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1 11.02.20

1.1 Triple Bottom Line

- An assessment of the cost of a good or service should include more than just the economic costs; it should also include the social and environmental cost
- IPAT Equation: $I = P * A * T$; I = Impact, P = Population size, A = Affluence(products/person), T = Tech Usage (impact/product)

1.2 Assumptions of Mainstream Economics

- Environmental economists argue that mainstream economics will fail in the long run because it makes some assumptions that are inconsistent with the way nature operates

1. Assumption:

- Natural and human resources are infinite, substitutes can be found as necessary
- Economic growth will go on forever
- Something that benefits/harms us today is more important than something that ight do so tomorrow

2. Impacts:

- Linear economic production models use inputs and produce waste without regard to sustainability; circular systems depend on renewable resources and see waste as a useful inp
- Cradle to Cradle mentality creates sustainability whereas crade to grave increase the amount of overall waste

1.3 Market solutions

- Alternative: Command and Control

- Command = establishment of performance standards by a govt authority that must be complied with
- Control = negative consequences that could result from non-compliance
- Performance Standards
- Tradeable permits
 - Important to consider the effect on environmental justice

Economic Incentives

- Seek to reduce or eliminate negative environmental externalities (such as pollution) by incorporating the external cost of production.
- The general focus is prevention rather than remediation
- Payment for Ecosystem Services
 - NYC protecting its water supply

1.4 Environmental Policy

- Environmental policy = A course of action adopted by a government or organization intended to improve the natural environment and public health and reduce human impact on the environment
- Collective action undertaken to manage natural resources and human impacts on the environment.
- Things like: – Laws – Regulations – International agreements – Funding decisions

1.5 Why is Environmental Policy Challenging

- Many environmental problems transcend boundaries
- Lots of WICKED problems, very complex with multiple stakeholders
- Lawmakers must juggle many factors
 - Effectiveness of the policy
 - Negative tradeoffs

- Cost burden (internal, external costs)
- Flexibility of the policy to accomodate changes
- Many times, voters and lawmakers don't agree that they are necessary

1.6 History of Environmental Policy

- Before 1960's
 - How best to use resources
 - Pollution not key objective
 - Primarily dealt with at the state level
 - Environmental problems addressed after the fact through litigation, favored the pollutor
- Changes
 - As industry, pollution inc, pollution crossed state lines
 - Massive outcry in the 60's and 70's led to federal legislation
 - Performance standards led to a prevention-focused regulation

1.7 Who Makes Environmental Policy?

- Elected Officials
- Federal and State Agencies
- Local departments: planning and zoning, public works, etc/
- Courts
- Corporations and other businesses

1.8 NEPA

- NEPA's key feature is the Environmental Impact Statement (EIS)—a report that details the likely impacts (positive and negative) of a proposed action.
- The goal of an EIS is to identify problems before they occur so that stakeholders can choose the most acceptable course of action.
- The findings are made available to everyone (citizens, policy makers, and special interest groups)—this keeps the process transparent and everyone is given a chance to respond

1.9 Policy Decision Making Process

- Identify problem -> Consider options -> Formulate Plan -> Adopt Law -> Implement Law -> Evaluate effectiveness
- Statutes:
 - Provide policies, goals
 - Typically mandate an agency to promulgate regulations according to statutory standards and enforce them
 - Often authorize states to enforce them
 - Often dictate funding allocations
- Regulations:
 - Regulation = rule = administrative law
 - The actual technical and programmatic standards for environmental protection
 - Standards usually in regulations instead of statutes because of ease of amendment
- Court Decisions
 - Rule on constitutionality of statute, regulation, or other deferral action
 - Rule on application of statute or regulation
 - Rule on meaning (language/intent)
- Executive Orders
 - Presidential directives to do something
 - Often involve internal affairs, Development of amendments to regulations

1.10 Misc

- Most environmental regulation passed between the 70's and 90's, no significant regulation since
- Enforcement and Definitions absolutely essential
- Trump and Environmental Policy

