Course Description: This course is designed to introduce students to all possible topics covered in introductory college programs in Environmental Science. AP Environmental Science will provide students with a better understanding of the relationships of organisms and humans to their environment and assessment of environmental stresses on these relationships. The connections between scientific concerns and environmental policy and decision-making will also be explored. Classwork will include lectures and discussions, outdoor field studies, laboratory activities, library research, and oral presentations. All students are strongly encouraged to take the Advanced Placement Examination in Environmental Science when it is offered.

Academic Expectations from the Mission Statement:
- Assume responsibility for academic achievement.
- Acquire, interpret, analyze, integrate, and apply information in a discerning manner.
- Demonstrate the ability to use technology appropriate to the subject area.
- Exhibit the ability to read, write, and communicate.

Reading Materials:
Primary textbook: *Environmental Science, Working with the Earth*, eleventh edition, G. Tyler Miller, Jr.

Supplemental reading/sources: Selected scientific papers and journal articles will supplement textbook readings for this class.

Course Outline:

Unit 1: Introduction to Environmental Science and Sustainability  10 days
Topics:
1. History of Environmentalism
2. The Global Environmental Picture, Sustainability
3. Conservation, Preservation, and Sustainable Development
4. The Tragedy of the Common
5. Ecological Footprint
6. Environmental Activism; the power of individual action
7. Introduction to the Scientific Method
8. The Massachusetts Envirothon
Case Study: Why Are Sharks Important Species?

Textbook References and Other Resources:
Miller, Chapter 1, Chapter 2
Supplementary Readings: assigned journal articles; Essays: Thoreau, Emerson, Native Americans
Videos: Shark Waters, The Environmental Revolution

Unit 2: Principles of Ecology 20 days
Topics:
1. Matter and Energy Change Laws
2. Structural Components of Ecosystems (categories of organisms; feeding and non-feeding relationships; populations and communities; ecological niches and habitats)
3. Energy Flow in Ecosystems (food chains; food webs; trophic levels; biomass and energy pyramids; photosynthesis and cellular respiration)
4. Nutrient Cycling (carbon; nitrogen; phosphorus)
5. Evolution and Biodiversity (natural selection and adaptation; speciation, extinction, and biodiversity)
6. Climate Basics
7. Major Terrestrial Biomes
8. Major Aquatic Life Zones
9. Ecological Succession
10. Population Ecology, Species Interactions, and Carrying Capacity
11. The Massachusetts Shoreline (barrier beaches, estuaries, salt marshes)

Role Play: The Chatham Break

Textbook References and Other Resources:
Miller, Chapters 2,3,4,5 and 6
Supplementary Reading: “Marine Ecology of Barrier Beaches”
Video: Cane Toads, An Unnatural History

Unit 3: Water – Issues of Quantity and Quality 15 days
Topics:
1. The Hydrologic Cycle (surface water, ground water)
2. Water Use (Agricultural, Industrial, Domestic)
3. Water Conservation
4. Sources of Water Pollution (point source and non-point source)
5. Types of Water Pollution (organic, inorganic, thermal, toxic)
6. Cultural Eutrophication
7. The Clean Water Act
8. Marine Pollution
Textbook References and Other Resources: Miller, Chapter 11
Supplementary Readings: Field Manual for Water Quality Assessment, assigned journal articles

Field Study: The Quinebaug River Survey

**Unit 4: Human Population**

**Topics:**
1. The Population Explosion and its Causes
2. Developed and Developing Countries
3. Exponential Growth, Growth With Limits
4. Population Statistics (crude birth rates; crude death rates; survival rates; average life expectancy; population growth rates; doubling time; the rule of 70; total fertility; replacement fertility)
5. Dynamics of Population Growth (population profiles; population projections; population momentum; the demographic transition)
6. Impacts of Population Growth (hunger; disease; environmental degradation)
7. Successes and Failures of the World Bank
8. Microfinance and the Debt Crisis
9. Urbanization and Urban Growth
10. Urban Resource and Environmental Resources
11. Sustainable Development

