

CHAPTER 3

The Biosphere

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Interest Grabber

Levels Within Levels

An ecosystem is a collection of all the organisms that live in a particular place, together with their nonliving, or physical, environment. Within an ecosystem, there are several levels of organization. Your school and its grounds are similar to an ecosystem.

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Interest Grabber *continued*

ANSWERS

1. What living things are found in and around your school? Make a list of at least 10 things.
2. What nonliving things are found in your school?
3. Into what large groups are the students in your school divided?
4. Into what smaller groups are these large groups divided?
5. Are these groups ever divided into even smaller groups? If so, what are these groups?

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Section Outline

3-1 What Is Ecology?

A. Interactions and Interdependence

1. Ecology is the scientific study of interactions among organisms and between organisms and their environment
2. The BIOSPHERE contains the combined portions of the planet in which all life exists, including land, water, and air (or atmosphere)

B. Levels of Organization

1. Biosphere
2. Biome
3. Ecosystem
4. Community
5. Population
6. Individual



Inquiry Activity – How do organisms affect one another's survival?

- I. OBSERVING AN ENVIRONMENT – HOW DO ORGANISMS AFFECT ONE ANOTHER'S SURVIVAL?**
- II. PURPOSE** – Students will observe a local environment and be able to identify relationships among various types of organisms that they observe
- III. SAFETY** – minimal safety precautions – don't touch insects (they may be poisonous), use caution around plants (thorns, etc.)
- IV. PROCEDURE**
 1. Make a list of all the types of organisms, including plants, humans, insects, etc. that you see/have seen on campus (senior lunch area)
 2. Make a diagram that shows how the organisms on your list interact with each other
- V. DATA**



Inquiry Activity – How Do organisms affect one another’s survival?

VI. QUESTIONS - THINK ABOUT IT

1. **Classifying** – Which organisms on your list provide energy or nutrients to the others?
2. **Predicting** – What would you expect to happen if all the plants on your diagram died? Explain your answer.
3. **Asking Questions** – Why is it difficult to make accurate predictions about changes in communities of organisms?

VII. CONCLUSION

Write a paragraph where you address how you have achieved the objective of the lab.



Interest Grabber *Video*

Ecology – The Biosphere

Concepts and terminology discussed include: ecosystem, wetland, biotic, abiotic, forest, precipitation, temperature, soil type, primary succession, secondary succession, climax community, biome, forest, tundra, taiga, ocean, estuary, freshwater, and rainforest.



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3-1 What Is Ecology? *continued*

C. Ecological Methods

1. Observing
2. Experimenting
 - a. Setting up laboratory experiments
 - b. Setting up field studies
3. Modeling
 - a. Used to “speed up” or “scale down” phenomena
 - b. Often use mathematical formulas based on data collected
 - c. Make predictions that are then tested further

NOTE – ALL of these approaches rely on the application of scientific methods to guide ecological inquiry