- Treaties
- Paris Climate Agreement
 - Agency heads, federal judges
 - Agency directives –rules/regulations
 - Rule rollbacks
 - No new rules or policies
 - More state authority

2 10.26.20

- Disease cases from infected mosquitoes, ticks, and fleas have tripled in the last 13 years

2.1 Malaria

- Vector: Mosquito
- Transmission: Bite from infected mosquitoes
- Prevalence: Est 219M cases of Malaria, cases are mostly children w 660k Deaths
- US Prevalence: An average of 1,500 reported cases of malaria in the U.S. each year

2.2 Dengue Fever:

- Vector: Asian tiger mosquito (in 36 US states)
- Transmission: Bite from infected mosquito
- Prevalence: 100M cases worldwide, endemic in the Americas
- Occurs rarely, but there is a small risk for dengue outbreaks in the continental United States, mainly in the Southern US

2.3 Chikungunya

- Transmitted by mosquitoes
- Mainly in Africa, Asia, Europe, Indian, and Pacific Oceans
- First found in the Americas on Caribbean islands in 2013
- Beginning in 2014, reported in US travelers

2.4 West Nile Virus

- Vector: Mosquito
- Transmission: Bite from infected mosquito
- Prevalence: commonly found in Africa, Europe, Middle East, North America, West Asia
- U.S. Prevalence: Between 1999 and 2012, about 37,000 cases of West Nile Virus were reported in the U.S. Over 1,500 people died as a result.

2.5 Spread of Disease

- Increased connectivity increases rate and spread of infectious diseases across the globe
- Correlation between travel advisory and amount of travel to infected areas for Zika
- Zika most likely to be found in the Southeast because of Zika-transmitting mosquito population residence
- High poverty rates correlated with high risk of disease spread due to high population density, potential lack of good healthcare
- Warmer average temps, longer growing seasons, changes in precipitation may lead to more standing water and conditions that may be better for disease spread
- Warmer temps could expose more than 1.3B people to Zika by 2050

2.6 Climate Change and Health

- Without effective responses, climate change will:
 - Water quality and quantity: Contributing to a doubling of people living in water-stressed basins by 2050.
 - Food security: In some African countries, yields from rain-fed agriculture may halve by 2020.
 - Control of infectious disease: Increasing population at risk of malaria in Africa by 170 million by 2030, and at risk of dengue by 2 billion by 2080s.
 - Protection from disasters: Increasing exposure to coastal flooding by a factor of 10, and land area in extreme drought by a factor of 10-30
- Rainfall: transports and disseminates infectious agents
- Flooding: sewage treatment plants overflow, water sources contaminated
- Sea levels rise: Increased risk of severe flooding
- Higher temps: increases growth and survival rates of infection
- Drought: increases concentration of pathogens, hurts hygiene

2.7 Health Outcomes from Climate Change

- Some expected impacts will be beneficial but most will be adverse. Expectations are mainly for changes in frequency or severity of familiar health risks
- See Zika Climate Final for diagrams

2.8 Poverty and Disease

- Diarrhea is related to temperature and precipitation; Diarrhea increased 8% for each 1 degree C temp increase
- Health impacts of climate change unfairly distributed, hurt mortality of developing, low-income countries, especially in Africa

2.9 Temperature Effects on Vectors and Pathogens

- Vector:
 - Survival inc/dec depending on species
 - Changes susceptibility of vectors to some pathogens
 - Changes in rate of vector population growth
 - Changes in feeding rate and host contact
- Pathogen:
 - Decreased incubation period at higher temps
 - Changes in transmission season
 - Changes in geographical distribution
 - Decreased viral replication

2.10 Precipitation Effects on Vectors

- Survival: increased rain may increase larval habitat
- Excess rain can eliminate habitat by flooding•Low rainfall can create habitat as rivers dry into pools (dry season malaria)
- Decreased rain can increase container-breeding mosquitoes by forcing increased water storage
- Heavy rainfall events can synchronize vector host-seeking and virus transmission
- Increased humidity increases vector survival and vice-versa

