Murrieta Valley Unified School District
High School Course Outline
April 2011

Department: Science - Environmental Engineering

Course Title: Environmental Engineering II

Course Number: 3610

Grade Level(s): 10-12

Length of Course: 1 year

Prerequisite(s): Successful completion of Environmental Engineering I, enrollment in Algebra II

UC/CSU (A-G) Requirement: G

Brief Course Description: Environmental Engineering II is an elective focused on water and energy literacy in preparation for career opportunities in the emerging green economy. The overall curriculum focuses on the energy (solar and wind), and sustainability components of Environmental Science, while reinforcing English language development and math through real-world application. This course creates a pathway for STEM (Science, Technology, Engineering and Math) related fields, including advancement into higher education as well as immediate career entry. Technology plays a vital role in the delivery of the course as students utilize an open-source, electronic learning platform (the Moodle learning management system) to fulfill various parts of the coursework, and assessments. Teachers are encouraged to participate in at least one field trip per semester to further enrich the learning experience by exploring various water and energy systems, both in their natural states and in industry. This course will also give students exposure to different types of engineering fields and careers. This is a challenging course with an emphasis on problem solving and requires the student to have strong math skills. At least 50% of the course will include laboratory activities that reinforce the concepts that are part of the curriculum.

I. Goals
Environmental Engineering II consists of a rigorous academic curriculum, which bridges school to work connections, and is a part of a larger effort to prepare young people for careers in the green economy. This course creates meaningful application of STEM education, while also exposing high school students to infrastructure industries and green careers, as well as a 21st century use of technology-enabled instruction. By implementing a project-based learning model, students utilize newly acquired knowledge and integrate purposeful experiences directly into service-learning outreach to the broader campus as well as the local community. The Environmental Engineering I course retains the rigor, relevance, and relationships of quality instruction while ensuring that a strong
student culture is developed, student learning is meaningful to students, while they develop skills that are useful in the real world.

**The student will:**

A. Learn about the academic fields of Science, Technology, Engineering, and Math (STEM) through the examination of key issues in the fields of sustainability, water, energy, and related fields
B. Gain an understanding of infrastructure industries and green career opportunities.
C. Be exposed to field work, hands-on construction, and project management
D. Develop an understanding of the pertinent environmental issues around water and energy that affect our daily lives and the future of our planet.
E. Develop and carry out multiple service-learning projects with the purpose of promoting sustainability in students’ daily routines and attempting to restore damage caused to the earth through unsustainable methods.
F. Understand environmental principles and how they are influenced by social, economic, political, and ethical issues; using these principles, students will construct solutions to current environmental problems.
G. Learn the waterways that provide water to California divisions (i.e., northern, central, and southern) and how those waterways are affected by overuse and waste; know the various projects outlined in the California State Water Project.
H. Calculate the rates of water depletion of the various sources of water to California.
I. Understand the principles involved in the creation and passage of electricity; know the sustainable methods of garnering and sharing electrical energy.
J. Learn the technical skills necessary for construction of various hands-on “green” projects, such as solar paneling and irrigation.
K. Build working relationships with various water and energy corporations, as well as other environmental and political agencies, within California; work with these agencies to learn about and develop solutions to current and predicted environmental problems, specifically surrounding the topics of water and energy.

II. **Outline of Content for Major Areas of Study**

*Module 1.1: Natural Resources and Sustainability*
- Raw materials, production, use, disposal
- Economic externalities and the Tragedy of the Commons
- Environmental standards and regulation
- Sustainability
- What is green?
- Green jobs

*Module 1.2: Our Ecological Footprint*
- Carbon footprint
- Water footprint
  - Quantitative school water usage analysis
  - Personal water usage analysis
  - School water audit
- Energy audit

**Module 1.3: Fossil Fuels & Climate Change**
- Analysis of fuels energy and carbon output
- Carbon usage
- Global warming effects and scientific evidence
- Scientific process

**Module 2.1: Sources of Water**
- Hydrologic cycle
- History of water and Los Angeles
- LA Aqueduct, Colorado River, State Water Project
- Desalination

**Module 2.2: Water Conveyance and Distribution**
- Engineering
- Water movement
- Aqueducts, reservoirs, water pipes
- Hydroelectric power
- DWP and water careers

