Course Proposal: The Global Environmental

College: Science and Mathematics
Proposer: Randy Knight/Physics on behalf of members of the Provost’s Seminar on Global Change
E-mail: rknight@calpoly.edu 6-1663
Date: January 14, 2002 - Revised March 30, 2002

Experimental: ☐
Subtitle: ☐
Begin Date: 2003-04

<table>
<thead>
<tr>
<th>I. Summary Description</th>
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<tr>
<td>1. Course Prefix, Number, Title: SCM 350 The Global Environment</td>
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<td>2. Catalog Description (substantive, but no more than 40 words of content description)</td>
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<tr>
<td>An interdisciplinary investigation of how human activities impact the Earth’s environment on a global scale. Examination of population, resource use, climate change, and biodiversity from scientific/technical and social/economic/historical/political perspectives. Use of remote sensing maps. Sustainable solutions. 3 lectures, 1 activity. Prerequisite: Completion of GE Areas A and B and junior standing.</td>
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<tr>
<td>3. Total Course Units: 4</td>
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<td>Number of units per mode of instruction:</td>
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<td>Lec 3</td>
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<td>Lab</td>
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<td>4. Grading Type:</td>
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<tr>
<td>Regular ☒</td>
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<tr>
<td>Credit/NC ☐</td>
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<td>5. Distance Education (DE):</td>
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<tr>
<td>No ☒</td>
</tr>
<tr>
<td>Yes ☐ If yes, % taught via DE. (see Draft DE Policy, under review)</td>
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<td>6. General Education (GE):</td>
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<td>No ☐</td>
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<tr>
<td>Yes ☒ If yes, GE Area: F</td>
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<td>7. United States Cultural Pluralism (USCP):</td>
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<tr>
<td>No ☒</td>
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<td>Yes ☐ If yes, refer to USCP criteria.</td>
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<td>8. Service Learning (SL):</td>
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<td>Proposed SL course?</td>
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<tr>
<td>No ☒</td>
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<td>Yes ☐</td>
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</table>
9. Prerequisite/Co-requisites: *(note: 300-400 level courses must have prerequisite)*
   Completion of GE Areas A and B and junior standing.

10. Cross-listed Course:
    No ☐
    Yes ☒
    If yes, indicate other course prefix and number: AG 350/BUS 350/EDES 350/ENGR 350/HUM 350/SCM 350.

    Is the course repeatable for multiple credit?
    No ☐
    Yes ☒

    Variable Course Content (Subtopics with Different Titles):
    No ☐
    Yes ☒

    Replacement Course: *(meets prior course requirement & repeats)*
    No ☐
    Yes ☒

14. Course Classification Number(s) C/S#:

II. Explanation

A. Proposed for Major, Minor, Support, Certificate or Credential Program(s)?

    Major, required (if yes, specify): No ☐ Yes ☒
    major, elective (if yes, specify): No ☐ Yes ☒
    concentration (if yes, specify): No ☐ Yes ☒
    specialization (if yes, specify): No ☐ Yes ☒

    Minor (if yes, specify): No ☐ Yes ☒ Proposed Minor in Environmental Studies
    Support for other programs (if yes, specify): No ☐ Yes ☒
    Certificate programs (if yes, specify): No ☐ Yes ☒
    Credential programs (if yes, specify): No ☐ Yes ☒

B. Need
   Briefly explain the need for this new course, and describe how it fits into the programs checked above and their missions and strategic plans.

   This is intended as an Area F capstone course that synthesizes technical and nontechnical thinking about issues of contemporary significance. It fills the need for capstone courses. In addition, it is needed as a required course for the proposed new Minor in Environmental Studies. Its role within the minor is to integrate the discipline-specific knowledge students have acquired in the other courses required for the minor into a holistic, functional relationship.

C. Prerequisites
   Briefly explain the reason for any prerequisites or co-requisites for the course.
   Course topics (energy, mapping, growth models, climate, biodiversity, etc.) depend on a basic understanding of mathematics and biological/physical science. In addition, this is a course with an extensive writing requirement.

III. Syllabus
For courses with multiple sections, faculty and/or subtopics, describe the consistent principles or key elements that will inform all sections regardless of the subtopic or faculty who will teach the course by providing a representative sample of a syllabus.

