

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

Description of the Course

The goal of this newest Advanced Placement (AP) science course is to provide students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and human-made, to evaluate the relative risks associated with these problems, and to examine alternative solutions for resolving and/or preventing them.

The course will focus on the "real science" behind environmental problems and issues, and it will be recommended that students successfully complete at least two years of high school laboratory science (one year of life science and one year of physical science, such as chemistry) before enrolling in this rigorous course. Laboratory and field study are envisioned to be an important element of the course.

Outline of Topics

- I. Scientific Analysis (5%)
 - A. Observing the Natural World and Developing Hypotheses
 - B. Collecting Data
 - C. Modeling
 - D. Critical Interpretation of Data
- II. Interdependence of Earth's Systems: Fundamental Principles and Concepts (25%)
 - A. The Flow of Energy
 - B. The Cycling of Matter
 - C. The Solid Earth
 - D. The Atmosphere
 - E. The Biosphere
- III. Human Population Dynamics (10%)
 - A. History and Global Distribution
 - B. Carrying Capacity -- Local, Regional, Global
 - C. Cultural and Economic Influences
- IV. Renewable and Nonrenewable Resources: Distribution, Ownership, Use, Degradation (15%)
 - A. Water
 - B. Minerals
 - C. Soils
 - D. Biological
 - E. Energy
 - F. Land
- V. Environmental Quality (20%)
 - A. Air/Water/Soil
 - B. Solid Waste
 - C. Impact on Human Health
- VI. Global Changes and Their Consequences (15%)
 - A. First-order Effects
 - B. Higher-order Interactions
- VII. Environment and Society: Trade-Offs and Decision Making (5%)
 - A. Economic Forces
 - B. Cultural and Aesthetic Considerations
 - C. Environmental Ethics
 - D. Environmental Laws and Regulations (International, National, and Regional)
- VIII. Choices for the Future (5%)
 - A. Conservation
 - B. Preservation
 - C. Remediation
 - D. Sustainability

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

Laboratory and Field Investigations

The goal of the laboratory and field investigation component of the AP Environmental Science course is to complement the classroom portion by allowing students to learn about the environment through firsthand observation. Experiences both in the laboratory and in the field provide students with important opportunities to test concepts and principles that are introduced in the classroom, explore specific problems with a depth not easily achieved otherwise, and gain an awareness of the importance of confounding variables that exist in the "real world."

Student Objectives

All teaching and learning activities are correlated with the objectives. The objectives for each unit of study are found at the end of this curriculum document, beginning on page 14.

Grading

Student's six-week grades will be determined by the following percentages: quizzes— 15%; labs—25%; tests—60%. Each final exam will count for 25% of the semester grade.

Textbook

Miller, G. Tyler Jr., *Environmental Science: Working with the Earth*, 6th ed., Belmont, CA: Wadsworth, 1997.

Alternative Resource ["LITE" references] Miller, G. Tyler Jr., *Living in the Environment: Principles, Connections, and Solutions*, 9th ed., Belmont, CA: Wadsworth, 1998.

Texas Education Agency: Texas Essential Knowledge and Skills

§112.66. Advanced Placement (AP) Environmental Science (One to One and One-Half Credits).

(a) General Requirements.

Students can be awarded one to one and one-half credits for successful completion of this course. Recommended prerequisites: Algebra I, two years of high school laboratory science including one year of life science and one year of physical science.

(b) Content Requirements.

Content requirements for Advanced Placement (AP) Environmental Science are prescribed in the College Board Publication Advanced Placement Course Description: Environmental Science, published by The College Board.

Source: The provisions of this §112.66 adopted to be effective September 1, 1998, 22 TexReg 7647.

The AP Exam

The exam is 3 hours long and divided equally in time between multiple-choice questions and free-response questions.

Section I: Multiple-Choice: 100 questions and constitutes 60% of the final grade.

Section II: Free-Response: Constitutes 40% of the final grade, three types of questions are included in this section: data-analysis questions, document-based questions, and synthesis and evaluation questions.

Exam Date for 2004 - May 11, 2004

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

FALL SEMESTER

SCOPE & SEQUENCE

| | | |
|---------------|---|----------------|
| UNIT 1 | Introduction to Environmental Problems | 2 Weeks |
| UNIT 2 | Matter and Energy Resources | 1 Week |
| UNIT 3 | Ecosystems | 3 Weeks |
| UNIT 4 | Climate and Weather | 2 Weeks |
| UNIT 5 | Population Dynamics | 2 Weeks |
| UNIT 6 | Earth Science | 2 Weeks |
| UNIT 7 | Human Populations | 3 Weeks |
| UNIT 8 | Global Problems | 3 Weeks |

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

FALL SEMESTER

UNIT 1 Introduction to Environmental Problems – 2 Weeks

TIME 2 Weeks

TOPICS CHAPTER 1: Growth, Resources, Pollution, Sustainable World

LABS

- Personal Materials Audit (TEA, p. 34-36)
- Biodiversity: Comparing Ant Fauna in Different Habitats (Lanza)
- Biodiversity: Measuring the Effect of Habitat Size on Species Diversity (Lanza)
- Biodiversity: Comparing the Effort Needed to Assess Diversity of Different Groups
- Biodiversity: Choosing Areas to Protect (Lanza)
- Biodiversity: Mission Possible-South America Refuges (TTT)
- Statistics (Lanza)

VIDEOS

- “The Lorax” by Dr. Seuss
- “The Living Planet” by New Worlds
- “Race to Save the Planet-Environmental Revolution”
- “Race to Save the Planet-In the Name of Progress”

FIELD TRIPS • Visit a creek or stream; complete a cleanup, show the diversity, test water quality

PROJECTS

- Build a Bottle Biosphere (Kraestner)
- Book reports, choose one from list: *Silent Spring* by Rachel Carson, *Ishmael* by Daniel Quinn, *Heart of the Land* by Barbato and Weirnerman, *A Sand County Almanac* by Aldo Leopold, *Into the Wild* by Jon Krakauer
- Begin reading packet: “The Good Earth Looks Better,” “Not That Hard Being Green,” “A Moment on the Earth”
- Adopt a developing country. Students investigate various aspects of the nation’s physical, population, economic, social characteristics, as well as quality of life.

TECHNOLOGY • “SimEarth” - Students modify, manage, and nurture a planet from creation

OBJECTIVES

1. Define Earth capital and solar capital. Explain the relationship between Earth capital and a sustainable society. Distinguish between living off of principal and living off of interest. Analyze which of these behaviors humans are currently illustrating. Evaluate the possibility of continuing to live in our current style.
2. Draw an exponential growth curve. Distinguish between exponential growth and linear growth. Describe what has happened to the length of the doubling time of the human population over the course of human history. Define gross national product. Describe the wealth gap and its development since 1960.
3. Distinguish among renewable resources, potentially renewable resources, and nonrenewable resources. Distinguish between recycling and reuse as strategies to extend supplies of nonrenewables. Describe a connection between potentially renewable resources and the concepts of sustainable yield and environmental degradation. List and define the components of biodiversity. Explain the significance of biodiversity as a potentially renewable resource.
4. Describe the tragedy of the commons. List three approaches which might lessen this problem. Evaluate the significance of a prevention or precautionary approach.

