"I can accept failure, everyone fails at something. But I can't accept not trying." - Michael Jordan

Environmental Science Midterm Review Packet

Chapter 1

NATURE OF SCIENCE
A. Terms:

1. **Observation:** What is seen or measured.
2. **Inference:** A conclusion based on observation or evidence.
3. **Hypothesis:** An untested prediction. A good hypothesis states both cause and effect ("If-then" statement).
4. **Theory:** A broad explanation of natural events that is supported by strong evidence.

B. **Graphing**

C. **Controlled Experiment:** Compares the results of an experiment between two (or more) groups.
1. **Experimental group:** Group being tested or receiving treatment. (ex: new drug)
2. **Control group:** "Normal" group. Should be identical to experimental group in every way except one: it does not receive the treatment (i.e.: no drug, or given the original drug or a placebo).
3. **Independent Variable:** Variable that is being tested; the variable the experimenter is manipulating (ex: new drug). In a graph the independent variable is always plotted on the X-axis.
4. **Dependent Variable**: Variable that is measured at the end of an experiment; the results (ex: does patient get better?) The dependent variable is always plotted on the Y-axis.)
5. **Control Variable:** Variable that stays the same or constant throughout the experiment (the same in both the experimental and control group).

D. **Characteristics of a good experiment.**
1. Can be repeated by anyone and get the same results.
2. Have large sample size/many test subjects.
3. Are performed for longer periods of time.
4. Test only one variable.
5. Are peer reviewed – examined by several scientists to determine its accuracy.
6. Does not have to agree with the hypothesis. A scientist's guess is allowed to be incorrect – and usually is.
7. Is objective – the experiment and conclusion are fair and unbiased. Fact and opinion are not mixed.

EXAMPLE OF EXPERIMENT

A scientist is testing the effect of temperature on the growth of a common houseplant. The scientist believes that higher temperatures will result in an increase in growth of the plant.

Hypothesis: If the temperature is increased, the growth of the houseplant will increase because higher temperatures are required for the plant enzymes to function correctly.

Independent Variable: The temperature the houseplant is placed in (Scientist is manipulating the temperature of the room the plant is in.)

Dependent Variable: The growth of the houseplant as measured by its height (Scientist is measuring the height of the plant.)

Control Variables: Type of plant, amount of water plant receives, amount of sunlight plant receives, location of plant, and amount of nutrients (Scientist is keeping all these factors the same in all groups of plants.)

Control Group	*Experimental Group(s)*
House plants found at normal temperature (room temperature)	Group 1: Plants found at 20 deg. C Group 2: Plants found at 30 deg. C Group 3: Plants found at 40 deg. C Group 4 Plants found at 50 deg. C

Chapter 3

- ⊙ **Atoms** *are the basic unit of matter*
    - ⊙ **Nucleus:** Contains protons and neutrons
    - ⊙ **Electrons:** Move around the nucleus.
- ⊙ Atoms can combine by sharing or transferring electrons to form **compounds**
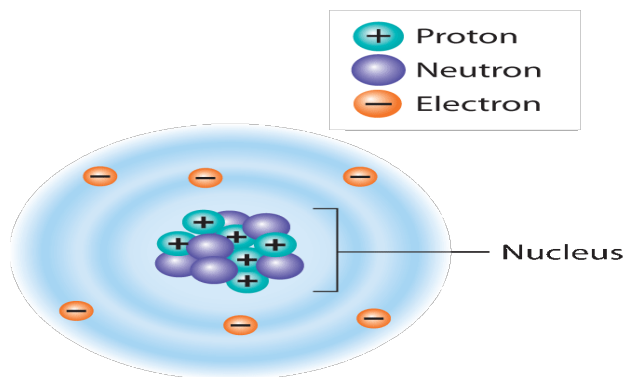
- ⊙ **Organic compounds: Compounds with carbon-to carbon bonds. Living things are made of organic compounds**
    - ⊙ **Lipids**
    - ⊙ **Sugar**
    - ⊙ **Ethanol**
- ⊙ **Inorganic compounds: Lack carbon-to-carbon bonds**

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| Macromolecules	Function	Basic Unit	Examples
Lipids:	Many functions: long-term energy storage (provides greatest amount of energy)	Fatty acid	Fats, waxes, hormones
Proteins:	Serve many functions; include enzymes	Amino acids	Amylase
Nucleic Acids	Direct protein production	Nucleotide	DNA and RNA
Carbohydrates	Provides short-term energy and structure	Monosaccharide	Glucose, starch

