Name of the Course

AP Environmental Science

Textbooks for class consultation:

Cunningham, William P., Cunningham, Maryann, and Saigo, Barbara. *Environmental Science: A Global Concern, 9th edition.* 2007. McGraw Hill.

Enger, Eldon and Smith, Bradley. *Environmental Science: A Study of Interrelationships*. 2006. McGraw-Hill.

Miller, G. Tyler. *Living in the Environment, 14th edition*. 2005. Brooks/Cole-Thomson Learning, Inc.
Raven, Peter and Berg, Linda. *Environment, 4th edition*. 2004. John Wiley and Sons Publishers.

Enviroliteracy Hyperlinked Course Outline http://www.enviroliteracy.org/article.php/1492.html

"The Habitable Planet" online textbook resource: http://www.learner.org/courses/envsci/unit/index.php

Supplementary Course Texts and Ancillary Materials

AP Environmental Science Labs available through UCCP:
http://www.ucopenaccess.org/course/view.php?id=13

Resources

Required reading texts are included within the course as lectures, Power Point presentations, Internet resources, and course outlines. Topics included are in compliance with the College Board AP guidelines and recommendations. All required and recommended reading is linked appropriately within each scheduled lesson in accordance with copyright law.

Course Prerequisites

Students taking AP Environmental Science should have completed two years of high school science consisting of one year of biology and one year of either physical science or chemistry. Students should also have completed Algebra 1.

Course Goal

Students will **master** the practical concepts and applications of environmental science at an advanced high school level in accordance with the College Board AP Environmental Science guidelines.

Course Objectives

At the conclusion of the course, students will be able to:

- Define science as a process.
- Discuss science as a method of learning more about the world.
- Describe how science constantly changes the way we understand the world.
- Discuss how energy conversions underlie all ecological processes.

- Explain that energy cannot be created but that it must come from somewhere.
- Illustrate the properties of energy flow within systems.
- Describe the Earth as one interconnected system.
- Examine how natural systems change over time and space.
- Analyze how biogeochemical systems vary in the ability to recover from disturbances.
- Describe how humans alter natural systems.
- Identify the impact that humans have had on the environment for millions of years.
- Discuss how technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.
- Identify environmental problems as having a cultural and social context.
- Understand and explain the role of cultural, social, and economic factors and explain how they are vital to the development of solutions.
- Discuss how human survival depends upon developing practices that achieve sustainable systems.
- Determine a suitable combination of conservation and development is required to reach sustainability.
- Examine how management of common resources is essential to reaching a sustainable environment.

Learning Outcomes

At the conclusion of this course, students will thoroughly understand the practical concepts and applications of environmental science at an advanced high school level and be well prepared to participate in the AP Environmental Science Exam.

Assessments

Assessments are conducted and submitted online in compliance with accreditation standards. Assessments are created using all 6 levels of Bloom's Taxonomy, but primarily focused on analysis, synthesis and evaluation and will incorporate 3 different learning styles, so students are challenged to learn at all levels. Assessment questions appear in a variety of formats: True/False, Define/Identify, Multiple Choice, Map Identification, Multiple Answer, Lab Write-ups Discussion-based, Short Answer, Projects and Essay. Assessments are comprehensive of the lesson content and some are conducted in a timed online environment.

Course Long Plan

Course Description

AP Environmental Science is a 1 credit course with 10 units of study. Each unit takes 20-25 hours to complete and includes online readings, laboratory experiments, interactive activities, threaded discussion, peer-to-peer learning, and a variety of formative and summative assessments. Although the course is structured to accommodate seat time requirements in some states, students may progress at their own speed throughout the course.

