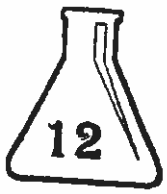


Blizzard Bag #2

EARTH SYSTEMS

FOCUS: Look at the environment around you. Can you see an area that is untouched by human influence? How have humans influenced the environment around them?

PURPOSE: When you have completed this lesson, you should be able to do the following items.

1. Explain how rock layers are not always in the order of youngest to oldest due to folding, faulting, and uplifting.
2. Describe the influence of the lithosphere and the atmosphere on the oceans.
3. Explain how the climatic zone determines the biome type.
4. Explain how geographic locations and features relate to climate and weather patterns.
5. Describe the various methods used to estimate geologic time.
6. Compare the oxygen content of the Earth's early atmosphere to the present atmosphere. Explain the contribution of early organisms to the change.
7. Describe how the acquisition and use of resources, urban growth, and waste disposal have affected the rate of natural change and how that impacted the quality of life.
8. Explain how human activity can change biogeochemical cycles, food webs, and energy pyramids.

WHAT YOU NEED TO KNOW

VOCABULARY:

1. Absolute age
2. Acid rain
3. Altitude
4. Atmosphere
5. Climate
6. Climatic zone
7. Conservation
8. Coriolis effect
9. Current
10. Equator
11. Erosion
12. Estivation
13. Fossil
14. Groundwater
15. Half-life
16. Hazardous waste
17. Humidity
18. Hurricane
19. Igneous rock
20. Latitude
21. Metamorphic rock
22. Ocean current
23. Phytoremediation
24. Plains
25. Plateau
26. Pollution
27. Principle of superposition
28. Radiometric dating
29. Recycling
30. Relative age
31. Runoff
32. Salinity
33. Sanitary landfill
34. Sediment
35. Sedimentary rock
36. Surface current
37. Tornado
38. Tornado alley
39. Trilobite
40. Unconformity
41. Uniformitarianism
42. Upwelling
43. Urban growth

MEMORIZE THESE FACTS:

Age of Rock

1. Fossils, the remains of prehistoric organisms, give evidence of when, where, and how organisms once lived.
2. The principle of superposition says the oldest rocks are on the bottom and the youngest rocks are on top. This is true if the layers of rock are undisturbed.
   a. These layers may be turned upside down when mountains form.
   b. Relative age doesn't determine the actual age of the rock. It only places it as younger or older than another object.
   c. Gaps or missing layers in rock sequences are called unconformities. These gaps occur as a result of erosion or if no new rock is deposited for a period of time.
   d. Fossils can help date a rock. Index fossils lived during specific intervals of time. They are useful for estimating the ages of rock layers.
      - Trilobite fossils show changes over millions of years as the environment changed.
      - Trilobite eyes changed as the trilobites changed from active swimmers to bottom dwellers.
      - Trilobite bodies changed from many segments to a few segments.
      - These changes help identify different periods of time when the trilobites lived.
3. Absolute age is the age of the rocks in years.
   a. Some elements have isotopes with unstable nuclei that break down giving off energy and changing the identity of the element.
      - The process of breaking down the nuclei is called radioactive decay.
      - Radioactive decay occurs in specific lengths of time for different isotopes. The amount of time it takes for half of the parent isotopes to decay to the daughter isotopes is the half-life. Carbon–14 has a half-life of 5730 years.
   b. Radiometric ages of rocks are determined by measuring the ratio of the parent isotope to the daughter product.
      - The correct isotope must be used for the age of the rock.
      - The rock must have the entire daughter product.
      - There must be no contamination of the daughter product.
      - Potassium-argon dating is useful for very old rocks.
      - Carbon–14 is useful for dating organic materials with large amounts of carbon.
      - Metamorphic and igneous rocks can be dated radiometrically. Sedimentary rocks may be made of older rock particles and cannot be dated with this method. Radiometric dating determines the age of the pre-existing older rock.
      - The oldest rocks dated are 3.96 billion years old. Based on other evidence, the age of the Earth is estimated at 4.6 billion years old.
   c. James Hutton first proposed uniformitarianism in the 1700's.
      - Uniformitarianism is based on the idea that the processes occurring today are the same as the processes that occurred long ago.
      - Slow everyday processes and violent unusual events have changed the Earth.