2.11 IPCC

- Intergovernmental Panel on Climate Change, intl body for assessing the science related to climate change
- Set up in 1988 by the World Meteorological Organization and the UN Environmental Programme
- Provide policymakers w regular assessments about climate change, impacts and future risks, options for mitigation and adaptation

3 10.14.20

- Exam Review
 - Taxonomic group with the most known species: insects
 - Types of biodiversity
 - * Genetic
 - * Species
 - * Ecosystem
 - Biodiversity in the Southeast
 - * Describe SE biodiversity using the terms “richness,” “endemic,” and “hotspot”
 - Mussels: diversity, life history, and ecosystem service (nutrient cycling)
 - What is diversity?
- Isolation & Extinction Risk
 - Hawaii’s biodiversity is vulnerable to extinction - more than 90% of native species on Hawaiian islands are endemic, one half of indigenous species face extinction

3.1 Community Ecology

- Mutualism - A symbiotic relationship between individuals where both species benefit
- Parasitism - A symbiotic relationship between individuals of two species in which one benefits and the other is negatively affected (may or may not lead to death)
- Commensalism - A symbiotic relationship between individuals of two species in which one is benefitted and the other is unaffected
- All species contribute to their ecosystem but some are more important than others
- Keystone species influence community structure disproportionately to their abundance
 - Role: create/modify habitats, influence interactions between other species

- Removal of a keystone species may lead to a loss of biodiversity and changes in community structure within the ecosystem
- Food web: complex and realistic representation of how species feed on each other in a community
- Food chains: a linear representation of how different species in a community feed on each other
- Producers and Consumers
 - Producers: photosynthetic organisms that capture energy directly from the sun and convert it into food
 - Consumers: organisms that gain energy and nutrients by eating other organisms
 - * Animals, fungi, most bacteria, and protozoa
- Trophic level - a level in a food chain or food web
 - Primary consumer: a species that eats producers
 - Secondary consumer: a species that eats primary consumers
 - Tertiary consumer: a species that eats secondary consumers
 - Decomposers can be put practically anywhere on the food web
- Conservation Status: IUCN Designations
 - The International Union for Conservation of Nature established the Red List of Threatened Species in 1963
- Single species conservation programs focus on an individual species, successfully protecting some high-profile species but are less often used for less visible or valued species
- CITES
 - Convention on International Trade in Endangered Species of Wild Flora and Fauna
- Lacey Act: First law protecting wildlife

4 10.12.20

4.1 Definitions of Diversity

- Genetic Diversity: Variations in the genes among individuals of the same species
- Species Diversity: The variety of species present in an area; includes the number of different species that are present as well as their relative abundance
- Ecological Diversity: The variety of habitats, niches, trophic levels, and community interactions

4.2 Robust Redhorse

- Thought to be extinct until rediscovered in the Oconee in 1991
- Extirpated: Extinct in a local area

4.3 Species Diversity

- Richness: number of different species
- Evenness: relative abundance of each species
- Diversity: combined richness and evenness

4.4 Endemic Species

- Because areas w high ecological diversity offer many habitats and niches, they have a large number of endemic species
- Endemic species: a species that is native to a particular area and not usually found elsewhere
 - Most commonly found in small ecosystems

4.5 Hotspots

- Biodiversity hotspots: areas that have high endemism and have lost at least 70% of their original habitat
- These areas contain a large number of endangered species (species at high risk of becoming extinct)

- The Southeast US is a global hotspot of freshwater biodiversity supporting 2/3 of the country's fish species, over 90% of the US total species of mussels and nearly half of the global total of crayfish species

4.6 Habitat v Niche

- Habitat: the physical location of an species
- Niche: the biotic and abiotic needs for a species to survive

