

Topic III: Populations (10-15%)

1. Carrying capacity (k)
 - a. The number of organisms that can be supported in a given area sustainable
2. Population curves
 - a. J-shaped (exponential growth)
 - b. S-shaped (logistic growth)
 - c. Real model (fluctuations around k)
3. Thomas Malthus and Malthusian Decline
 - a. Decline of living conditions, and hence, populations
 - i. Overpopulation of the young
 - ii. Inability of resources to keep up with the rising population
 - iii. Irresponsibility of the lower classes
4. Reproductive strategies
 - a. r-strategists
 - i. mature rapidly, short lived, many offspring, tend to be prey
 - b. k-strategists
 - i. mature slowly, long lived, tend to be both predator and prey, pop. stabilizes around k
5. Survivorship curves
 - a. Type I
 - i. Late loss
 - b. Type II
 - i. Constant loss
 - c. Type III
 - i. Early loss
6. Population history
 - a. Major influences in growth
 - i. Industrial Revolution(s)
 - ii. Improved medical and public health technologies
 - iii. Improved sanitation and personal hygiene
7. Pop. Change
 - a. $\text{Change} = (\text{crude BR} + \text{immigration}) - (\text{crude DR} + \text{emigration})$
8. Pop. Distribution
 - a. By country
 - i. 61% - Asia
 - ii. 13% - Africa
 - iii. 12% - Europe
 - iv. 9% - South America
 - v. 4.5% - North America
 - vi. 0.5% - Oceania
 - b. Urbanization
 - i. For the first time in history, more people (51%) live in urban areas than in rural areas
9. Replacement Level Fertility (RLF)
 - a. Number of children a couple must have on average to replace themselves
 - b. Global average of 2.1 children (higher in less developed countries [LDC])
 - c. Global TFR is 2.6
10. Doubling Time
 - a. $DT = 70 / \%r$

11. Demographic Transition
 - a. Pre-industrial
 - b. Transitional
 - c. Industrial
 - d. Post-industrial
12. Age-Structure Diagrams (pop. Histograms)
13. Case Studies in policy
 - a. China
 - i. “One Child Policy”
 1. incentives for only one child

Topic IV: Land and Water Use (10-15%)

1. Agriculture types
 - a. Crop rotation
 - b. Industrial agriculture/Corporate farming (includes pressures to raise as monocultures)
 - c. Intercropping/Interplanting (more than one crop on the same field)
 - d. Low-till/conservation tillage
 - e. Monoculture
 - f. Organic farming
 - g. Subsistence (carried out for survival)
2. Green revolution
 - a. Introduction of more industrial practices to agriculture, including synthetics and artificial irrigation
3. GMOs
 - a. modifying genes from one organism to carry out a role in another, or designing “designer” genes to carry out novel functions
4. Irrigation
 - a. $\frac{3}{4}$ of all fresh water used on Earth is for agriculture
5. Controlling pests
 - a. Biological (ladybeetles, etc.)
 - b. Carbamates (affect the nervous system of pests. More water soluble, so carries water pollution risk)
 - c. Chlorinated hydrocarbons (synthetics that affect the nervous system like DDT. Highly resistant to decomposition and require larger volumes than carbamates)
 - d. Inorganic (metals that kill broadly. Accumulate in the environment)
 - e. Organophosphates (extremely toxic but only remain in the environment for a short time. Examples include malathion for mosquitoes and parathion)
 - f. Integrated pest management (IPM) – uses a series of ecological controls that are not intended to eradicate pests, but to control their numbers to acceptable levels
6. Forestry*
 - a. Tree plantations
 - i. Monocultures of trees prim. for pulp and lumber
 - b. old-growth forests
 - i. not been significantly impacted by humans for hundreds of years