Climate

1. Climate is a weather pattern that occurs in an area and determines the types of organisms that live there.

2. The climate of an area is based on average temperature, precipitation, air pressure, humidity, and days of sunshine over a long period of time.
3. Climate is affected by six climate controls: latitude, altitude, prevailing winds, topography, distance from large bodies of water, and nearby ocean currents.
   a. Latitude is the distance north or south of the equator.
      - Tropics are hot regions that receive the most sunlight.
      - Polar zones receive the least sunlight and are always cold.
      - Temperate zones have moderate temperatures. The U.S. is located in the temperate zones.
      - The higher the latitude is, the lower the yearly average temperature and the larger the yearly temperature range.
   b. Altitude is the distance up into the atmosphere.
      - The higher the altitude, the lower the average yearly temperature will be.
      - Due to altitude, mountains will have different climates than other areas in the same latitude.
      - Mountains will be cooler than at sea level. With fewer particles in the atmosphere in the mountains, less heat is absorbed.
   c. The distance from large bodies of water is most important to the coastal areas.
      - Ocean areas tend to have marine climates with small temperature ranges.
      - Continental interiors have continental climates with large temperature ranges.
      - Water is able to hold more heat than land. Water absorbs heat and gives it off more slowly than land. As the ocean gives off heat, nearby land is warmed and the average temperature range is less.
      - As warm ocean currents from the equator move north, the land areas they pass are warmed. When the cool currents move south, the land areas are cooled.
   d. Prevailing winds bring moisture and warmer temperatures to the land.
      - Winds blowing from the ocean carry larger amounts of moisture.
      - The coastal land areas where these winds blow over have more rainfall than other areas.
      - The west coast has a marine climate, but the east coast has a continental climate due to the prevailing winds blowing from the west.
      - The mountain ranges prevent the winds from carrying the moisture and warm temperatures farther east.
   e. Topography takes into account the different landforms that affect a climate.
      - Mountain ranges also affect regional weather. It rains on the windward side of the mountains where air rises and cools. As the air goes down the leeward side, it warms up and dries the land. Deserts often form on the leeward side of mountains.
      - Cities tend to absorb heat in the paved concrete areas. Air pollution holds in the heat. The temperature of a city can be several degrees higher than the surrounding countryside.
   f. Ocean currents affect the winds blowing from water to land.
      - Warm currents increase the temperature.
      - Cold currents decrease the temperature.
4. Wladimir Köppen developed the classification system for climates.
5. The six groups are: tropical, mild, dry, continental, polar, and high elevation.
   a. Vegetation of an area is determined by its climate. All organisms adapt to fit their climate.
      - Adaptations may include structural adaptations such as hair, thick fleshy stems, waxy stem coverings, or needles instead of broad leaves.
      - Behavioral adaptations such as obtaining moisture from food, hibernation, nocturnal habits, estivation, and perspiration help organisms survive.

b. The tropical areas have large amounts of sunlight and are hot. The amount of precipitation determines if the resulting biome will be rainforest, desert, or savanna.
c. Polar zones have little sunlight, are cold, and have little precipitation in the form of water. The biome is arctic tundra.
d. Temperate zones have a variety of biomes. The key factor is the precipitation.
   - The temperate deciduous forest has a large amount of precipitation. Examples of these forests lie along the windward side of the Appalachian Mountains.
   - The temperate grassland has less precipitation because it may be on the leeward side of mountains. Examples of these grasslands would be found east of the Rocky Mountains.
   - Deserts in the western U.S. receive little water as the wind comes over the Rocky and Sierra Nevada Mountains.
e. Certain geographic locations create special climate and weather patterns.
f. Tornado alley is a region where tornadoes occur more often than other regions.
   - The area is flat and allows warm moist air from the Gulf of Mexico to clash with the cool dry air of Canada.
   - This creates large super cells that can spawn tornadoes.
g. Tropical hurricanes form in the area of the Atlantic Ocean near the equator.
   - The warm saturated air is forced upward by cooler denser air.
   - Atmospheric pressure drops and wind velocity rises.
   - The storms move northwesterly first. As they reach higher latitudes they turn northeasterly.
   - Tropical hurricanes begin to lose energy and dry out as they pass over land.
h. Lake-effect snow is common around the Lake Erie region of Ohio.
   - Cold air picks up large amounts of heat and moisture as it passes over the water surface.
   - Terrain features such as small hills or mountains on the leeward shore enhance the effect of the lake-effect snow.
   - Moisture, in the form of snow, is deposited inland from the downwind shore. The amount deposited can be quite large.
   - The snow is sporadic in an area.