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

5. Distinguish between point sources and nonpoint sources of pollution. Distinguish among degradable, slowly degradable, and nondegradable pollutants.
 6. Distinguish between pollution prevention and pollution cleanup. Explain the limitations of pollution cleanup strategies. Explain the general relationship between pollution control and developing countries, using Poland as an example.
 7. Summarize the root causes of environmental problems. Describe a simple model and a complex model of relationships among population, resource use, technology, environmental degradation, and pollution. Evaluate which model is most useful to you. Assess which model would be most useful in explaining relationships to young children and which more closely resembles reality.
 8. Define environmental worldview. Distinguish between a planetary management worldview and an Earth-wisdom worldview. Compare the worldviews of Julian Simon and the Ehrlichs. Evaluate which position most closely reflects your experience.
 9. Evaluate the sustainability of human societies at this point in time. List five guidelines which would move the United States toward sustainability.
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AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

UNIT 2 Matter and Energy Resources – 1 Week

TIME 1 Week

TOPICS CHAPTER 3 [*LITE* 4]: Matter, Energy, Energy Conversions, Thermodynamics, Basic Chemistry (acids, bases, salts)

LABS

- Acids and Bases from Vernier's "Biology with Computers" (Lab #3)
- Photosynthesis - from Vernier's "Biology with Computers" (Lab #7)
- Acid Rain from Vernier's "Biology with Computers" (Lab #18)
- Power Plant Exercise (Bauer)
- Energy Conservation (Bauer)
- Red Cabbage Juice pH (Hamilton)
- Miscellaneous charts, articles, references

VIDEOS

- "Futures - Renewable Energy and Environmental Science"

PROJECTS

- Begin recycling aluminum cans, glass, and/or paper
- Complete a survey of students' attitudes towards environmental problems

OBJECTIVES

1. Define matter. Distinguish among the following: atoms, ions, molecules, isotopes; protons, neutrons, electrons; atomic number and mass number. List three physical states of matter.
 2. Briefly describe the structure of the periodic table of the elements. Distinguish between periods and groups; metals, nonmetals, and metalloids.
 3. Define chemical formula. Distinguish between molecular compounds held together by covalent bonds and ionic compounds held together by ionic bonds. Describe hydrogen bonds.
 4. Define organic compound. List four important organic polymers and their building blocks. Contrast inorganic compounds with organic compounds.
 5. Distinguish between high-quality matter and low-quality matter. Relate the concept of entropy to the quality of matter.
 6. Describe how the law of conservation of matter governs normal physical and chemical changes. Explain the phrase: "There is no away."
 7. Describe why the law of conservation of matter and energy is necessary to govern nuclear changes. Distinguish among gamma rays, alpha particles, beta particles; nuclear fission and nuclear fusion.
 8. Define energy. Distinguish between kinetic and potential energy; ionizing and nonionizing radiation; high-quality energy and low-quality energy.
 9. Summarize the first and second laws of energy and give one example to illustrate each.
 10. Describe the implications of the law of conservation of matter and the second law of energy for high-waste, matter-recycling, and low-waste societies.
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AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

UNIT 3 Ecosystems – 3 Weeks

TIME 3 Weeks

TOPICS CHAPTER 4 [LITE 5]: Ecosystems, Food Chains/Webs, Trophic Levels, Energy Flow, Matter Recycling (C, N, P, S, water), Sustainability

CHAPTER 5 [LITE 6]: Niches, Interactions, Succession

LABS

- Interdependence of Plants and Animals - from Vernier's "Biology with Computers (#14)
- Biodiversity and Ecosystems - from Vernier's "Biology with Computers (Lab #15)
- Dissolved Oxygen in Water - from Vernier's "Biology with Computers (Lab #19)
- Biological Oxygen Demand - from Vernier's "Biology with Computers (Lab #22)
- Biological Classification - Key to Insects and Crustaceans
- Background Packet on Stream Quality Monitoring
- Plankton Community (Lab #3 from Miller's Lab Book)
- Introduction to Arthropods
- Aquatic Adaptations (Bauer)
- Aquatic Sampling (Bauer)
- Nitrogen Cycle (Bauer)
- Pond in a Jar (Allard)
- Miscellaneous articles on wetlands

VIDEOS

- "The Living Edens: Palau, Paradise of the Pacific" by PBS
- "The Fire That Threatened Yellowstone" by PBS Nova
- "Life on Earth" by CBS
- "Rain Forest" by National Geographic

FIELD TRIPS

- Visit a natural area (forest, etc.) to study various ecosystems
- Participate in stream quality monitoring (LCRA River Watch)

PROJECTS

- Build and maintain a terrarium and aquarium

OBJECTIVES

1. List five characteristics of life. List four spheres which interact to sustain life on Earth.
2. Compare the flow of matter and the flow of energy through the biosphere. Briefly describe how the sun, gravity, and nutrient cycles sustain life on Earth. Distinguish between an open system and a closed system. Name and describe three types of biogeochemical cycles.
3. Distinguish among organism, species, population, community, ecosystem, and ecosphere. Define biological diversity. Briefly describe its three components.
4. Define biotic component of an ecosystem. Distinguish between producers and consumers. List and distinguish four types of consumers. Distinguish among scavengers, detritus feeders and decomposers. Distinguish between photosynthesizers and chemosynthesizers; aerobic respiration and anaerobic respiration.
5. Define abiotic component of an ecosystem. List three important physical factors and three important chemical factors that have large effects on ecosystems.
6. Summarize the law of tolerance. Describe the relationship of time and adjustment to limits. Define threshold and limiting factor. Compare limiting factors in terrestrial and aquatic ecosystems.
7. Distinguish between food chains and food webs; grazing food web and detrital food web. Apply the second law of energy to food chains and pyramids of energy, which describe energy flow in

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

ecosystems. Explain how there may be exceptions to pyramids of numbers and biomass, but not energy. Evaluate which ecosystems show the highest average net primary productivity and which contribute most to global net primary productivity.

8. Briefly describe the carbon, nitrogen, phosphorous, sulfur, and hydrological cycles. Apply the law of conservation of matter to biogeochemical cycles. Summarize processes by which humans affect these cycles.
 9. Briefly describe three strategies ecologists use to learn about ecosystems. Summarize two controlled field experiments described in this chapter. Explain why a combination of all three research strategies is important.
 10. Summarize the two basic principles of ecosystem sustainability. List services you receive from the ecosystem where you live and tell how much those services cost.
 11. Define ecological niche. Distinguish between fundamental niche and realized niche. List the factors that determine the realized niche.
 12. Distinguish between a specialist and a generalist. Evaluate the conditions that favor these two approaches.
 13. Distinguish among the following roles played by species and give one example of each: native species, nonnative species, indicator species, keystone species. Explain why these labels are important.
 14. Distinguish among the following species interactions and give one example of each: interspecific competition, predation, and symbiosis. Distinguish between interference competition and exploitation competition. Summarize the competitive exclusion principle. List two strategies species use to reduce competition.
 15. List two strategies that predators use to capture their prey. List at least five strategies that prey use to defend themselves against predators.
 16. Distinguish among three forms of symbiotic relationships and give one example of each: parasitism, mutualism, and commensalisms.
 17. Define succession. Distinguish between primary and secondary succession. List four categories of successional species and give one example of each. List three factors that affect how succession occurs.
 18. Summarize contributions of disturbances (such as fire) to your understanding of succession. Summarize the results of the field experiments at Hubbard Brook Experimental Forest. Evaluate the intermediate disturbance hypothesis. Support your conclusions with examples from your own experience if possible. Summarize how chaos theory contributes to your understanding of succession.
 19. Distinguish among the following types of stability and give an example of an ecosystem which exemplifies each: inertia, constancy, resilience. Evaluate the interaction of stability and diversity.
 20. Summarize the theory of island biogeography. Imagine two islands of two different sizes and distances from the mainland. Predict which would show the greatest species diversity. Defend your position.
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AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

UNIT 4 Climate and Weather – 2 Weeks

TIME 2 Weeks

TOPICS CHAPTER 10 [LITE 7]: Weather, Climate, Biomes

LABS • Measure Relative Humidity

TECHNOLOGY • Use Internet to seek out weather reports, etc.