ACIDS, BASES, and pH

1. The separation of water molecules into ions causes solutions to be acidic, basic, or neutral.
2. The pH scale measures how acidic or basic a solution is.
- **pH of 7—Neutral: Equal concentrations of H^+ and OH^-**
- **pH below 7—Acidic: Relatively high concentration of H^+**
- **pH above 7—Basic: Relatively high concentration of OH^-**

| Acids	Bases
1. Taste Sour 2. Affect indicators (red = acid) 3. Neutralize Bases 4. Often produce hydrogen gas 5. pH between 0 and LESS than 7 6. The closer pH is to 0, the stronger the acid	1. Taste Bitter 2. Feel Slippery 3. Neutralize Acids (Antacids) 4. Affect indicators (base=blue) 5. pH between >7 and 14 6. Dissolve grease (Drano, Windex) 7. The closer pH is to 14, the stronger the base
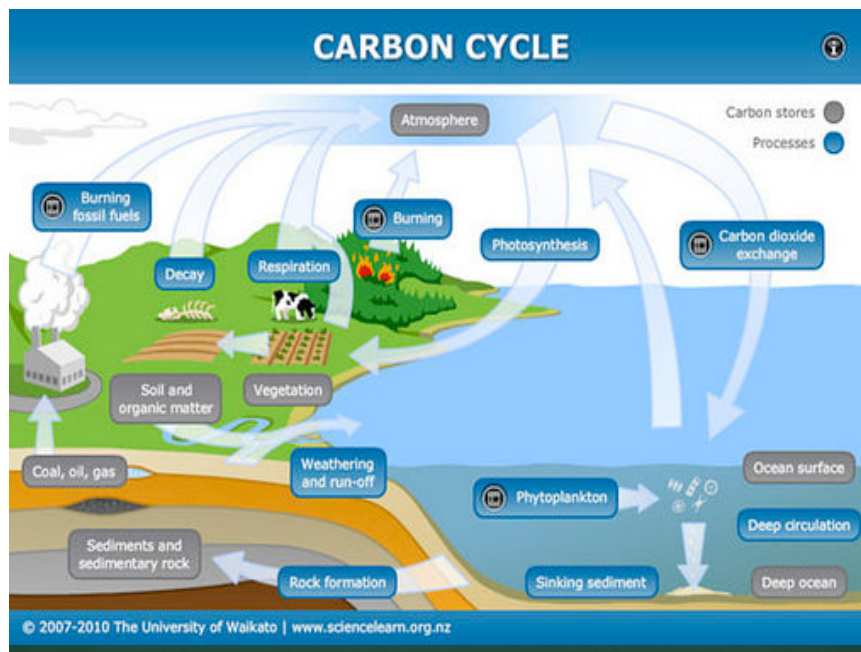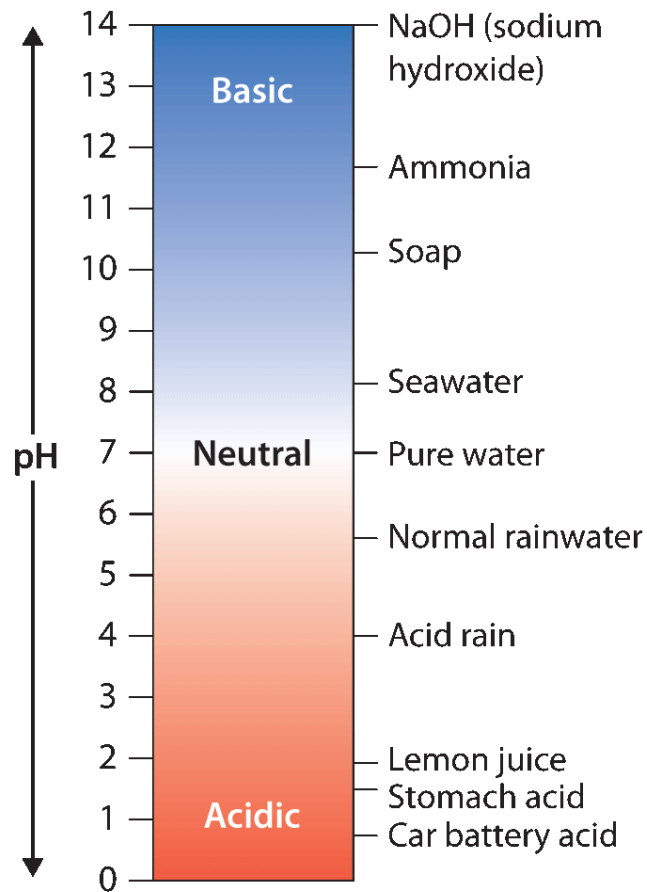
Sources of carbon:
- Cellular respiration
- Burning of fossil fuels
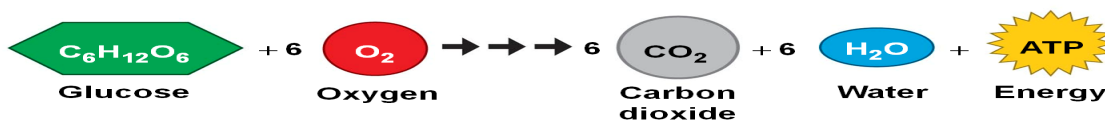- Exhaust from automobiles and factories
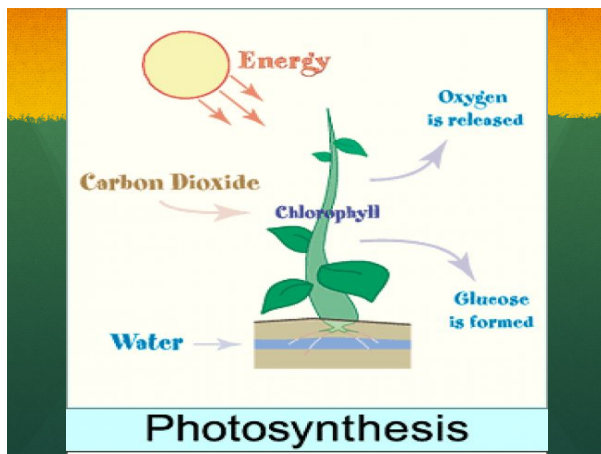
Photosynthesis