4.7 Biodiversity Loss

- As much as 20% of the world's biodiversity may be lost in the next 30 years
- 50-66% of biodiversity may be lost by the end of the century
- Current rate of extinction is 1500 times greater than pre-human background rate

4.8 Causes of Biodiversity Loss

- Human actions are having significant impacts on biodiversity loss
- Threats include:
 - Habitat destruction
 - Invasive Species introduction
 - Pollution
 - Overharvesting
 - Climate change

4.9 Value of Biodiversity

- Provides key connections between species and their environment
- Provides direct protection against disease
- Provide food, fuel, building materials, and pharmaceuticals

4.10 Ecosystem Services

- Supportive Services:
 - Purification of air and water
 - Carbon sequestration
 - Erosion Prevention
 - Habitats for animals and Plants
- Provisioning Services: Food, resources, water, fuel
- Regulating Services: Pollination, seed dispersal, protection, biological control
- Cultural Services: Recreation, Spiritual Tourism, mental health
- Human Wellbeing:
 - Strong economic growth
 - Medicinal resources
 - Reduction in toxin exposure

4.11 Isolation and Extinction Risk

- Number of unique species increases with isolation
 - Isolation and high endemism makes remote islands particularly vulnerable to species loss
 - Human impact contributes to isolation in the form of habitat fragmentation
 - Habitat fragmentation: destruction of part of an area that creates a patchwork of suitable and unsuitable habitat areas that may exclude some species altogether

5 10.09.20

5.1 Evolution and Resistance

- Evolution happens to populations, not individuals
- Natural selection is the mechanism for evolution

- Genetic drift more likely with low population size
- The potential for antibiotic resistance to develop in bacteria is very high
- Improper waste disposal

5.2 Athens Water Quality

- 10/17 Athens watershed are impaired or unhealthy
- Athens drinking water comes from:
 - N Oconee River
 - Middle Oconee River
 - Cedar Creek
- Athens had E. Coli outbreaks in water, showing prevalence of bacteria

5.3 Gonorrhea & Resistance

- Gonorrhea treatment is done through antibiotics
- Shown increase in resistance to every drug used to treat Gonorrhea
- CDC currently recommending two-drug combination to preserve our last highly effective antibiotic
- Higher reported rates of Gonorrhea occur in SE US, on an overall upward trend with younger populations

5.4 Developing new Antibiotics

- First antibiotic developed by Alexander Fleming in 1928 after noticing the fungus penicillium could kill disease causing bacteria
- Antibiotics aren't profitable for drug companies
- Developing antibiotics are high risk, very expensive, and very difficult
- Low return on investment, development void since 1990

5.5 Post-antibiotic Era

- Currently:
 - 80% of gonorrhea infections now resistant to antibiotics- 440,000 new cases of resistant tuberculosis annually
- In the future
 - Strep throats to scraped knees could be deadly
 - Cost to treat drug resistant double that of the status quo
- Davos Declaration
 - Reducing the development of drug resistance.
 - Increasing investment in R&D that meets global public health needs.
 - Improve access to high-quality antibiotics for all.
 - Signed by 98 companies, 11 industrial associations in 21 countries

6 10.07.20

6.1 Genetic Diversity & Natural Selection

- Genetic diversity in a population is the raw material natural selection
- The larger the amount of genetic diversity, the higher probability that some individuals from that pool can survive changes to its environment
- Phenotype = expressed gene
- Natural selection acts directly on the phenotype, resulting in changes in allele frequencies from parental to offspring generations

7 10.05.20

- Following widespread usage of antibiotics on humans and animals, waste from livestock and humans is generating antibiotic-resistance bacteria
- These bacteria are getting back into the environment through out waste

7.1 Antibiotic Resistance:

- A complex problem that involves helping many actors see the big picture and not just their part of it
- Issues where an action affects (or is affected by) the environment surrounding the issue, either the natural environment or the competitive environment
- Problem whose solutions are not Obvious

7.2 Systems Thinking

- Considers the whole rather than parts of the whole:
 - Events
 - Patterns
 - Underlying Structure

7.3 Cycle of Infection

- Farm animals receive antibiotics often, developing resistant bacteria in their gut
- This can be transmitted through produce, waste, shared environments, etc.