VIDEOS

- “Race to Save the Planet-Only 1 Atmosphere”
- “Hurricanes” by PBS/Nova
- “Tornados” by PBS/Nova
- “Cyclone” by National Geographic
- “The Water Cycle” by The Video Project

SPEAKERS • Invite a climatologist or meteorologist to discuss weather patterns and measurement

FIELD TRIPS • Visit a weather station

PROJECTS

- Develop reports on biomes (use Hyperstudio)
- Develop examples of art/poetry/music of human thoughts about Earth
- Participate in the “Clean Air Challenge”

OBJECTIVES

1. Distinguish between weather and climate. Summarize how warm fronts, cold fronts, high pressure air masses, and low-pressure air masses effect weather. Describe at least five different factors which contribute to global air-circulation patterns. Distinguish between a tornado and a tropical cyclone. Describe how ocean currents generally redistribute heat. Describe an upwelling and how it might be affected by an El Nino-Southern Oscillation.
 2. Define greenhouse effect. Name greenhouse gases. State the significance of the greenhouse effect. Describe the general effects of the following microclimates: windward and leeward sides of a mountain, forests, cities.
 3. Describe how climate affects the distribution of plant life on Earth. Draw connections between biomes and the following plants, which are particularly adapted for different biomes: succulent plants, broadleaf evergreen plants, broadleaf deciduous plants, coniferous evergreen plants.
 4. Compare the climate and adaptations of plants and animals in deserts, grasslands, and forests. Describe the distinctive qualities of a chaparral ecosystem. Be sure to distinguish among the three major kinds of forests. Compare the biodiversity and stratification in the three major kinds of forests. Describe how a mountain ecosystem is like an "island of biodiversity."
 5. Summarize the distribution of light, salt, and temperature in different aquatic ecosystems. Evaluate the significance of the ecological contributions of the oceans. Distinguish between coastal zones and open sea.
 6. Briefly describe the characteristics and ecological significance of coral reefs. Describe environmental and economic problems of coral reefs.
 7. Distinguish between coastal and inland wetlands. Describe the ecological functions performed by wetlands. Describe environmental problems associated with coastal and inland wetlands.
 8. List and compare the four zones of a lake. Distinguish between oligotrophic and eutrophic lakes. Describe stratification and a turnover in a lake.
 9. Define watershed. List and distinguish the three zones of a river system.
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AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

UNIT 5 Population Dynamics – 2 Weeks

TIME 2 Weeks

TOPICS [*LITE* only - CHAPTER 8: Populations, Reproductive Strategies, Evolution and Adaptations, Speciation]

LABS

- Population Dynamics by Vernier’s “Biology with Computers”
- Cemetery Population (see handouts)
- Commons Population Simulation (TEA, Baur)
- Estimating Population Size (Oriabure)
- Animal Behavior (Kaestner)
- Bacteria Bottles (TEA)
- Power of the Pyramids/Population Trends
- Lichen and Moss Populations on Tree Bark (Kaestner)
- Biodiversity: Comparing Ant Fauna in Different Habitats (Lanza)
- Biodiversity: Measuring the Effect of Habitat Size on Species Diversity (Lanza)
- Biodiversity: Comparing the Effort Needed to Assess Diversity of Different Groups
- Biodiversity: Choosing Areas to Protect (Lanza)
- Biodiversity: Mission Possible (TTT)

TECHNOLOGY

- “SimEarth—The Living Planet”
- “Population Sampling” from NIH Imaging
- “Animal Hands” from NIH Imaging
- “Population Ecology” from Logal’s Biology Explorer
- Use the Internet to research the Gaia Hypothesis and the Endosymbiont Hypothesis

VIDEOS

- “The Secret of Life”

SPEAKER

- Invite a evolutionary biologist to discuss the evidence for the theory of evolution

PROJECTS

- Art/poetry/music of human thoughts of living systems living under stress

OBJECTIVES

1. List and define four variables which collectively determine population dynamics. Write an equation that expresses the relationships among four variables that determine changes in population. Define zero population growth. Define biotic potential. List four factors which contribute to biotic potential.
2. Define carrying capacity. Draw population growth curves that reflect exponential growth, exponential growth leveling off gradually to limits, and exponential growth limited by a reproductive time lag. Analyze the variables that result in these different outcomes.
3. Distinguish between density-dependent and density-independent checks on population growth, and list three examples of each. List three types of population curves found in nature, and identify one organism which exemplifies each.
4. Distinguish between r-strategists and K-strategists, and give two examples of each. Draw the type of survivorship curve you would expect each type of strategist to exhibit. Explain the meaning of the curves.
5. Distinguish between prokaryotic and eukaryotic cells. List the current five kingdoms of life and give three examples of organism from each kingdom.
6. Define species. Describe how species are named scientifically. Summarize the role of geographic and reproductive isolation in forming new species.

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

7. List major steps which have occurred in Earth's chemical and biological evolution. Include scientific evidence which has led to the theory of evolution. Describe three alternative hypotheses for the formation of complex chemicals necessary for life. List potential sources of energy available for synthesis of biological chemicals. Describe how the first law of thermodynamics and polymers contribute to your understanding of evolution.
 8. Compare the gradualism model and punctuated equilibrium hypothesis. Distinguish between macroevolution and microevolution. Define gene pool and describe the process that increases variability of the gene pool. Describe connections among mutations, adaptations, differential reproduction, and biological evolution. List and describe three possible outcomes of natural selection. List four limits of adaptation to change. Summarize three common misconceptions about evolution.
 9. Describe biodiversity in terms of speciation and extinction. Summarize how humans have tinkered with evolutionary processes; nature's lessons that can be adopted as principles for more sustainable lifestyles; and ways that humans can restore and rehabilitate ecosystems.
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AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

UNIT 6 Earth Science – 2 Weeks

TIME 2 Weeks

TOPICS [*LITE* only - CHAPTER 9: Earth Structure, Plate Tectonics, Rock Cycle, Weathering, Erosion, Volcanoes, Earthquakes, Natural Disasters]

LABS

- Soil Profiles
- Soils - measure temp., pH, water holding, nutrients, etc.
- Locate Epicenter of Earthquakes
- Rocks and Minerals - a survey
- Soil: The Wealth Beneath Your Feet (Bauer, TEA)

TECHNOLOGY • Use the Internet to investigate earthquakes, volcanoes, and cyclones

VIDEOS

- “Savage Earth”--4 Parts: Hells Crust, The Restless Planet, Out of the Inferno, Waves of Destruction by PBS
- “Water--The Well Runneth Over” by National Geographic
- “Killer Quake--The Northridge Earthquake” by PBS/Nova
- “Earth Revealed--Plate Dynamics”
- “Our Dynamic Earth” by National Geographic

PROJECTS • Graph the Earth's history to show when major events occurred, including extinctions

OBJECTIVES

1. Make a simple drawing of Earth's three major zones. Describe the composition of the zones.
 2. Distinguish between internal and external Earth processes. Describe plate tectonics. List and distinguish among three types of plate boundaries.
 3. Compare and contrast the external Earth processes of weathering, erosion, and mass wasting.
 4. Distinguish between mechanical and chemical weathering and give one example of each. Describe how humans contribute to erosion.
 5. Distinguish between a mineral and a rock. List three major types of rock. Describe how each type is formed and give three examples of each. Briefly describe the rock cycle.
 6. List three types of mineral resources, and give one example of each. Clarify the relationship between identified resources and reserves.
 7. List and briefly describe four ways that mineral deposits may be produced. Distinguish between subsurface and surface mining.
 8. Briefly describe the environmental impacts of mining.
 9. List five natural hazards. Briefly describe the relationships between human activities and each hazard. List the best efforts being made to minimize the threat of each hazard to humans.
 10. Give the time frame of each of the following: speciation, climate, weather, population size, internal crust changes. Then list in order from shortest to longest time frame.
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AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

UNIT 7 Human Populations – 3 Weeks

TIME 3 Weeks

TOPICS CHAPTER 6 [LITE 11]: Population Size, Growth, Demography, Distributions

[LITE only - CHAPTER 12: Urbanization]

LABS

- Exponential Growth (#5 from Miller's lab book)
- Population Control (#6 from Miller's lab book)
- Human Population--Changes in Survival (Kaestner)
- Miscellaneous resources (Population Trends)

TECHNOLOGY • Use the Internet: Center for Population Biology, Population and Demography Information, US Census Bureau, World Population Clock, Zero Population Growth, the United Nations Family Planning Association, International Planned Parenthood

VIDEOS

- "World Population" by ZPG

SPEAKERS

- Invite a public health official or nutritionist to discuss the decline in the global death rate over the past century and the decline in the infant mortality rate in the US
- Invite an urban planner to discuss demographics and land-use planning

PROJECTS

- Surveys (of students and community: ages, etc)
- Local agricultural land issues
- Attend a zoning meeting or other public forum for land-use planning
- Study local transportation networks (p. 56)

OBJECTIVES

1. Define birth rate, death rate, emigration rate, and immigration rate. Write an equation to mathematically describe the relationship between these rates and the rate of population change.
2. Distinguish between replacement-level fertility and total fertility rate. Describe how total fertility rate affects population growth. List at least five factors that affect birth and fertility rates and five factors that affect death rate.
3. Summarize changes over time in the U.S. population growth rate. Give reasons for the high rate of teen pregnancy in the United States compared to the rate in other industrialized countries. Draw connections between population growth and environmental degradation in California.
4. Define infant mortality rate. Explain why it is considered a good indicator of quality of life.
5. Compare rates of population growth in developed countries and developing countries. Explain the differences you find.
6. Using population age structure diagrams, explain how the age structure of a country creates population growth momentum. Summarize problems associated with a baby boom and a declining population.
7. Summarize key factors used to influence population size: immigration policy, family planning, economic rewards and penalties, empowering women. Summarize the current attitudes toward immigration policy in the United States.
8. Summarize key findings of the new Limits to Growth computer model.
9. List the four stages of the demographic transition. List social, biological, political, and economic issues that can be addressed to help developing countries undergo a demographic transition. List

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

three factors that may limit the effectiveness of a demographic transition in influencing population size.