- c. World forest distribution
 - i. 22% S. America
 - ii. 19% N. America
 - iii. 19% Russia
 - iv. 18% Africa
 - v. 13% Asia
 - vi. 5% Oceania
 - vii. 4% Europe
- d. World Land Use
 - i. 32% forest
 - ii. 26% rangeland
 - iii. 11% cropland
 - iv. 4% preserves
 - v. 10% unproductive
 - vi. 17% other
- 7. Urban land development
 - a. Planned development (sustainability, minimize waste, air quality, UHI, etc.)
 - b. Suburban sprawl and urbanization
- 8. Transportation infrastructure*
 - a. Federal Highway System
 - i. Reduce pollution due to traffic reductions, improve fuel economy, return \$6 in economic productivity for every \$1 invested
 - ii. Federal Aid Highway Act (1956)
 - 1. Fed agreed to fund 90% of the construction costs for interstates with states absorbing all other costs and responsibilities
- 9. Public and Federal Lands*
 - a. BLM (manages about 1/8 of the land in the US)
 - b. National Parks (over 1,100 N.P. in the world)
 - c. Wildlife refuges
 - d. Wetlands (very high plant productivity)
- 10. Mining
 - a. Types
 - b. AMD
 - c. Processing (chemical intense)
 - d. Global reserves
 - i. Oil (from 45-70% has already been depleted)
 - ii. Coal (abundant reserves – 300 years remain globally at current trends)
- 11. Fishing*
 - a. Bottom trawling – funnel shaped net dragged across the ocean bottom
 - b. Drift net – long nets hand down that traps many species (1992 voluntary ban on drift nets longer than 1.5 miles has had some success)
 - c. Longline – contains thousands of baited hooks
 - d. Purse seine – surrounds large schools of fish spotted by aircraft or sonar, then net is drawn tight
- 12. Overfishing*
 - a. Oceans provide 1% of the world's food and 10% of the world's protein
- 13. Aquaculture*
 - a. Fish farming
- 14. Tragedy of the Commons – Garrett Hardin

Topic V: Energy (10-15%)

1. Prefixes (kilo-, mega-, giga-)
2. Laws of thermodynamics
 - a. First – energy can't be created or destroyed
 - b. Second – energy tends toward a state of disorder (entropy)
3. Consumption trends (US)
 - a. Transportation (27%)
 - b. Industrial (38%)
 - c. Residential and commercial (36%)
4. Commodity consumption by the US (% of total world usage)
 - a. Oil (40%)
 - b. Natural Gas (23%)
 - c. Coal (23%)
5. Energy Fuels (nonrenewable)
 - a. Coal
 - b. Oil
 - c. Natural Gas
 - d. Synfuels – liquid fuel synthesized from a nonpetroleum source
6. Future energy needs
 - a. Methane hydrates – pressure and low temps
 - b. Clean coal – cleaning and pulverizing to increase combustion and capturing air emissions
 - c. Oil Shale – contains organics called kerogen, which can be turned to oil at high temperatures
 - d. Tar Sands – contains bitumen, a type of oil that doesn't flow. Can be converted into liquid fuels at high energy costs
7. OPEC – Organization of Petroleum Exporting Countries
8. Nuclear
 - a. U-235 – must be enriched to increase concentration of U-235
 - b. U-238 – most common isotope (99.3%)
 - c. Pu-239 – can be produced in breeder reactors from U-238
 - d. Reactor design
 - i. Core – contains rods
 - ii. Fuel – fuel rods
 - iii. Control rods – in and out to absorb neutrons
 - iv. Neutron moderator – reduces velocity of neutrons to allow them to sustain the nuclear chain reaction
 - v. Coolant – removes heat and produces steam to generate electricity
9. Hydroelectric Dams
 - a. Flood control
 - b. Salmon
 - c. silting
10. CAFE standards
11. Renewables (all associated pros and cons)
 - a. Solar
 - i. Active and passive
 - b. hydrogen fuel cells ($2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$)
 - c. biomass
 - d. wind
 - e. ocean waves and tidal energy
 - f. geothermal