Photosynthesis is carried out by plants, alga and blue-green bacteria (autotrophs). It takes the radiant energy of the sun and puts it in the bonds of sugar molecules. Photosynthesis occurs mostly in the chloroplast of plant cells.

- o *Materials needed for photosynthesis*: carbon dioxide (CO_2), water, and energy from the sun
- o *Products of photosynthesis:* sugar molecules (glucose) and oxygen
- o **ONLY PRODUCERS (AUTOTROPHS) UNDERGO PHOTOSYNTHESIS**

Cellular Respiration: Organisms get energy by breaking the bonds of sugar molecules. The released energy is used to make a molecule of ATP, which gives all organisms their energy.

- **O** *Materials needed for cellular respiration:* sugar and oxygen
- **O** *Products of cellular respiration:* energy, carbon dioxide, and water
- **O** **CONSUMERS and PRODUCERS UNDERGO CELLULAR RESPIRATION**

$C_6H_{12}O_6$ (Glucose) + 6 O_2 (Oxygen) → → → 6 CO_2 (Carbon dioxide) + 6 H_2O (Water) + ATP (Energy)

© 2010 Pearson Education, Inc.   Figure 6.UN01

Photosynthesis and Aerobic Respiration are <u>opposite reactions</u>! They are also important in cycling oxygen, carbon, hydrogen and water through the environment.

Chapter 4

Individual   Population   Community   Ecosystem   Biosphere
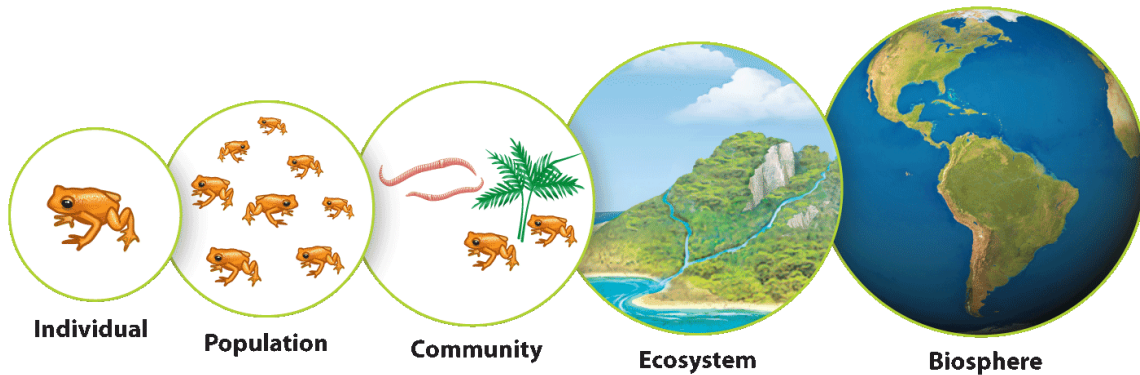
Ecosystem *includes all of the living things and their physical environments within a particular area.*

Abiotic factors *are parts of an ecosystem that have never been living.*
   Example: sunlight, water, air, rocks
Biotic factors *are parts of an ecosystem that are living or used to be living.*
   Example: rotting tree, plants, bacteria, squirrels

Logistic Growth	Exponential Growth
Carrying capacity / Stabilized population size / Limiting factors: • Water • Space • Food • Predators • Disease — Population Size vs Time, Exponential growth	Population Size vs Time
• *Carrying capacity* – **largest population size a given environment can sustainably support** • **Growth almost always slows and stops due to limiting factors.**	• **Population increases by a fixed percentage every year.** • **Normally occurs only when small populations are introduced to an area with ideal environmental conditions** • **Rarely lasts long**

Chapter 5

EVOLUTION

A. Basically states that modern species evolved from earlier, different species and share a common ancestor.

Main Mechanisms of Biological Evolution

1. Mutations	• **Mutations** *are changes in DNA* • Gives rise to variation among individuals • May be passed onto the next generation of offspring if mutation occurs in egg cell or sperm cell
2. Migration	• Immigration or emigration can cause a change in a population's gene pool. This process is called **gene flow.**
3. Genetic Drift	• Caused by an unusual event that Happens by chance • ***Kills* or *somehow separates* all except** a few individuals in a population
4. Natural Selection**	• *Process by which traits that improve an organism's chances for survival and reproduction are passed on more frequently to future generations than those that do not.*

B.** Charles Darwin proposed that **natural selection** is the mechanism that causes species to change. The requirements in natural selection are:
      1. Overproduction of offspring.
      2. Competition for limited resources.
      3. Survival and reproduction OR death.
      4. Individuals vary in characteristics, some of which are heritable.
      5. Individuals vary in fitness, or reproductive success.