10. Compare and evaluate the population policies of India and China. Summarize what we have learned from decades of trying to influence human population growth. List the major goals of the UN Conference on Population and Development.
 11. List five worldwide trends in population distribution. Describe the three major shifts in population distribution in U.S. history. Summarize the factors that contribute to urban growth.
 12. List and briefly describe three models of urban structure.
 13. Summarize the following urban environmental problems: vegetation, water runoff and flooding, heat islands and dust domes, solid-waste disposal, air pollution, noise pollution, human health, land conversion, social disruption. List three ways that urban areas positively affect the environment.
 14. List the pros and cons of the major urban transportation options: individual transit (walking, biking, motorized vehicles) and mass transit (rail systems and buses). List three policies that contribute to a positive feedback loop creating more dependence on automobiles. Describe three policies that would create negative feedback loops.
 15. Differentiate between conventional and ecological land-use planning. List two means by which local governments can control the rate of development. Summarize obstacles to more ecological land-use planning.
 16. Summarize urban maintenance and repair problems.
 17. Identify one positive loop that tends to harm urban areas. Briefly consider ways to counteract that loop.
 18. List five approaches to improving urban life. Choose one case study from your textbook. Evaluate how far your chosen urban area has come in implementing these five approaches.
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AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

UNIT 8 Global Problems – 3 Weeks

TIME 3 Weeks

TOPICS [*LITE* only - CHAPTER 13: Forests, Deforestation, Loss of Biodiversity, Endangered Plants and Animals]

CHAPTER 10 [*LITE* 14]: Greenhouse Effect, Global Warming, Ozone Depletion, Solutions of Problems

LABS

- Constructing a Model of the Greenhouse Effect
- Greenhouse Effect and the Relationship to Global Warming
- Identifying Greenhouse Gases and Sources
- Analyzing Global Warming Impact
- Reducing Global Warming
- Your Contribution to Global Warming

TECHNOLOGY

- NIH Imaging: “Where Did the Ozone Go?” - p. 159
- Use the Internet: Earth Summit (Rio Treaty), global warming, ozone, global climate

VIDEOS

- “Our Endangered Forest” by the National Forestry Association
- “The Living Planet—Part 4: The Jungle”
- “The Earth At Risk—Ozone Layer”
- “The Earth At Risk—Global Warming
- “Race to Save the Planet—Only One Atmosphere”
- “The Hole in the Sky” by PBS/Nova

SPEAKERS

- Invite an atmospheric scientist or climatologist to discuss global climatic change
- Invite a representative from Tree Folks to discuss regional tree planting efforts

FIELD TRIPS

- Visit a botanical garden to investigate the ecology of a tropical rain forest

PROJECTS

- Initiate tree planting around the school or in the community
- Study energy efficiencies (CFC ratings: refrigerators, A/C units, etc.)

OBJECTIVES

1. Distinguish between old-growth and second-growth forests and give one example of each. Distinguish between a second-growth forest and a tree farm.
2. List five reasons why forests are commercially important. List five reasons forests are ecologically important.
3. Summarize the range of estimates of rates of tropical deforestation. Explain why there is so much variation among estimates. List five ways that tropical forests touch lives in the temperate zones. Summarize the impact of deforestation on some of the world's indigenous cultures. Describe a plan to protect indigenous peoples.
4. List three factors underlying causes of tropical deforestation. List six human activities which actually destroy the tropical forests.
5. Evaluate Japan's environmental track record.
6. Summarize the fuelwood crisis. List ways to help reduce the interlocking problems of tropical deforestation and the fuelwood crisis. Address scientific data collection, economic strategies, policy-making strategies, cultural strategies, and strategies to reduce demand for fuelwood. Summarize

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

Costa Rica's efforts to protect and restore forests. Evaluate the "debt-for-nature" experiment in Bolivia.

7. Describe the ecology of the ancient forests of the Pacific Northwest and state how much of them remain. Briefly describe the controversy over the use of U.S. ancient forests. Analyze the connection between junk bonds and redwood trees. Describe one tool that could change this positive feedback loop into a negative feedback loop.
 8. List ways that environmentalists recommend to reduce old-growth forest destruction, including changes in resource-use practices, economic strategies, and political strategies. Describe one case where individual actions made a difference in helping to reduce forest destruction.
 9. Describe the greenhouse effect and what the Earth would be like without a greenhouse effect. List the two predominant greenhouse gases. List four greenhouse gases which have risen in the last few decades. List four human activities which contribute greenhouse gases to the atmosphere.
 10. Describe the pattern of the earth's average surface-temperature fluctuation throughout geologic time. Describe the period the earth has been experiencing for the last 10,000 years.
 11. Describe the general trend of mean global temperature since 1860. List two factors other than the greenhouse effect that may have contributed to the general temperature change. State the consensus science view about the relationship between observed temperature changes and the likelihood of global climate change brought on by human activities.
 12. Briefly describe projections of the major climate models regarding changes in mean surface temperature and average sea level. List eight important factors that lend considerable uncertainty to climate models and their projections.
 13. State the range of temperature change which could cause real damage to ecosystems. Explain why a range so seemingly small can have such major consequences. Summarize the projections of possible effects of global warming on (a) food production, (b) water supplies, (c) forests, (d) biodiversity, (e) sea levels, (f) weather extremes, (g) human health, and (h) environmental refugees.
 14. Describe three schools of thought about global warming and how we as a human society should act. List seven strategies which would slow potential global warming, including both prevention and cleanup approaches.
 15. Describe the origin of stratospheric ozone and the role it plays in protecting life on Earth. Briefly describe changes which have been occurring in stratospheric ozone.
 16. Describe the scientific work on CFCs and their relationship to ozone. Describe the political response to the scientific information. Summarize the consensus science view of CFCs and stratospheric ozone. Summarize alternative views that have received much attention. Explain the significance of a critically thinking citizenry to the democratic process.
 17. Explain the potential consequences of ozone depletion. Propose three ways for slowing these changes.
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AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

SPRING SEMESTER

SCOPE & SEQUENCE

| | | |
|----------------|--|-----------------------|
| UNIT 9 | Energy Resources | <i>3 Weeks</i> |
| UNIT 10 | Human Health | <i>2 Weeks</i> |
| UNIT 11 | Air and Air Pollution | <i>1 Week</i> |
| UNIT 12 | Water and Water Pollution | <i>2 Weeks</i> |
| UNIT 13 | Soil | <i>1 Week</i> |
| UNIT 14 | Toxic and Solid Waste | <i>2 Weeks</i> |
| UNIT 15 | Food Resources | <i>1 Week</i> |
| UNIT 16 | Pesticides and Pest Control | <i>2 Weeks</i> |
| UNIT 17 | Land Management and Diversity | <i>2 Weeks</i> |
| UNIT 18 | Economics, Politics, and Ethics | <i>2 Weeks</i> |

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

SPRING SEMESTER

UNIT 9 Energy Resources – 3 Weeks

TIME 3 Weeks

TOPICS CHAPTER 18 [*LITE* 15]: Energy Resources, Energy Efficiency, Solar Energy, Moving Water, Wind, Biomass, Solar- Hydrogen, Geothermal

CHAPTER 19 [*LITE* 16]: Oil, Natural Gas, Coal, Nuclear Energy

LABS

- Energy Alternatives (#18 from Miller's lab book)
- Energy Conservation (#19 from Miller's lab book)
- Student's Personal Energy Consumption
- Exxon Energy Cube

VIDEOS

- "Race to Save the Planet–More For Less"
- "The Earth At Risk–Nuclear Energy"

