CAREER TECHNICAL EDUCATION (CTE)
COURSE DESCRIPTION
(SECONDARY NON-ROCP)

Course Title: Environmental Technology 1A/B								
Prerequisite: Algebra 1, Geometry								
Teaching Credential/s Required:								
Course Level		**Introductory**	**x**	**Concentrator**			**Capstone**	
Course Number:	**361801/02**			**CBEDS NO.**	5691			
CBEDS Title:	**Energy and Environmental Technology**							
CTE Industry Sector:	Energy and Utilities							
Career Pathway:	Energy and Environmental Technology							
Course Description	The major emphasis of this course is on providing project based learning experiences in the application of environmental science and technology that address issues in water and energy. The course examines key issues and developments in the fields of sustainability, water conservation, renewable energy and energy efficiency. The use of data gathering, modeling and analysis to understand how computer modeling is used to predict the effects of energy and water consumption on climate change is stressed. The course also explores career applications and opportunities in the Energy and Environmental Technology pathway and builds usable skills for employment. Linked Learning opportunities exist between this course and courses in Science, Math, Social Studies and English Language Arts. The content of this course is aligned with the Model CTE Standards and California high school academic core content area standards.							
Instructional Hours	180 hours (two semesters)							

_____ Public Services

_____ Human Services

_____ Legal and Government Services

_____ Protective Services

_____ Transportation

_____ Aviation and Aerospace Transportation Services

_____ Collision Repair and Refinishing

_____ Vehicle Maintenance, Service, and Repair

- **Catalog Description**

Brief Course Description

NOTE: Briefly (in a short paragraph) describe the course, focusing on content, rather than instructional strategies, assessments, or rationale. If school has a catalog, enter the description that is in the catalog.

Environmental Technology 1AB introduces principles and applications of environmental science by focusing on water and energy issues. The course provides a scientific foundation for understanding water and energy issues facing the world today. Local, regional and global issues associated with water and energy are addressed as well as how increasing demands for energy and water resources will be met while balancing environmental, social and economic interests. Laboratory investigations are an essential component of the course.

Pre-Requisites: Algebra I, Geometry Required X ____ Recommended _____

NOTE: Laboratory science and Advanced VPA courses require a pre-requisite. Submissions will not be allowed if this is not included. Some courses, particularly in the mathematics subject areas, require appropriate pre-requisites. For further explanation, refer either to the "Guide to a-g Requirements" document or the a-g Interactive Guide web site at www.ucop.edu/a-gGuide.

Co-Requisites: Algebra II Required _____ Recommended X ____

- **Background Information**

NOTE: Do not include information that could identify your school or district.

Context for Course (optional) **REQUIRED FOR CTE COURSES**

NOTE: In order to understand the context for a new course, sometimes it is helpful for UC to understand the broader educational program and/or reform efforts of the school. How does this course fit into broader departmental and/or pathway structure? How does it fit into the overall school restructuring plans? Is the course intended to be a core course or supplemental? What are the student/school/community needs met by this course?

Environmental Technology 1AB consists of a rigorous science curriculum and is 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.

Through this inquiry-based course, students will have the opportunity to apply the scientific process to environmental issues. Projects allow students to 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 Technology 1 course retains the rigor, relevance, and relationships of quality instruction while ensuring that students develop scientific skills.

History of Course Development (optional) **REQUIRED FOR CTE COURSES**

NOTE: Likewise, it is sometimes helpful for UC to know the origins of a course and who was involved in its development. Did you consult with UC Admissions personnel or UC professors? If so, what was the nature of such consultation and what was the result? Was this course modeled after another course at another school? If so, is that course UC approved? How does the course being submitted differ from the course after which it was modeled? Has this course received any special recognitions, designations or awards? Has it been articulated to local community colleges or universities?

