

## APES Review: “155 Ways to go APE(S)” For the AP Environmental Science Exam Review Sheet for the Exam in May.

Place these facts on index cards. The underlined term goes on one side and the definition and or explanation goes on the other side.

1. **Ionizing Radiation:** enough energy to dislodge or free electrons from atoms, forming ions: capable of causing cancer (gamma, X-rays, UV)
2. **High Quality Energy:** organized and concentrated: can perform useful work (fossil fuels and nuclear energy)
3. **Low Quality Energy:** disorganized, dispersed (heat in ocean or air, wind or solar)
4. **First Law of Thermodynamics:** energy is neither created or destroyed, but may be converted from one form to another (**Law of Conservation of Energy**)
5. **Second Law of Thermodynamics:** when energy is changed from one form to another, some useful energy is ALWAYS degraded into lower quality energy, usually heat.
6. **Natural Radioactive Decay:** unstable radioactive decay releasing gamma rays, alpha particles, and beta particles. (ex. Radon)
7. **Half-Life:** the time it takes for  $\frac{1}{2}$  the mass of a radioactive isotope to decay.
8. **Estimate of how long a radioactive isotope must be stored until it decays to a safe level:** A radioactive isotope must be stored for approximately 10 half-lives until it decays to a safe level.
9. **Nuclear Fission:** nuclei of isotopes split apart when struck by neutrons
10. **Nuclear Fusion:** two isotopes of light elements (H) forced together at high temperatures till they fuse to form a heavier nucleus (He). Process is expensive; break-even point has not yet been reached. Happens in the Sun.
11. **Ore:** a rock that contains a large enough concentration of a mineral making it profitable to mine.
12. **Mineral Reserve:** identified deposits currently profitable to extract.
13. **Best Solution To Energy Shortage:** conservation, increase efficiency, explore alternative energy options.
14. **Organic Fertilizer:** slow-acting and long lasting because the organic remains need time to be deposited.
15. **Surface Mining:** cheaper and can remove more minerals, less hazardous to workers
16. **Humus:** organic, dark material remaining after decomposition by microorganisms.
17. **Leaching:** removal of dissolved materials from soil by water moving downwards
18. **Illuviation:** deposit of leached material in lower soil layers (B Horizons)
19. **Loam:** perfect agricultural soil with optimal portions of sand, silt, clay (40%, 40%, 20%)
20. **Soil Conservation Methods:** conservation tillage, crop rotation, contour plowing, organic fertilizers.
21. **Soil Salinization:** in arid regions, water evaporates leaving salts behind. (ex: Fertile Crescent in southwestern US)
22. **Conservation:** allowing the use of resources in a responsible manner.
23. **Preservation:** setting aside areas and protecting them from human activities.
24. **Water Logging:** water completely saturates soil and starves plant roots of oxygen, rots roots.
25. **Hydrologic Cycle Components:** evaporation, transpiration, runoff, condensation, precipitation and infiltration.
26. **Watershed:** all of the land that drains into a body of water.
27. **Aquifer:** underground layers of porous rock allow water to move slowly.
28. **Cone of Depression:** lowering of the water table around a pumping well.
29. **Salt Water Intrusion:** near the coast, overpumping of groundwater causes saltwater to move into the aquifer.
30. **ENSO: El Nino Southern Oscillation:** See-Sawing of air pressure over the South Pacific.
31. **During an El Nino year:** trade winds weaken and warm water sloshed back towards South America. Diminished fisheries off South America, drought in western Pacific, increased precipitation in southwestern North America, fewer Atlantic hurricanes.
32. **Effects of El Nino:** Upwelling decreases disrupting food chains; Northern US has mild winters and Southwest US has increased rainfall, less Atlantic Hurricanes.
33. **La Nina:** “Normal” year, easterly trade winds and ocean current pool warm water in the western Pacific, allowing upwelling of nutrient rich water off the West Coast of South America.
34. **Nitrogen Fixation:** because atmospheric nitrogen cannot be used directly by plants, it first must be converted into ammonia by bacteria.
35. **Ammonification:** decomposers convert organic waste to ammonia.
36. **Nitrification:** ammonia is converted to Nitrate ion ( $\text{NO}_3^-$ )
37. **Assimilation:** inorganic N is converted into organic molecules such as DNA/amino acids and proteins.
38. **Denitrification:** bacteria convert nitrate ( $\text{NO}_3^-$ ) and nitrite ( $\text{NO}_2^-$ ) back into  $\text{N}_2$  gas.