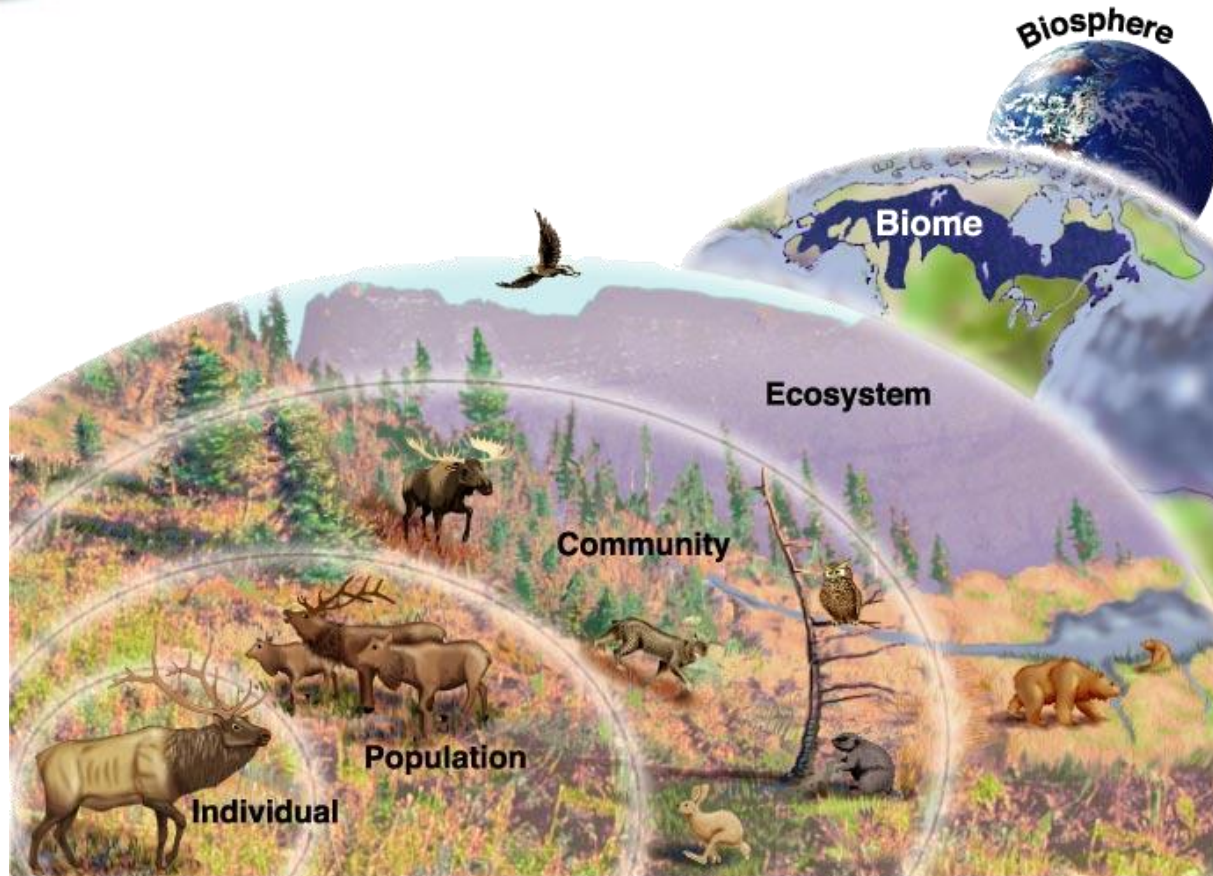


Compare/Contrast Table

Ecological Methods			
	Observation	Experiment	Model Building
Sites	Field site	Experimental plots, field sites, laboratory	Many sites for data collecting
Measuring Tools	Tapes, compass, Global Positioning System, thermometer, sensors	Tapes, compass, Global Positioning System, thermometer, sensors	Aerial views, Global Positioning System, weather balloons
Magnifying Tools	Binoculars, microscope, telescope	Binoculars, microscope, telescope	Satellite images
Written Record	Notes, automated data storage	Notes, automated data storage	Automated data storage
Chemical Testing	Test kits	Test kits	Large database, multiple sensors
Computer/Calculators	Mathematical analysis and graphics, statistics	Mathematical analysis and graphics, statistics	Mathematical analysis and graphics, statistics, simulations



Figure 3-2 Ecological Levels of Organization



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Interest Grabber

Pass It Along

Energy flows in one direction through an ecosystem, from the sun or inorganic compounds to producers (organisms that can make their own food) through various levels to consumers (organisms that rely on other organisms for food). Your body gets the energy and materials it needs for growth and repair from the foods you eat.

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Interest Grabber *continued*

ANSWERS

1. Make a list of five foods that you like to eat. Indicate whether the food comes from a plant (producer) or an animal (consumer).
2. Like many birds, chickens eat grains, which are seeds. Where do seeds come from?
3. Meat comes from beef cattle. What do cattle eat?
4. Construct a diagram showing how one of your favorite foods obtains its energy. Include as many levels as you can.