The goal of AP Environmental Science is to provide students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world and to identify and analyze environmental problems that are both natural and human-made. Students will evaluate the relative risks associated with these problems and examine alternative solutions for resolving or preventing problems. Required laboratory Internet-based activities are included with each unit, each

taking a minimum of one hour to complete. Additionally, hands-on laboratory assignments are included in each unit to challenge student abilities on the following tasks:

- Critically observe environmental systems
- Develop and conduct well-developed experiments
- Analyze and interpret data , including appropriate statistical and graphical presentations
- Think analytically and apply concepts to the solution of environmental problems
- Make conclusions and evaluate their quality and validity
- Propose further questions for study
- Communicate accurately and meaningfully about observations and conclusions

Environmental science is interdisciplinary; the course includes a wide variety of topics from different disciplinary areas. The course is organized in accordance with six themes:

- Science is a process
    a. Science is a method of learning more about the world.
    b. Science constantly changes the way we understand the world.
- Energy conversions underlie all ecological processes.
    a. Energy cannot be created; it must come from somewhere.
    b. As energy flows through systems, it becomes less usable at each step.
- The Earth is one interconnected system.
    a. Natural systems change over time and space.
    b. Biogeochemical systems vary in ability to recover from disturbances.
- Humans alter natural systems
    a. Humans have an impact on the environment and have had for millions of years.
    b. Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.
- Environmental problems have a cultural and social context.
    a. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.
- Human survival depends upon developing practices that achieve sustainable systems.
    a. A suitable combination of conservation and development is required to reach sustainability.
    b. Management of common resources is essential to reaching a sustainable environment.

Throughout the course, students are given the opportunity to participate in critical thinking exercises which require research, analysis and presentation. Lessons, written with a global perspective in mind, enable students to collaborate with students around the world on projects, presentations, and assignments. Students develop 21st century skills, including cross-border perspectives and solutions, and apply "tangible" skills such as language proficiency as well as skills that are less tangible, including greater sensitivity to cultural differences, openness to new and different ideas, and the ability to adapt to change (as stated by the Partnership for 21st Century Skills).

This course is designed to be **highly teacher facilitated**. Instructors give a great deal of specific and timely feedback per lesson as students progress through the course. Students have opportunities for oral examinations, discussions, and whiteboard interactions. Additionally, teachers conduct online synchronous Elluminate sessions that require critical thinking and analysis.

In addition, this course is accompanied by an online tutorial and review that uses released AP Exams. Students are given systematic and timed practice for all portions of the exam. Students receive specific feedback on progress and mastery levels on the practice exams.

Laboratory Experience

Laboratory activities are a critical component of the AP Environmental Science course. There are 22 labs provided for students to learn about the environment through experience. These 22 labs are completed through a variety of methodologies including hands-on student conducted labs and virtual or simulated labs. Simulated activities are correlated to the corresponding AP Lab and structured so that students are familiar with key concepts, experimental design, and data analysis as presented in the lab write-ups. At all stages of lab work, students have one-on-one access to their instructors. Synchronous opportunities, such as graded oral assessment, phone calls, chats and/or whiteboard sessions, are utilized to maximize student understanding of lab processes, design and concepts.

Lab Materials:
This AP Environmental Science course will utilize a variety of household items in its hands-on labs. Few items listed will require purchase from a local grocery or home improvement store.

For a list of the AP Environmental Science Labs and required materials, please go to:
http://develop.flvs.net/Collaborate/ravery/educator_ap_environ_aplabs/

Conceptual Connections and/or Skills:
The AP Environmental Science course promotes connection to concepts by providing students with opportunities for manipulation of information and ideas related to the major topics and themes though a variety of methodologies including:

- reading of the course content
- readings and activities from text referenced sources, ancillary texts, and a wide variety of current, external Web resources
- use of interactive content components in which data is often collected and analyzed
- streaming video and multimedia components that dimensional learning opportunities
- expression of thought and understanding through writing
- exposure to released AP Environmental Science tests and practice with free response question types
- student-conducted hands-on and simulated laboratory investigations

Student assessment occurs at a variety of levels throughout the course. Students are assessed via discussion-based assessment and other synchronous sessions. Actual course assessment types include student assessed work, auto-graded, partially auto-graded, and totally instructor graded assignments.