39. **Phosphorous does not circulate as easily as nitrogen because:** it does not exist as a gas, but is released by weathering of phosphate ( $\text{PO}_4$ )<sup>-3</sup> rocks.
40. **Phosphorous Cycle is: (speed-wise):** a slow cycle and not atmospheric.
41. **Phosphorous is a major limiting nutrient:** in the growth of plants.
42. **How phosphorous is added to aquatic ecosystems:** runoff of animal wastes, fertilizer, discharge of sewage.
43. **Sustainability:** the ability to meet the current needs of humanity with compromising the ability of future generations to meet their needs.
44. **Photosynthesis:** plants convert  $\text{CO}_2$  (atmospheric carbon) into complex carbohydrates (sugars) (glucose  $\text{C}_6\text{H}_{12}\text{O}_6$ )
45. **Aerobic Respiration:** Oxygen ( $\text{O}_2$ ) consuming producers, consumers and decomposers break down complex organic compounds and convert Carbon (C) back into  $\text{CO}_2$
46. **Largest Reservoirs of Carbon (C):** carbonate ( $\text{CO}_3$ )<sup>-2</sup> rocks first, oceans second.
47. **Biotic:** the living component of an ecosystem
48. **Abiotic:** non-living component of an ecosystem
49. **Producer/Autotroph:** organisms that make their own food—photosynthetic or chemosynthetic life
50. **Trophic Levels:** producers → primary consumer → secondary consumer → tertiary consumer.
51. **Energy Flow in Food Webs:** only 10% of the usable energy is transferred to the next trophic level: **REASON:** because usable energy is lost as heat. (Second law of thermodynamics): not all biomass is digested and absorbed; predators expend energy to catch prey.
52. **Succession:** in ecology, the gradual colonization of a habitat after an environmental disturbance (ex fire, flood), usually by a series of species.
53. **Primary Succession:** development of communities in a lifeless area not recently inhabited by life (ex. retreating glacier) or those in which the soil profile is completely destroyed (lava flows): begin with lichen action.
54. **Secondary Succession:** life progresses where soil remains (clear cut forest, vacant lot, old farm or fire)
55. **Climax Community:** the stable, final community that develops from ecological succession.
56. **Symbiosis:** occurs when members of two different species live in close physical contact with each other.
57. **Mutualism:** symbiotic relationship where both organisms benefit
58. **Commensalism:** symbiotic relationship in which one organism benefits and the other organism is unaffected.
59. **Parasitism:** relationship in which one organism (the parasite) obtains nutrients at the expense of the host.
60. **Biomes:** large distinct terrestrial region having similar climate, soil, plants and animals.
61. **Carrying Capacity:** the number of individuals that can be sustained in an area.
62. **R strategist:** reproductive strategy in which organisms reproduce early; bear many small; unprotected offspring (ex. insects, mice)
63. **K strategist:** reproduce late in life; few offspring; care for offspring
64. **Positive Feedback:** when a change in some conditions triggers a response that intensifies the changing condition (warmer Earth—snow melts—less sunlight is reflected and more is absorbed, therefore a warmer Earth)
65. **Negative Feedback:** when a change in some condition triggers a response that counteracts the changed condition (warmer Earth—more ocean evaporation—more stratus clouds—less sunlight reaches the ground—therefore a cooler Earth)
67. **Natural Selection:** organisms that possess favorable adaptations (traits) and pass them onto the next generation. These organisms have higher reproductive success.
68. **Exotic Species/Invasive Species:** non-Native species to an area; often thrive and disrupt the ecosystem balance; examples African Honeybee; Fire Ant, Zebra Mussel, Purple Loosestrife.
69. **Doubling Time: (Rule of 70):** doubling time equals 70 divided by the percent growth rate. For example, if a population is growing at 5% annually, it doubles in 14 years;  $70/5 = 14$  years.
70. **Replacement Level Fertility:** the number of children a couple must have to replace themselves (averages 2.1 in developed nations, 2.7 in less developed nations)
71. **World Population:** 6.7 billion; **U. S. Population:** 305 million