Ocean Currents and Tides

1. Shorelines are where land meets the ocean.
   a. Three major forces that work on the shoreline are waves, currents, and tides.
   b. Wind blowing on the surface of the water creates the waves. Waves can move large amounts of sediment in a short time.
   c. Rocky shorelines have rocks and cliffs that are eroded by waves and sediment. Softer rocks erode first leaving rock islands.
   d. Beaches are gentle shorelines with rock fragments, seashell fragments, and quartz grains. The jagged edges of the particles on the beach are smoothed off by the constant wave action.
   e. Barrier islands occur when underground ridges are formed. Hurricanes and storms add sediment. Eventually the barrier island rises above the surface of the ocean.
2. Ocean currents are mass flows of ocean water.
   a. Currents are created due to the Coriolis effect.
      - The Coriolis effect is the shifting of wind and surface currents from their expected path.
      - This is caused by the rotation of the Earth.

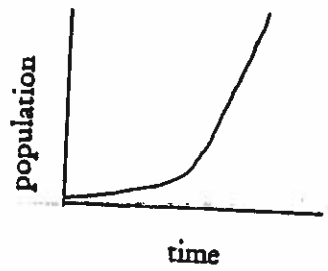
- Winds and currents turn right in the Northern Hemisphere and left in the Southern Hemisphere.

b. Wind causes water to pile up, and gravity pulls it off the pile.
c. Surface currents move parallel to the Earth's surface and are powered by the winds in the atmosphere.
d. As waves collide with the shoreline at an angle, longshore currents can occur. A longshore current runs parallel to the shoreline.
e. Tidal currents run perpendicular to the shore.
f. The Gulf Stream current is a major current from North America to Europe.
g. Drift bottles with cards inside are released to study the movement of currents. Once they wash up on shore and are found, the cards are returned and the information is studied.
h. Warm surface currents on the east coast of North America originate near the equator and move northward.
i. Cold surface currents on the west coast of North America originate near the pole area and move southward.
j. As warm surface currents move away from the equator, heat is released into the atmosphere and influences the climate.

3. Upwelling brings deep cold water to the ocean surface.
   a. If the wind blows parallel to the coast, it will carry water away from the land.
   b. As the water moves away, deep cold water moves upward to replace it.
   c. The water contains high concentrations of nutrients that increase the growth of plankton. This creates great fishing grounds.
4. Density currents occur when salinity or temperature changes cause density changes.
   a. The dense water sinks and then spreads throughout the ocean.
   b. Deep waters are dense waters.
   c. One density current occurs in Antarctica where water freezes and leaves the salt in the water. The extra salt increases the density. This current moves slowly toward the equator.

Human Influence

1. As humans acquire and use resources and dispose of wastes, they will affect the rate of natural change.
2. Humans have a constant effect on the environment.
   a. As the population increases exponentially, the demand for resources, land, and water increases.
      - The exponential growth of a population occurs when the population's growth rate continues to increase as its population increases.
      - A graph of exponential growth would resemble this graph.



   b. Acquisition of resources produces many changes in the environment such as mining, farming, and using water.

c. Using the resources also causes changes. An example is the release of chemicals into the air and water.
d. The processes used to make products have an impact on the environment that may produce pollutants as well.
e. Discarded products and packaging lead to problems of waste disposal.