SPEAKERS

- Invite a local Energy Auditor (from city)
- Invite an architect or contractor - designing and installing small-scale solar, wind, and biogas systems for residences and businesses

FIELD TRIPS

- Tour a Nuclear Power Plant
- Tour homes with solar heating systems
- Tour earth-sheltered home

PROJECTS

- Energy Audits of Home (by local electric utilities)
- Complete an audit of school's energy use and waste

OBJECTIVES

1. How much of the total energy used to heat the earth and earths buildings come from commercial energy? List five key questions to ask about each energy alternative to evaluate energy resources. Define net energy and state its significance in evaluating energy resources.
2. List the advantages and disadvantages of improving energy efficiency so that we do more with less. Define life cycle cost and cogeneration and describe their potential for saving energy. Describe changes which can be made in industry, transportation, buildings, lights, and appliances which would improve energy efficiency.
3. List the advantages and disadvantages of using direct solar energy to heat air and water for buildings. Distinguish between active and passive solar heating. Compare the following solar technologies and evaluate the advantages and disadvantages of each: solar power tower, solar thermal plant, nonimaging optical solar concentrator, solar cooker.
4. List the advantages and disadvantages of using water in the forms of hydropower, tidal power, wave power, ocean thermal currents, and solar ponds to produce electricity.
5. List the advantages and disadvantages of using wind to produce electricity.
6. List the advantages and disadvantages of using biomass to heat space and water, produce electricity, and propel vehicles. Consider burning wood, agricultural wastes, and urban wastes as well as conversion of biomass to biofuels.

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Pflugerville Independent School District • August 2003

7. List the advantages and disadvantages of using hydrogen gas to heat space and water, produce electricity, and propel vehicles. State the energy source that is needed to produce hydrogen to create a truly sustainable future. Describe constraints to a solar-hydrogen revolution.
 8. Distinguish among dry steam, wet steam, and hot water sources of geothermal energy. List the advantages and disadvantages of using geothermal energy for space heating, high temperature industrial heating, and electricity production.
 9. If the picture puzzle is a sustainable energy picture for the earth, describe as many of the pieces as you can visualize.
 10. Based on your reading of the introduction, evaluate what you think the most important lesson of Chernobyl is.
 11. Distinguish among primary, secondary, and tertiary oil recovery. List the advantages and disadvantages of using conventional oil, oil from oil shale, and oil from tar sands to heat space and water, produce electricity, and propel vehicles.
 12. Distinguish among natural gas, liquefied petroleum gas, liquefied natural gas, and synthetic natural gas. List the advantages and disadvantages of using natural gas as an energy source.
 13. List and describe three types of coal. Indicate which is preferred for burning and which is most available. List and briefly describe three methods for extracting coal. List advantages and disadvantages of using coal as a fuel source.
 14. List two processes used to convert coal to synfuels. List the advantages and disadvantages of using synfuels.
 15. Briefly describe the components of a conventional nuclear reactor. List advantages and disadvantages of using conventional nuclear fission to create electricity. Be sure to consider the whole nuclear fuel cycle, including disposal of radioactive wastes, safety and decommissioning of nuclear power plants, and the potential for proliferation of nuclear weapons. Summarize current thinking about disposal of low-level and high-level radioactive wastes.
 16. List and briefly describe three ways to decommission a nuclear power plant. List findings of a 1987 commission which bring the credibility of the Nuclear Regulatory Commission to safeguard the nuclear power industry into question. Describe the potential use of breeder nuclear fission and nuclear fusion as energy sources.
 17. Analyze the interactions of economic policy and energy resources. In particular consider the results of using free-market competition, keeping energy prices low, and keeping energy prices high.
 18. Design an energy strategy for the United States for the short term, intermediate term, and long term.
 19. List three ways that individuals can use energy to contribute to a more sustainable future for the United States.
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UNIT 10 Human Health – 2 Weeks

TIME 2 Weeks

TOPICS CHAPTER 8 [*LITE* 10]: Risks and Hazards, Toxicology, Chemical Hazards, Radiation, Biological Hazards, Risk Analysis

LABS

- Human Respiratory System (#12 from Miller's lab book)
- Survey organically grown and "natural" foods - describe advertising claims

VIDEOS

- "Cleaning Up Toxins at Home" by The Video Project

SPEAKERS

- Invite local health officials to discuss types and frequency of diseases in local area
- Invite the American Cancer Society to discuss "nonsmokers' rights"

FIELD TRIPS

- Visit the local or state department of health

TECHNOLOGY

- Internet sites: National Centers for Disease Control, Occupational Safety and Health Administration (OSHA), the Food and Drug Administration (FDA), Sweden's antismoking campaign

OBJECTIVES

1. Define risk and risk assessment. List four general types of common hazards and give two examples of each.
2. List five principal types of chemical hazards and give two examples of each. Define and describe relationships among dose, response, toxicity, and poison. Distinguish between acute and chronic exposures and acute and chronic effects.
3. Describe a dose-response curve. Evaluate the usefulness and limits of case studies, laboratory experiments, and epidemiology studies in determining toxicity of substances.
4. Distinguish between a linear dose-response model and a threshold dose-response model. Describe the difficulty in deciding which model applies best when low doses are involved. Evaluate the effectiveness of risk assessment and pollution prevention in dealing with hazards we face.
5. Define ionizing radiation. Give two examples. Describe physical effects which can result from exposure to ionizing radiation. Distinguish between genetic and somatic damage. List four factors which can affect the impact of ionizing radiation.
6. Distinguish between transmissible and nontransmissible diseases. List the six deadliest infectious diseases. Summarize the state of the battle against bacterial infections. Describe how transmission of viral diseases can result in pandemics. Relate an epidemiologic transition to a demographic transition. Summarize how developing countries and developed countries can best improve their health.
7. Define risk analysis. Compare technology reliability to human reliability.
8. Define risk-benefit analysis and desirability quotient. Give examples of technologies with high and low desirability quotients. List five problems with risk assessment.
9. List seven questions risk managers ask. List seven cases in which the public generally perceives that a technology or product has a greater risk than the risk estimated by experts.

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UNIT 11 Air and Air Pollution – 1 Week

TIME 1 Week

TOPICS CHAPTER 9 [LITE 17]: Atmosphere, Smog, Acid Deposition, Effects, Solutions

LABS

- Human Respiratory System (#12 from Miller's lab book)
- Air Pollution (#13 from Miller's lab book)
- Thermal Inversion (#14 from Miller's lab book)
- Noise Pollution (#17 from Miller's lab book)
- Lung capacity of students
- How Can We Detect Radon? (Bauer)
- What Do You Emit (CO₂ concentrations) (Kaestner)
- Clean Air Kit (from Clean Air Challenge)

TECHNOLOGY

- Acid Rain from Vernier's "Biology with Computers" (Lab #18)
- Internet: Environmental Protection Agency (EPA), The Clean Air Act

VIDEOS

- "Earth At Risk–Acid Rain"
- "Earth At Risk–Clean Air"

SPEAKERS

- Invite a chemistry professor on the measurement of air pollution
- Invite a doctor or health official on the types of lung disease
- Invite a meteorologist to discuss weather and climate patterns of locale

OBJECTIVES

1. Briefly describe the structure of the atmosphere being sure to include troposphere, stratosphere, mesosphere, thermosphere, and the boundaries between each set of layers.
2. Summarize ways in which humans disrupt Earth's major nutrient cycles.
3. Distinguish between primary pollutant and secondary pollutant; stationary source and mobile source; photochemical smog and industrial smog. List eight major classes of primary outdoor pollutants. Describe how smog is formed. Describe a thermal inversion and conditions under which it is most likely to occur.
4. Define acid deposition. Identify the level of risk that acid deposition creates for ecological systems and for human health. Give one example of the complexities of interactions which can be set in motion by acid deposition. List six strategies to prevent acid deposition.
5. Compare the risks of indoor and outdoor air pollution. List the four most dangerous indoor air pollutants, the potential health effects of each, and strategies for dealing with each.
6. Briefly describe how air pollution affects human health, plants, aquatic life, and materials.
7. Summarize the Clean Air Act. List six criticisms that environmentalists make about the Clean Air Act.
8. List four prevention strategies and three cleanup strategies to reduce emissions from stationary sources of air pollution. Define emissions trading policy. List eight prevention strategies and three cleanup strategies to reduce emission from motor vehicles. List six prevention strategies and six cleanup strategies to reduce indoor air pollution.
9. Visualize an integrated picture puzzle of a healthy sustaining atmosphere. Describe as many pieces of the puzzle as you can.