#### **DEMOGRAPHIC TRANSITION MODEL:**

72. **Preindustrial Stage:** birth and death rates high, population grows slowly, infant mortality high
73. **Transitional Stage:** death rate (infant mortality) lower, birth rates remain high, better health care, population grows fast.
74. **Industrial Stage:** decline in birth rate, population growth slows
75. **Postindustrial state:** low birth rate and low death rate
76. **Age Structure Diagram:** broad base → rapid growth; narrow base → negative growth; uniform shape → zero growth

77. **Top Four Most Populated Nations:** 1) China; 2) India; 3) U.S. and 4) Indonesia
78. **Most Important Thing Affecting Population Growth:** low status of women
79. **Methods or Ways to Decrease Birth Rate:** family planning; contraception, economic rewards and penalties
80. **Composition of Water on Earth:** 97.5% Seawater; 2.5% freshwater
81. **Ways to conserve water:** **Agriculture:** drip/trickle irrigation; **Industry:** recycling; **Home:** use gray water, repair leaks, low flow fixtures, different types of yard (xeriscape not planting Kentucky Blue grass), time of day watering...
82. **Gray Water:** Any wastewater from a house EXCEPT TOILET WATER; (dish water, shower water...) this water can be used for irrigation water...
83. **Aquaculture:** farming aquatic species, commonly salmon, shrimp, tilapia, oysters.
84. **Point Source:** source from specific location such as pipe or smokestack
85. **Non-point Source: (Area/Dispersed Source):** source spread over an area such as agricultural/feedlot runoff, urban runoff, and traffic runoff.
86. **Primary Sewage Treatment:** first step of sewage treatment; eliminates most particulate material from raw sewage using grates, screens, and gravity (settling).
87. **Secondary Sewage Treatment:** second step of sewage treatment; bacteria breakdown organic waste; aeration accelerates the process.
88. **BOD: (Biological Oxygen Demand),** amount of dissolved oxygen needed by aerobic decomposers to break down organic materials.
89. **Eutrophication:** rapid algal growth (algal bloom) caused by an excess of nitrogen and phosphorous, blocks sunlight, causing the death/decomposition of aquatic plants, decreasing dissolved oxygen (DO), suffocating fish. The rapid growth is caused by an excess nitrates ( $\text{NO}_3^-$ ), and phosphates ( $\text{PO}_4^{3-}$ ) in water.
90. **Hypoxia:** water with very low dissolved oxygen levels, the end result is eutrophication. The BOD rises as aerobic decomposers breakdown the plants, the dissolved oxygen (DO) drops and the water cannot support life.
91. **Fecal coliform (Enterococcus bacteria):** Coccus (round shaped bacteria); indicator of sewage contamination (Happens over the summer at Chatfield or Cherry Creek Reservoir once in a while.)
92. **Chlorine:** Good: disinfection of water; Bad: forms trihalomethanes (this group of compounds are byproducts of chlorination and are known carcinogens)
93. **Minamata Disease:** (1932-1968 Japan) mental impairments caused by methylmercury ( $\text{CH}_3\text{Hg}$ )<sup>-1</sup> poisoning
94. **CAFÉ standards:** Corporate Average Fuel Economy : standards enacted into law in 1975, established fuel efficiency standards for passenger cars and light trucks. The fuel economy ratings from a manufacturer's entire line of passenger cars must currently average at least 27.6 mpg for the manufacturer to comply with the standard.
95. **Primary Air Pollutants:** produced by human and nature ( $\text{CO}$ ,  $\text{CO}_2$ ,  $\text{SO}_x$ ,  $\text{NO}_x$ , hydrocarbons, particulates)
96. **Secondary Pollutants:** formed by reaction of primary pollutants.
97. **Particulate Matter:**
- Source:** burning fossil fuels and diesel exhaust
  - Effects:** reduces visibility and respiratory irritation
  - Reduction:** filtering, electrostatic precipitators, alternative energy
98. **Nitrogen Oxides: ( $\text{NO}_x$ )**
- Source :** auto exhaust
  - Effects:** acidification of lakes, respiratory irritation, leads to smog and ozone
  - Equation For Acid Formation:**  $\text{NO} + \text{O}_2 \rightarrow \text{NO}_2 + \text{H}_2\text{O} \rightarrow \text{HNO}_3$
  - Reduction:** Catalytic Converter
99. **Sulfur Oxides: ( $\text{SO}_x$ )**
- Source:** coal burning
  - Effects:** acid deposition, respiratory irritation, damages plants
  - Equation for acid formation:**  $\text{SO}_2 + \text{O}_2 \rightarrow \text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$
  - Reduction:** scrubbers, burn low sulfur fuels
100. **Carbon Dioxide ( $\text{CO}_2$ )**
- Source:** combustion of fossil fuels
  - Effects:** greenhouse gas—contributes to global warming
  - Reduction:** accomplished by increased fuel efficiency (gas mileage) mass transit (reduction)
101. **Carbon Monoxide: ( $\text{CO}$ )**
- Sources:** include incomplete combustion of fossil fuels.
  - Effects:** binds to hemoglobin reducing blood's ability to carry  $\text{O}_2$
  - Reduction:** accomplished by catalytic converters, oxygenated fuel, mass transit (reduction)