A. Learning Outcomes
What should students know or be able to do after taking this course?

Students will meet the GE Area F educational objectives to
E1. understand the relationship between technology and its scientific basis.
E2. understand and be able to articulate the considerations (which may include scientific, mathematical, technical, economic, commercial, and social) that are necessary for making rational, ethical, and humane technological decisions.

Students will
C1. build upon their Area B Foundation.
C2. learn about one or more areas of technology.
C3. develop an awareness of how basic scientific and mathematical knowledge is used to solve technical problems.
C4. develop an awareness of the methods used and difficulties inherent in applying technology to solve social, economic, scientific, mathematical, artistic, and/or commercial problems.
C5. address the ethical implications of technology.
C6. make a critical examination of technology from multiple perspectives.
C7. obtain an historical, contemporary, and future-looking perspective of the technology.
C8. express their ideas in writing.

More specifically, after taking this class, students will be able to explain:
L1. how and where human activities impact the earth’s environment on a global scale.
L2. how global issues of population, resources, climate, and biodiversity are interconnected.
L3. how environmental issues have both scientific/technical and social/political/ethical/economic aspects.
L4. how global measurements and mapping technologies are based on scientific principles.
L5. how energy is transformed from raw materials into electricity and liquid fuels.

After taking this class, students will be able to:
L6. access, interpret, and use global maps.
L7. evaluate evidence and information about environmental issues.
L8. integrate and synthesize information from multiple disciplines.
L9. apply problem-solving strategies using techniques from multiple disciplines to complex problems involving both natural and human-constructed systems.
L10. work with others from different backgrounds to pose and evaluate solutions to complex problems.

B. Course Content
Provide a week-by-week outline (readings, discussion topics, lab experiments, activities, assignments, etc.)

**Topic 1: Overview of global environmental issues**
**Time:** 1 week  
**Content:** What is meant by a global perspective?  
How/where are humans affecting/altering the earth?  
Contrast/compare the situation in the developed world and the developing world.  
Using data.  
Finding solutions.  
The concept of sustainability.  

Technology component: Introduction to the idea of technology. Technology in the developed and developing world.  

**Reading:** Hardin The Tragedy of the Commons (essay)  
Schneider Laboratory Earth (excerpts)  

**Activity:** General discussion of global issues.  
**Area F:** C3, C7

**Topic 2: Maps and mapping technology**
**Time:** 1 week  
**Content:** Types of maps.  
Remote sensing science and technology.  
Measuring the earth.
Finding maps on the internet.
Interpreting and using maps.

**Technology component:** The science and technology of remote sensing. Accessing, interpreting, and using maps.

**Reading:**
- NASA on-line tutorial on remote sensing
- Scientific American articles on remote sensing and mapping technology

**Activity:** Practice acquiring and interpreting various types of maps.

**Area F:** C1, C2

**Topic 3: Population and food**

**Time:** 1 week

**Content:**
- Historical information on population.
- Exponential growth and other growth models.
- Demographic projections of future population.
- Population issues in the developed and the developing worlds.
- Feast or famine? Malthus revisited.
- Land use, agriculture, food production.

**Technology component:** Food production in developed and developing nations. Mapping of land use.

**Reading:**
- Reports from the Worldwatch Institute
- Bouvier and Bertrand *World Population: Challenges for the 21st Century* (excerpts)
- Essays on the successes and failures of the “Green Revolution” in the developing world

**Activity:**
- Mapping of population density and land use.
- Discussion of population issues.

**Area F:** C2, C4, C5

**Topic 4: Energy and resources**

**Time:** 2 weeks

**Content:**
- Energy use: How much energy is used, and for what purposes?
  - Energy supply: Where does energy come from? Basic types of energy (fossil, nuclear, solar, etc.).
  - Energy technologies: How is energy transformed from raw materials into end-user products?
  - Energy futures: What are the options for future energy sources?
  - Other resources, especially water and minerals.
  - Impacts of resource use, especially air and water pollution.
  - Resource efficiency and conservation.
  - Connections between energy/resource use and economics, standards of living, and quality of life.
  - Global oil politics.