7.4 Bacteria

- Bacteria are single celled organisms that can grow in colonies
- Many different kinds of bacteria can grow together in similar environments

7.5 Explaining Resistance

- Antibiotics kill almost all antibiotic sensitive bacteria, leaving few sensitive and many unsensitive
- Reproduction occurs with the mostly-unsensitive remaining bacteria, leaving to many unsensitive offspring. This increases the amount of resistant bacteria as a whole.

7.6 Genetic Variation

- Variation in the susceptibility of bacteria to antibiotics allows for the propagation of these genes in bacterial communities
- Individuals of the same species have the same basic gene
- Alleles: variants of genes that account for the diversity of traits seen in a population
- Adaptation: traits that promote the success of a species
- An adaptive trait for one environmental condition does not mean that it is adaptive for all conditions

7.7 Genetic Diversity

- Within populations, biodiversity is measured by genetic diversity
- Genetic diversity improves survival of a population
- Outbreeding, through sexual reproduction of not closely related individuals, maximizes genetic diversity
- Inbreeding, or mating between closely related individuals, results from small populations, and increases chances of genetic diseases (e.g., hemophilia, cystic fibrosis, etc.)

7.8 Sources of Genetic Variation

- Mutation: A change in the DNA sequence of sex cells that alter a gene
 - Can be neutral, beneficial, or harmful
- Genetic Recombination: The production of eggs and sperm that results in a shuffling of alleles, creating new combinations in offspring

7.9 Natural Selection

- Constant struggle of organisms to survive and mate
- Organisms tend to produce more offspring that can survive
- Individuals of the same species are not identical

- Evidence of Natural Selection: Selective breeding (artificial selection) of dogs and cats
- Natural selection results in changes in gene frequencies
 - Some individuals will be able to obtain more resources and can produce more offspring
 - * Differential reproductive success results in changes to gene frequencies

8 09.18.20

8.1 Hurricanes

8.1.1 How Hurricanes Form

- Water evaporates over the ocean and forms clouds when it touches cold air
- A column of low pressure develops at the center with winds around the column
- Speed of the wind around it increases
- Categorized based on wind speed (1-5)
- Hurricane development requires warm water and low wind shear
 - Caribbean has warm water all year but also high wind shear which isn't conducive to hurricanes

8.1.2 Climate Change & Hurricanes

- Storm surge more dangerous (accounts for 90% of hurricane deaths)
- 40% increase with a 0.5 degree C inc in temperature
- Increasing of North Atlantic hurricane season
- Climate change is expected to shift the Bermuda high westward
 - Bermuda High is a pressure system over the Atlantic
 - Has the ability to move hurricanes on the Atlantic

8.1.3 Hurricane Harvey Intensification

- Went from a tropical depression to a Cat 4 Hurricane in 57 hours
- Soil in TX affected the amount of water maintained in the Earth
- Huge economic impacts

8.1.4 General Impacts

- Storm Surge
- Extreme Rainfall
- Potential Wind Speed

9 09.16.20

9.1 Heat Waves

- Heat extremes doubled in frequency from 1980-1999 to 2000-2019
- Climate change affecting heat waves
 - Shifting the frequency of hot and cold weather, heat waves are more frequent
 - Exacerbating heat inducing droughts, dry land leads to even hotter temps
- Causes: Global warming ->
 - Large scale global circulation change
 - Atmospheric Blocking increase
 - Air mass temp increase
- Effects and Consequences
 - Decreased human productivity
 - Increased tropical disease and death
 - Environmental racism
 - Crop productivity decreases
 - Lower biodiversity
 - Decreased water availability
 - Increased fire risk