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3-2 Energy Flow

A. Producers – also called *autotrophs*

1. Energy From the Sun

- a. Only 1% of all energy from sun is used by living things
- b. Only plants, some algae and certain bacteria can capture this energy to make food
- c. They make their own food through *photosynthesis*
 1. Converts CO₂ and H₂O into carbohydrates
 2. Releases O₂ as a waste product

2. Life Without Light

- a. Use chemical energy like those in hot springs or near undersea vents
- b. They make their own food through chemosynthesis
 1. Often use H₂S (hydrogen sulfide) and CO₂
- c. Represent the largest proportion of autotrophs



Section Outline *continued*

3–2 Energy Flow (continued)

B. Consumers

1. Called *heterotrophs*

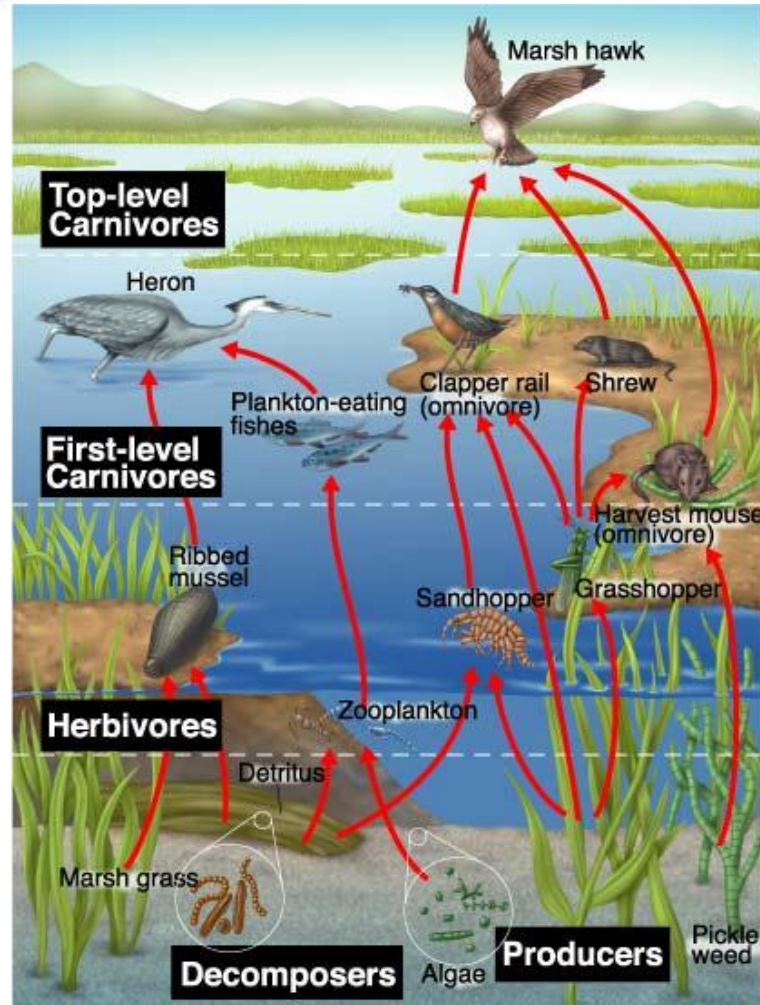
- a. Herbivores
- b. Carnivores
- c. Omnivores
- d. Decomposers (break down organic matter)
 1. Detritivores (eat decaying organic matter; often called decomposers but are actually heterotrophs)

C. Feeding Relationships

1. Food Chains – energy passed through an ecosystem
2. Food Webs – a complex network of feeding relationships *next slide*
3. Trophic Levels – each step in the food chain or food web
 - a. Producers make up the first level
 - b. Consumers make up the second, third or higher level



Figure 3-8 A Food Web



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3–2 Energy Flow (continued)

D. Ecological Pyramids

1. Energy Pyramid
2. Biomass Pyramid
3. Pyramid of Numbers

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Ecological Pyramids

Energy Pyramid

Shows the relative amount of energy available at each trophic level. Organisms use about 10 percent of this energy for life processes. The rest is lost as heat.