**Technology component:** Technology of energy production, transformation, and utilization.

**Reading:**
- Excerpts from various textbooks on energy and the environment
- On-line data (Department of Energy) regarding energy supplies and uses
- Hawken, Lovins, and Lovins *Natural Capitalism* (excerpts)

**Activity:**
- Mapping of energy use, water quality, air quality (e.g. acid rain and forest destruction).
- Discussion of energy issues.

**Area F:** C1, C2, C3, C4, C5, C7

**Topic 5: Climate change and global warming**

**Time:** 1.5 weeks

**Content:**
- The earth’s energy balance
  - How might human activities affect the climate?
  - Evidence that human activities are affecting the climate.
  - Future scenarios of global warming.
  - The technology, economics, and politics of responding to climate change.

**Technology component:** Resource technologies that contribute to or mitigate against climate change.

**Reading:**
- Schneider *Global Warming* (excerpts)
- Houghton *The Science of Climate Change* (excerpts)

**Activity:**
- Mapping of temperature and precipitation.
- Discussion of climate and climate change.

**Area F:** C1, C2, C3, C4, C5, C7

**Topic 6: Biodiversity and Extinction**

**Time:** 1.5 weeks
| Content: | What is biodiversity? Why is it important?  
Ecosystem services and functions.  
The species-area relationship.  
How might human activities affect biodiversity?  
Evidence that human activities are affecting biodiversity.  
Connections between biodiversity and population/land use/agriculture/global warming.  
Options for preserving biodiversity.  
Technology component: Land use and agriculture technologies that impact biodiversity. Mapping of species distributions, deforestation, and urban growth.  
Reading: Wilson *The Diversity of Life* (excerpts)  
Eldredge *Life in the Balance* (excerpts)  
Quammen’s *Song of the Dodo* (excerpts)  
Activity: Mapping of species distributions, deforestation, and urban growth.  
Discussion of biodiversity.  
Area F: C1, C2, C3, C4, C5, C7 |
| Topic 7: | **Environmental Ethics** |
| Time: | 1 week |
| Content: | Are humans part of or apart from nature?  
Needs versus wants.  
Value systems  
Compare/contrast the perspectives of the developed world and the developing world.  
Technology component: Critique of technology.  
Reading: Leopold *The Land Ethic* (essay)  
Zimmerman *Environmental Ethics* (excerpts)  
McKibben *The End of Nature* (excerpts)  
Activity: Discussion of how environmental decisions depend on values and ethics.  
Establishment of a basis for planning and decision making.  
Area F: C4, C5, C6 |
| Topic 8: | **Solutions and sustainability** |
| Time: | 1 week |
| Content: | Finding solutions that allow humans to live happy, prosperous, meaningful lives without destroying or permanently damaging the earth.  
The role of growth, development, and technology in a sustainable society.  
The politics and economics of changing the status quo.  
Technology component: Technologies that promote sustainability.  
Reading: Pough, Costanza, and Daly *The Local Politics of Global Sustainability* (excerpts)  
Roseland *Toward Sustainable Communities* (excerpts)  
Warkentin *Reshaping World Politics: NGOs, the Internet, and Global Civil Society* (excerpts)  
Activity: Discussion of how to achieve a sustainable future.  
Area F: C3, C4, C5, C6, C7 |

**Comments**

We propose to cross list this course in all colleges, using the college-level prefixes. Each of the listed sections will be scheduled for the same room and time, forming a single class. The rationale for this proposal are:
- To indicate this is an interdisciplinary course in the broadest sense of the term. We wish it to appeal equally to students from all colleges.
- To support the proposed new Minor in Environmental Studies, for which this will be a required course.
- To support team-teaching with faculty from different colleges. It will be easier to justify assigning faculty to the course if they are teaching a course listed in their own college and if SCUs accrue to their college.

A trickier logistical problem, but one we feel can be solved, is to ensure that students from the different colleges are uniformly mixed in the six activity sections.

We recognize this is an unusual request. We hope to be able to work with the college curriculum committees and Academic Affairs to find a way to make this happen.