The Environmental Technology 1AB curriculum was developed and is supported by the Infrastructure Academy, a non-profit organization whose mission is to "build a pipeline of diverse, well-qualified young people for the career opportunities of the green economy." The Infrastructure Academy has been supported by the major utilities of Southern California; labor associations; a K-12 school district, charter schools, and a higher education institution; environmental organizations; and other policy, regulatory, and advocacy organizations and industries. Many of these organizations were intimately involved in the development of the curriculum because they are concerned about their future workforce and seek to encourage young people to pursue careers in sustainability, water, energy, and related sectors.

- **Textbooks**

NOTE: Include list of Primary and Secondary Texts. Make sure to note the books that will be read entirely and those that will be as excerpts. Textbook information is not necessary if your course is a Visual and Performing Arts, Advanced Placement or an International Baccalaureate course. Online texts or non-standard text materials should include a link to the online text

Textbook

Title: Living in the Environment

Edition: 16th

Publication Date: 2009

Publisher: Brooks/Cole Publishing

Author(s): G. Tyler Miller, Jr.

URL Resource(s):

Usage: x_____ Primary Text _____ Read in entirety or near entirety

(Be sure to list any additional textbooks that are used for the class.)

Supplemental Instructional Materials: *Please describe. If using online text or non-standard material, please provide the title of the material or webpage and the URL link.*

Organization/Tool	Website

Los Angeles Department of Water & Power	http://www.ladwp.com/ladwp/homepage.jsp
Metropolitan Water District	http://www.mwdh2o.com/
National Oceanic and Atmospheric Administration	http://www.noaa.gov/
U.S. Department of Energy	http://www.energy.gov/
Energy Information Administration	http://www.eia.doe.gov/
U.S. Environmental Protection Agency	http://www.epa.gov/
United States Geological Survey	http://www.usgs.gov/
Hippocampus	http://www.hippocampus.org/Environmental%20Science;jsessionid=152BA9B917540A9664666E103D800FD4

Book	Source/Author	Website
2008 National Electrical Code	NFPA	
Water Quality Standards Handbook	EPA	http://www.epa.gov/waterscience/standards/handbook/

Supplemental Texts

Text	Author/Organization	Website
Cadillac Desert	Marc Reisner	
Ecological Literacy	Stone and Barlow, eds.	
Hot, Flat, and Crowded	Thomas L. Friedman	
Our Choice	Al Gore	
2009: Waxman-Markey Global Warming Tax	U.S. House Committee on Energy and Committee	http://www.govtrack.us/congress/billtext.xpd?bill=h111-2454
2006: California Global Warming Solutions Act	California Environmental Protection Agency	http://www.arb.ca.gov/cc/docs/ab32text.pdf
1997: Kyoto Protocol	UN Framework Convention of Climate Change	http://unfccc.int/resource/docs/convkp/kpeng.html
1992: Agenda 21	UN Department of Economic and Social Affairs	http://www.un.org/esa/dsd/agenda21/res_agenda21_00.shtml

Video Resources

- "11th Hour," Leonardo DiCaprio
- "Cadillac Desert," PBS
- "Home," EuropaCorp-Elzevir Films
- "Inconvenient Truth," Participant Films
- "Liquid Assets," WPSU
- "Story of Stuff," http://www.storyofstuff.com/

Infrastructure Academy – Environmental Technology 1AB

Course Purpose: *What is the purpose of this course? Please provide a brief description of the goals and expected outcomes. (How these will be accomplished should be reserved for the Course Outline, Key and Written assignments, Assessments, and/or Instructional Methods.)*

NOTE: More specificity than a simple recitation of the State Standards is needed.

Environmental Technology 1AB introduces principles and applications of environmental science by focusing on water and energy issues. The course provides a scientific foundation for understanding water and energy issues facing the world today. Local, regional and global issues associated with water and energy are addressed as well as how increasing demands for energy and water resources will be met while balancing environmental, social and economic interests. Laboratory investigations are an essential component of the course.