Course Outline

Each module of study contains the following:

- ☐ Readings
- ☐ Supplemental Online Readings
- ☐ Map and Data Sets
- ☐ Mapping Activities
- ☐ Laboratory Experiments and Activities
- ☐ Interactive Online Activities
- ☐ Threaded Discussion
- ☐ Discussion-based (oral assessment)
- ☐ Formative and Summative Assessments

---Semester 1--- (18 Weeks)

Topics, Themes and Laboratory Experiences (by module)

- **Module 1** (Environmental Science and Sustainability)
  - **The main themes** covered in module 1 include: Science as a process, The Earth is one interconnected system**,** Environmental problems have a cultural and social context, and Human survival depends upon developing practices that achieve sustainable systems.
  - **The topics** covered will include: strategies for sustainability, sustainable land use strategies, resource use, Tragedy of the Commons, relevant laws and treaties, scientific method, worldviews, economic impacts, cost-benefit analysis, external costs, marginal costs, sustainability, Agricultural Revolution, Industrial Revolution.
  - **The lab experience** in module 1 will be:
    - 1.01 Sustainability Lab (60 – 90 minutes) - This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. The Sustainability lab is an activity that focuses student attention on creating a sustainable island using resources provided. Students will create a data table and graph to depict their outcomes and evaluate the effectiveness of their choices during the lab.
    - 1.04 Experimental Design (60 minutes)- This activity inspires students to design a lab based on choice scenarios. Students will incorporate the Scientific Method in developing their experimental design.
    - Research and Design Project: Eco-Vacations- (120 minutes) - Students collaboratively research and design a "green" vacation. Project includes information on transportation, lodging, food, and entertainment options, evaluating different choices for their environmental impact. Cost calculations are included.

  - **Readings and Ancillary Resources**

    - "The Worst Mistake in the History of the Human Race" by Jared Diamond http://www.environnement.ens.fr/perso/claessen/agriculture/mistake_jared_diamond.pdf
    - "The Tragedy of the Commons" by Garrett Hardin http://dieoff.org/page95.htm
    - "Secrets of Easter Island" PBS Nova http://www.pbs.org/wgbh/nova/easter/

- **Module 2** (The Living World)
  - **The main themes** covered in this module include: Science as a process, Energy Conversions underlie all ecological processes, The Earth is one interconnected system, Humans alter natural systems, Environmental problems have a cultural and social context, and Human survival depends upon developing practices that achieve sustainable systems.
  - **The topics** in this module include: biological populations and communities, ecological niches, interactions among species, keystone species, species diversity, photosynthesis, cellular respiration, laws of thermodynamics, food webs, trophic levels, ecological pyramids, biodiversity, natural selection, evolution, ecosystem resources, ecological succession, natural biogeochemical cycles (carbon, nitrogen,

phosphorus, sulfur, water, conservation of matter), loss of biodiversity, extinctions, endangered and threatened species, relevant laws and treaties.

- **The lab experiences** in module 2 will be:
  - 2.02 Eating at a Lower Trophic Level Activity (60 minutes) - Students hypothesize and predict the effect of human food consumption at lower trophic levels. Students then perform calculations based on provided data to create an energy pyramid and biomass pyramid. Additionally, students calculate the number of humans that could be supported at the various trophic levels and evaluate the feasibility of vegetarian diets for the world's population
  - 2.04 Cloud Lab (60 minutes) - This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. The student simulates the hydrologic cycle within a plastic bottle to create a cloud.
  - 2.07 Predatory/Prey Lab (90 minutes) - This lab activity is a student manipulated virtual simulation. Students experiment with the relationship between killer whales and seals. Students design three different experiments and test their assumptions by manipulating their choice of five different variables: initial predator population, initial prey population, prey growth rate, predator death rate, and capture efficiency. Data is collected and evaluated in a formal lab write-up with proposed ideas for future experiments.