102. **Ozone: (O<sub>3</sub>)**
- Formation:** secondary pollutant
  - Equation:**  $\text{NO}_2 + \text{UV} \rightarrow \text{NO} + \text{O}$ ;  $\text{O} + \text{O}_2 \rightarrow \text{O}_3$ , with VOC's (Volatile Organic Compounds)
  - Effects:** respiratory irritant, plant damage
  - Reduction:** reduce NO and VOC emissions
103. **Radon: (Rn):** naturally occurring colorless, odorless, radioactive gas, found in some types of soil and rock, can seep into homes and buildings, formed from the decay of uranium (U), causes lung cancer
104. **Photochemical Smog:** formed by chemical reactions involving sunlight (NO, VOC, O<sub>3</sub>)
105. **Acid Deposition:** caused by sulfuric and nitric acids resulting in lower pH of surface waters.
106. **Greenhouse Gases:** Most significant: H<sub>2</sub>O, CO<sub>2</sub>, methane (CH<sub>4</sub>), CFC's. Trap outgoing infrared energy (heat) causing Earth to warm.
107. **Effects of Global Warming:** rising sea level (due to thermal expansion not melting ice), extreme weather, drought, famine, extinctions.
108. **Greenhouse Effect:** a vital process, required for life to exist on Earth. If accelerated, bad, leads to global warming.
109. **Ozone Depletion:** caused by CFC's, methyl chloroform, carbon tetrachloride, halon (haloalkanes), methyl bromide all of which attack the stratospheric ozone.
110. **Effects of Ozone Depletion:** include increased UV, skin cancer, cataracts, and decreased plant growth.
111. **Love Canal, NY:** (1950's +) chemicals buried in old canal; school and homes built over it; caused birth defects and cancer.
112. **Main Components of Municipal Solid Waste:** is mostly paper and mostly put in the landfills.
113. **Sanitary Landfill Problem and Solutions**
- problem= leachate; solution= linear collection system**
  - problem= methane gas; solution= collect gas and burn**
  - problem= volume of garbage; solution= compacted and reduce**
114. **Incineration Advantages:** volume of waste reduced by 90% and waste heat can be used. The process that uses waste heat to generate electricity is called **Cogeneration**.
115. **Incineration Disadvantages:** toxic emissions (polyvinyl chloride, dioxins), scrubbers and electrostatic precipitators needed, ash disposal (contains heavy metals)
116. **Best Way To Solve Waste Problems:** reduce the amounts of waste at the source
117. **True Cost/External Cost:** harmful environmental side effects that are not reflected in the product's price.
118. **Brownfield:** is an abandoned industrial site.
119. **Keystone Species:** species whose role in an ecosystem is more important than others. Examples are Sea Otter, Sea Stars, Grizzly Bear, Prairie Dogs.
120. **Indicator Species:** species that serve as early warnings that an ecosystem is being damaged (ex. trout)
121. **In Natural Ecosystems, Methods Which Control 50-90% Of Pests:** Predators, Disease, Parasites
122. **Major Insecticide Groups:** chlorinated hydrocarbons (ex DDT); organophosphates (ex malathion); carbamates (ex aldicarb)
123. **Pesticides: Pro:** saves lives from insect-transmitted disease, increased food supply, increases profits for farmers.
124. **Pesticides: Con:** genetic resistance, ecosystem imbalance, pesticide treadmill, persistence, bioaccumulation, biological magnification.
125. **Natural Pest Control:** better agricultural practices, genetically resistant plants, natural enemies, and biopesticides, sex attractants.
126. **Genetically Modified Organisms: (GMOs):** new organisms created by altering the genetic material (DNA) of existing organisms; usually in attempt to remove undesirable or create desirable characteristics in the new organism.
127. **Electric Generation Methods:** steam, from water boiled by fossil fuels or nuclear energy, or falling water is used to turn a turbine and that turns a generator to generate electricity.
128. **Petroleum (Crude Oil) Formation:** microscopic aquatic organisms in sediments are converted by heat and pressure into a mixture of hydrocarbons.
129. **Pros of Petroleum:** cheap, easily transported, high quality energy.
130. **Cons of Petroleum:** reserves will be depleted soon; pollution during drilling, transport and refining, burning makes CO<sub>2</sub>.
131. **Coal Formation:** prehistoric plants buried un-decomposed in oxygen-depleted water of swamps/bogs converted by heat and pressure.
132. **Ranks of Coal:** Peat, Lignite, Bituminous coal, anthracite coal. (Best to worst)

