

APES REVIEW: “THE MANY WAYS TO GO APE(S)”

Put these facts on index cards. Study them throughout the year.

The underlined term or phrase goes on one side, and the definition/explanation goes on the other side.

BIODIVERSITY

- 1) Conservation: allowing the use of resources in a responsible manner
- 2) Preservation: setting aside areas and protecting them from human activities
- 3) Keystone species: species whose role in an ecosystem are more important than others (sea otters, sea stars, grizzly bears, prairie dogs)
- 4) Indicator species: species that serve as early warnings that an ecosystem is being damaged ex. trout
- 5) Characteristics of endangered species: small range, large territory, or live on an island
- 6) 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 (loss of old growth forest), Bald Eagle (thinning of eggs caused by DDT), Piping Plover (nesting areas threatened by development), and many others
- 7) Invasive/Alien/Exotic species: non-native species to an area; often thrive and disrupt the ecosystem balance; examples: kudzu vine, purple loosestrife, African honeybee “killer bee”, water hyacinth, fire ant, zebra mussel, gypsy moth, Asian Long Horned Beetle

CYCLES/PROCESSES

- 8) Parts of the hydrologic cycle: evaporation, transpiration, runoff, condensation, precipitation, infiltration
- 9) Nitrogen fixing: because atmospheric N_2 cannot be used directly by plants it must first be converted into ammonia (NH_3) by bacteria (*rhizobium* or cyanobacteria)
- 10) Ammonification: nitrogen is converted into ammonia by ammonifying bacteria; may occur when nitrogen in organic wastes in the soil are converted to ammonia or when atmospheric nitrogen (N_2) is converted to NH_3
- 11) Nitrification: ammonia (NH_3) is converted to nitrate ions (NO_3^-)
- 12) Assimilation: inorganic N_2 is converted into organic molecules such as DNA/amino acids & proteins - plants assimilate nitrogen as NH_4^+ or NO_3^- through their roots; animals (herbivores) assimilate organic nitrogen compounds by eating plants
- 13) Denitrification: bacteria convert nitrate (NO_3^-) and nitrite (NO_2^-) back into N_2 gas; bacteria convert ammonia (NH_3) back into N_2 or N_2O – typically accomplished by anaerobic bacteria
- 14) 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; this is a SEDIMENTARY cycle – it is never found as a gas
- 15) How excess phosphorus is added to aquatic ecosystems: runoff of animal wastes, fertilizer, discharge of sewage; limiting factor in freshwater ecosystems; excess P leads to eutrophication
- 16) Photosynthesis: plants convert atmospheric carbon (CO_2) into complex carbohydrates (glucose $C_6H_{12}O_6$); energy is consumed and oxygen is released as a waste product
- 17) Aerobic respiration: O_2 -consuming producers, consumers & decomposers break down complex organic compounds & convert C back into CO_2 ; energy is released and oxygen is consumed in the process
- 18) Anaerobic Respiration: break down of carbohydrates without oxygen – products are methane (CH_4), alcohols and other organics

- 19) Transpiration – process where water is absorbed by plant roots, moves up through plants, passes through pores (stomata) in leaves or other parts, evaporates into atm. as water vapor
- 20) Largest reservoirs of C: carbonate (CO_3)²⁻ rocks first, oceans second