9.2 Wildfires

- Climate change is increasing the size, intensity, and frequency of wildfires
- Wildfires create more climate change through the increase of carbon expulsion through wildfires
- Wildfires have global impacts due to smoke and temperature changes
- Wildfire season has gotten longer due to climate change

10 09.14.20

10.1 Coriolis Effect

- Deflection of an object's path due to the rotation of the Earth
- North and south poles have different deflections of wind patterns
- Little/no deflection at the equator

10.2 Air circulation

- Hottest air at the equator, moves north or south, cools, then comes back into equator

10.2.1 Cells

- Hadley cells: 0-30 degrees North and South
- Ferrell Cell: 30-60 degrees North
- Polar cells: North and South poles
- Northeast and Southeast trade winds (remember directions!)
- Westerlies: bring rain and precipitation

10.3 Surface Ocean Currents

- Ocean currents also affect the distribution of climates
- Surface ocean currents generated by wind, Coriolis effect, heat, and continents

- Heat redistribution from the Tropics
 - Trade winds push warm surface waters west
 - Water reaches continents and flows north and south
 - water cools
 - Westerlies push cooler water east
 - Water reaches continents and flows to equator

10.4 El Nino (Southern Oscillation)

- Recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean.
- The ocean and atmosphere can interact to affect climate
 - Water in the eastern pacific warms up
 - Sea level pressure drops but rises in the W pacific
 - Trade winds weaken
 - Upwelling in the Pacific is reduced
 - Warmer waters - increased rainfall in Peru
 - Cooler waters, drought in Australia/Indonesia
- Critical because of its ability to change atmospheric circulation, temps, and precipitation
- Significantly hurts fisheries and developing countries

10.5 La Nina

- exacerbates normal conditions and leads to cooling in the Eastern pacific

10.6 Heat Waves

- Global warming has amplified the intensity, duration, and frequency of extreme heat and heat waves.

11 09.11.20

- Northern latitudes experience greater seasonality in CO₂ concentrations
 - This is due to variation in photosynthetic activity by plants
- Greenhouse effect
 - Some incoming solar radiation is absorbed
 - Other amounts are reflected back into the atmosphere
 - Greenhouse gases capture and reradiate some heat over and over, warming the Earth
 - More gases, more heat
- Albedo: measure of the reflectivity of a surface
 - light surfaces have a higher albedo, darker surfaces have a lower albedo
 - surfaces with a low albedo release more heat into the atmosphere
- Positive Feedback Loops
 - applied to albedo:
 - temps rise -> more ice melting -> more water warming -> temps rise
- Urban Heat Island Effect
 - cities will be inc their population, inc energy and temperature
 - cities in particular have higher temperatures
 - tree cover -> cooler temperatures
- Small changes in overall global temp can cause significant changes in weather creating more extreme storms and more record temps
 - roughly twice as many heat records
 - alterations in global jet streams
 - frost comes later and begins earlier
- General climate change impacts:

- Health impacts
- Crop productivity
- Coastal erosion
- Biodiversity
- Water availability
- Fire risk
- Weather events getting more extreme with
 - sea levels
 - wildfires
- Need both adaptation and mitigation
 - Adaptation: Responding to warming that has already happened
 - Mitigation: Preventing further warming by addressing climate change causes

12 09.09.20

12.1 The Earth's Atmosphere

- Climate change is a serious environmental problem impacting species, ecosystems, and the globe
- The atmosphere helps protect the Earth from the sun and keeps the temperature of the Earth cool
- Atmosphere has a significant impact on climate
- Earth's Atmosphere Composition
 - Nitrogen (78%)
 - Oxygen (21%)
 - Other - Greenhouse Gases (1%)

12.2 The Keeling Curve

- Curve developed to track atmospheric CO₂ levels in Earth's atmosphere since 1952