C. Organisms that are better adapted to their environment and able to reproduce successfully are considered "fit". Unfit organisms die, and their traits are eventually removed from the gene pool.

      NOTE: Evolutionary fitness has nothing to do with physical fitness. Stronger is not always better.

D. Evolution is usually driven by a change in the environment.

E. To evolve, variations must exist in a species BEFORE the environment changes. **They do not get a trait just because it is needed.**

F. **Variations** exist primarily as the result of <u>**sexual reproduction**</u> **and** <u>**mutation.**</u>

G**. Species with more variation** are better able to survive environmental changes. **Adaptations** are heritable traits (can be passed onto offspring) that increases an individual organism's fitness.
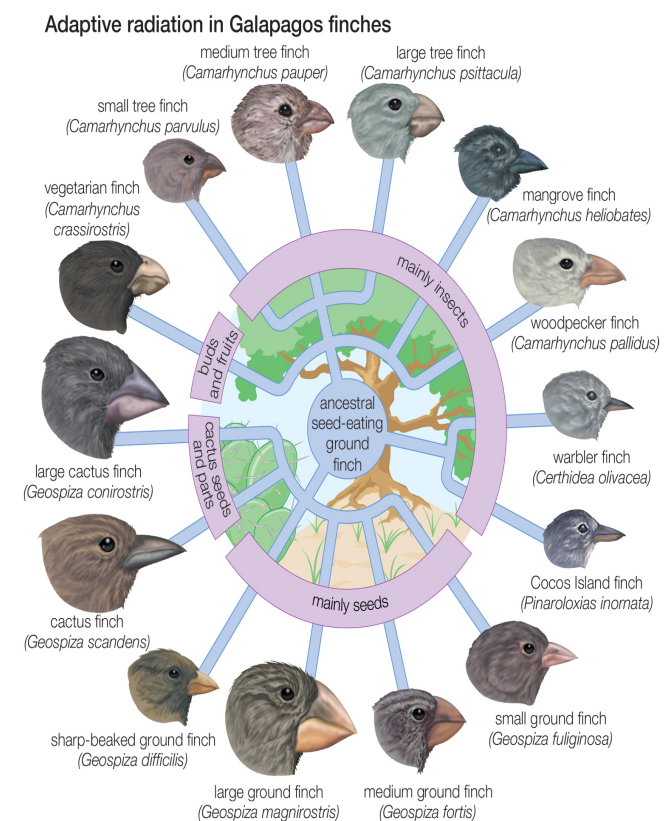
H. Gradualism is a theory that says change occurs slowly. Punctuated equilibrium is a theory that says evolution happens in quick spurts.

I. Creation of new species usually requires geographic isolation, which eventually results in reproductive isolation.

J. **Evidence in support of evolution** comes from the fields of geology (fossil record and radioactive dating), genetics, biochemistry, anatomy and embryology (among others).
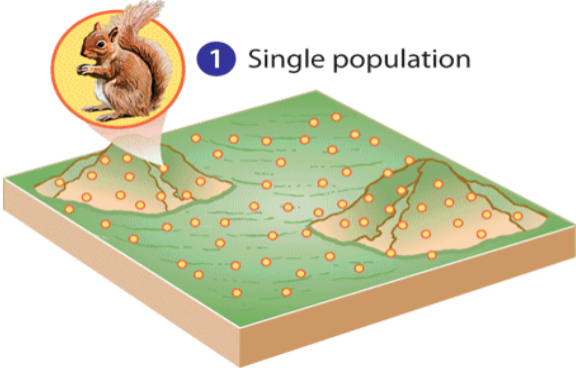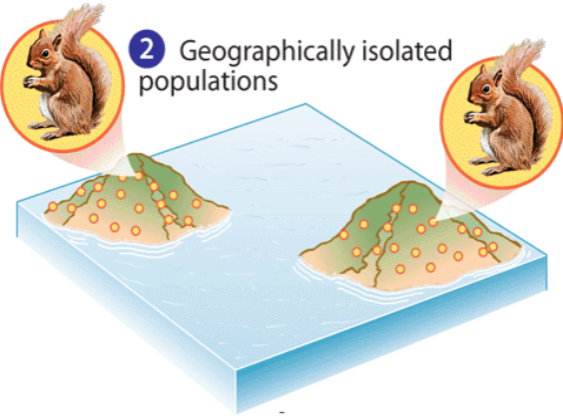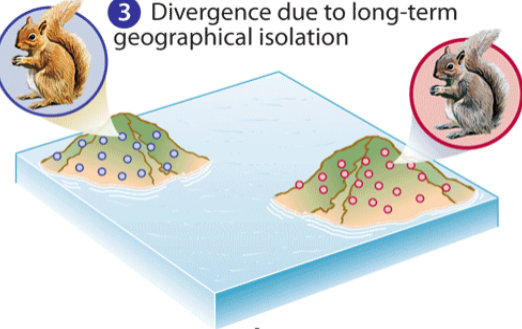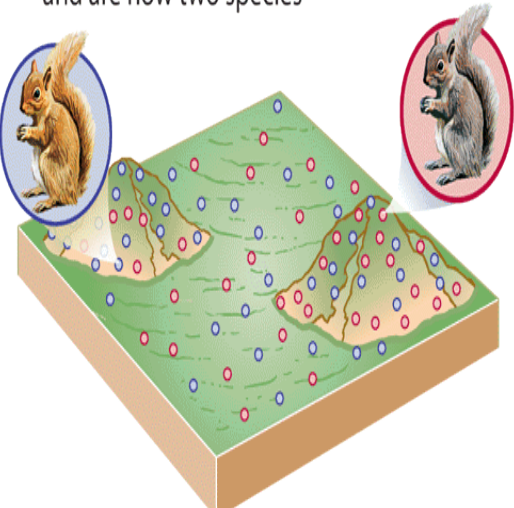
- o *Fossil Evidence* shows structures of older organisms. They show the history of life on earth and how different groups of organisms have changed over time.
- o *Similarity in DNA* shows the relationship between species (most convincing piece of evidence)
- o *Embryological Development*: In their early stages of development, chickens, turtles and rats look similar, providing evidence that they shared a common ancestry.