- **Readings and Ancillary Resources**
  - Bagheera: A Website for Earth's Endangered Animals http://www.bagheera.com/
  - Ecological Studies of Wolves on Isle Royale http://www.isleroyalewolf.org/ann_rep_pdf/ISRO_annrep07-08.pdf

- **Module 3** (The Living World)
  - **The main themes** covered in module 3 include: Science as a process, The Earth is one interconnected system, Humans alter natural systems, Environmental problems have a cultural and social context, and Human survival depends upon developing practices that achieve sustainable systems.
  - **The topics** covered will include: weather and climate, seasons, solar intensity and latitude, major terrestrial and aquatic biomes, plate tectonics, earthquakes, volcanism, greenhouse gases and the greenhouse effect, rock cycle, mineral formation, extraction, global mining reserves, relevant laws and treaties.

  - **The lab experiences in** module 3 will be:
    - 3.02 Water Lab on Sustainability (90 minutes) - This lab activity is a student manipulated virtual simulation. Students experiment with sustainability, balancing a fish population with human harvesting, environmental variations, and carrying capacity. Students design three different experiments and test their assumptions by manipulating their choice of five different variables. Data is collected and evaluated in a formal lab write-up with proposed ideas for future experiments.
    - 3.04 Cookie Mining Lab (60- 90 minutes) – This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. Students simulate mining and reclamation activities, including economic considerations and calculations. Students

arrange loan, purchase or rent equipment and resources, calculate recovery percentage and profit/loss. Students discuss relevant mining laws and reclamation effectiveness.

- **Readings and Ancillary Resources**
  - Hippocampus Educational Resources
    http://www.hippocampus.org/AP%20Environmental%20Science
  - Major Biomes of the World
    http://www.runet.edu/~swoodwar/CLASSES/GEOG235/biomes/main.html

- **Module 4** (Population)
  - **The main themes** covered in module 4 include: Science is a process, The Earth is one interconnected system, The Earth is one interconnected system, Humans alter natural systems, Environmental problems have a cultural and social context, and Human survival depends upon developing practices that achieve sustainable systems.
  - **The topics** covered will include: historical population sizes, human population distribution, fertility rates, growth rates and doubling times, demographic transition, age-structure diagrams, case studies, national policies, economic effects, carrying capacity, survivorship, reproductive strategies, tree plantations, old growth forests, forest fires, forest management, national forests, federal rangelands, deforestation, public and federal lands, relevant laws and treaties.
  - The lab experiences in module 4 will be:
    - 4.02 Lab on Habitat Loss (90 minutes) – This is a student-manipulated virtual simulation lab. Students experiment with habitat loss and its effect on species populations. Variables to be manipulated are habitat loss rate, habitat loss amount, and food production rate. Students design two different experiments and test their assumptions by manipulating the variables, obtaining output data on population, carrying capacity, and the effects of habitat fragmentation. Data is collected and evaluated in a formal lab write-up with proposed ideas for future experiments.
    - 4.03 Cemetery Lab – (120 minutes) - This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. The students then collect and compare age-specific mortality data from gravestones in two cemeteries, one representing a historical population, and the other, a modern one. Students construct life tables and graphically illustrate survivorship and mortality rates.
    - 4.04 Tree Lab (120 min) – This is a hands-on lab activity and math practice. Students measure circumference of a tree and the length of its shadow. Using geometry, students calculate tree diameter and height. Using US Forest Service models, students then calculate tree weight, dry weight, and mass of carbon in tree. Using percent composition, students calculate mass of carbon dioxide sequestered by tree. Stoichiometric calculations allow students to calculate the gallons of combusted gasoline their tree represents. Students evaluate the number of trees needed to sequester one family's yearly gasoline combustion and the accuracy of mathematical models.

  - **Readings and Ancillary Resources**

    - US Census Bureau Age Structure diagrams
      http://www.census.gov/ipc/www/idb/pyramids.html
    - The Population Reference Bureau: "India's Population" Case Study

http://www.prb.org/Publications/PopulationBulletins/2006/IndiasPopulationReconcilingChangeandTradition.aspx
- The Population Reference Bureau: "China's Population New Trends and Challenges"