Course Goals:

The course will provide students with the opportunity to:

- Use environmental science principles to understand the world around them
- Gain understanding on how scientific models are used to represent and explain phenomena in the physical world
- Examine key issues and developments in the fields of sustainability, water conservation, renewable energy and energy efficiency
- Apply the scientific process (observation, inference, experimental design and data analysis) to explore environmental issues in depth

Expected Outcomes:

After completing the course "students will":

- Develop an understanding of the pertinent environmental issues around water, energy and low impact development that affect our daily lives and the future of our planet and how applications of science can help find solutions
- Know the global carbon cycle: the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, fossil fuels, and the movement of carbon among these reservoirs.
- Understand the concept of sustainability and its underlying scientific principles
- Know how computer models are used to predict the effects of the increase in greenhouse gases on climate for the planet
- Recognize the importance of water conservation to society
- Know that energy appears in different forms, and can be transferred and transformed
- Understand the principles involved in the creation and passage of electricity; know the sustainable methods of garnering and distributing electrical energy.
- Understand environmental issues and how they are influenced by social, economic, and ethical issues
- 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.

Course Outline: A *detailed descriptive summary of all topics covered. All historical knowledge is expected to be empirically based, give examples. Show examples of how the text is incorporated into the topics covered. A mere listing of topics in outline form is not sufficient (i.e. textbook table of contents or California State Standards).*

Textbook - Living in the Environment, G. Tyler Miller, Jr., 16th ed., Brooks/Cole Publishing, 2009.

Unit 1: Environmental Principles

This unit introduces environmental science principles that give students a framework for understanding environmental issues that the world faces today. An emphasis is placed on how these principles are influenced by social, economic, and ethical issues. It also presents introductory energy and electricity concepts and

terminology necessary to understand how sustainable energy technologies work. Knowledge of these principles and concepts will prepare students to study and propose solutions to current environmental problems.

Topic 1:Natural Resources and Sustainability
Textbook chapter(s): Chapter 1 – Environmental Problems, Their Causes and Sustainability

This topic sets the stage for understanding the precipice upon which the survival of humanity delicately balances. Students will learn about the four scientific principles of sustainability and how these principles can be applied to create a more environmentally sustainable society. In addition, the concept of sustainability will be examined through the lens of economics (the Tragedy of the Commons). By taking a critical look at the linear system of "material goods" production, students will see exactly how their consumer choices directly impact the planet. This awareness allows students to better analyze where Earth's natural limits exist, and how, as educated humans, we must respond. Students will also have the opportunity to explore and measure the size of their personal impact on the planet (ecological footprint).

- Raw materials, production, use, disposal
- Economic externalities and the Tragedy of the Commons
- Causes of environmental problems
- Four scientific principles of sustainability
    - reliance on solar energy, biodiversity, nutrient cycling and population control
- What is green?
- Ecological footprint analysis

Topic 2: Introduction to Energy
Textbook chapter(s): Chapter 2 – Science, Matter, Energy and Systems

Students are introduced to concepts of energy and principles of electricity. Fuels, energy measurement and other key issues in energy production, and transmission are also covered.

- Definition of energy
- Kinetic and Potential Energy
- Forms of Energy
- First and Second Laws of Thermodynamics
- Measurements of energy
- Electricity
- Voltage, Current, Resistance (Ohm's Law)
- Power

Topic 3: Fossil Fuels & Climate Change
Textbook chapter(s): Chapter 15 – Nonrenewable Energy and Chapter 19 – Climate Change and Ozone Depletion

This topic examines the differing impacts that coal, oil, and natural gas (nonrenewable energies) have in generating greenhouse gases. Students also learn about the scientific process and evidence behind global warming and predictions for climate change.

- Fossil fuels resources
- Carbon usage
- Environmental advantages and disadvantages of fossil fuels
- Global warming effects and scientific evidence
- Greenhouse gases and the Greenhouse effect
- Reducing climate change

Unit 2: Solutions to Environmental Problems
The unit focuses on existing solutions to environmental problems including renewable sources of energy, energy efficiency and low-impact development designs. Students will have the opportunity to design models of sustainable

efficiency and conservation applications and create their own designs.