Galapagos Finches eventually developed different sized and shaped beaks depending on the food commonly found in the island they lived on.

Adaptive radiation in Galapagos finches

medium tree finch
(Camarhynchus pauper)

large tree finch
(Camarhynchus psittacula)

small tree finch
(Camarhynchus parvulus)

mangrove finch
(Camarhynchus heliobates)

vegetarian finch
(Camarhynchus crassirostris)

mainly insects

woodpecker finch
(Camarhynchus pallidus)

buds and fruits

ancestral seed-eating ground finch

cactus seeds and parts

warbler finch
(Certhidea olivacea)

large cactus finch
(Geospiza conirostris)

Cocos Island finch
(Pinaroloxias inornata)

cactus finch
(Geospiza scandens)

mainly seeds

small ground finch
(Geospiza fuliginosa)

sharp-beaked ground finch
(Geospiza difficilis)

large ground finch
(Geospiza magnirostris)

medium ground finch
(Geospiza fortis)

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SPECIATION

	Individuals mate with one another and share genetic information.
	If populations are somehow broken into smaller populations that are isolated, individuals from one population cannot mate with individuals populations in another.
	• Mutations can occur and over time genetic divergence occurs. • Genetic divergence means that different populations develops its own set of mutations.
	Each population becomes so different that the two populations no longer interbreed.

EXTINCTION
- The disappearance of species from Earth
- Generally occurs gradually, one species at a time, when environmental conditions change more rapidly than the species can adapt
- *Possible causes of extinction:*
  1. Destruction caused by humans
  2. Introducing invasive species
  3. Natural disasters
  4. Removal of keystone species in an ecosystem

ECOLOGICAL RELATIONSHIPS

A. Understand how organisms interact with their environment (food webs, nutrient cycles).
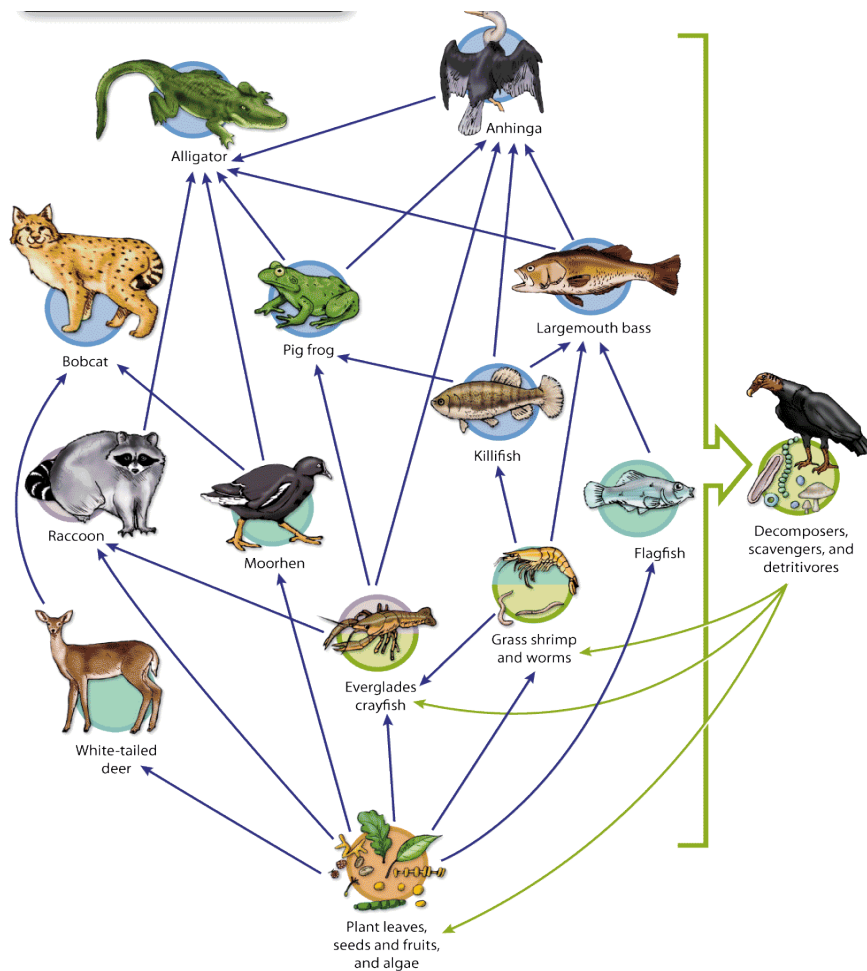
- **Food chain:** Linear series of feeding relationships
- **Food web:** Shows the overlapping and interconnected food chains present in a community