http://www.prb.org/Source/59.2ChinasPopNewTrends.pdf

- **Module 5** (Energy)
  - **The main themes** in module 5 include: Science is process, Energy Conversions underlie all ecological processes, The Earth is one interconnected system, Humans alter natural systems, Environmental problems have a cultural and social context, and Human survival depends upon developing practices that achieve sustainable systems.
  - **The topics** covered will include: energy forms, power, units, conversions, global energy use, formation of coal, oil, and natural gas, extraction methods, world reserves, global demand, nuclear fission process, nuclear fuel, electricity production, nuclear reactor types, safety issues, radioactive wastes, dams, flood control, hydroelectric power, energy conservation, solar energy, hydrogen fuel cells, biomass, wind energy, ocean waves and tidal energy, geothermal, environmental advantages and disadvantages for all types of energy production, relevant laws and treaties.

  - **The lab experiences** in module 5 will be:
    - 5.01 Energy Flow Lab (90 minutes) – This is a student manipulated virtual simulation lab. Students experiment with the energy use of a home that has several sources of energy available: wind power, a hydropower system that stores elevated water with excess wind energy, and a gasoline-powered electric generator. Variables to be manipulated are wind speed, energy usage rate, and water tank capacity. Students design three different experiments and test their assumptions by manipulating the variables, obtaining output data on all energy production and consumption. Data is collected and evaluated in a formal lab write-up with proposed ideas for future experiments.
    - 5.06 Global Energy Options (90 minutes) – This is a student manipulated virtual simulation lab. Students manipulate sources for the world, adjusting the percentage of energy use from coal, oil, natural gas, solar power, wind power, biofuel, hydro power and nuclear power. Students can also manipulate energy efficiencies and carbon sequestration rates. Based on these variables, students attempt to achieve equilibrium between energy supply and demand, while maintaining atmospheric CO2 levels below 500 ppm. Data is collected and evaluated in a formal lab write-up with predictions for the world's future.
    - 5.07 Hands-on Personal Energy Assessment Lab – (180 min) - This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. Students conduct energy use audit of their family home over a one week period. Energy use is categorized and summarized in table format. Students then calculate kilowatt hours, cost information, and evaluate fuels for electricity production.
    - 5.08 Global Warming Lab– (90 min) – This is a student manipulated virtual simulation lab. Students experiment with a simple model of global warming, balancing greenhouse forcing, feedback loops, and time. Students design two different experiments and test their assumptions by manipulating their choice of three different variables, obtaining output data on albedo and

surface temperature. Data is collected and evaluated in a formal lab write-up with proposed ideas for future experiments.

- **Readings and Ancillary Resources**
  - "The Big Energy Gamble" PBS Nova
    http://www.pbs.org/wgbh/nova/energy/program.html
  - Coal Mine Virtual Tour
    http://www2.illinoisbiz.biz/coal/virtualtour/index.html
  - Chernobyl Accident
    http://www.world-nuclear.org/info/chernobyl/inf07.html

---Semester 2--- (18 Weeks)

Topics, Themes and Laboratory Experiences (by module)

Module 6 (The Atmosphere and Climate Change)

- **The main themes** in module 6 include: Science as a process, The Earth is one interconnected system, Humans alter natural systems, Environmental problems have a cultural and social context, and Human survival depends upon developing practices that achieve sustainable systems.
- **The topics** covered in this module include: composition of the atmosphere, stratospheric ozone, primary and secondary air pollution, major air pollutants, smog, thermal inversions, indoor air pollution, acid deposition causes and effects, human health effects of air pollution, Clean Air Act and other relevant laws and treaties.

- **The lab experiences** in module 6 will be:
  - 6.00 Collaborative Lab on Solid Waste (240 minutes) – This lab activity is a long-term, hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. Students collaboratively design their own experiment, focusing on sound scientific experimentation. The degradability of various landfill items is evaluated over several weeks in simulated landfill conditions. Students collect data, graph data, and evaluate/interpret results.
  - 6.01 Air Pollution Lab: (90 minutes) – This is a student manipulated virtual simulation lab activity. Students experiment with the release of air pollutants from a tall smokestack located on a flat plain. The atmosphere is modeled with a simple set of factors: wind, temperature, diffusion, and convection. Variables to be manipulated are temperature gradient in the atmosphere, humidity, and wind speed. Students design three different experiments and test their assumptions by manipulating the variables, obtaining output data on the vertical and horizontal dispersion of the pollutants. Data is collected and evaluated in a formal lab write-up with proposed ideas for future experiments.
  - 6.05 Climatography Activity: (60 minutes) – This is a hands-on student conducted lab. Students create climatographs using precipitation/temperature data for known biomes. Unknown biome climate data is presented to students for graphing and biome determination.