Topic 1: Energy Efficiency and Renewable Energy
Textbook chapter(s): Chapter 16 – Energy Efficiency and Renewable Energy

Wind, solar, hydro-electric, geothermal, and biomass energy are different sources of clean, renewable energy. Students learn to differentiate between renewable sources of energy and begin to explore the best applications and uses for each. Energy efficiency has received tremendous recognition recently as the most cost-effective way to reduce energy production and greenhouse gases. Techniques for improving building energy efficiency will be explored.

- Types and technologies of renewable energy (wind, solar, hydro, biomass, geothermal)
- Growth projections for renewable energy
- Residential energy usage
- Distributed generation
- Energy efficiency opportunities
- Smart grid

Topic 2: Water Conservation and Reuse
Textbook chapter(s): Chapter 13 – Water Resources

Water conservation techniques including water fixtures, landscaping, irrigation, and behavioral changes will be explored. The topics addressed will increase students' awareness of the concepts of water conservation and reuse. Students will also compare the Southern California's per capita water usage with that in other arid regions. Students will appreciate how and why we need to use less of our most precious natural resource.

- Conservation: as a source of supply and all the technologies related to it
- Residential water usage
- Stormwater capture, treatment, and pollution prevention
- Recycled or reclaimed water—gray water, reclaimed water, purple pipe
- Hands-on piping and irrigation: plumbing, equipment and materials
- School water usage data analysis

Topic 3: Low Impact Development
Textbook chapter(s): Chapter 22 – Sustainable Cities

Low Impact Development (LID) is an integrated site design approach for addressing hydrologic and environmental impacts often associated with conventional land development. Students will examine LID design principles and apply them to a site design and a sustainable garden. Sustainable landscaping will also be

- Low impact development – definition and principles
- LID urban design strategies – rain gardens, rain barrels, permeable pavement, green roofs
- Native landscaping – California friendly plants
- Organic growing
- Sustainable landscaping

Laboratory Activities: *Acceptable courses include hands-on scientific activities that are directly related to and support the other classwork, and that involve inquiry, observation, analysis, and write-up. These hands-on activities should account for at least 20% of class time, and should be listed and described in detail. Please itemize and describe each laboratory activity in detail.*

Students will engage in a series of labs designed to create hands-on scientific experiences connected to the course topics. The inquiry-based labs vary in duration and allow students to think critically about experimental design and use evidence as a basis for explanations. All labs start with a guiding question to help students with the inquiry process. Labs will cover at least one day per week (20% of class time).

Natural Resources and Sustainability

How does my own energy use affect the environment?
This activity gives students the opportunity to examine their personal energy usage and the impacts their habits have on the environment. Students will collect data to analyze their personal energy consumption and calculate the cost of different forms of energy and energy production rates. Students will identify the major sources of energy consumption and will propose detailed suggestions based on data about how they can conserve energy by changing patterns of energy consumption.

Fossil Fuels and Climate Change

How does the greenhouse effect affect the earth?
Students will design an experiment that will compare the temperatures of heated air to a heated greenhouse gas (carbon dioxide). Students will measure the difference carbon dioxide makes to the amount of heat retained in a simulated atmosphere. This lab allows students to understand, make inferences and draw conclusions on how greenhouse gases affect our atmosphere.

Introduction to Energy

What is the relationship between potential and kinetic energy?
The goal of this lab is to help students understand the relationship between potential and kinetic energy. Students will learn about mechanical energy by analyzing and recording the amount of work done by three different objects and will hypothesize about the reasons for the differences. Students will also identify examples of storing and using energy in our environment.

How is chemical energy converted to electrical energy?
This lab focuses on how chemical energy is converted to electrical energy. Students will make functional electrical cells using gelatin and other materials that will be used to power a small electric motor. Students will determine the relative strength of each type of cell.