SPECIES INTERACTIONS

Interaction	Effect on Species A	Effect on Species B	Description
Commensalism	+	0	One species benefits while the other is not affected
Competition	-	-	Species are competing for the same resource
Mutualism	+	+	Both species benefit
Parasitism	+	-	One species benefits while the other is harmed
Predation	+	-	One species is hunted while the other hunts

B. **Energy** is needed to keep an ecosystem going. The energy comes from the sun and is made usable by **producers** (plants and other autotrophs). They create their own food through photosynthesis.

C. Energy is passed on to other organisms in the form of food. Since all organisms must use energy for their own needs, most energy is lost before it can be passed to the next step in the food chain. As a result, organisms high on the food chain have less energy available to them and must have smaller populations.

Consumers	
rely on other organisms for energy and nutrients - Use oxygen to break bonds in sugar and release its energy through cellular respiration (primary producers do this, too)	
Herbivores	*Eat plants*
Carnivores	*Eat meat*
Omnivores	*Eat both plants and meat*
Detritivores	*Eat dead bodies; scavengers. Helps recycle nutrients within an ecosystem*
Decomposers	*Breaks down nonliving matter. Helps recycle nutrients within an ecosystem*

Third-level consumer   0.1%   Heat

Second-level consumer   1%   Heat

First-level consumer   10%   Heat

Primary producer   100%   Heat

Light Energy   or   Chemical Energy
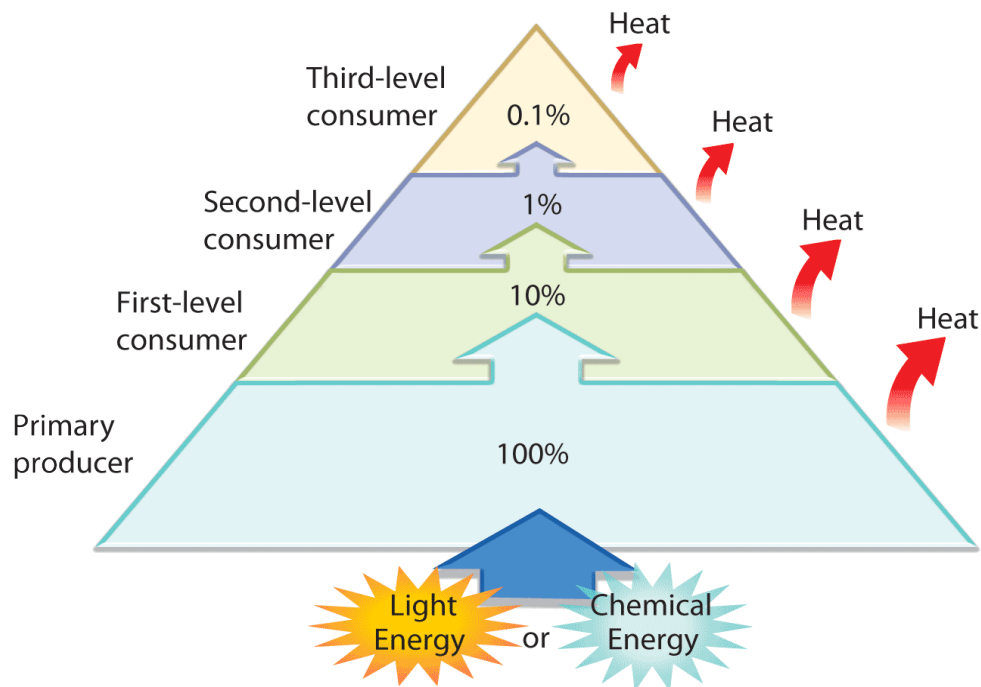
- *An organism's rank in a feeding hierarchy is its* **trophic level**.
- **Primary producers** always occupy the first trophic level of any community.
- In general, only about **10% of the energy** available at any trophic level is passed to the next; most of the rest is lost to the environment as heat.