Textbook References and Other Resources:
Miller, Chapter 7
Supplementary Readings: assigned journal articles

**Unit 5: Biodiversity and Ecosystem Resources**

**Topics:**
1. Species Biodiversity, Genetic Biodiversity, Ecosystem Biodiversity
2. Value of Biodiversity (ecosystem goods; ecosystem services; keystone species; medicinal plants; ecotourism; intrinsic value)
3. Human Impact on Biodiversity (habitat loss and degradation, fragmentation and edge effect, introduction of exotic species; species-area relationship; tropical deforestation; loss of wetlands; decline of fisheries)
4. Species Extinction (background extinction; local extinction; biological extinction; the extinction crisis)
5. Strategies for Protecting Biodiversity (managing and sustaining forests, national parks and wilderness areas, nature reserves, ecological restoration and mitigation)
6. Sustaining Aquatic Ecosystems
7. Laws and Treaties (CITES; Convention on Biological Diversity; Endangered Species Act; Marine Mammal Protection Act; The Lacey Act)
Unit 6: Atmospheric Change 15 days

Topics:
1. Structure and Composition of the Atmosphere
2. Weather, Climate, Atmospheric Circulation, and Atmosphere-Ocean Interactions
3. Outdoor Air Pollution (major pollutants; primary pollutants; secondary pollutants; temperature inversions)
4. Indoor Pollutants
5. Human Health Concerns
6. Clean Air Act
7. Acid Deposition (sources and effects)
8. Ozone Depletion (formation and breakdown of the ozone layer; the Montreal Protocol)
9. Climate Change (the greenhouse effect and the natural heating of the earth’s atmosphere; past climate change; greenhouse gases; amount of warming and its probable effects; dealing with climate change)

Unit 7: Energy 20 days

Topics:
1. Energy from Fossil Fuels (exploitation of crude oil, natural gas, and coal)
2. Electricity from Nuclear Power (nuclear fission; safety and economic issues; the waste disposal issue; more advanced reactors)
3. Alternative Renewable Energy (solar; wind; hydroelectric; geothermal; biomass; wave and tidal power)
4. Hydrogen Economy
5. Conservation and Energy Efficiency
6. Sustainable Energy Future
Unit 8: Solid Waste, Hazardous Chemicals, Human Health and Toxicology  15 Days

Topics:
1. The Solid Waste Problem (landfills, incinerators, and NIMBY)
2. Producing Less Waste (source reduction; reuse, recycling, and composting)
3. Hazardous Waste
4. Resource Conservation and Recovery Act
5. Hazardous Waste Remediation
6. Human Health and Risk Analysis
7. Disease in Developed and Developing Countries
8. Toxicology: Assessing Chemical Hazards
9. Risk Analysis

Textbook References and Other Resources:
Miller, Chapters 14 and 17
Video: Erin Brockovich

Unit 9: Earth Science, Soil and Agriculture  15 days

Topics:
1. Plate Tectonics, Earthquakes and Volcanoes
2. Seasons, Solar Intensity, Atmospheric Circulation, Atmosphere-Ocean Interactions
4. Soil Characteristics (soil profiles; soil textures; soil nutrients)
5. Soil Degradation (erosion and desertification; irrigation and salinization; deforestation)
6. Food Production (subsistence agriculture; modern industrialized agriculture; biotechnology and the prospects for increasing food production)
7. Food Distribution (patterns of distribution; hunger, malnutrition, and famine)
8. Integrated Pest Management
9. Sustainable Agriculture

Textbook References and Other Resources:
Miller, Chapters 4, 10, and 12
Video: “Supersize” Me

Unit 10: Environmental Economics, Politics, and Worldviews  10 days

Topics:
1. Economic Systems and Sustainability
2. Using Economics to Improve Environmental Quality
3. Reducing Poverty to Improve Environmental Quality and Human Well-Being
4. Politics and Environmental Policy
Unit 11: Massachusetts Envirothon Community Research Project 5 Days

Topics:
1. Envirothon Content Review
2. Current Issue Presentation

Unit 12: Review for AP Exam 5 Days

AP Environmental Science Students will participate in two on-going field studies described below. In addition to their participation in the field work, students will also complete lab work one or two days each week.