ECOLOGY

- 21) Sustainability: the ability to meet the current needs of humanity without compromising the ability of future generations to meet their needs
- 22) The Tragedy of the Commons: (1968 paper by ecologist Garret Hardin) “Freedom to breed” is bringing ruin to all. Global commons such as atmosphere & oceans are used by all and owned by none. When no individual has ownership, no one takes responsibility. Examples: overfishing in the oceans, over pumping of the Ogallala Aquifer
- 23) Natural selection: organisms that possess favorable adaptations survive and pass them onto the next generation
- 24) Energy flow in food webs or chains, through trophic systems: 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; the 10% value is an average value
- 25) Biotic and abiotic: living and nonliving components of an ecosystem
- 26) Competition – a type of population interaction, usually over a limited resource – may be intraspecific or interspecific
- 27) Producer/Autotroph: photosynthetic or chemosynthetic life; Chemotroph – organism undergoing chemosynthesis – usually carried out by sulfur bacteria in aphotic zones in the ocean (deep ocean vents, etc.)
- 28) 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); no soil substrate present; begins with lichen action
- 29) Secondary succession: life progresses where soil remains (clear-cut forest, fire, disturbed areas)
- 30) Mutualism: symbiotic relationship where both partners benefit and both participate
- 31) Commensalism: symbiotic relationship where one partner benefits & the other is unaffected or may benefit
- 32) Parasitism: relationship in which one partner obtains nutrients at the expense of the host
- 33) Biome: large distinct terrestrial region having similar climate, soil, plants & animals; terrestrial biomes determining factors are temperature and precipitation
- 34) Carrying capacity: the number of individuals (size of the population) that can be sustained in an area (supported by available resources in the environment)
- 35) R strategist: reproduce early in life; many small unprotected offspring; tend to be generalists, short lifespan
- 36) K strategist: reproduce late in life; few offspring; care for offspring; tend to be specialists, longer lifespan
- 37) Positive feedback: when a change in some condition triggers a response that intensifies the changing condition (warmer Earth - snow melts - less sunlight is reflected & more is absorbed, therefore warmer Earth)
- 38) Negative feedback: when a changing 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 cooler Earth)
- 39) Malthus: said human population increases exponentially, while food supplies increase arithmetically; factors that keep the population in check include war, famine & disease
- 40) Doubling time: rule of 70; 70 divided by the percent growth rate

- 41) Replacement level fertility: the number of children a couple must have to replace themselves (2.1 developed, 2.7 developing); biotic potential; total fertility rate (TFR)
- 42) World Population: ~ 6.8 billion U.S. Population: ~ 310 million
- 43) Preindustrial stage: (demographic transition) birth & death rates high, population grows slowly, infant mortality high
- 44) Transitional stage: (demographic transition) death rate lower, better health care, population grows fast
- 45) Industrial stage: (demographic transition) decline in birth rate, population growth slows
- 46) Postindustrial stage: (demographic transition) low birth & death rates
- 47) Age structure diagrams: broad base = rapid growth; narrow base = negative growth; uniform shape = zero growth; Major Age Cohorts → pre-reproductives, reproductives, post-reproductives
- 48) First and second most populated countries: China and India
- 49) Most important thing affecting population growth: low status of women
- 50) Ways to decrease birth rate: family planning, contraception, economic rewards and penalties
- 51) True cost / External costs: harmful environmental side effects that are not reflected in a product's price

ELECTRICITY

- 52) Cogeneration: using waste heat to make electricity
- 53) Electricity generated by fossil fuels, biomass or nuclear power: heat is produced which creates steam → steam turns a turbine → the mechanical energy from the turbine is converted to electrical energy in a generator and that energy is transmitted to homes through power lines
- 54) Hydroelectric power: potential energy of stored water is used to turn a turbine → the mechanical energy from the turbine is converted to electrical energy in a generator and that energy is transmitted to homes through power lines

ENERGY, GENERAL

- 55) Thermal gradient: spontaneous flow of heat from warmer to cooler bodies
- 56) Ionizing radiation: enough energy to dislodge electrons from atoms, forming ions; capable of causing cancer (gamma, X-rays, UV)
- 57) High Quality Energy: organized & concentrated; can perform useful work (fossil fuel & nuclear)
- 58) Low Quality Energy: disorganized, dispersed (heat in ocean or air wind, solar)
- 59) First Law of Thermodynamics: energy is neither created nor destroyed, but may be converted from one form to another (Law of Conservation of Energy)
- 60) 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
- 61) Best solutions to energy shortage: conservation, increase efficiency, explore alternative energy options
- 62) Alternate energy sources: wind, solar, waves, biomass, geothermal, fuel cells

ENERGY, NUCLEAR

- 63) Natural radioactive decay: unstable radioisotopes decay releasing gamma rays, alpha particles, and beta particles