What is the relationship between voltage, current, and resistance?
The purpose of this lab is to investigate the relationship between current (I), voltage (V) and resistance (R). Students will design a circuit and perform measurements that will allow them to experimentally confirm Ohm's Law (V=IR).

How much power can a human-powered generator produce?
This lab gives students the opportunity to apply the energy concepts they have learned in this unit. Students will build a human-powered generator (using a bicycle) and measure how much power it can produce. . Additionally, they will hypothesize what types of items and appliances their generator can power. This lab serves as a way to assess students' knowledge of energy and electricity

Energy Efficiency and Renewable Energy

What factors affect the output of wind turbines?
Students will first examine factors that may determine the amount of power a wind turbine produces. They will then design and test blades that extract as much energy from a wind turbine as possible throughout a range of wind speeds.

How is solar radiation reflected and absorbed by different surfaces?
In this lab students will analyze how solar radiation is absorbed and reflected by building a solar oven. They will also model the greenhouse effect and global warming to their advantage as they heat an oven. Students will explore different components of the solar oven and evaluate how each variable contributes to the collection of heat within the oven.

Which vegetable oils are best for use as biodiesel?
In this experiment, students will evaluate four different kinds of vegetable oils and recommend which is best for using in a biodiesel engine. Students will develop an experiment to determine the relative melting points of the four unknown oils and will compare the physical changes of each.

Water Conservation and Reuse

Can plants tolerate recycled gray water?
The goal of this lab is to investigate the effects of gray water on plant growth and health. As part of this lab, students will design an experiment that will compare plants that are watered with gray water to those watered with drinking water. By making recording daily changes on plant growth and health, students will determine the effects of gray water on plants and conclude if this type of water can be used for plants.

How much water does my school consume?
Students will perform a school-wide water audit in which they will calculate the average amount of water used by each toilet and faucet in the school. Students will collaboratively compile the data into a comprehensive report to be published to their school, and will provide suggestions for decreasing potential, or found, water waste.

Key Assignments: *Detailed descriptions of all Key Assignments which should incorporate activities and projects, as well as, short answers and essay questions. How do assignments incorporate topics? Include all assignments that students will be required to complete. Assignments should be linked to components mentioned in the course outline. It is not appropriate or necessary to include instructions given to students regarding the execution of assignments (formatting, timeliness, etc.). Do not include exams or assessments in this section.*

Natural Resources and Sustainability

Tragedy of the Commons Simulation
The purpose of this activity is to explore how resources are used and exploited when they are available to multiple parties. The "tragedy of the commons" is the situation in which individuals use a common resource for their own personal gain and degradation of the common resources results, leading to a decrease in yield for both the group and the individual. In small groups, students will go through a simulation activity that will help them explore this situation.

Natural Cycles Poster Activity
Students will be divided into small groups. Each group will be assigned to create a poster illustrating one of the following environmental problems: 1) Carbon dioxide from fossil fuel combustion, 2) Non-native plants and water overconsumption, and 3) Wasting water. Groups will hang their posters in class and all students will have the opportunity to comment on them.

Electronic Product Deconstruction Project
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.

Introduction to Energy

Science of Energy Activity
The goal of this activity is for students to understand the main forms of energy, differentiate between forms and sources of energy and explain energy transformations. This activity is designed so that the teacher introduces and first gives several demonstrations of the forms of energy activities. Students will rotate in groups through stations and complete activities for each. At each station, groups will discuss activities and each student will complete a science journal entry about each form of energy.

Fossil Fuels and Climate Change

Mining for Oil, Gas and Coal Activity
In this activity, students will familiarize themselves with the different methods of fossil fuel extraction. Pairs of students will perform an activity designed to simulate the extraction of oil from beneath the earth's surface. After this activity, each student will research other methods of oil extraction and will write a report documenting the pros and cons of each method according to safety concerns, environmental impacts and economic feasibility.