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Pflugerville Independent School District • August 2003

UNIT 12 Water and Water Pollution – 2 Weeks

TIME 2 Weeks

TOPICS CHAPTER 11 [*LITE* 18]: Unique Properties, Supply, Renewal, Resources, Dams and Reservoirs, Groundwater

[*LITE* only - CHAPTER 19: Types and Sources, Streams and Lakes, Ocean, Surface and Groundwater]

LABS

- Watershed Testing from Vernier's "Biology with Computers" (Lab #20)
- Physical Profile of a Lake from Vernier's "Biology with Computers" (Lab #21)
- Watershed Water (Bauer, p. 8)
- Aquatic Field Study (Bauer, p. 9)
- Water Hardness, Dissolved Oxygen (Bauer)
- Dissolved Oxygen and Aquatic Primary Productivity (Bauer, 103)
- Water: The Magical Solvent (Bauer, p. 110)
- Water Essay Writing
- Project W.E.T.
- Measuring Fecal Coliform from Miller's Lab #8
- Measuring Dissolved Oxygen from Miller's #9
- Measuring pH from Miller's #10
- Wastewater Treatment from Miller's #11
- Miscellaneous articles: Water in Your Life-Water Facts, Common Water Problems, Water Trivia, Hardness, Turbidity
- Miscellaneous: Biological Stream Testing Key
- Miscellaneous: Edward Aquifer Information
- Miscellaneous: EPA Water Standards

TECHNOLOGY

- Edwards Aquifer Simulation Program
- Internet: Safe Drinking Water Act of 1974, water-rights battles, Valdez oil spill

VIDEOS

- "Earth At Risk–Clean Water"
- "Race to Save the Planet–Do You Want to Live This Way?"
- "The Power of Water" by National Geographic
- "Earth Revealed–Groundwater"

FIELD TRIPS

- Visit a wastewater treatment plant
- Visit a dam to investigate environmental impacts

PROJECTS

- Keep a log of home water use. Survey the major users of water in community
- Investigate water-saving showers, faucets, and toilets

OBJECTIVES

1. List seven unique qualities of water. Describe connections between the hydrogen bonds that water forms and the unique qualities that water exhibits. Explain the significance of these qualities for the role water plays in the environment.
2. Briefly describe Earth's water supply. Compare amounts of salt water and fresh water. Compare amounts of frozen fresh water and water available for human use. Define watershed and groundwater.
3. Summarize water use in the United States and the world.

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Pflugerville Independent School District • August 2003

4. List four causes of water scarcity. Describe the factors which play into a positive feedback loop creating water stress. Assess the significance of water resources for international relations.
 5. List three ways that humans contribute to flooding. List four strategies humans employ to minimize the risks of flooding. Analyze the water problems of Bangladesh. What key principles are illustrated by this case study?
 6. List five ways to increase the water supply. List advantages and disadvantages of each strategy. Summarize a key lesson learned from the following case studies: the Colorado River; Egypt's Aswan High Dam; the California Water Project; the James Bay project; the Aral Sea disaster.
 7. Describe the role of groundwater in supplying fresh water. Assess our current use of groundwater: is it sustainable use? Determine which principles are best illustrated by the Ogallala Aquifer experience.
 8. Distinguish between riparian rights and prior appropriation as to regulate water use.
 9. State the percentage of water wasted throughout the world. Briefly describe measures which can be taken to reduce water losses through irrigation, industry, and home use.
 10. Describe the history of the development of the Columbia River Basin. Summarize the lessons learned from the problems that were generated and the plans to address those problems.
 11. Describe the pieces that contribute to a picture of sustainable water use.
 12. List nine types of water pollutants and give an example of each. List three strategies to determine the presence and concentration of water pollutants.
 13. Distinguish between point and nonpoint sources of pollution. Summarize the availability of clean drinking water for the earth's human population.
 14. Draw an oxygen sag curve to illustrate what happens to dissolved oxygen levels in streams below points where degradable oxygen-demanding wastes are added. Compare problems of lake water pollution to those of stream pollution.
 15. List three ways to prevent eutrophication and three ways to clean up cultural eutrophication. State three ecological principles illustrated by the Great Lakes and Lake Baikal case studies.
 16. Distinguish between thermal pollution and thermal enrichment. Give five ways to reduce thermal water pollution.
 17. Describe what is happening to the quality of coastal waters and how coastal waters can be protected. State one ecological principle illustrated by the Chesapeake Bay case study. Describe the status of ocean dumping and oil spills in the ocean. List six ways to prevent and two ways to clean up ocean pollution.
 18. List the major pollutants of groundwater. Explain why cleanup of groundwater is so difficult. List five ways to prevent groundwater pollution.
 19. Briefly describe two major laws that protect water quality in the United States. State three strategies to reduce nonpoint pollution. Briefly describe and distinguish among primary, secondary, and tertiary sewage treatment.
 20. Explain some of the problems with drinking bottled water. Summarize five home water purification devices and their effectiveness in treating different types of water problems.
 21. List three strategies to shift emphasis from pollution cleanup to pollution prevention strategies.
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UNIT 13 Soil – 1 Week

TIME 1 Week

TOPICS CHAPTER 12 [*LITE* 20]: Mineral supplies, soil structure, erosion, conservation

LABS

- Soil: The Wealth Beneath Your Feet
- Soil Texture (Bauer)
- Soil Nutrients (Bauer)
- Planning a Garden (Bauer, p. 45)
- Soil Profiles
- Soil Properties: temperature, pH, water-holding, texture, etc.
- Soil Diversity (#16 from Miller's lab book)
- Soil Organisms
- Miscellaneous: ASCS-free books, Extension Service maps of soil types

VIDEOS

- "Water–The Well Runneth Dry" by National Geographic
- "Earth Revealed–Weathering and Soils"

SPEAKERS

- Invite a local garden club, local garden supply company
- Invite a soil Conservation Service representative to discuss local problems
- Invite an organic farmer to discuss how to preserve soil and inorganic fertilizers

FIELD TRIP

- Visit sloped areas that are eroding significantly, investigate source, devise plan to prevent further erosion

OBJECTIVES

1. Draw a hypothetical depletion curve. Project how this curve would be affected by the following changes in assumptions: (a) recycling of the resource is increased, (b) discoveries of new deposits of the resource are made, (c) prices rise sharply, (d) a substitute for the resource is found.
2. Visually illustrate distribution of the world's nonfuel mineral resources. State which foreign sources are most critical to U.S. needs. State which of those sources are potentially politically unstable.
3. List environmental impacts of extracting, processing, and using mineral resources. Summarize the U.S. 1872 Mining Law. List seven ways to reform this law.
4. Assess the possibility of increasing mineral resource supplies through finding new deposits, improving technology of mining low-grade ore, getting minerals from the ocean, and finding substitutes. Take a position on this issue of mining Antarctica.
5. Define soil horizon. Briefly describe six soil layers. Using the text, compare soil profiles of five important soil types.
6. Distinguish among four soil textures. Distinguish between soil porosity and soil permeability. Describe how humus and pH contribute to soil fertility.
7. Describe the problem of soil erosion. Describe both world and U.S. soil erosion situations. Explain why most people are unaware of this problem.
8. Define desertification. Summarize the state of desertification in the world and in the United States. Identify the major causes of desertification. Describe the problems of salinization and waterlogging of soils and how they can be controlled.
9. Distinguish between conventional-tillage farming and conservation-tillage farming. List and briefly describe eight soil-conservation strategies. Describe how land-use planning can help prevent soil erosion.
10. Describe three ways to increase soil fertility. Compare the pros and cons of using inorganic and organic fertilizers.