Field Studies

Field Study 1: Quinebaug River Survey
Students use a variety of techniques to assess the water quality of the major river in their Regional School District. Students collect data at several of the ten survey sites that have been established on the Quinebaug and its tributaries. This field study has been on-going since 1996. At the conclusion of the survey work, students write a comprehensive water quality analysis report which is shared with the U.S. Army Corps of Engineers who manage a significant portion of the watershed along the Quinebaug River.

The following water quality assessments are used in the survey:

1. The National Sanitation Foundation Water Quality Index. Students learn how to perform a series of nine weighted tests including the following:
   - dissolved oxygen
   - fecal coliform
   - pH
   - biochemical oxygen demand
   - total phosphates
   - nitrates
   - temperature change
   - turbidity
   - total dissolved solids
2. The Pollution Tolerance Index, a benthic macroinvertebrate index that uses the concepts of pollution tolerance and indicator organisms to assess water quality. Using kick screens, D-frame nets, and identification keys, students capture and identify macroinvertebrate to analyze water quality.
3. The **Sequential Comparison Index**, an assessment tool that analyzes water quality based on diversity of macroinvertebrates.

Students also learn how to measure the discharge of the river and why discharge can be an important variable in water quality.

**Field Study 2: Terrestrial Salamander Monitoring Project**

Using artificial cover objects, students measure population trends of redback salamanders in two distinct New England forest habitats; a mixed deciduous forest, and a white pine/eastern hemlock forest. This is an ongoing study that began in the fall of 2001. In addition to comparing population trends between the two types of forest, significant data now exists for students to correlate several other variables that impact salamander populations including:

- time of year
- time of day
- air temperature
- precipitation
- cloud cover
- frequency of sampling
- topography

**Laboratory Activities**

1. **Tragedy of the Commons.** Students explore the concepts of carrying capacity, maximum sustainable yield, and exploitation of common renewable resources in a simulation lab activity that looks at human impact on world fisheries.

2. **Owl Pellet Dissection.** Students dissect owl pellets and construct a representative food web to study the principles of biomass pyramids, trophic levels, and energy flow in ecosystems.

3. **The Effects of Road Salts on Seed Germination.** Students design and carry out their own experiments on the impacts of salt on seed germination as part of a lesson on experimental design. Students are introduced to the concepts of independent variables, dependent variables, constants, controls, repeated trials, and hypothesis design and evaluation.

4. **The Effects of Abiotic Factors on the Behavior of Aquatic Organisms.** Students test the effects of geotaxis, phototaxis, and other abiotic factors of their choosing on the behavior of brine shrimp.

5. **Changing Shorelines.** Using old charts and maps along with current technologies including Google Earth, students study the changes that have occurred to the outer barrier beaches of Cape Cod. In a role play following the mapping exercise, students reenact a town meeting held to discuss the impacts, challenges, and solutions to human development of the shoreline.

6. **Dissolved Oxygen.** Using LaMotte test kits, students learn how to measure dissolved oxygen in a waterway and study the relationships between the level of dissolved oxygen and other variables including; temperature, stream velocity, and time of day.

7. **Fecal Coliform.** Using standard millipore equipment and techniques, students culture
fecal coliform and assess water quality.

8. **Nitrates, Phosphates, and BOD.** Using Hach colorimeters, COD reactors and chemical reagents, students assess the impact of nutrients on local waterways.


10. **Estimating Population Size.** In the first part of this lab, students learn the mark and recapture technique for estimating mobile populations using a simulation. The simulation lab is followed by field study where mark and recapture techniques are used to study the crayfish population of a nearby river.

11. **Survival Rate, Average Life Expectancy, and Longevity.** Students collect data on human populations from an old cemetery and compare it with recent obituary data to analyze changes that have occurred over the past 200 years.

