APES REVIEW: “135 WAYS TO GO APE(S)”

Put these facts on index cards. The underlined term or phrase goes on one side, and the definition/explanation goes on the other side.

1. **Ionizing radiation**: enough energy to dislodge electrons from atoms, forming ions; capable of causing cancer (gamma, X-rays, uv)
2. **High Quality Energy**: organized & concentrated; can perform useful work (fossil fuel & nuclear)
3. **Low Quality Energy**: disorganized, dispersed (heat in ocean or air wind, solar)
4. **First Law of Thermodynamics**: energy is neither created nor 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 radioisotopes decay releasing gamma rays, alpha particles, and beta particles
7. **Half-life**: the time it takes for ½ the mass of a radioisotope to decay
8. **Estimate of how long a radioactive isotope must be stored until it decays to a safe level**: approximately 10 half-lives
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 not reached yet
11. **Ore**: a rock that contains a large enough concentration of a mineral making it profitable to mine
12. **Organic fertilizer**: slow-acting & long-lasting because the organic remains need time to be decomposed
13. **Best solutions to energy shortage**: conservation, increase efficiency, explore alternative energy options
14. **Surface mining**: cheaper and can remove more minerals; less hazardous to workers
15. **Humus**: organic, dark material remaining after decomposition by microorganisms
16. **Leaching**: removal of dissolved materials from soil by water moving downwards
17. **Illuviation**: deposit of leached material in lower soil layers (B horizon)
18. **Loam**: perfect agricultural soil with optimal portions of sand, silt, clay (40%, 40%, 20%)
19. **Conservation**: allowing the use of resources in a responsible manner
   **Preservation**: setting aside areas and protecting them from human activities
20. **Parts of the hydrologic cycle**: evaporation, transpiration, runoff, condensation, precipitation, infiltration
21. **Aquifer**: any water-bearing layer in the ground
22. **Cone of depression**: lowering of the water table around a pumping well
23. **Salt water intrusion**: near the coast, over-pumping of groundwater causes saltwater to move into the aquifer
24. **ENSO**: El Niño Southern Oscillation, see-sawing of air pressure over the S. Pacific
25. **During an El Niño year**: trade winds weaken & warm water sloshed back to SA
   **During a non El Niño year**: easterly trade winds and ocean currents pool warm water in the western Pacific, allowing upwelling of nutrient rich water off the west coast of South America
26. **Effects of El Niño**: upwelling decreases disrupting food chains, N U.S. has mild winters,
SW U.S. has increased rainfall, less Atlantic hurricanes
27. **Nitrogen fixing**: because atmospheric N\(_2\) cannot be used directly by plants it must first be converted into ammonia (NH\(_3\)) by bacteria (*rhizobium*)
28. **Ammonification**: decomposers convert organic waste into ammonia
29. **Nitrification**: ammonia (NH\(_3\)) is converted to nitrate ions (NO\(_3^-\))
30. **Assimilation**: inorganic nitrogen is converted into organic molecules such as DNA/amino acids & proteins
31. **Denitrification**: bacteria convert nitrate (NO\(_3^-\)) and nitrite (NO\(_2^-\)) back into N\(_2\) gas
32. Phosphorus does not circulate as easily as nitrogen because: it does not exist as a gas, but is released by weathering of phosphate (PO\(_4^{3-}\)) rocks
33. **Sustainability**: the ability to meet the current needs of humanity without compromising the ability of future generations to meet their needs
34. How excess phosphorus is added to aquatic ecosystems: runoff of animal wastes, fertilizer, discharge of sewage
35. **Photosynthesis**: plants convert atmospheric carbon (CO\(_2\)) into complex carbohydrates (glucose C\(_6\)H\(_{12}\)O\(_6\))
36. **Aerobic respiration**: O\(_2\)-consuming producers, consumers & decomposers break down complex organic compounds & convert C back into CO\(_2\)
37. Largest reservoirs of C: carbonate (CO\(_3^{2-}\)) rocks first, oceans second
38. **Biotic and abiotic**: living and nonliving components of an ecosystem
39. **Producer/Autotroph**: photosynthetic or chemosynthetic life
40. **Fecal coliform/Enterococcus** bacteria: indicator of sewage contamination
41. **Energy flow in food webs**: only 10% of the usable energy is transferred because usable energy lost as heat (second law); not all biomass is digested and absorbed; predators expend energy to catch prey
42. **Chlorine**: good = disinfection of water; bad = forms trihalomethanes
43. **Primary succession**: development of communities in a lifeless area not previously inhabited by life or those in which the soil profile is totally destroyed (lava flows); begins with lichen action
44. **Secondary succession**: life progresses where soil remains (clear-cut forest, fire)
45. **Cogeneration**: using waste heat to make electricity
46. **Mutualism**: symbiotic relationship where both partners benefit
47. **Commensalism**: symbiotic relationship where one partner benefits & the other is unaffected
48. **Parasitism**: relationship in which one partner obtains nutrients at the expense of the host
49. **Biome**: large distinct terrestrial region having similar climate, soil, plants & animals
50. **Carrying capacity**: the number of individuals that can be sustained in an area
51. **R strategist**: reproduce early in life; many small unprotected offspring
52. **K strategist**: reproduce late in life; few offspring; care for offspring
53. **Malthus**: said human population cannot continue to increase exponentially; consequences will be war, famine & disease
54. **Doubling time**: rule of 70; 70 divided by the percent growth rate