133. **Major Nuclear Reactor Components:** consists of a core, control rods, moderator, steam generator, turbine, containment building.
134. **Two Most Serious Nuclear Accidents:** Chernobyl, Ukraine (1986), and Three Mile Island, PA (1979)
135. **Alternative Energy Sources:** wind, solar, waves, biomass, geothermal, fuel cells.
136. **Remediation:** return a contaminant area to its original state.
137. **LD 50 (LD-50, LD<sub>50</sub>):** the amount of a chemical that kills 50% of the animals in test population.
138. **Mutagen:** causes changes to DNA that may result in hereditary changes; **Teratogen:** causes fetus deformities (birth defects), **Carcinogen:** substance that causes cancer.
139. **Threshold Dose:** the maximum dose that has no measurable effect.
140. **Major Source of Sulfur:** burning coal; (new article cruise ships)
141. **Sources of Mercury:** burning coal, compact fluorescent bulbs.
142. **Volcano and Earthquake Occurrence:** at plate boundaries (**divergent plate boundary**=spreading, new crust being formed, example-- mid-ocean ridges) (**convergent plate boundaries**= trenches, tectonic plates with the oldest crustal material on Earth moving together, one moving under another; mid-oceanic trenches) (**transform plate boundary**=sliding, tectonic plates sliding by one another, San Andreas Fault in California)
143. **The Tragedy of the Commons:** (1968 paper by ecologist Garret Hardin) global commons such as atmosphere and oceans are used by all and owned by none.
144. **Forest Fires: Types: Surface:** usually burn only under growth and leave litter on forest floor; **Crown** hot fires, may start on ground but eventually leap from treetop to treetop; **Ground** go underground, may smolder for days or weeks, difficult to detect and extinguish i.e. peat bogs.
145. **Food:** Wheat, rice, and corn provide more than ½ of the calories in the food consumed by the world's people.
146. **Monoculture:** cultivation of a single crop, usually in a large area.
147. **Temperature Inversion:** layer of dense, cool air trapped under a layer of warm dense air, pollution in trapped layer may build to harmful levels. Frequent in Los Angeles, California; Mexico City, Mexico; often in Denver, Colorado.
148. **Transpiration:** process where water is absorbed by plant roots (caused by difference in pressure (Soil higher pressure and atmosphere lower pressure, water moves up through plants, passes through pores called stomata in leaves or other parts, evaporates into the atmosphere as water vapor. Hydrogen bonding, cohesion and adhesion help water move up a plant.
149. **Troposphere:** first layer of the atmosphere, 0-10 miles above Earth's surface. Contains weather, greenhouse gases (bad ozone).
150. **Stratosphere:** second layer of atmosphere, 10-30 miles above Earth's surface. Contains protective ozone layer (good ozone).
151. **Dioxin:** one of the most toxic human-made chemicals. Stable, long-lived, by-product of herbicide production enters the environment as fallout from the incineration of municipal and medical waste and persists for many years.
152. **PCB's:** (Polychlorinated Biphenyls): Stable, long-lived, carcinogenic chlorinated hydrocarbons. Produced by the electronics industry.
153. **Multiple Use Public Lands:** National Forest and National Resource Land
154. **Moderately Restricted Use Public Lands:** National Wildlife Refuges
155. **Restricted Use Public Lands:** National Parks and National Wilderness Preservation System

### **Endangered Species (Defined, Characteristics and Commonly Known Examples)**

**Defined:** A group of organisms in a danger of becoming extinct if the situation is not improved; population numbers have dropped below the critical number of organisms.