- 64) Half-life: the time it takes for ½ the mass of a radioisotope to decay
- 65) Estimate of how long a radioactive isotope must be stored until it decays to a safe level: approximately 10 half-lives
- 66) Nuclear Fission: nuclei of isotopes split apart when struck by neutrons
- 67) 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; $D + D \rightarrow He$ or $D + T \rightarrow He$
- 68) Mass deficit: not all matter is converted into matter in a fusion reaction – some (the mass deficit) is converted into energy. $E = mc^2$. Explains the energy released in a fusion reaction.
- 69) Major parts of a nuclear reactor: core, control rods, steam generator, turbine, containment building
- 70) Two most serious nuclear accidents: Chernobyl, Ukraine (1986) and Three Mile Island, PA (1979)

FOSSIL FUELS

- 71) Petroleum formation: microscopic aquatic organisms in sediments converted by heat and pressure into a mixture of hydrocarbons (animal remains)
- 72) Pros of petroleum: relatively cheap, easily transported, high-quality energy
- 73) Cons of petroleum: reserves will be depleted soon; pollution during drilling, transport and refining; burning makes CO_2
- 74) Steps in coal formation: peat, lignite, bituminous, anthracite

PESTS

- 75) Major insecticide groups (and examples): chlorinated hydrocarbons (DDT); organophosphates (malathion); carbamates (aldicarb)
- 76) Pesticide pros: saves lives from insect-transmitted disease, increases food supply, increases profits for farmers
- 77) Pesticide cons: genetic resistance, ecosystem imbalance, pesticide treadmill, persistence, bioaccumulation, biological magnification
- 78) Natural pest control: better agricultural practices, genetically resistant plants, natural enemies, biopesticides, sex attractants
- 79) In natural ecosystems, methods which control 50-90% of pests: predators, diseases, parasites

POLLUTION, AIR

- 80) Particulate matter:
 Source: burning fossil fuels and diesel exhaust
 Effect: reduces visibility & respiratory irritation
 Reduction: filtering, electrostatic precipitators, alternative energy)
- 81) Nitrogen Oxides (NO_x):
 Source: ~50% from transportation (exhaust), ~50% from industry
 Effects: acidification of lakes, respiratory irritation, leads to photochemical smog & ozone formation
 Equation for acid formation: $NO + O_2 \rightarrow NO_2 + H_2O \rightarrow HNO_3$
 Reduction: selective catalytic reduction unit, more efficient combustion processes like FBC (fluidized bed combustion), lower combustion temperatures, find alternatives to fossil fuels

- 82) Sulfur oxides (SO_x):
 Source: coal burning
 Effects: acid deposition, respiratory irritation, damages plants
 Equation for acid formation: $\text{SO}_2 + \text{O}_2 = \text{SO}_3 + \text{H}_2\text{O} = \text{H}_2\text{SO}_4$
 Reduction: scrubbers, burn low sulfur fuel)
- 83) Carbon oxides (CO and CO₂):
 Source: auto exhaust, incomplete combustion
 Effects: CO binds to hemoglobin, reducing blood's ability to carry O₂; CO₂ contributes to global warming
 Reduction: catalytic converter, emissions testing, oxygenated fuel, mass transit, increase efficiencies, find alternatives to fossil fuels
- 84) Ozone (O₃):
 Formation: secondary pollutant,
 $\text{NO}_2 + \text{uv} \rightarrow \text{NO} + \text{O}^*$ $\text{O}^* + \text{O}_2 \rightarrow \text{O}_3$, with VOCs (volatile organic compounds)
 Effects: respiratory irritant, plant damage
 Reduction: reduce NO and VOC emissions
 Tropospheric ozone is BAD, stratospheric ozone is GOOD
- 85) 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 cancer and is a problem in the Reading Prong area of PA. Radon decays to Polonium (Po), which is a solid. Po particles sit in lung tissue and are alpha (α) emitters. This leads to lung cancer.
- 86) Photochemical smog: formed by chemical reactions involving sunlight (NO, VOC, O*); associated with automobile traffic
- 87) Acid deposition: caused by sulfuric and nitric acids (H₂SO₄, HNO₃), resulting in lowered pH of surface waters, soil acidification and destruction of building materials
- 88) Greenhouse gases: Examples: H₂O, CO₂, O₃, chlorofluorocarbons (CFCs), methane (CH₄). Effect: they trap outgoing infrared (IR, heat) energy, causing Earth to warm
- 89) Effects of global warming: rising sea level (thermal expansion), extreme weather, drought, famine, extinctions
- 90) Stratospheric ozone depletion: caused by ozone-depleting chemicals (ODCs) such as CFCs, methyl chloroform or trichloromethane (CHCl₃), carbon tetrachloride (CCl₄), halon (haloalkanes), methyl bromide (CH₃Br)— all of which attack stratospheric ozone. The Cl or Br atoms “attack” the ozone molecules and cause the thinning of this layer. Global Agreement to decrease ODC – Montreal Protocol (1987)
- 91) Effects of ozone depletion: increased UV light that results in skin cancer, cataracts, decreased plant growth (inhibits photosynthesis, decline in Antarctic and Arctic phytoplankton population), impaired immune systems
- 92) Primary air pollutants: produced by humans & nature (CO, CO₂, SO_x, NO_x, hydrocarbons, particulates)
- 93) Secondary Air Pollutants: produced as a result of reactions that primary air pollutants undergo (include photochemical pollutants O₃, PAN and NO₂, and acids such as H₂SO₄ and HNO₃)
- 94) Sources of mercury: burning coal (25% of atmospheric deposition), compact fluorescent bulbs
- 95) Major source of sulfur: coal –burning power plants