E. There are many roles in an ecosystem (niche), but competition between species usually results in only one species occupying a niche at any one time. Often, organisms with similar needs will divide resources.

ECOLOGICAL SUCCESSION

Ecological succession *is the predictable series of changes over time that happen after a disturbance, like fire, in a community.*

Primary	Secondary
Occurs when there are <u>no traces</u> of the original community remaining, including vegetation and soil	*Occurs when a disturbance dramatically alters a community but <u>does not completely destroy it</u>*

Chapter 7

BIODIVERSITY

Biodiversity *refers to the variety of life on earth.*
- **Includes three types:**
    - **Genetic diversity: Differences in DNA among individuals**
    - **Species diversity: Variety of species in a given area**
    - **Ecosystem diversity: Variety of habitats, ecosystems, communities**

Loss of Biodiversity
- *Habitat change and loss*
- *Invasive species*
- *Pollution*
- *Overharvesting*

As habitats are lost and species become extinct, biodiversity is reduced. This is bad because 1) ecosystems with low diversity take longer to recover from environmental changes and 2) we use organisms for many things such as food and medicine; by reducing biodiversity we are losing potentially valuable resources.

Protecting Biodiversity
- *Laws* that make destruction and hunting of endangered species illegal
- *Captive Breeding:* Raising and breeding organisms in controlled conditions, such as zoos or aquariums
- *Cloning*

AGE STRUCTURE DIAGRAMS
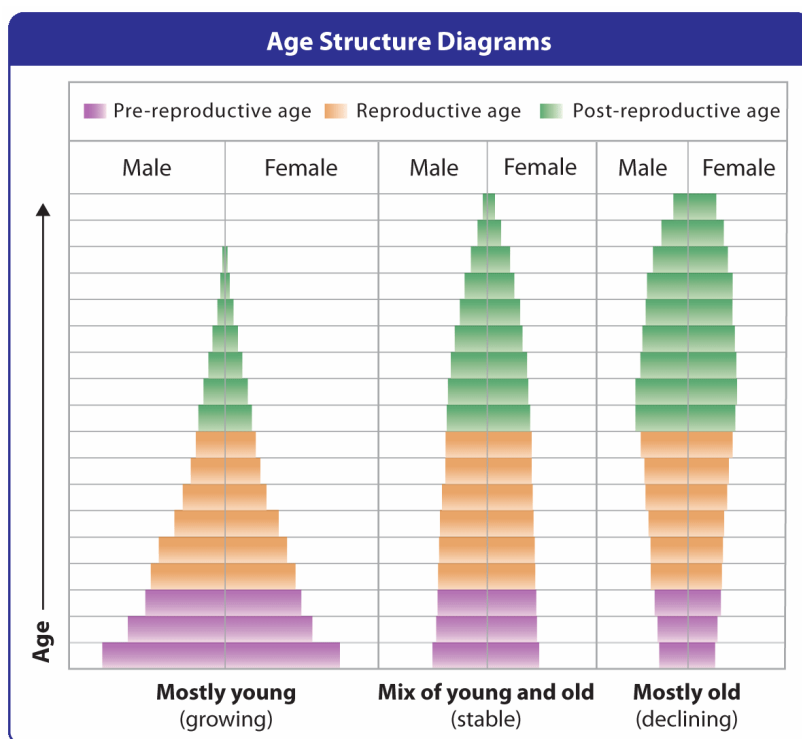
- Relative number of organisms of each age group within population
- Can be used to predict future population growth of a population
- Pyramid-shaped age structure diagram = mostly young individuals so you can expect population growth in the future

Studying Strategies

1. ***Outlining/rewriting your notes.***
2. ***Explaining*** a concept to a classmate or family member.
3. Creating ***possible questions*** you may be asked about and having a classmate answer them.
4. ***Flashcards.***
5. ***Drawing diagrams*** to show relationships between concepts and topics.
6. ***Video Tutorials*** on the following websites:
   - www.youtube.com
   - www.khanacademy.org
7. ***Quizlet*** (online flashcards). (www.quizlet.com)
8. Creating ***mnemonics***, or something that helps you remember.
   (For example, to help you remember the colors of the rainbow: ROYGBIV R = red, O = orange, Y = yellow, etc…)
9. Creating a ***cheat sheet*** that contains only the most important concepts and details. (Of course, don't count on that cheat sheet on being there for the actual exam!)

Exam Taking Tips

1) Draw diagrams to help you visualize the questions asked - where possible.

2) Read introductory paragraphs and study diagrams before looking at questions. Underline key words. Read all choices before deciding on an answer, sometimes a question has a good and a better answer. Always choose the best answer.

3) If you are not sure of an answer, try to eliminate choices that you think are clearly wrong and narrow down your choices. Then make your most careful guess.

4) Skip over hard questions that are stumping you. Go back to them later. Something else in the test may give you a clue to the harder problems.