Atmospheric CO_2 Levels Exercise
Using Atmospheric carbon dioxide concentration data, students will create graphs of year versus concentration of carbon dioxide and year versus the average global temperature. Students will use these graphs to complete short answer questions related to carbon dioxide levels after the Industrial Revolution and to determine other factors that have contributed to average global temperature.

Renewable Energy and Energy Efficiency

Power From the Earth Project
This project will focus on increasing students' knowledge of existing hydropower and geothermal power plants in the U.S. Each student will research a different hydroelectric or geothermal site and will design a presentation containing a description of the site, how it generates energy, amount of power generated and how energy is stored and distributed. In small groups, students will make presentations to each other.

Energy Trade-Offs Project
In this group activity, students will evaluate the advantages and disadvantages of the energy sources used to generate electricity by developing energy plans for a fictitious country and presenting the plans to the class. The activity includes a limited number of variables. The goal is for students to recognize and evaluate the economic, environmental, and societal trade-offs of the major energy sources used to generate electricity.

Water Conservation and Reuse

Water Availability, Usage and Future Demand Research Project
Students research historical and projected local water resources. Using this data, they construct graphs to predict the availability and demand for water fifty years from now. Students will write a report describing local water resources, identifying different water consumers, and discussing how increased water demand can be met through conservation and new water infrastructure in the most cost effective way.

Square Foot Cube Activity
The purpose if this activity is to give students an intrinsic understanding of volume, in measurable terms of cubic inches and cubic feet. Since water is specifically measured in 'cubic feet' and 'acre feet,' this activity lays a tangible foundation for students to fully understand water measurement in a standard, scalable volume. The critical skill of conceptualizing volume (especially of water) is essential to water conservation techniques and advocacy. In teams of three, students will construct a square foot cube and will answer questions related to water measurements.

School/Community Stormwater Pollution Prevention Project
To investigate the ways in which their school or community may be contributing to stormwater pollution, small groups of students will survey different areas and identify potential risk areas in the day-to-day operation of the school and/or community. After identifying risk areas, students will design and develop outreach materials such as a brochure, fact sheet, article or poster identifying a stormwater problem and suggesting a solution for community members to address the problem.

Low Impact Development

Low-Impact Development Design Project
This project aims to have students apply low-impact development principles to a landscape design. Students will identify a landscape site at their school that would benefit from LID techniques. Students will then propose a solution for the site and submit a report detailing their proposals and designs.

Xeriscape
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.

Instructional Methods and/or Strategies: *Indicate how the Instructional Methods and/or Strategies support the delivery of the curriculum. What portions of the Course Outline are supported by the methods and strategies?*

Students will engage in a variety of activities that balance direct instruction with laboratory work. Students will be expected to apply the concepts and processes learned during direct instruction to their assignments. Students will attend lectures, perform real-world projects, and participate in field trips, and have the opportunity to explore opportunities in water conservation, energy efficiency, and renewable energies.

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 interactive tools such as videos and animations to demonstrate concepts and introduce topic areas
- Simulation activities where students are able to experience consequences of their behavior and decisions
- 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

Assessments Including Methods and/or Tools: *Indicate the intent of each assessment and a brief description of how each relates to the Course Purpose and goals related to the development of critical thinking and other habits of mind skills.*

Approximately 40 percent of the course 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 (presentations and assessments). Demonstration of student progress, proficiency in learned skills and topical knowledge, and work habits and cooperation, will be determined as follows:

Area for Evaluation	% of Total
Attendance, behavior, participation	10%
Presentations (Individual and Collaborative)	10%
Writing Assignments (Journals, reports, reflections)	10%
Labs and experiments	15%
Course Projects	25%
Assessments	30%

Evaluative strategies, including 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, labs,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
- Assessments including multiple-choice, short answer, essay, and problem-solving questions
- Self- and peer-evaluations of work habits, collaboration, and cooperation