- **Readings and Ancillary Resources**
  - El Nino Theme Page
    http://www.pmel.noaa.gov/tao/elnino/nino-home.html

Module 7 (Soil)

- **The main themes** in module 7 include Science as a Process, The Earth is one interconnected system, Humans alter natural systems, Environmental problems have a cultural and social context, Human survival depends upon developing practices that achieve sustainable systems
- **The topics** covered in this module include soil formation, composition, physical and chemical properties, soil types, erosion, soil conservation, deforestation, irrigation, types of agriculture, Green Revolution, genetic engineering, sustainability, food distribution, hunger, human nutritional requirements, fishing techniques, overfishing, aquaculture, types of pesticides, costs and benefits of pesticide use, integrated pest management, relevant laws and treaties.

- **The lab experiences** in module 7 will be:
  - 7.01 Soil Lab (90 minutes) – This is a hands-on student conducted lab. Students perform hands-on investigation of soil near their home, evaluating horizons and physical/chemical characteristics of soil (texture, permeability, leaching). Data is recorded and plotted on interactive map, and students compare/contrast their local soil type with soil types from other locations.
  - 7.02 Experimental Design (60 minutes) - This is a suggested activity that inspires students to design a lab based on desertification. Students will incorporate the Scientific Method in developing their experimental design.
  - 7.06 Hands-on Lab on Pest Management: (60 minutes) – This is a hands-on student conducted lab. Students examine household food products for pests, identifying them with the help of online resources. Students investigate integrated pest management and propose different methods of pest control.

- **Readings and Ancillary Resources**
  - New Neighbors: Suburbs and Pesticides
    http://www.pbs.org/now/science/pesticides.html
  - Rachel Carson Council: "Pesticides, Chemicals, and Alternatives"
    http://www.rachelcarsoncouncil.org/index.php?page=pesticides-chemicals-alternatives

Module 8 (Water)

- **The main themes** in module 8 include Science as a Process, The Earth is one interconnected system, Humans alter natural systems, Environmental problems have a cultural and social context, and Human survival depends upon developing practices that achieve sustainable systems
- **The topics** covered in this module include global water resources, water use, surface and groundwater issues, global water problems, water conservation, dissolved oxygen, watersheds, floodplains, water pollution types and sources, groundwater pollution, maintaining water quality, water purification, wastewater treatment, Clean Water act, relevant laws and treaties.

- **The lab experiences in** module 8 will be:
  - 8.02 Hands-on Water Usage Lab: (90 minutes) – This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. Students collect and average data for water use while brushing teeth with water continuously running and water running only when necessary. Data is collected for at least three individuals and averaged. Students calculate savings in gallons per person, gallons per town, gallons per state, and gallons per country.

Calculations are repeated using a standard cost per gallon to determine monetary savings. Students evaluate other water saving methods for their own family, and develop government programs to encourage water conservation.
    - 8.03 Virtual Lab on Water Pollution: (120 minutes) – This is a student manipulated virtual simulation lab activity involving water sampling.

- **Readings and Ancillary Resources**
    - Florida Estuaries
    http://kwanga.net/apesnotes/estuary-article.pdf
    - DC Water and Sewer Virtual Tour
    http://www.dcwasa.com/about/vtour/virtual_tour.html

Module 9 (Toxicology and Risk)

- **The main themes** in module 9 are Science as a Process, Environmental problems have a cultural and social context, and Human survival depends upon developing practices that achieve sustainable systems
- **The topics** covered in this module include **r**isk analysis, acute and chronic effects, dose response relationships, smoking, types of hazardous waste, treatment/disposal of hazardous wastes, cleanup of contaminated sites, remediation, mitigation, restoration, epidemiology, toxicology, relevant laws and treaties.