5) Don't leave any questions blank. Check your test a second time, but only change an answer if you find an obvious mistake. Your first choice is usually correct.

6) Take your time.

7) Have a healthy meal for breakfast the morning of and a good night sleep is as important as the above items.

Practice Questions

1. An ecosystem is represented below. This ecosystem will be self-sustaining if
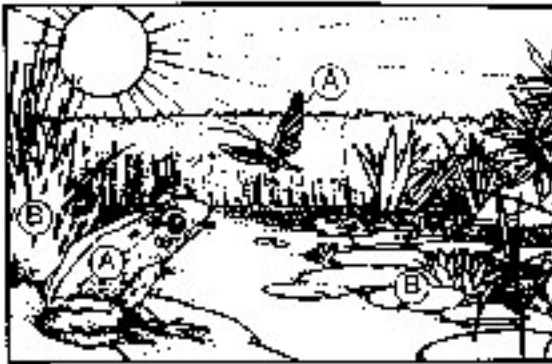
A. the organisms labeled A outnumber the organisms labeled B
B. the organisms labeled A are equal in number to the organisms labeled B
C. the type of organisms represented by B are eliminated
D. materials cycle between the organisms labeled A and the organisms labeled B

2. According to Darwin's theory of evolution, differences between species may be the result of
A. the disuse of body structures
B. the transmission of acquired characteristics
C. natural selection
D. mutagenic agents

3. Which concept was not included in Charles Darwin's theory of natural selection?
A. survival of the fittest
B. struggle for existence
C. overproduction of offspring
D. punctuated equilibrium

4. Mutations can be considered as one of the raw materials of evolution because they
A. contribute to new variations in organisms

B. are usually related to the environment in which they appear
C. are usually beneficial to the organism in which they appear
D. usually cause species of organisms to become extinct

All of Earth's water, land, and atmosphere within which life exists is known as

1. a population
2. a community
3. a biome
4. the biosphere

Which statement best describes some organisms in the food web shown below?
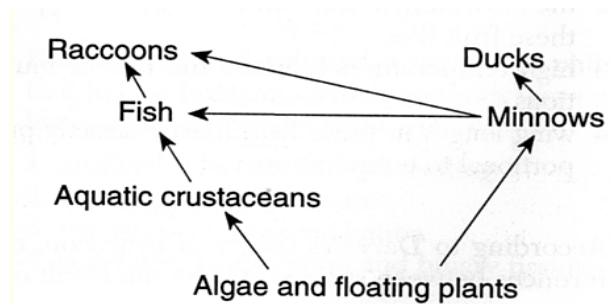
1. Minnows and fish are primary consumers.
2. Algae and floating plants are decomposers.
3. Aquatic crustaceans are omnivores.
4. Raccoons, fish, and ducks are secondary consumers.

Most autotrophs store energy in the form of

1. starches
2. carbon dioxide
3. water
4. nucleic acids

The timber wolves, rabbits, and vegetation in a particular region of northern New York together constitute part of a

1. population
2. community
3. genus
4. species

A rocky island appears as oceanic waters recede. Which of the following forms of vegetation would probably appear first on the bare rocks?

1. lichens
2. weeds
3. shrubs
4. pioneer trees

After a building was torn down and the area was cleared, grasses began to grow in the area. Several years later, small bushes replaced the grasses. This pattern of plant growth is known as ecological

(1) stability   (3) succession
(2) cultivation   (4) coordination

A human activity that could significantly *decrease* the amount of carbon dioxide in the air is

(1) increasing the use of fossil fuel
(2) controlling insect pests that eat stored grain
(3) burning garbage and trash to generate electricity
(4) preserving and expanding forest habitats that shelter wildlife

The wetland plant purple loosestrife was imported to North America from Europe. Since its introduction, the loosestrife has spread, which has resulted in a dramatic decline in the biological diversity of native wetland plants. A likely reason for the spread of the purple loosestrife is that it can

(1) successfully compete with native herbivores for food
(2) serve as an excellent food source for native herbivores
(3) successfully compete with native plants for space
(4) prevent the migration of native plants

The diagram below represents a food web.
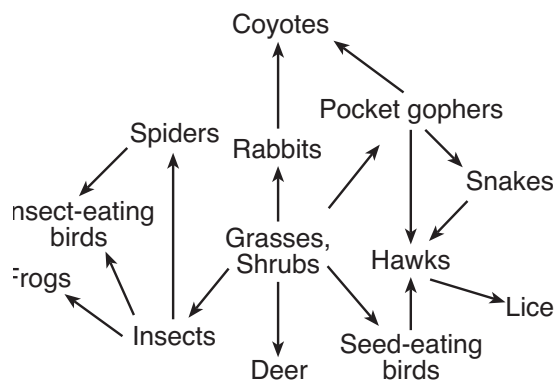
Which statement regarding organisms in this food web is correct?

(1) There would be more snakes than pocket gophers.
(2) There would be more coyotes than rabbits.
(3) There would be more insects than insect-eating birds.
(4) There would be more hawks than seed-eating birds.

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