12. **Demographic Analysis.** Using the CIA World Fact Book and other demographic data web sites, students gather data on developing and developed countries looking for correlation between population growth rates and demographic statistics.

13. **Woodlot Analysis.** Students learn a variety of forestry measurement techniques to assess the economic value of a New England woodlot. Students use hipsometers, diameter tapes, and field guides to identify and measure the volume of merchantable trees, and assess their economic value.

14. **Particulate Pollution.** Using simple home-made particulate collectors, students design an experiment to measure the level of particulates locally and evaluate the data using EPA standards.

15. **Solar Home Design.** After studying the principles of passive and active solar design, students compete in small groups to design a model passive solar house.

16. **Wind Turbine Blade Design.** Using materials from *Kid Wind Project*, students study the process of blade design and create a model turbine in a classroom competition.

17. **Soil Profile Analysis.** Students dig a soil pit on campus and identify the soil horizons. Soil samples are analyzed in the lab for nutrients, texture, and pH.

18. **Using Macroinvertebrate to Assess Water Quality.** Students collect, identify, and use a variety of assessment techniques to assess the water quality of a campus stream.

19. **Measuring the Discharge of a Stream.** Students use Vernier stream flow equipment along with tape measures and meter sticks to measure the velocity and cross-sectional area of a campus stream.

**Teaching Strategies**

Methods of instruction include; lectures, discussions, outdoor field studies, laboratory activities, library research, and oral presentations. Quizzes are given at least once a week on textbook readings. Students are required to outline assigned textbook chapters and notes are allowed to be used on all quizzes. Major exams are given less frequently at the conclusion of each unit of study. All students who are enrolled in AP Environmental Science are required to complete a summer reading assignment which is evaluated at the beginning of the school year. Students are strongly encouraged to take the AP exam.
Grading/Evaluation of Learning:

Quarter Grades
- tests and quizzes .........................................................50 %
- labs and fieldwork .........................................................30 %
- homework, participation, and classroom activities ............20 %

Course Grade
- first quarter ..........45 %
- second quarter ......45 %
- final exam ...........10 %

Materials: (what students are expected to bring to class each day)
- text book
- three-ring binder

Academic Integrity

Academic integrity provides the foundation for educational achievement and personal growth within Tantasqua’s school community. Integrity guides the choices which lead toward honesty, respect, and responsibility. A student with academic integrity gains knowledge through hard work and honest effort. The result is genuine accomplishment and learning.

Academic Integrity promotes:
- positive relationships based on trust
- work that reflects one’s own best effort
- respect for the intellectual property of others
- responsibility for one’s own actions
- real learning

Violations of Academic Integrity
Violations of academic integrity include cheating and plagiarism.

Cheating is an unacceptable form of behavior. Real learning stops when cheating begins. It casts a shadow of doubt on the credibility of a student’s academic performance preceding the cheating incident, and may have an effect on how people perceive the student for the consideration of future honors, awards, or letters of recommendation.

Test or homework dishonesty is the use of any means not specifically accepted by the teacher to obtain answers to a test, quiz, or homework assignment. Test or homework dishonesty includes giving, receiving, passing, or using in any way specific information about the test, quiz, or homework assignment, whether in oral or written form.

Plagiarism is the use of another person’s words, ideas, or facts as if they were your own, without giving credit to the original source. Plagiarism may occur in any medium, including written composition, oral or artistic presentations, and technology. Plagiarism
in any form is unacceptable. During the first weeks of school, teachers will clarify their specific policies on plagiarism.

**Consequences**
A student found in violation of academic integrity may face one or more of the following consequences:

- loss of credit for the assignment/paper/test, and a grade of zero
- notification of parent or guardian
- disciplinary referral to the assistant principal and resulting penalty

Repeated violations of academic integrity will result in:

- a meeting including the student, parent(s) or guardian(s), teacher, counselor, and/or an administrator
- loss of credit and a failing grade for the course