POLLUTION, GENERAL

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

POLLUTION, WATER

- 97) Chlorine: good= disinfection of water; bad = forms trihalomethanes when organics are present in the water; many systems now use chloramines to treat waste water before it is discharged. Alternatives to chlorine disinfection – ozone

or UV light

- 98) Fecal coliform/Enterococcus bacteria: indicator of sewage contamination ; found in the intestines of all warm blooded mammals (coliform bacteria)
- 99) BOD: biological oxygen demand, amount of dissolved oxygen needed by aerobic decomposers to break down organic materials in water
- 100) Eutrophication: may result in rapid algal growth caused by an excess of nitrates (NO_3^-) and phosphates (PO_4^{3-}) in water
- 101) Hypoxia: when aquatic plants die, the BOD rises as aerobic decomposers break down the plants, the DO (dissolved O_2) drops & the water cannot support life; very low DO levels; dead zone in the Gulf of Mexico
- 102) Anoxic: no DO (dissolved O_2) in the water

SOIL/GEOLOGY

- 103) Surface mining: cheaper and can remove more minerals; less hazardous to workers
- 104) Ore: a rock that contains a large enough concentration of a mineral making it profitable to mine
- 105) Humus: organic, dark material remaining after decomposition by microorganisms
- 106) Leaching: removal of dissolved materials from soil by water moving downwards
- 107) Illuviation: deposit of leached material in lower soil layers (B horizon)
- 108) Loam: perfect agricultural soil with optimal portions of sand, silt, clay (40%, 40%, 20%)
- 109) Soil Profile, horizons in order: O – A – E – B – C – R
- 110) Organic fertilizer: slow-acting & long-lasting because the organic remains need time to be decomposed
- 111) Salinization of soil: in arid regions, water evaporates leaving salts behind
- 112) Volcano and Earthquake occurrence: at plate boundaries (divergent= spreading, mid-ocean ridges) (convergent= trenches) (transform= sliding, San Andreas)
- 113) Monoculture – cultivation of a single crop, usually in a large area
- 114) Food: wheat, rice and corn provide more than 1/2 of the calories in the food consumed by the world's people

TOXICOLOGY

- 115) LD50 (LD-50, LD₅₀): the amount of a chemical that kills 50% of the animals in a test population within 14 days of the initial dose
- 116) Threshold dose: the maximum dose that has no measurable effect on a given population

WATER

- 117) Percent water on earth by type: 97.5% seawater, 2.5% freshwater
- 118) Aquifer: any water-bearing layer in the ground; confined or artesian, unconfined or water table
- 119) Subsidence: land sinks as result of over pumping an aquifer
- 120) Cone of depression: lowering of the water table around a pumping well

- 121) Salt water intrusion: near the coast, over-pumping of groundwater causes saltwater to move into the aquifer
- 122) Ways to conserve water: agriculture = drip/trickle irrigation; industry = recycling; home = use gray water, repair leaks, low flow fixtures. reclaimed water for agriculture and golf courses