**Characteristics:** Most have a small range, require a large amount of territory, have long generations, have a very specialized niche, or live within an island.

#### **Examples:**

**Atlantic Salmon:** interbreeding with competition from escaped farm-raised salmon from the aquaculture industry threaten the wild salmon population.

**California Condor:** reason for decline include shootings, poisoning, lead poisoning, collisions with power lines, egg collecting, pesticides, habitat loss, and the decline of large and medium-sized native mammals due to encroachments of agriculture and urbanization.

**Delhi Sands Flower-Loving Fly:** a one inch long insect currently restricted to only 12 known populations in San Bernardino and Riverside counties. An estimated 98% of its habitat has been converted to residential, agricultural, and commercial use.

**Florida Panther:** hunting and development that resulted in habitat loss and fragmentation

**Grizzly Bear:** conflict with humans and development that resulted in habitat loss and fragmentation.

**Gray Wolf:** subject of predator eradication programs sponsored by the Federal government. Prior to Endangered Species Act of 1973, exterminated from lower 48 states except for a few hundred inhabiting extreme northeastern Minnesota, and a small number on Isle Royale, Michigan.

**Whooping Crane:** drainage of wetlands, conversion of grasslands to agriculture, and for hunting feathers.

**Manatee:** Initial population decreases resulted from overharvesting for meat, oil and leather. Today, heavy mortality occurs from accidental collisions with boats and barges, and from canal lock operations.

### Not Endangered Species

**American Alligator:** overhunting and destruction of habitat caused original listing, removed from the list of the endangered species by the Fish and Wildlife Service in 1987.

**Bald Eagle:** ingested DDT by eating contaminated fish. The pesticide caused the shells of the bird's to thin and resulted in nesting failures. Loss of nesting habitats and hunting for feathers also contributed to the population decline. Reclassified from endangered to threatened in 1995.

**Peregrine Falcon:** ingested DDT by eating smaller birds, which had eaten contaminated prey. The pesticide caused the shells of the birds to thin and resulted in nesting failures. Removed from the list of endangered species by the Fish and Wildlife Service in 1999.

**Gray Whale:** the eastern Northern Pacific stock in gray whale has the distinction of being the first population of a marine mammal species to be removed from the List of Endangered and Threatened Species.

### Biomes: Defined and Examples

**Defined:** large distinct terrestrial region having similar climate, soil, plants and animals.

**Examples:**

**Tropical Rain Forest:** characterized by the greatest diversity of species, believed to include many undiscovered species. Occur near the equator. Soil tends to be low in nutrients. Distinct seasonality: winter is absent and only two seasons are present (rainy and dry).

**Temperate Forests:** occur in eastern North America, Japan, northeastern Asia, and western and central Europe. Dominated by tall deciduous trees. Well-defined seasons include a distinct winter. Logged extensively, only scattered remnants of original temperate forest remain.

**Boreal Forests or Taiga:** represents the largest terrestrial biome. Dominated by needleleaf, coniferous trees. Found in the cold climates of Eurasia and North America: two-thirds in Siberia with the rest in Scandinavia, Alaska, and Canada. Seasons are divided into short moist, and moderately warm summers, and long, cold, and dry winters. Extensive logging may soon cause their disappearance.

**Temperate Shrub Lands or Chaparral:** occurs along the coast of Southern California and the Mediterranean region. Characterized by areas of Chaparral—miniature woodlands dominated by dense stands of shrubs.

**Savannas:** grassland with scattered individual trees. Cover almost half of the surface of Africa and large areas of Australia, South America, and India. Warm or hot climates where the annual rainfall is 20-50 inches per year. The rainfall is concentrated in a six to eight month period of the year, followed by a long period of drought when fires can occur.