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Pflugerville Independent School District • August 2003

UNIT 14 Toxic and Solid Waste – 2 Weeks

TIME 2 Weeks

TOPICS CHAPTER 13 [*LITE 21*]: Wasting Resources, Reuse, Recycling, Current Disposal Methods, Alternatives, Regulation

LABS

- Wastewater Treatment (TEA, #11)
- Foul Water (ChemCom, Bauer, p. 153)
- Solid Waste Prevention and Management (#20 from Miller's lab book)
- Herbicides on Plants

TECHNOLOGY • Internet: recycling, Superfund, Resource Conservation and Recovery Act, Environmental Protection Agency (EPA), state bottle bills, nuclear waste sites

VIDEOS

- "Race to Save the Planet—Waste Not, Want Not"
- "Earth At Risk—Recycling"

FIELD TRIPS

- Visit an open dump, a sanitary landfill, or an incinerator
- Visit a community recycling center to observe its operations

PROJECTS

- Begin a recycling program to collect bottles, cans, and paper
- Survey the school and community to determine how wastes are disposed of
- Maintain a record of solid wastes discarded at home in the course of a week
- Survey excess packaging in various products at local supermarkets
- Investigate recycling practices of businesses: dry cleaners, servicers of air conditioning systems and refrigeration equipment, servicers of oil changes

OBJECTIVES

1. State the percentage of the world's solid wastes that is produced by the United States. State the percentage of solid waste produced in the United States that is municipal solid waste. Define hazardous waste. State the percentage of hazardous waste that is not regulated. List seven substances that are "linguistically detoxified."
2. Compare waste management and pollution prevention approaches to solid and hazardous waste. List the hierarchy of goals for a low-waste approach. Evaluate which approach makes the most sense to you. Give reasons for your choice. List seven ways to reduce waste and pollution. List four goals of an ecoindustrial revolution.
3. List reuse strategies for refillable containers, grocery bags, and tires. Compare the costs and benefits of disposable vs. cloth diapers. Define compost. Analyze the impact that widespread use of composting would have in the United States.
4. Distinguish between closed-loop recycling and open-loop recycling; centralized recycling of mixed solid waste and a source-separation approach.
5. List seven obstacles to recycling in the United States and suggest ways to overcome them. Summarize lessons to be learned from Germany's experience with tough packaging laws. Summarize the U.S. experience with recycling aluminum, wastepaper, and plastics.
6. Summarize Denmark's experience with detoxification of hazardous waste. Assess the pros and cons of incineration of hazardous and solid wastes. Compare U.S. incinerators with the Japanese fluidized-bed incinerators.
7. Describe a modern sanitary landfill. Summarize the benefits and drawbacks of burying solid wastes in sanitary landfills. Summarize the benefits and drawbacks of deep-well disposal of hazardous wastes.

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Pflugerville Independent School District • August 2003

Summarize the status of export of wastes. Summarize the causes, effects, and ways to deal with lead, dioxins, and chlorine.

8. Name and briefly describe two U.S. hazardous-waste laws. Describe how Superfund has been subverted and how its enforcement can be improved.
 9. Summarize the goals of the ecojustice movement. Visualize a low-waste society. Describe the pieces that will form the framework and fill in this picture.
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Pflugerville Independent School District • August 2003

UNIT 15 Food Resources – 1 Week

TIME 1 Week

TOPICS CHAPTER 14 [*LITE 22*]: Food Production, World Problems, Sustainable Agriculture

TECHNOLOGY • “Ecosystems--Competition for Resources” from Logal’s Biology Explorer
• Internet: Food and Drug Administration (FDA), US Department of Agriculture, United Nations Food Conferences

VIDEOS • “Earth At Risk–Degradation of Land”
• “Race to Save the Planet–Save the Earth, Feed the World”

SPEAKERS • Invite an agricultural economist to discuss shifts in the US from farming to agribusiness
• Invite a US Department of Agriculture to discuss emergency foreign aid and global trade
• Invite a county agricultural agent to discuss problems and opportunities

PROJECTS • Hold a class debate on the proposition that food-exporting nations should use population control and resource development as criteria to determine priority

OBJECTIVES

1. List four major types of agriculture. Compare the energy sources, environmental impacts, yields, and sustainability of traditional and industrial agriculture.
 2. Evaluate the green revolution. What were its successes? Its failures? Summarize the benefits and problems of livestock production over the history of agriculture.
 3. Define interplanting and explain its advantages. List and briefly describe four types of interplanting commonly used by traditional farmers.
 4. Summarize the state of global food production. Define malnutrition and undernutrition, and overnutrition. Indicate how many people on Earth suffer from these problems and where these problems are most likely to occur. List six steps proposed by UNICEF to deal with malnutrition and undernutrition. Describe a strategy to reduce overnutrition. Define food additive. Evaluate the usefulness of food additives.
 5. Summarize environmental impacts from agriculture.
 6. Summarize food distribution problems. Describe the possibilities of increasing world food production by increasing crop yields, cultivating more land, and using unconventional foods and perennial crops.
 7. Describe trends in the world fish catch since 1950. Assess the potential for increasing the annual fish catch and use of aquaculture. Distinguish between fish farming and fish ranching.
 8. Assess the pros and cons of agricultural subsidies and international food relief. Describe strategies that you feel would be most sustainable.
 9. Define sustainable agriculture. Summarize how the United States could move toward creating a more sustainable agricultural system.
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Pflugerville Independent School District • August 2003

UNIT 16 Pesticides and Pest Control – 2 Weeks

TIME 2 Weeks

TOPICS CHAPTER 15 [*LITE* 23]: Types and Uses, Regulations, Solutions

LABS

- Herbicides on Plants
- Toxicity of Herbicides (TEA)

PROJECTS

- Investigate food irradiation, integrated pest management, genetic control by sterilization, the screwworm fly, pheromones
- Investigate pesticide advertising
- Discuss the book *Silent Spring* by Rachel Carson

SPEAKERS

- Invite a county agricultural agent to discuss pesticide use and abuse in locale
- Invite a chemist to evaluate the ingredients, uses, and warning labels on pesticides

OBJECTIVES

1. List the five types of pesticides and what they are used to treat.
 2. Briefly describe the history of the development of pesticides.
 3. List five common household pests and two ways to control them other than using pesticides.
 4. List the five major classes of pesticides. Tell if each is broad spectrum or narrow spectrum; state its degree of persistence; give two examples; and tell if each is bioaccumulated or biologically magnified.
 5. Compare contact and systemic herbicides.
 6. Give seven reasons to use pesticides. List five characteristics of the ideal pesticide.
 7. Describe the consequences of relying heavily on pesticides. Describe the pesticide treadmill. Be sure to describe biological magnification. Briefly describe the threat of pesticides to wildlife and human health.
 8. Name the U.S. law that controls pesticide regulation. Give three reasons why this law is considered the weakest and most poorly enforced of the environmental laws. Summarize how the 1996 Food Quality Protection Act extends this law.
 9. List and briefly describe nine alternative pest management strategies.
 10. Define integrated pest management. Analyze the pros and cons of using IPM. List six steps which could be taken to help promote IPM.
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Pflugerville Independent School District • August 2003

UNIT 17 Land Management and Diversity – 2 Weeks

TIME 2 Weeks

TOPICS CHAPTER 16 [*LITE* 24]: Conservation, Problems, and Wilderness

CHAPTER 17 [*LITE* 25]: Wild Species, Sustainable Management

TECHNOLOGY • “Wildlife Forever” by the National Wildlife Federation (CD-ROM)

- Internet: US Forest Service, Bureau of Land Management, National Parks System, the Nature Conservancy, Ducks Unlimited, the National Wildlife Federation, Greenpeace, the Audubon Society, Earth First, Everglades restoration, Endangered American Wilderness Act of 1978, Forest Reserves Management Acts, Scenic Rivers Act, the World Wildlife Fund

VIDEOS

- “Race to Save the Planet—In the Name of Progress”
- “Race to Save the Planet—Remnants of Eden”
- “Earth At Risk—The Rainforest”
- “The Un-endangered Species”

SPEAKERS

- Invite a conservation biologist to discuss his/her work

PROJECTS

- Visit a wilderness area. Collect works of art, music, and literature which reflect human feelings toward the wilderness. Discuss the value of wilderness areas.
- Survey zoos, aquariums, botanical gardens, or arboretums to see if they operate programs to increase the populations of endangered species. Invite a speaker.
- Compile a list of the fish and wildlife species in the locale that have been officially designated as threatened or endangered. Find out what specific actions are being taken to assist these species.