55. **Replacement level fertility**: the number of children a couple must have to replace themselves (2.1 in developed countries)

56. **World Population**: ~6½ billion
   - **U.S. Population**: ~300 million

57. **Preindustrial stage**: (demographic transition) birth & death rates high, population grows slowly, infant mortality high

58. **Transitional stage**: (demographic transition) death rate lower, better health care, population grows fast

59. **Industrial stage**: (demographic transition) decline in birth rate, population growth slows

60. **Postindustrial stage**: (demographic transition) low birth & death rates

61. **Age structure diagrams**: broad base = rapid growth; narrow base = negative growth; uniform shape = zero growth

62. **First and second most populated countries**: China and India

63. **Most important thing affecting population growth**: low status of women

64. **Ways to decrease birth rate**: family planning, contraception, economic rewards and penalties

65. **Percent water on earth by type**: 97.5% seawater, 2.5% freshwater

66. **Salinization of soil**: in arid regions, water evaporates leaving salts behind

67. **Ways to conserve water**: agriculture = drip/trickle irrigation; industry = recycling; home = use gray water, repair leaks, low flow fixtures

68. **Point vs non point sources**: point, from specific location such as a pipe. Non-point, from over an area such as runoff

69. **BOD**: biological oxygen demand, amount of dissolved oxygen needed by aerobic decomposers to break down organic materials

70. **Eutrophication**: rapid algal growth caused by an excess of nitrates (NO\textsubscript{3})\textsuperscript{-} and phosphates (PO\textsubscript{4})\textsuperscript{3-} in water

71. **Hypoxia**: when aquatic plants die, the BOD rises as aerobic decomposers break down the plants, the DO drops & the water cannot support life

72. **Minamata Disease**: (1932-1968, Japan) mental impairments caused by methylmercury (CH\textsubscript{3}Hg\textsuperscript{+}) poisoning

73. **Primary air pollutants**: produced by humans & nature (CO, CO\textsubscript{2}, SO\textsubscript{x}, NO\textsubscript{x}, hydrocarbons, particulates)

74. **Natural selection**: organisms that possess favorable adaptations pass them onto the next generation

75. **Particulate matter**: 
   - **Source**: burning fossil fuels and diesel exhaust 
   - **Effect**: reduces visibility & respiratory irritation 
   - **Reduction**: filtering, electrostatic precipitators, alternative energy)

76. **Nitrogen Oxides (NO\textsubscript{x})**: 
   - **Source**: auto exhaust 
   - **Effects**: acidification of lakes, respiratory irritation, leads to smog & ozone 
   - **Equation for acid formation**: NO + O\textsubscript{2} = NO\textsubscript{2} + H\textsubscript{2}O = HNO\textsubscript{3} 
   - **Reduction**: catalytic converter

77. **Sulfur oxides (SO\textsubscript{x})**: 
   - **Source**: coal burning
Effects: acid deposition, respiratory irritation, damages plants
Equation for acid formation: \( SO_2 + O_2 = SO_3 + H_2O = H_2SO_4 \)
Reduction: scrubbers, burn low sulfur fuel

78. **Carbon oxides (CO and CO\(_2\))**:
   - Source: auto exhaust, incomplete combustion
   - Effects: CO binds to hemoglobin, reducing blood’s ability to carry \( O_2 \); \( CO_2 \) contributes to global warming
   - Reduction: catalytic converter, emission testing, oxygenated fuel, mass transit

79. **Ozone (O\(_3\))**:
   - Formation: secondary pollutant, \( NO_2 + uv = NO + O^* \quad O^* + O_2 = O_3 \), with VOCs (volatile organic compounds)
   - Effects: respiratory irritant, plant damage
   - Reduction: reduce NO and VOC emissions

80. **Radon (Rn)**: radioactive gas, formed from the decay of uranium (U), causes lung cancer

81. **Photochemical smog**: formed by chemical reactions involving sunlight (NO, VOC, O\(^*\))

82. **Acid deposition**: caused by sulfuric and nitric acids (H\(_2\)SO\(_4\), HNO\(_3\)), resulting in lowered pH of surface waters

83. **Greenhouse gases**: Examples: H\(_2\)O, CO\(_2\), O\(_3\), chlorofluorocarbons (CFCs), methane (CH\(_4\)).
   - Effect: they trap outgoing infrared (heat) energy, causing Earth to warm