Pyramid of Numbers

Shows the relative number of individual organisms at each trophic level.

Biomass Pyramid

Represents the amount of living organic matter at each trophic level. Typically, the greatest biomass is at the base of the pyramid.

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It's Raining, It's Pouring

How many times have you had to change your plans because of rain? It probably didn't help if someone tried to cheer you up by saying, "But we really need the rain."

However, rain is important. If it didn't rain, how would living things on land get water?

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Interest Grabber *continued*

ANSWERS

1. When rain falls on the ground, it either soaks into the soil or runs across the surface of the soil. When rainwater runs across the land, what body of water might collect the rain?
2. From here, where might the water flow?
3. After the rain, the sun comes out and the land dries. Where does the water that had been on the land go?
4. Construct a diagram that would illustrate all the places a molecule of water might go. Begin with a raindrop and end with a cloud.

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Section Outline

3–3 Cycles of Matter

A. Recycling in the Biosphere

1. Biogeochemical cycles – pass the same molecules around over and over

B. The Water Cycle

1. Evaporation and Transpiration
2. Condensation and Precipitation
3. Runoff, Seepage, Root Uptake

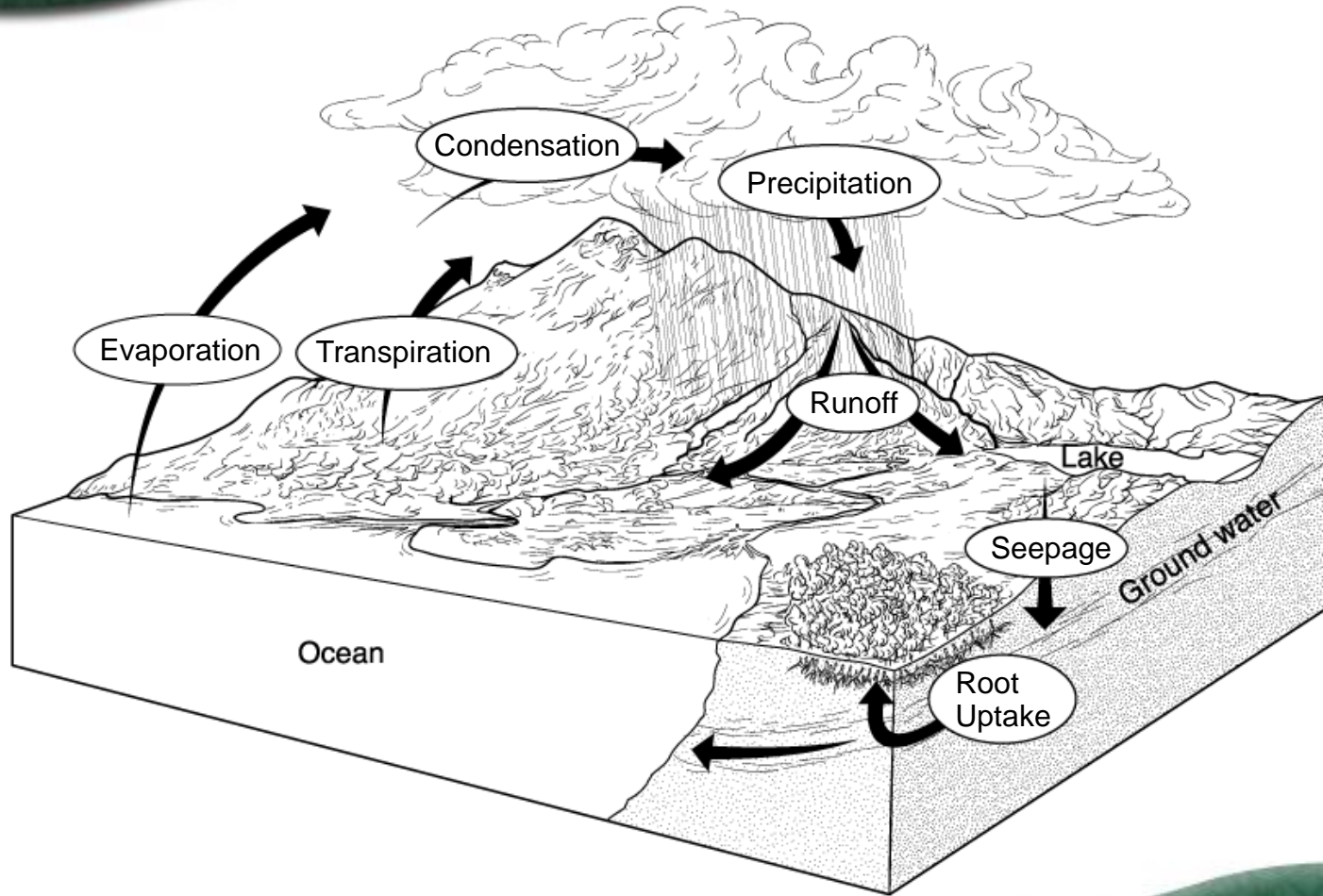
C. Nutrient Cycles

1. The Carbon Cycle

- a. Biological processes take up and release carbon and oxygen
- b. Geochemical processes release CO₂ into atmosphere
- c. Mixed processes (producing coal, petroleum) store carbon in ground
- d. Human activities release CO₂ into environment



The Water Cycle

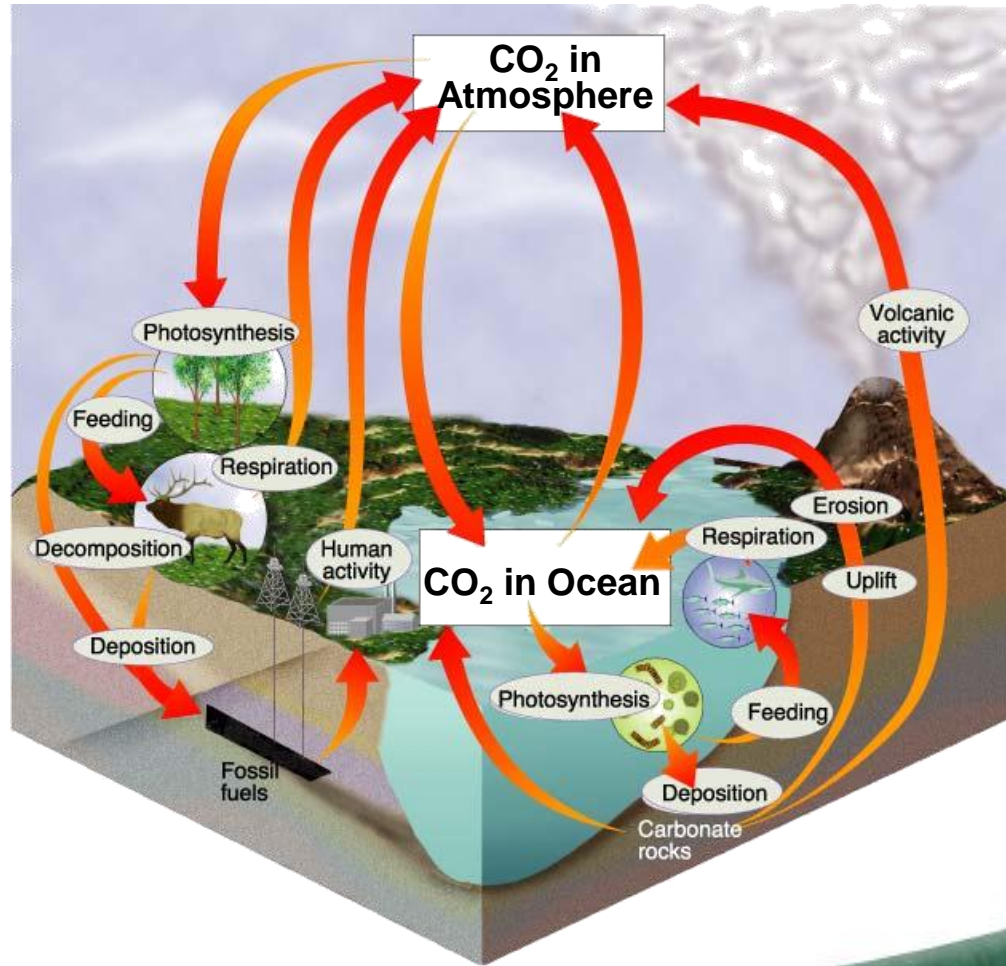


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Figure 3-13 The Carbon Cycle