OBJECTIVES

1. Define ecological integrity. Distinguish conservation biology from wildlife management. State the goal and four ethical principles that guide conservation biology.
2. List five types of public lands in the United States. Explain the mission and principles of management of each. Summarize the "takings issue" currently being used by the Wise-Use Movement.
3. Distinguish between the goals of even-aged management and uneven-aged management. List four types of tree harvesting, indicating which type of management they are most likely to be used for. Distinguish between whole-tree harvesting and strip logging. Evaluate which is the most sound practice from an environmental viewpoint.
4. Distinguish among surface fires, crown fires, and ground fires. Summarize threats to forests from fires, pathogens, and air pollution and strategies for dealing with each threat.
5. Distinguish between "New Forestry" and sustainable forestry management. List eight ways to move toward sustainable forestry management. List at least five ways to reform federal forest management.
6. List three ways to reduce demand for wood products. Explain the roles that straw and kenaf can play in reducing demand for wood.
7. Define rangeland. State the significance of rangelands. Summarize the status of U.S. rangelands. State and briefly describe the major problems of overgrazing and predator control. State at least three steps to make grazing more sustainable. Summarize the appeal of wild game ranching.
8. Briefly describe the extent of national parks worldwide. Describe a major problem of national parks. State at least five steps which could help sustain and expand the National Park System.

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

9. Describe the changes that occurred in the Everglades over the last half century. Describe restoration strategies. Summarize what we have learned from human interactions with the Everglades.
 10. Define wilderness. Describe a biosphere reserve. Summarize the status of the national Wild and Scenic Rivers System and the National Trails System.
 11. Describe the economic, medical, scientific, ecological, and aesthetic, recreational, and ethical significance of wild species. Define biophilia. Summarize your position toward protection of different species.
 12. Describe the general process of extinction. Compare past extinctions to present extinctions. Start with E. O. Wilson's estimates for habitat destruction and loss of biodiversity. Calculate a range of estimations of biodiversity loss based on high and low assumptions.
 13. Distinguish among local extinction, ecological extinction, and biological extinction. Distinguish between threatened and endangered species. List nine characteristics that make species extinction prone.
 14. List three root causes of extinction of wildlife. List eight human activities which directly increase the wildlife extinction rate. Summarize the condition of the world's fisheries and the causes of those conditions.
 15. State and briefly describe the most far-reaching international treaty to protect wildlife. List four strategies that have been used recently to weaken the Endangered Species Act. List three recommendations for strengthening the Endangered Species Act. State three guidelines that conservation biologists would use to set determine "priority species."
 16. Assess the advantages and disadvantages of using wildlife refuges, gene banks, botanical gardens, and zoos to protect wildlife.
 17. Describe how wildlife populations can be managed by manipulating the successional stage of the habitat and by sport hunting. Evaluate whose interests are generally the most influential in determining wildlife management priorities.
 18. Describe freshwater and marine fishery management and how it can be improved. Analyze the lessons to be learned from the decline of the whaling industry.
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AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

UNIT 18 Economics, Politics, and Ethics – 2 Weeks

TIME 2 Weeks

TOPICS CHAPTER 2 [LITE 26]: Economic Growth, Solutions
CHAPTER 7 [LITE 27]: Politics and Environmental Policy
[LITE only - CHAPTER 28: Environmental Education]

LABS

- Environmental Resources Survey (Kaestner)
- Noise Pollution (#17 from Miller's lab book)
- Land Use Planning

TECHNOLOGY • Internet: Earth Day, the Nature Conservancy, Sierra Club, Ducks Unlimited, the National Wildlife Federation, Greenpeace, the Audubon Society, Earth First, Germany's Green Party, Environmental Defense Fund, 1992/1997 Rio Earth Summit, Clean Air Act, Clean Water Act, the UN Environmental Program (UNEP)

VIDEOS

- "Race to Save the Planet—Now or Never"
- "Race to Save the Planet—It Needs Political Decisions"
- "The Un-endangered Species—What They Say About Hunting"
- Earth Day 1990

SPEAKERS

- Invite a Sierra Club member or an environmental lobbyist to discuss their goals, methods and problems
- Invite a policy maker who has been involved in writing environmental legislation

PROJECTS

- Identify a local environmental issue early in the semester and follow the actions of environmental groups addressing that issue. Investigate the strategies and tactics used.
- Set up a debate of a local issue
- Investigate green taxes, user fees, and subsidies

OBJECTIVES

1. Define economy and economic resource. Distinguish among the following: Earth capital, manufactured capital, and human capital; pure command economic system and pure market economic system. Define market equilibrium. Explain why the most common economic system is a mixed system.
2. Distinguish among economic growth, economic development, and ecologically sustainable development.
3. Distinguish between gross domestic product (GDP) gross national product (GNP). Evaluate the commonly held belief that GNP is an indicator of a country's well-being. Describe three alternative indicators that take social and environmental factors into account. Evaluate the accuracy of these indicators. Describe the trend in the Genuine Progress Indicator over the last two decades.
4. Distinguish between internal and external costs. Distinguish between external costs and external benefits. Describe measures that can be taken to achieve full-cost pricing.
5. Define cost-benefit analysis.
6. List seven political tools that can be used to improve environmental quality and reduce resource waste. List advantages and disadvantages of each tool. Evaluate which tool you think is best. Be prepared to defend your choice.
7. Distinguish zero pollution from optimal level of pollution. Describe how the optimal level of pollution is determined.
8. Summarize the concerns that many workers, consumers, and environmentalists have about the General Agreement on Tariffs and Trade. Summarize seven steps to improving trade agreements.

AP ENVIRONMENTAL SCIENCE CURRICULUM

Pflugerville Independent School District • August 2003

9. Define poverty. Describe and evaluate the trickle-down theory. Describe how redistribution of wealth and development of self-reliance can be stimulated by governments of developing and developed countries.
10. Describe an Earth-sustaining economy. Describe a plan to move toward creation of Earth sustaining economies. Summarize efforts by Germany and the Netherlands to move toward ecological sustainability.
11. Summarize the basis of a constitutional democracy. Evaluate the position of special interest groups. Distinguish between profit-making organizations and nonprofits, nongovernmental organizations (NGOs). Explain how governmental structure drives a reactive rather than a proactive stance.
12. Briefly describe how environmental policy is made in the United States. Distinguish the roles played by the legislative, executive, and judiciary branches. List five approaches that legislation uses to protect the environment. Give one example of legislation for each method.
13. Name five general principles for setting environmental regulations. Give one example of legislation using each strategy. Summarize how the courts are used to implement or weaken environmental regulations.
14. Describe how environmental policy can be influenced by individuals exercising their democratic responsibilities, leadership skills, and career choices.
15. Summarize the struggle between the Greens and the Browns. Be sure to distinguish between national and grass roots environmental groups. Be sure to list the strategies that are being used by the current Wise-Use Movement.
16. Explain the importance of critical thinking and distinguishing between pioneer science and consensus science in evaluation of claims by environmental and anti-environmental groups.
17. Summarize a strategy to bring about election finance reform. List three strategies to improve bureaucracies. List four strategies to give ordinary citizens a stronger role in governance. List three linkages between crime and environmental quality.
18. Summarize the results of the 1992 Rio Earth Summit. Describe the development of the ecojustice movement. Suggest ways to improve global environmental protection.
19. List four basic beliefs common to the human-centered, planetary management worldviews. List and contrast four different schools of thought within the planetary management worldview. Evaluate past human performance in managing the planet.
20. Distinguish between instrumental value and intrinsic value. Distinguish between biocentric and ecocentric worldviews. Compare basic beliefs of an earth-wisdom worldview and planetary management worldviews.
21. Summarize the basic beliefs of deep ecology.
22. Distinguish among ecofeminism, social ecology, and social and worldviews. Evaluate where you stand.
23. Summarize guidelines that emerge from environmental ethics.
24. Summarize how each of the following contributes to a more sustainable future: caring about future generations; listening to children; Earth education; living bioregionally; experiencing the Earth; living more simply.
25. List four strategies to empower your environmental knowledge and awareness. List six common traps to be avoided in moving toward a more sustainable future.
26. List four components of an earth-wisdom revolution. From the elements in this chapter, design your own worldview and personal plan to implement the goals of that worldview.

Curriculum Developed By

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Eanes Independent School District, Westlake High School – August 1998