3. Humans use land resources in many ways.
   a. Agriculture is one of the major uses of land.
      - Increased populations mean an increase in the food produced. This can involve more herbicides and pesticides, chemical fertilizers, and erosion. This was publicized by Rachel Carson in her book *Silent Spring*.
      - Contour plowing and no-till farming are ways to reduce the amount of erosion.
   b. Forests are cut down to provide resources such as lumber, fuel, and paper.
      - When forests are cut down in the U.S., new trees are planted to replace them.
      - In the tropical rainforest areas, the trees are not replaced and habitat and soil nutrients are lost.
      - Lost vegetation means less carbon dioxide is used in photosynthesis. Less oxygen is produced for animals. Increased carbon dioxide levels could lead to global warming.
      - Water from leaves evaporates into the air and forms rain. Fewer trees could lead to less rainfall, and this affects the water cycle.
   c. Land development causes major changes in the environment.
      - When buildings and pavement cover land surfaces, less water is absorbed into the ground.
      - Increased amounts of water run into streams increasing the stream discharge and possibly leading to flooding.
      - A decrease in water absorbed into the groundwater could affect communities that use groundwater as their water source.
      - Some communities require that some land be set aside for environmental protection.
   d. Sanitary landfills are designed to accept waste products and reduce the threat to land and water resources.
      - The landfill provides an area that reduces the litter on the landscape, decomposes some materials, reduces odor, and prevents liquid wastes from entering the groundwater.
      - Decomposition of materials occurs very slowly or not at all. New landfills must be built as old ones fill up.
4. Hazardous wastes are wastes that cause illnesses, are poisonous, or catch fire.
   a. Many hazardous wastes come from the home.
   b. Some can be recycled so disposal needs are reduced.
   c. Hazardous waste collection sites are available because disposal is regulated.
   d. Phytoremediation can be used to remove hazardous waste that has filtered into the ground.
      - Certain plants can absorb metals from the soil.
      - The plants are then burned or composted to recycle the metals.
   e. The plants release enzymes that speed up the breakdown of the organic pollutants.
5. Natural preserves are lands set aside for protection.

Biogeochemical Cycles

1. Humans affect the biogeochemical cycles as well as food webs and energy pyramids.
   a. Humans affect the biogeochemical cycles in a variety of ways.

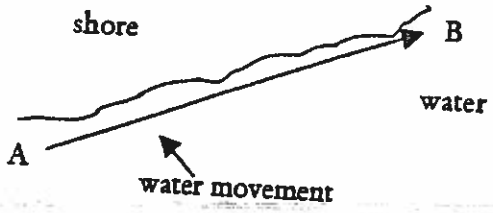
b. Some examples include pollution from pesticides and fertilizers, erosion, sewage, metals released into streams, oil and gasoline runoff from parking lots, and heat from water used to cool an industrial process.

2. Pesticides run off into the water and can poison other organisms. As organisms die, food webs and energy pyramids are affected.
3. Fertilizers lead to increased algae growth. When the algae die, oxygen is used up and fish may die. Fertilizers modify the nitrogen cycle.
4. Treating sewage helps to reduce the amount of nitrogen and phosphorus in the water. This helps both the water cycle and the nitrogen cycle.
5. Erosion causes a large amount of sediment to enter streams and cuts down on the amount of sunlight underwater plants receive. It can also affect the development of eggs deposited in the water. Organisms that don't develop change food webs and energy pyramids.
6. Metals are often used in processes to make other items. The metals do not leave water or soil easily and build up, causing problems for long periods of time.
7. Oil and gasoline can release pollutants that cause cancer.
8. Heat increases in water cause a drop in the oxygen level in the water. The temperature and decrease in oxygen can lead to fish kills. Loss of fish affects energy pyramids and food webs.

GUIDED PRACTICE

Plains, plateaus, and mountains are developed by a variety of processes including plate movement, erosion, and weathering. They have different climates and characteristics.

1. Thick, fertile soil and grassy meadows are most often found on _____.
   a. plateaus b. plains c. upwarped mountains d. volcanic mountains
2. Many human activities cause soil erosion. This could include _____.
   a. agriculture
   b. planting trees after cutting a forest
   c. covering an exposed area of soil with mulch or straw
   d. terracing
3. This diagram illustrates which of the following is occurring between A and B? _____
   a. longshore current
   b. tidal current
   c. shoreline wave
   d. wind current



Fossils form when organisms are quickly covered by sediment and are formed into rock. Fossils are important because they give evidence of when, where, and how organisms lived. There are many different types of fossils. Fossils are useful when trying to determine the age of rock.

4. Fossils used to determine the age of the rock layers are known as _____.
   a. radiometric fossils
   b. radioactive fossils
   c. sedimentary fossils
   d. index fossils

Rock layers are often helpful in determining the relative age of rock. Problems occur if unconformities occur or matching rock layers are far apart and erosion or faults have occurred.