**Temperate Grasslands:** dominated by grasses, trees and large shrubs are absent. Temperature vary more from summer to winter, and the amount of rainfall is less than in savannas. Temperate grasslands have hot summers and cold winters. Occur in South Africa, Hungary, Argentina, the steppes of the former Soviet Union, and the plains and prairies of central North America.

**Deserts:** covers about one fifth of the Earth's surface and occur where rainfall is less than 50 cm a year (less than 20 inches a year). Most deserts occur at low latitudes, have a considerable amount of specialized vegetation, as well as specialized animals. Soils have abundant nutrients, need only water to become productive, and have little or no organic matter. Common disturbances include occasional fires or cold weather, and sudden, infrequent, but intense rains that cause flooding.

**Tundra:** treeless plains that are the coldest of all the biomes. Occur in the arctic and Antarctica. Dominated by lichens, mosses, sedges, and dwarfed shrubs. Characterized by extremely cold climate, permanently frozen ground (permafrost) low biotic diversity, simple vegetation structure, limitation of drainage, short seasons of growth and reproduction.

**Wetlands:** areas of standing water wet all or most of the year that support aquatic plants including marshes, swamps, and bogs. Species diversity is very high. Includes bogs, swamps, sloughs, marshes.

**Fresh Water:** defined as having a low salt concentration (less than 1%). Plants and animals have adjusted to the low salt content and would not be able to survive in areas of high salt concentration (i.e. oceans). There are different types of freshwater regions: ponds and lakes, streams, and rivers and estuaries.

**Oceans:** the largest of all of the ecosystems. The ocean regions are separated into separate zones: intertidal, pelagic, abyssal, and benthic. All four zones have a great diversity of species.

#### **Places to Know:**

**Chernobyl, Ukraine:** April 26, 1986, unauthorized safety test (irony), leads to fire and explosion at nuclear power plant—millions exposed to unsafe levels of radiation.

**Three-Mile Island, Pennsylvania:** March 29, 1979, nuclear power plant loses cooling water, 50% of core melts, radioactive materials escape into the atmosphere, near meltdown (disaster).

**Yucca Mountain, Nevada:** controversial as proposed site for permanent storage of high-level nuclear waste, 70-miles northwest of Las Vegas, near volcano and earthquake faults.

**Aral Sea: Uzbekistan/Kazakhstan (former Soviet Union):** large inland sea is drying up as a result of water diversion.

**Love Canal, NY:** chemical buried in old canal, school and homes built over it led to birth defects and cancers.

**Aswan High Dam, Egypt:** the silt that made the Nile region fertile fills the reservoir. Lack of irrigation controls causes waterlogging and salinization. The parasitic disease schistosomiasis thrives in stagnant water of the reservoir.

**Three Gorges Dam, China:** world's largest dam on Yangtze River will drown ecosystems, cities, archeological sites, fragment habitats, and displace 2 million people.

**Ogallala Aquifer:** world's largest aquifer; under parts of Wyoming, South Dakota, Nebraska, Kansas, Colorado, Oklahoma, New Mexico and Texas. Hold enough water to cover the U.S. with 1.5 feet of water. Being depleted for agricultural and urban use.

**Minamata, Japan:** mental impairments, birth defects, and deaths caused by mercury dumped in the Minamata Bay by a factory. Mercury entered humans through their diet (fish).

**Bhopal, India:** December 2, 1984, methyl isocyanate released accidentally by Union Carbide pesticide plant kills over 5,000.

**Valdez, Alaska:** March 24, 1989: tanker Exxon Valdez hits submerged rocks in Prince William Sound—Worst Oil Spill in US waters.

#### **People to Know**

**Rachel Carson:** published *Silent Spring* in 1962; documented the environmental damage done by DDT and other pesticides. Which heightened public awareness at the start of the modern environmental movement.

**John Muir:** founded Sierra Club in 1892; fought unsuccessfully to prevent damming of the Hetch Hetchy Valley in Yosemite National Park.

**Gifford Pinchot:** the first chief of the US Forest Service; advocated managing resources for multiple use using principles of sustainable yield.

**Garrett Hardin:** published "The Tragedy of the Commons" in the journal of *Science* in 1968; argued that rational people will exploit shared resources (commons).

**Aldo Leopold:** wrote *A Sand County Almanac* published the year after his death in 1948; promoted a "Land Ethic" in which humans are ethically responsible for serving as the protectors of nature.