13 09.02.20

13.1 Demographic Transition Model

- Demographers use age structure diagrams to predict future growth potential of a population
 - Pyramid structures indicate fast growth
 - House-shaped structures have moderate growth
 - Diamond structures have low/negative growth
- Development leads to smaller families
- Demographic transitions happen country by country
- Industrialization might not lead to a demographic transition in all countries
 - May not be linked to quality of life
 - Religion/Cultural beliefs
 - Social justice issue, improving the well-being of women and children key to dec. fertility

13.2 Social Justice: Education for Women

- Education of girls & economic opportunities for women are correlated with lower birth rates
- Education empowers women to take control over their own fertility through:
 - Birth control
 - Marrying later
 - Delaying childbirth for career opportunities
- Women earning more money is correlated to lower child mortality

13.3 Environmental Impact

- Slowing population growth is critical to sustainability and reducing our population impact

- Our impact on the population is a result of (1) our population size and (2) our consumption habits - both must be addressed
- Ecological footprint: the land area needed to provide the resources for, and assimilate the waste of, a person or population

13.4 Sustainability

- A dynamic process between the economy, society, and environment
- Sustainable: The process or the activity can be maintained without exhaustion or collapse
 - Intra & Inter-generational issue
 - Capacity of a system to accomodate changes:
 - * rates of renewable resource use should not exceed regeneration rate
 - * rates of non-renewable resource use should not exceed rate of renewable substitute dev
 - * rates of pollution should not exceed ssimilative capacity of the environment
- Sustainable development has three factors:
 - Social equity
 - Economic efficiency
 - Environmental responsibility

13.5 Worldviews

- Culture influences our beliefs through:
 - Knowledge
 - Beliefs
 - Values
 - Learned ways of life
- Worldviews are affected by:
 - Environmental Ethics

14 08.31.20

14.1 Human Populations

- 3 major sparks of growth
 - Agricultural Revolution
 - Industrial Revolution
 - Green Revolution
- With more food and technology, the population and need for more human labor increased
- The human population is rapidly increasing and the impact of humans is due to:
 - More humans overall
 - Greater growth / person
- To address population growth, we need to pursue a variety of approaches that address factors encouraging high birth rates
- Zero population growth: the absence of population growth, occurs when birth rates = death rates
 - Replacement fertility is reached

14.2 Population Ecology

- Analyze and categorize human populations using population ecology techniques
- Population Ecology: a branch of biology dealing with the number of individuals in a particular species in an area over time
- Ecologists study populations to understand what makes them survive and thrive
- Size, distribution, and growth rate is influenced by a variety of factors and are important to understanding population ecology

14.3 Monitoring Population Dynamics

- Population Dynamics: Changes over time in population size and composition
- Important metrics:
 - Minimum viable population - min number of individuals that would still allow population to persist or grow
 - Carrying Capacity (K) - the maximum population size that a particular environment can support indefinitely
- Population Density - the overall density a particular population can sustain

14.4 Exponential Growth & Populations

- Exponential growth occurs in populations when growth is unrestricted. This is, overall, unsustainable
- Growth which becomes progressively larger each breeding cycle
- Produces a J curve when plotted

14.5 Monitoring Population Growth

- Population growth rate - the rate at which a population of a species grows over time
- Growth factors - factors which assist in the growth of a population
- Resistance factors - factors which inhibit the growth of a population
- Limiting factors: resources needed for survival but that may be in short supply

14.6 Logistic Growth

- Occurs when a population nears carrying capacity (k)
 - Maximum sustainable population size
 - Determined by limiting factors

14.7 Density-dependent/ Density-independent Factors

- Density dependent factors increase as populations grow, typically biotic
 - Disease
 - Competition
 - Predation
- Density independent facts affect population growth regardless of population size
 - Storm
 - Fire/Flood
 - Avalanche

14.8 Regulation

- Tendency for populations to decrease in size when above a certain level, and increase in size below that level
- Populations can only be regulated by density-dependent factors
- Top down Regulation
 - Predation
 - Disease
- Bottom up Regulation
 - Nutrients
 - Water
 - Sunlight