5. Sedimentary rock is formed in layers. The oldest layer is on the bottom unless a force has acted on the rock. This is the _____.
   a. Law of Conservation of Mass and Energy
   b. Principle of superposition
   c. Coriolis effect
   d. Principle of unconformities

6. Sometimes gaps or missing layers occur in rock. If the sedimentary rock layers have tilted and uplifted and the top undergoes erosion, new layers of rock are deposited. This forms a(n)_____.
   a. disconformity
   b. angular unconformity
   c. nonconformity
   d. fossil conformity

The absolute age of rocks is determined by radiometric dating. Radiometric dating involves the use of radioactive isotopes. Carbon-14 and potassium-40 are common isotopes used for dating. Igneous and metamorphic rocks work best for radiometric dating.

7. Sedimentary rock cannot be dated radiometrically because _____.
   a. sedimentary rock is too young for available isotopes
   b. the igneous and metamorphic rock sediment that makes up sedimentary rock is older
   c. sedimentary rock is too old to form available isotopes
   d. radioactive isotopes are not found in sedimentary rock

8. Carbon-14 has a half-life of 5730 years. If a rock has 25% of the isotopes still present, how old is the rock? _____
   a. 1432 years b. 4298 years c. 11,460 years d. 10,000 years

9. The idea that processes occurring today are the same as the processes that occurred long ago is _____.
   a. Uniformitarianism
   b. the Principle of superposition
   c. the Coriolis effect
   d. the Principle of unconformities

The climate is controlled by major landforms and winds over the ocean and land. Six climate controls affect the climate of an area. These controls include latitude, altitude, distance from large bodies of water, prevailing winds, topography, and ocean currents. Some geographic locations have special climate and weather patterns.

10. Water holds more heat than the land and gives it off more slowly. This explains why _____.
    a. continental land areas have a smaller temperature range
    b. coastal land areas have a smaller temperature range
    c. mountain areas are cooler
    d. deserts form on the leeward side of mountains

11. Latitude has a great effect on temperature. Biomes in high latitudes will have average temperatures that are _____.
    a. low b. high c. mid-range d. variable

12. The central plains area of the U.S. is characterized by very cold winters because _____.
    a. the prevailing winds cannot make it over the mountain ranges
    b. the winds from the North Pole have no mountain ranges to block them from sweeping across the plains
    c. the altitude of the Rocky Mountains cools off the air as it goes over the mountains to the plains
    d. the latitude of the central plains area is much higher than other areas of the U.S.

13. Organisms have a variety of ways to adapt to the climate of a biome. Plants might adapt to a desert biome by _____.
    a. forming thick fleshy stems
    b. producing flat broad leaves
    c. growing very tall
    d. growing with large moisture requirements

14. Inhabitants of northern Ohio, especially the Cleveland area, often receive lake-effect snow. This snow is produced by _____.
    a. warm air picking up moisture as it passes over the surface of the lakes and releasing it over land
    b. mountains on the coastline causing the wind to drop its moisture as snow on the windward side
    c. cold air picking up large amounts of heat and moisture as it passes over the surface of the lake
    d. atmospheric pressure drops and wind velocity increases

15. The flat area of the plains, with no mountain ranges to prevent the moist air from the Gulf of Mexico and the cold air from Canada, is an ideal area for the production of _____.
    a. hurricanes
    b. lake-effect snow
    c. tsunamis
    d. tornadoes

Ocean currents are the movements of ocean water. They can be powered by the wind or created by density differences. The rotation of the Earth affects the direction of the currents.

16. The rotation of the Earth causes currents to curve. This is known as the _____.
    a. Coriolis effect
    b. upwelling trait
    c. Gulf Stream effect
    d. deep-water effect

17. Great fishing grounds occur in areas where _____ bring cold water and nutrients to the surface.
    a. density currents
    b. upwellings
    c. intermediate waters
    d. surface currents

18. Currents are formed when _____ causes water to pile up, and gravity pulls water off the pile.
    a. a fault b. a ridge c. wind d. density

19. Density differences can cause layers in the ocean water. The cold water of Norway and Greenland sinks and forms the _____.
    a. Mediterranean Intermediate Water
    b. North Atlantic Deep Water
    c. Pacific Deep Water
    d. Antarctica Deep Water

20. Density will increase with _____.
    a. an increase in salinity
    b. an increase in temperature
    c. no change in temperature
    d. a decrease in salinity

Humans affect the natural processes of change in the environment due to population increases, resource needs, and waste disposal. There is a need to protect and regulate the use and disposal of resources. Humans need resources for survival, but the way the resources are used is important. The need for land is constantly increasing as the population increases.