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3–3 Cycles of Matter

C. Nutrient Cycles *continued*

2. The Nitrogen Cycle

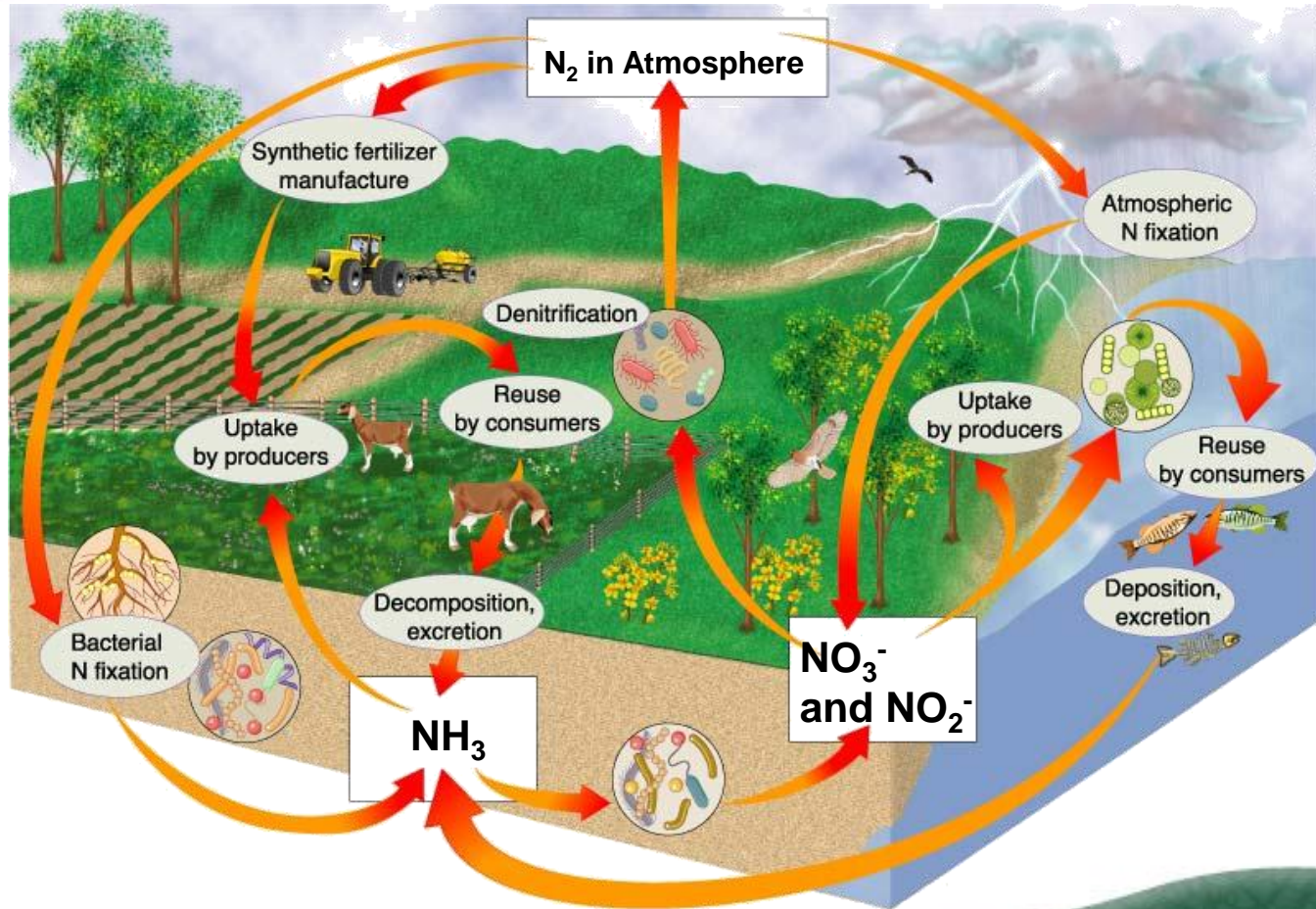
- a. All living things require nitrogen (N₂) to live
- b. 78% of the atmosphere is nitrogen
- c. Present in waste products (ammonia, etc)
- d. The breakdown of organic matter releases nitrogen back into the environment through nitrogen fixation (nitrogen gas into ammonia then into nitrates and nitrites – then producers use these to make proteins)
- e. Some convert nitrates and nitrites into N₂ through denitrification