- **The lab experiences in** module 9 will be:
    - 9.03 Human Health Dose Response Activity: (90 minutes) – This is a student manipulated virtual simulation lab. Students experiment with a linear-fit zero-threshold dose-response curve. Variables to be manipulated are dose and number of individuals tested. Students design three different experiments and test their assumptions by manipulating the variables, obtaining output data and creating dose-response curves. Data is collected and evaluated in a formal lab write-up with proposed ideas for future experiments.

- **Readings and Ancillary Resources**
    - National Library of Medicine: Tox Town
    http://toxtown.nlm.nih.gov/text_version/index.php

Module 10 (Recycling and Sustainability)

- **The main themes** in module 10 are Science as a Process, The Earth is one interconnected system, Humans alter natural systems, Environmental problems have a cultural and social context, and Human survival depends upon developing practices that achieve sustainable systems.
- **The topics** covered in this module include solid waste types, solid waste disposal, reduction, landfills, recycling, reuse, relevant laws and treaties.

- **The lab experiences in** module 10 will be:
    - 10.01 Hands-on Personal Garbage Analysis: (120 minutes) – This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. Students sort and analyze family household garbage, categorizing each item and calculating percentages for each category. Family data is then compared to national averages and student evaluates family solid waste production by category. Waste reduction plans are created and analyzed.

- **Readings and Ancillary Resources**
  - The Green Guide for Everyday Living
    http://www.thegreenguide.com/
  - Superfund: US EPA
    http://www.epa.gov/superfund/
  - Landfill Virtual Tour
    http://www.rumpke.com/Landfill/Virtual_Tour.asp

---Long-term Projects and Field Experience---

Long-term Projects

- 6.00 Collaborative Lab on Solid Waste (240 minutes) – This lab activity is a long-term, hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. Students collaboratively design their own experiment, focusing on sound scientific experimentation. The degradability of various landfill items is evaluated over several weeks in simulated landfill conditions. Students collect data, graph data, and evaluate/interpret results.

Field Experience

- 4.03 Cemetery Lab – (120 minutes) - This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. The students then collect and compare age-specific mortality data from gravestones in two cemeteries, one representing a historical population, and the other, a modern one. Students construct life tables and graphically illustrate survivorship and mortality rates.

- 4.04 Tree Lab (120 min) – This is a hands-on lab activity and math practice. Students measure circumference of a tree and the length of its shadow. Using geometry, students calculate tree diameter and height. Using US Forest Service models, students then calculate tree weight, dry weight, and mass of carbon in tree. Using percent composition, students calculate mass of carbon dioxide sequestered by tree. Stoichiometric calculations allow students to calculate the gallons of combusted gasoline their tree represents. Students evaluate the number of trees needed to sequester one family's yearly gasoline combustion and the accuracy of mathematical models.

- 5.07 Hands-on Personal Energy Assessment Lab – (180 min) - This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. Students conduct energy use audit of their family home over a one week period. Energy use is categorized and summarized in table format. Students then calculate kilowatt hours, cost information, and evaluate fuels for electricity production

- 8.02 Hands-on Water Usage Lab: (90 minutes) – This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. Students collect and average data for water use while brushing teeth with water continuously running and water running only when necessary. Data is collected for at least three

individuals and averaged. Students calculate savings in gallons per person, gallons per town, gallons per state, and gallons per country. Calculations are repeated using a standard cost per gallon to determine monetary savings. Students evaluate other water saving methods for their own family, and develop government programs to encourage water conservation.

- 10.01 Hands-on Personal Garbage Analysis: (120 minutes) – This lab activity is a hands-on, student conducted lab during which the student carries out the experiment using materials gathered at home. Students sort and analyze family household garbage, categorizing each item and calculating percentages for each category. Family data is then compared to national averages and student evaluates family solid waste production by category. Waste reduction plans are created and analyzed.