84. **Effects of global warming**: rising sealevel (thermal expansion), extreme weather, drought, famine, extinctions

85. **Causes of ozone depletion**: CFCs, methyl chloroform or trichloromethane (CHCl\(_3\)), carbon tetrachloride (CCl\(_4\)), halon (haloalkanes), methyl bromide (CH\(_3\)Br)—all of which attack stratospheric ozone

86. **Effects of ozone depletion**: increased uv, skin cancer, cataracts, decreased plant growth

87. **Love Canal, NY**: (1950s +) chemicals buried in old canal; school and homes built over it; caused birth defects and cancer

88. **Main component of municipal solid waste (MSW)**: paper; most is landfilled

89. **True cost / External costs**: harmful environmental side effects that are not reflected in a product’s price

90. **Sanitary landfill problems and solutions**:
   - problem = leachate; solution = liner with collection system
   - problem = methane gas; solution = collect gas and burn
   - problem = volume of garbage; solution = compact and reduce

91. **Incineration advantages**: volume of waste reduced by 90%, and waste heat can be used

92. **Incineration disadvantages**: toxic emissions (polyvinyl chloride, dioxins), scrubbers and electrostatic precipitators needed, ash disposal (contains heavy metals)

93. **Best way to solve waste problem**: reduce the amounts of waste at the source

94. **Keystone species**: species whose role in an ecosystem are more important than others, such as a sea otter

95. **Indicator species**: species that serve as early warnings that an ecosystem is being damaged

96. **Characteristics of endangered species**: small range, large territory, or live on an island

97. **In natural ecosystems, methods which control 50-90% of pests**: predators, diseases, parasites

98. **Major insecticide groups (and examples)**: chlorinated hydrocarbons (DDT);
organophosphates (malathion); carbamates (aldicarb)

99. **Pesticide pros**: saves lives from insect-transmitted disease, increases food supply, increases profits for farmers

100. **Pesticide cons**: genetic resistance, ecosystem imbalance, pesticide treadmill, persistence, bioaccumulation, biological magnification

101. **Natural pest control**: better agricultural practices, genetically resistant plants, natural enemies, biopesticides, sex attractants

102. **Electricity generation methods**: using steam from water boiled by fossils fuels or nuclear reactions; falling water to turn a turbine to power a generator

103. **Petroleum formation**: microscopic aquatic organisms in sediments converted by heat and pressure into a mixture of hydrocarbons

104. **Pros of petroleum**: relatively cheap, easily transported, high-quality energy

105. **Cons of petroleum**: reserves will be depleted soon; pollution during drilling, transport and refining; burning makes \( \text{CO}_2 \)

106. **Steps in coal formation**: peat, lignite, bituminous, anthracite

107. **Major parts of a nuclear reactor**: core, control rods, steam generator, turbine, containment building

108. **Two most serious nuclear accidents**: Chernobyl, Ukraine (1986) and Three Mile Island, PA (1979)

109. **Alternate energy sources**: wind, solar, waves, biomass, geothermal, fuel cells

110. **LD50 (LD-50, LD50)**: the amount of a chemical that kills 50% of the animals in a test population

111. **Mutagen; Teratogen; Carcinogen**: (in order) causes hereditary changes through mutations; causes fetus deformities; causes cancer

112. **Endangered species**: a group of organisms in danger of becoming extinct if the situation is not improved; population numbers have dropped below the critical number of organisms; North spotted owl, Arctic polar bear, many others…

113. **Invasive/ Alien/ Exotic species**: non-native species to an area; often thrive and disrupt the ecosystem balance

114. **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

115. **Volcano and Earthquake occurrence**: at plate boundaries (divergent= spreading, mid-ocean ridges) (convergent= trenches) (transform= sliding, San Andreas)

116. **Sources of mercury**: burning coal, compact fluorescent bulbs

117. **Major source of sulfur**: burning coal

118. **Threshold dose**: the maximum dose that has no measurable effect

**LEGISLATION**: Note – original years of inception are included FYI

**MINING**

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

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

**WATER**

121. **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

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

WASTE
Resource Conservation & Recovery Act (RCRA): (1976) controls hazardous waste with a cradle to grave system
Comprehensive Environmental Response, Compensation & Liability Act (CERCLA): (1980) “Superfund,” designed to identify and clean up abandoned hazardous waste dump sites

LIFE
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 fisheries
Food Quality Protection Act: (1996) set pesticide limits in food, & all active and inactive ingredients must be screened for estrogenic/endocrine effects

GENERAL
National Environmental Policy Act: (1969) Environmental Impact Statements must be done before any project affecting federal lands can be started
Stockholm Convention on Persistent Organic Pollutants: (2004) Seeks to protect human health from the 12 most toxic chemicals (includes 8 chlorinated hydrocarbon pesticides / DDT can be used for malaria control)