3. The Phosphorus Cycle

D. Nutrient Limitation



Figure 3-14 The Nitrogen Cycle



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CLOSE PRESENTATION

Section Outline *continued*

3–3 Cycles of Matter

C. Nutrient Cycles *continued*

3. The Phosphorus Cycle

- a. Necessary for DNA and RNA
- b. Typically used by marine organisms and from there to animals
- c. Also used by plants and from there to animals
- d. Not found in atmosphere!

D. Nutrient Limitation

1. Primary productivity – the rate at which organic matter is created by producers
2. Growth can be limited by availability of a particular nutrient (limiting nutrient)
 - a. A sudden availability of a limiting nutrient results in a sudden increase in the number of producers (algae bloom)



Cycles in Nature



Click the image to play the video segment.





[The latest discoveries in preserving the environment](#)

[Links from the authors on exploring ecology from space](#)

[Interactive test](#)



For links on energy pyramids, go to www.SciLinks.org and enter the Web Code as follows: cbn-2032.

For links on cycles of matter, go to www.SciLinks.org and enter the Web Code as follows: cbn-2033.



Interest Grabber Answers

1. What living things are found in and around your school?

Living things in the school are students, teachers, principal, assistant principals, clerical staff, custodians, lunchroom staff. Students may also include animals in science labs. Living things around the school include grass, trees, shrubs, insects, birds, and so on.

2. What nonliving things are found in your school?

The building, furniture, desks, books, papers, and so on

3. Into what large groups are the students in your school divided?

9th, 10th, 11th, 12th grades, or years

4. Into what smaller groups are these large groups divided?

Classes

5. Are these groups ever divided into even smaller groups? If so, what are these groups?

Students may say that science classes are divided into lab groups; other classes may be divided into groups for projects.



Interest Grabber Answers

1. Make a list of five foods that you like to eat. Indicate whether the food comes from a plant (producer) or an animal (consumer).

Student lists will be individualized. One possible example would be a hamburger, which comes from a cow or steer.

2. Like many birds, chickens eat grains, which are seeds. Where do seeds come from?

Seeds come from plants.

3. Meat comes from beef cattle. What do cattle eat?

Cattle eat grass or grains.

4. Construct a diagram showing how one of your favorite foods obtains its energy. Include as many levels as you can.

Student diagrams will be individualized based on their food choice. Using the hamburger example, the beef in the hamburger comes from cattle. The cattle feed on grass or grain. Grass or grains are plants, which use energy from the sun to make their own food.



Interest Grabber Answers

1. When rain falls on the ground, it either soaks into the soil or runs across the surface of the soil. When rainwater runs across the land, what body of water might collect the rain?

Possible answers: a stream, river, pond, or lake

2. From here, where might the water flow?

Into a river, and eventually into the ocean

3. After the rain, the sun comes out and the land dries. Where does the water that had been on the land go?

It evaporates and becomes a gas in the atmosphere.

4. Construct a diagram that would illustrate all the places a molecule of water might go. Begin with a raindrop and end with a cloud.

Student diagrams may include the following: a raindrop → lawn → a stream → river → large lake → atmosphere → cloud.