21. The greatest use of land is agriculture. The need to produce more food is constantly increasing. There are ways to use the soil wisely. One way is _____.
    a. no-till farming
    b. grazing animals till the grass is gone
    c. plowing and tilling the soil to keep the weeds out
    d. using chemical fertilizers

22. Larger populations require more homes, schools, stores, and buildings for workplaces. This produces _____.
    a. greater water runoff for the groundwater reserves
    b. greater ground cover to protect the groundwater reserves
    c. increased water in streams that could lead to flooding
    d. less protected land

23. Waste production increases with population increases. Most waste is placed in regulated landfills. This leads to _____.
    a. less litter in the environment
    b. more liquid wastes in the ground water
    c. increased odor since the wastes are concentrated in one area
    d. less land used for landfill development

24. Disposal of hazardous waste is more difficult. All of the following are ways to dispose of hazardous wastes except _____.
    a. phytoremediation
    b. recycling
    c. burning in high temperature incinerator disposal stations
    d. using plants to break down organic pollutants

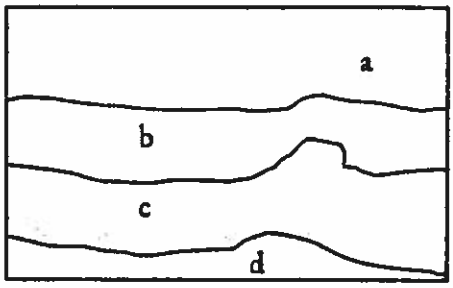
Humans also affect the biogeochemical cycles. The effects come from a variety of sources. Other organisms are often affected by these changes.

25. Chemical fertilizers are often part of the runoff from a field during a rainstorm. As these fertilizers flow into a stream they can cause _____.
    a. decreased growth of algae
    b. increased growth of algae
    c. increased numbers of fish
    d. increased amounts of oxygen in the water

26. Increased heat in water can lead to a drop in the oxygen level. This in turn will affect the _____.
    a. food web of which fish are a part
    b. nitrogen cycle
    c. rate of erosion
    d. level of metals in the water

27. By treating sewage, the water cycle and the_____ are benefited.
    a. carbon cycle b. nitrogen cycle c. hydrogen cycle d. oxygen cycle

INDEPENDENT PRACTICE



1. The principle of superposition would identify the oldest layer of rock in the above diagram as _____.
    a. a b. b c. c d. d

2. The northwestern U.S. is sometimes referred to as a temperate rainforest. This occurs because _____.
   a. its higher latitude gives it a lower yearly temperature range
   b. the prevailing winds bring in moisture and warmer temperatures from the ocean
   c. it has a continental climate
   d. there is no mountain range close by

3. Students in northeastern Ohio may use more bad weather days as a result of _____.
   a. cool dry air from Canada
   b. warm saturated air from the Gulf of Mexico
   c. lake-effect snow
   d. atmospheric pressure drops

4. Two ships are competing to see which can cross the Atlantic Ocean in the least number of days. Ship A leaves from England (going to New York City) and Ship B leaves from New York City (headed for England). Which one will arrive at its destination first? Why? _____
   a. Ship A, because the Gulf Stream moves in a clockwise direction
   b. Ship B, because the Gulf Stream moves in a clockwise direction
   c. Ship A, because the North Equatorial current moves toward England
   d. Ship B, because the North Equatorial current moves toward New York City

5. Swimming in the Atlantic Ocean might be more comfortable than in the Pacific Ocean because the currents in the _____.
   a. Pacific Ocean originate near the South Pole
   b. Atlantic Ocean originate near the equator
   c. Atlantic Ocean originate near Labrador
   d. Pacific Ocean originate near the equator

6. Erosion in agriculture can be reduced by all but _____.
   a. contour plowing
   b. terracing
   c. no-till farming
   d. clear-cutting

7. Plants used in phytoremediation must be _____.
   a. burned and the ashes placed in a hazardous waste site
   b. composted and placed in a sanitary landfill
   c. transplanted in an agricultural field
   d. used for cloning purposes

8. The book, *Silent Spring* by Rachel Carson, helped to identify and recognize the effects of _____ on wildlife.
   a. fertilizers b. pesticides c. sewage d. erosion

9. Hot water from the cooling tower of a nuclear power plant is released into a stream nearby. A fish kill occurs. The _____ is most affected.
   a. energy pyramid b. food web c. nitrogen cycle d. water cycle