15 08.28.20

15.1 What is Science?

- Science: a body of knowledge that allows us to understand the world around us
- Science is based on empirical evidence

- Science allows us to test our ideas and evaluate the evidence
- Scientific knowledge, including facts, theories, and laws, is subject to change
- Scientific claims change as new evidence is made available

15.2 White-Nose Syndrome Case Study

15.2.1 About WNS

- White-Nose Syndrome
 - 2007-2016, 6+ million bats dead as a result of White Nose Syndrome
 - The reason for the deaths was White-Nose Syndrome
- Chytridiomycosis
 - Infectious, fungal disease affecting amphibians
 - Helped understand white-nose syndrome with bats

15.2.2 Science with WNS

- Scientific Method: the procedure used to empirically test a hypothesis
 1. Observations generate questions
 2. Choose a question to investigate
 3. Consult literature
 4. Develop a hypothesis and make a testable prediction
 5. Design and carry out a study
 6. Analyze data
 7. Draw a conclusion
- Inferences: Conclusions drawn based on observations
- Hypothesis: An inference that proposes possible explanation that includes previous knowledge/observation
- Testing a Hypothesis: Hypotheses can be tested through an observational or experimental study

- Scientific Studies: A fair test with results that could support or falsify the research prediction
 - Experimental Studies: Conditions are manipulated intentionally
 - * Test Group: the group in an experimental study such that it differs from the control in only one way
 - * Control Group: the group in an experimental study to which the test group's results are compared
 - Observational Studies: Gather real-world data without any intentional variable manipulation
- Theory: A hypothesis that survives repeated testing by significant research can become a theory
- Correlation v Causation
 - Correlation: two things occurring together but not necessarily having a cause-effect relationship
 - Cause-Effect Relationship: the association of two variables that identifies one variable occurring as a result of the other
 - Observational studies can derive correlation but not causation
 - Experimental studies can derive causal relationships
- Policy: a formalized plan that addresses a desired outcome or goal
 - policies need to be flexible, adapt to new findings, address the environmental problem, fit social need and be economically viable in order to work effectively.

15.3 Summary

- Scientific knowledge, though reliable and durable, is never absolute or certain
- This knowledge, including facts, theories, and laws, is subject to change
- Physical evidence, systematically collected and logically analyzed, helps scientists understand environmental issues and guide policy decisions

16 08.25.20

16.1 Applied v Empirical Science

- Applied Science = research whose findings are used to solve practical problems
- Empirical science: A scientific approach that investigates the natural world through case studies

16.2 Social Traps

- Occurs when a large amount of people are using a shared resource
- Seem good in the short term but are actually bad in the long term
- 3 Types:
 - Tragedy of the Commons: When resources are shared, individuals try to maximize personal benefit which hurts the resource itself
 - Time delay: Collective decisions that are good today but gone tomorrow
 - Sliding reinforcer: related to the evolution of natural organisms and GMOs

16.3 Beginning with Data Interpretation

- Variables represent factors that can be manipulated, controlled, or merely measured for research
- Variation = how much a variable changes
- Independent var is controlled to see effects in the Dependent var
- Graphs explore relationships with data and report this data

16.4 Observational v Experimental Studies

- Observational studies can observe a correlation but are unable to derive a causational reln.
- Experimental studies have a control var (required) and are able to derive causational relns.

17 08.24.20

17.1 Definitions

- Ecology: the branch of science dealing with the relationships of living things to one another & the environment
- Environmental Science: The study of all aspects of the environment, including physical, chemical, and biological factors, particularly with respect to how these aspects affect humans, and vice versa
- Environmental Ethics: Personal philosophy that influences how a person interacts with their natural environment and thus influences how one responds to environmental problems

17.2 Ecology != Environmentalism

- Distinguish between environmentalism & ecology

Environmentalism	Ecology
Activism to protect the environment	Scientific study of living and non-living things