**Module 2.3: Watersheds, Wastewater, Water Pollution, and Treatment**
- Local watersheds
- Water pollutants
- Residential vs. industrial waste
- TMDLs in local water channel
- Sewer system
- Water quality levels into Bay

**Module 3.1: Intro to Energy**
- Definition of energy
- How energy works, energy transfers & efficiency
  - Laws of Thermodynamics
- Sources of energy
- Electricity
- Fuels
- Measurement (Watts, BTUs, time, peak load, Ohm’s Law)

**Module 3.2: Renewable Sources of Energy**
- Types of renewable (wind, solar, hydro, biomass)
• Growth projections for renewable energy

**Module 3.3: Energy Generation and Distribution**
- AC and DC power
- Transmission grid
- Energy careers
- Principles of combustion pressure
- Natural gas

**Module 4: Landscape and Urban Agriculture**
- Types of plants and water usage
- California friendly plants
- Analysis of types of plants on campus
- Agriculture vs. residential vs. commercial use of water
- Green roofs
- Sprinkler systems, drip irrigation and bubblers
- Organic vs. pesticide farming

**Module 5.1: Energy Efficiency**
- Residential energy usage
- Smart grid
- Distributed generation
- Energy efficiency opportunities
- Hands-on electrical opportunity
- Obama plan

**Module 5.2: Water Conservation**
- Conservation: as a source of supply and all the technologies related to it
- Residential water usage
- Stormwater capture, harvest, storage, treatment, and usage
- Stormwater pollution prevention/mitigation
- Recycled or reclaimed water—grey water, reclaimed water, purple pipe, etc.
- Hands-on piping and irrigation: plumbing, equipment and materials
- School water usage data analysis
- Plumbing and conservation careers

**Module 5.3: Building and Products Efficiency**
- Global consumption levels
- Architecture, construction, maintenance process
- LEED standards
- Products and appliances life cycle impact

**Module 6: Global Water and Energy Issues**
• Rising ocean levels
• Deforestation
• Increasing per capita energy needs
• Water scarcity
• Impacts of climate change
• Water pollution and treatment solutions

III. Accountability Determinants

A. Key Assignments: Labs
To create hands-on experiences which will deepen the learning experience, students will engage in a series of labs and projects, such as the following:
• Students will research, design, construct, and maintain a sustainable garden, or xeriscape, at their school site using developed knowledge and hands-on skills of agriculture, native planting, and waterwise irrigation methods.
• A schoolwide water audit in which students will calculate the average amount of water used by each toilet and faucet in the school; collaboratively compile the data into a comprehensive report to be published to their school, in which students will provide suggestions for decreasing potential, or found, water waste.
• Personal/household water and energy audits: Students will utilize water and electrical bills, as well as household and personal data to compile figures that summarize their water and electrical use.
• Deconstruct electronic products (e.g., cell phone, DVD player, computer, modem) to study the various components necessary to build such products; research the sources of these components, the environmental damage to acquire such materials, and the passageways of the materials to needed locations. Students will compile all findings into collective reports of the life of each manufactured product from raw materials acquisition to disposal, with attention to recycling and reuse.
• Students will create demo examples of renewable energy methods, such as a small-scale turbine.
• Students will study wastewater treatment methods through the construction of a small-scale model, after researching and visiting a wastewater treatment plant.
• Students across schools will collaborate in building a solar-paneled shed, cultivating their construction skills.

B. Assessment Methods
Approximately 40 percent of the grade will be based on direct hands-on work (labs, experiments, and projects), with another 30 percent involving a combination of independent and collaborative student work (on-line work and assessment). Demonstration of student progress, proficiency in
learned skills and topical knowledge, and work habits and cooperation, will be determined as follows:

<table>
<thead>
<tr>
<th>Area for Evaluation</th>
<th>% of Total</th>
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<tbody>
<tr>
<td>Attendance, behavior, participation</td>
<td>10%</td>
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<tr>
<td>Workforce Skills</td>
<td>10%</td>
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<tr>
<td>Journal Writing, Documentation</td>
<td>10%</td>
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<tr>
<td>Labs, experiments</td>
<td>15%</td>
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<tr>
<td>Service-Learning Projects</td>
<td>25%</td>
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<tr>
<td>Online Coursework &amp; Assessment</td>
<td>30%</td>
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Evaluative strategies will include formal and informal assessments will include (but not be limited to) the following:

- Presentations, independent or collaborative
- Performance-based activities and assessments such as experiments, demonstrations, discussions, debates, simulations, and projects
- Written evaluations, reflections, and analysis of performance-based activities
- Other written assignments, such as investigations, research (primary and secondary sources), justifications, and technical
- Written tests including multiple-choice, short answer, essay, and problem-solving questions
- Self- and peer-evaluations of work habits, collaboration, and cooperation

IV. Instructional Materials and Methodologies

A. Online Curriculum

This course will use instructional content from an online learning management system (based on the open source Moodle platform) that the Infrastructure Academy has developed. This content includes links to instructional resources (text, video, animations) from many different web sites, lesson plans for teachers, and assessments. This curriculum can be accessed here:

http://learn.infrastructureacademy.org
username: infrastructure
password: academy

B. Required Textbook(s)


C. Supplementary Materials

<table>
<thead>
<tr>
<th>Organization/Tool</th>
<th>Website</th>
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<tbody>
<tr>
<td>Los Angeles Department of Water &amp; Power</td>
<td><a href="http://www.ladwp.com/ladwp/homepage.jsp">http://www.ladwp.com/ladwp/homepage.jsp</a></td>
</tr>
<tr>
<td>Metropolitan Water District</td>
<td><a href="http://www.mwdh2o.com/">http://www.mwdh2o.com/</a></td>
</tr>
<tr>
<td>Books</td>
<td>Source/Author</td>
</tr>
<tr>
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<tr>
<td>2008 National Electrical Code</td>
<td>NFPA</td>
</tr>
<tr>
<td>Pipe Trades</td>
<td>Thomas W. Frankland</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplemental Text</th>
<th>Author/Organization</th>
<th>Website</th>
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</thead>
<tbody>
<tr>
<td>Cadillac Desert</td>
<td>Marc Reisner</td>
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<tr>
<td>Ecological Literacy</td>
<td>Stone and Barlow, eds.</td>
<td></td>
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<tr>
<td>Hot, Flat, and Crowded</td>
<td>Thomas L. Friedman</td>
<td></td>
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<tr>
<td>Our Choice</td>
<td>Al Gore</td>
<td></td>
</tr>
<tr>
<td>2006: California Global Warming Solutions Act</td>
<td>California Environmental Protection Agency</td>
<td><a href="http://www.arb.ca.gov/cc/docs/ab32text.pdf">http://www.arb.ca.gov/cc/docs/ab32text.pdf</a></td>
</tr>
<tr>
<td>1997: Kyoto Protocol</td>
<td>UN Framework Convention of Climate Change</td>
<td><a href="http://unfccc.int/resource/docs/convkp/kpeng.htm1">http://unfccc.int/resource/docs/convkp/kpeng.htm1</a></td>
</tr>
</tbody>
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**Video Resources**
1. “11th Hour,” Leonardo DiCaprio
2. “Cadillac Desert,” PBS
3. “Home,” EuropaCorp-Elzevir Films
5. “Liquid Assets,” WPSU
D. Instructional Methodologies
Students will engage in a variety of activities that balance direct instruction with project work. Students will be expected to apply the concepts and processes learned during direct instruction to their projects. Students will attend lectures, perform real-world projects, and participate in field trips, and have the opportunity to participate in summer employment opportunities in water conservation, energy efficiency, and others.

Methods of instruction will include:

- Hands-on learning opportunities using tools and scientific equipment
- Direct instruction (lectures, discussions, readings, and lab activities specific for mastery of content)
- Use of online curriculum including readings, videos, animations, and interactive tools
- Embedded assessments as a learning tool
- Student presentations, exhibits, and competitions
- Self-directed, cooperative, and collaborative learning to increase responsibility of students for their own learning
- Use of a variety of instructional materials and resources including electronic media, handbooks, professional journals, reference materials, and textbooks
- Participation in community-based research projects with professional mentors
- Field research projects in schools and communities to relate classroom topics to real-world applications, e.g. water usage and conservation techniques
- Service learning with younger students to share knowledge and engage younger students in applied research
- SDAIE (Specially Designed Academic Instruction in English)
- Development of language arts skills while students complete reports, journals, analyses, essays