WASTE, HAZARDOUS and effects

- 123) Hazardous Waste (as defined by RCRA) – Mutagen, Teratogen, Carcinogen: (in order) causes hereditary changes through mutations; causes fetus deformities; causes cancer
- 124) Minamata Bay disease: (1932-1968, Japan) physical and mental impairments caused by methylmercury (CH₃Hg)⁺ poisoning
- 125) Love Canal, NY: (1950s +) chemicals buried in old canal; school and homes built over it; caused birth defects and cancer

WASTE, SOLID

- 126) Main component of municipal solid waste (MSW): paper; most is landfilled
- 127) 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
- 128) Incineration advantages: volume of waste reduced by 90%, and waste heat can be used
- 129) Incineration disadvantages: toxic emissions (polyvinyl chloride, dioxins), scrubbers and electrostatic precipitators needed, ash disposal (contains heavy metals)
- 130) Best way to solve waste problem: reduce the amounts of waste at the source (source reduction)

WEATHER/CLIMATE

- 131) ENSO: El Niño Southern Oscillation, see-sawing of air pressure over the S. Pacific
- 132) During an El Niño year: trade winds weaken & warm water sloshed back to SA
- 133) 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
- 134) Effects of El Niño: upwelling decreases disrupting food chains; N U.S. has mild winters, SW U.S. has increased rainfall, less Atlantic hurricanes
- 135) 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 and Mexico City, Mexico
- 136) Forest Fires: Types – Surface, Crown, Ground (in order) usually burn only under growth and leaf litter on forest floor; hot fires, may start on ground but eventually leap from treetop to treetop; go underground, may smolder for days or weeks, difficult to detect and extinguish, i.e. peat bogs.

LEGISLATION: Note – original years of inception are included FYI

MINING

- 137) Surface Mining Control & Reclamation Act: (1977) requires coal strip mines to reclaim the land Madrid Protocol: (1991) Suspension of mineral exploration (mining) for 50 years in Antarctica
- 138) Madrid Protocol: (1991) Moratorium on mineral exploration for 50 years in Antarctica

WATER

- 139) Safe Drinking Water Act: (SDWA, 1974) set maximum contaminant levels for pollutants in drinking water that may have adverse effects on human health
- 140) 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
- 141) Ocean Dumping Ban Act: (1988) bans ocean dumping of sewage sludge and industrial waste in the ocean

AIR

- 142) Clean Air Act: (CAA, 1970) set emission standards for cars and limits for release of air pollutants
- 143) Kyoto Protocol: (2005) controlling global warming by setting greenhouse gas emissions targets for developed countries
- 144) Montreal Protocol: (1987) phase-out of ozone depleting substances

WASTE, SOLID AND HAZARDOUS

- 145) Resource Conservation & Recovery Act (RCRA): (1976) controls hazardous waste with a cradle-to-grave system
- 146) Comprehensive Environmental Response, Compensation & Liability Act (CERCLA): (1980) “Superfund,” designed to identify and clean up abandoned hazardous waste dump sites
- 147) Nuclear Waste Policy Act: (1982) U.S. government must develop a high level nuclear waste site (Yucca Mtn)
- 148) Food Quality Protection Act (FQPA, 1996): set pesticide limits in food, & all active and inactive ingredients must be screened for estrogenic/endocrine effects

LIFE

- 149) Endangered Species Act: (1973) identifies threatened and endangered species in the U.S., and puts their protection ahead of economic considerations
- 150) Convention on International Trade in Endangered Species (CITES): (1973) lists species that cannot be commercially traded as live specimens or wildlife products
- 151) Magnuson-Stevens Act: (1976) Management of marine fisheries
- 152) Healthy Forest Initiative: (HFI, Healthy Forests Restoration Act of 2003) thin overstocked stands, clear away vegetation and trees to create shaded fuel breaks, provide funding and guidance to reduce or eliminate hazardous fuels in national forests, improve forest fire fighting, and research new methods to halt destructive insects

GENERAL

- 153) National Environmental Policy Act: (1969) Environmental Impact Statements must be done before any project affecting federal lands can be started
- 154) 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)