**Sherwood Rowland and Mario Molina:** in 1974, determined that CFC's destroy stratospheric (good) ozone.

**Thomas Malthus:** said: "human population cannot continue to increase exponentially; consequences will be war, famine and pestilence (disease)."

#### **Legislation and International Treaties: Note Year of Inception**

##### **Mining**

**Surface Mining Control And Reclamation Act (1977):** requires coal strip mines to reclaim the land

**Madrid Protocol (1991):** Suspension of mineral exploration (mining) for 50 years in Antarctica

##### **Water**

**Safe Drinking Water Act (SDWA, 1974):** set maximum contaminant levels for pollutants in drinking water that may have adverse effects on human health.

**Clean Water Act (CWA, 1972):** set maximum permissible amounts of water pollutants that can be discharged into waterways; aims to make surface waters swimmable and fishable.

**Ocean Dumping Ban Act (1988):** bans ocean dumping of sewage sludge and industrial waste in the ocean.

**National Wild and Scenic Rivers Act:** ( ) protects rivers with due to aesthetic, recreational, wildlife, historical, or cultural reasons.

## Air

**Clean Air Act: (CAA, 1970):** set emission standards for cars and limits for release of air pollutants.

**Kyoto Protocol: (2005):** controlling global warming by setting greenhouse gas emissions targets for developed countries.

**Montreal Protocol: (1987):** phase-out of ozone depleting substances.

## Waste

**Resource Conservation and Recovery Act (RCRA): (1976):** controls hazardous waste with a cradle to grave system.

**Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): (1980):** "Superfund", designed to identify and clean up abandoned hazardous waste dump sites.

**Nuclear Waste Policy Act: (1982):** U.S. government must develop a high level of nuclear waste site by 2015 (Yucca Mtn.)

**Low-Level Radioactive Policy Act:** all states must have facilities to handle low-level radioactive wastes.

## Life and Land

**Endangered Species Act: (1973):** identifies threatened and endangered species in the U.S. and puts their protection ahead of economic considerations.

**Convention on International Trade in Endangered Species (CITES): (1973):** lists species that cannot be commercially traded as live specimens or wildlife products.

**Magnuson-Stevens Act: (1976):** Management of Marine Species

**Food Quality Protection Act: (1996):** set pesticide limits in food and all active and inactive ingredients must be screened for estrogenic and endocrine effects.

**Lacey Act (1900)** prohibits interstate transport of wild animals dead or alive without federal permit.

**U.S. Marine Mammal Protection Act:** prohibits taking marine mammals in U.S. waters and by U.S. citizens, and the importing marine mammals and marine mammal products into the U.S.

**Federal Insecticide, Fungicide and Rodenticid and Act: (1947)** regulates effectiveness of pesticides

**Wilderness Act: (1964):** Established the national wilderness preservation system.

**Toxic Substance Control Act of 1976:** EPA ban or regulated deemed a risk to health to the environment.

**Costal Zone Management Act (CZMA) (1972):** A Federal law that provides guidance and federal assistance to voluntary state and local coastal management programs. Goals are for the protection of natural resources and management of land development along coasts.

**Federal Land Policy and Management Act (FLPMA) (1976):** A Federal law that outlines procedures concerning the use and the preservation of public US lands.

**Food Drug and Cosmetic Act: (1906)** A federal law passed in 1906 that regulates the sanitary conditions and safety of food, drugs, and cosmetics. It includes food additives.

## General

**National Environmental Policy Act: (NEPA)(1969):** Environmental Impact Statements must be done before any project affecting federal lands can be started

**Stockholm Convention on Persistent Organic Pollutants: (2004):** Seek to protect human health from the 12 most toxic chemicals (Includes 8 chlorinated hydrocarbon pesticides/DDT can be used for malaria control)

**North American Free Trade Agreement (NAFTA):** Trade alliance between U.S, Canada and Mexico

**The World Trade Organization (WTO):** Designed to make international trade more fair and encourage development. --It has been used to subvert national environmental laws. Has the effect of hurting small, local farmers and businesses.

**Earth Summit:** Held in the 1970's, discussed clean water and air. Held in South Africa. The last summit tried to pass a world law by the year 2010, that 15% of our power was to be created by air and solar power. But the summit was shut down.