored in in these ecosystems?

21. Using the picture to the right, name two **producers**, two **primary consumers**, and two **secondary consumers.**



22. Which trophic level(s) would you assign to the hawk. Explain.

23. Describe a scenario that could lead to the decreased population of one of the primary consumers you identified above.

A group of ecosystems that have the same climate and dominant communities make up a	An organism that cannot make its own food and must rely on other organisms for it energy and food supply. You are an example. There are two terms that fit this description, write them both.	The scientific study of interactions among organsisms and between organisms and their environments.	A cow eats only grasses. Grasses are producers. Therefore, the cow is an .....
The process of using light energy to power chemical reactions that convert water and carbon dioxide into carbohydrates (sugar) and oxygen gas.	When water escapes from plants through an open stoma on the under side of leaves.	The total amount of living tissue in a given environment.	All the different populations of living things that inhabit a particular area.
A diagram that shows the relative amounts of energy or matter within each trophic level in a food chain or food web.	The network of complex interactions formed by the feeding relationships among the various organisms in an ecosystem.	I like to eat hamburgers and salads, therefore I am an.....	A group of organisms so similar that they can breed and produce fertile offspring.
Certain chemicals cycle through the Earth and living things. Some examples are water, carbon, nitrogen and phosphorus. The paths of these chemicals through the biosphere are called.....	Some organisms use inorganic chemicals for the energy they need to make carbohydrates. This process is called.....	Sponges live on the bottom of the ocean and rely on dead plants and animals falling from the surface as a source of energy. Animals who eat dead things are called....	A series of steps in an ecosystem in which organisms transfer energy by eating and being eaten.

A chemical substance, like nitrogen or phosphorus, that an organism requires to live.	Organisms that can take energy from sunlight or chemicals and use it to produce food. There are two terms that fit this description, write them both.	Runoff from farm fields contains a lot of chemical fertilizer. This fertilizer gets dumped into lakes and streams and a huge increase in the amount of algae is the result.	A bunch of blue jays who all live in the same area are all members of the same .....
The process of converting nitrogen gas in ammonia.	A step in a food chain or food web. Some examples are: producers, herivores, primary carnivores	A nutrient that is in such short supply in an environment that it limits the growth of organisms in an ecosystem.	A fly breaks down dead plants and animals and waste from other organisms so it is called a .....
A tyrannosaurus rex ate only meat so it was considered a	The part of the Earth in which life exists.	All of the living and nonliving things in a given area make up an...	