The subject matter is intentionally broad, not deep. Full courses are taught at Cal Poly on topics covered in one week. Indeed, no one of the faculty teaching this class is an expert on all of the topics. This is by design. Citizens of the 21st
century will have to deal with complex, multidisciplinary issues with few experts. The hallmark of an educated leader will be the ability to gather information, examine evidence, reason critically, and make informed judgements in the face of incomplete information. This is an acquired skill, one developed through practice. The students who take this course will have completed at least half their Cal Poly coursework and all of their Area B math and science courses. This course will challenge them to draw on everything they’ve learned to make sense of a vast quantity of information coming at them quickly. The group project will enable them to combine their knowledge with students from other backgrounds to develop a whole that is more than the sum of the parts. In other words, this is a capstone course in every sense of the word.

A list of topics inherently suggests a linear sequencing of information. In practice, we hope to present the information more as a web of interconnected ideas. Two important goals of this course are:
- To integrate and synthesize various strands of information, as is the function of a capstone course.
- To see the interconnectedness of these ideas.

To meet these goals, each of the topics will refer (both backward and forward) to the other topics. As an example, consider energy and resource use.
- Energy demand, now and in the future, is linked to population.
- One likely consequence of an increasing population is more energy use, more fossil-fuel burning, and thus increased global warming.
- Increased global warming will likely have negative consequences for biodiversity.
- Energy use is linked to our standard of living. Can the developed world deny the developing world the opportunity to increase substantially its energy use? (An ethical and political question.)
- Many of the technologies of the Green Revolution are energy and fossil-fuel intensive. Can developing nations continue to feed their populations as we exhaust our fossil fuels?
- What sustainable ways can be developed to meet energy and resource needs? (A technical and an economic question.)

Many other examples of interconnectedness could be cited. The group projects will be structured to focus students’ attention on these interconnections.

It’s all too easy for courses about the environment to be swayed by political/economic/philosophical beliefs. One theme running throughout the course is the need to base knowledge and decision making on evidence. This is an essential aspect of critical thinking. The course will examine the best current evidence as to whether global problems exist, what the real issues are, and what potential solutions might be available or developed in the future. This is not a course with a predetermined outcome or point of view.

The nature of the course requires team teaching. As noted, no faculty members (or at least extremely few) are expert and up-to-date on all the topics this course will address. Team teaching serves two important goals:
- It increases the amount of faculty expertise available in the classroom and for the students.
- It brings in different points of view and different methodologies.

The second point may be more important than the first in teaching students how to grapple with complex issues.

We anticipate three faculty members will teach a large lecture of roughly 150 students. Because the course is cross listed in all colleges, students will enroll under the label of their college. Because the student-faculty ratio is 50-to-1, more than in many upper-division classes, each faculty member can receive 3 WTUs for the three-hour-a-week lecture. Lectures will be for the purpose of dissemination of basic information, and the three faculty will share these duties.

The heart of this class will be the opportunity for students from different majors, different backgrounds, and different points of view to interact with each other in discussion and debate. This should be the essence of a capstone experience. Because such discussion cannot occur in a large lecture, students will meet for two hours a week in activity sections of roughly 25. Each of the three faculty members will have overall responsibility for 2 of the 6 activity sections. The activity sections will serve three other purposes. Early in the quarter, the activity section will provide explicit hands-on instruction on acquiring and using maps. Later in the quarter, activity sections will provide student groups some time to meet together and discuss the project they are working on. Some activity sections may use field trips to see environmental actions being taken at Cal Poly or the nearby community.

This will be a required course for students in the proposed Minor in Environmental Studies. A survey of student interest has found possibly 200 or more students per year might be enrolled in this minor. In addition, a large demand is likely from other students seeking to meet their GE Area F requirement. We initially plan to offer the course twice a year, serving roughly 300 students. With experience, we’ll adjust the frequency and the size of the course to match student demand.
GE Area F

This course is being proposed as a GE Area F course. Area F educational objectives E1 and E2 are met throughout the course, as are criteria C1, C9, C10, and C11. Criterion C8 is met through the two essays and the larger group project report.

Students will receive instruction about two areas of technology. (Criteria E1, C1, C2, and C3)

- First is the use of remote sensing to produce global maps of the earth’s characteristics and resources. Students will learn the scientific principles of remote sensing and mapping technology. In addition, they will learn to access and interpret data and maps on the internet. This aspect of the course will allow information to be far more up-to-date than any textbook.
- Second is energy technology. Students will explore the properties of various fuel and energy resources and learn the processes that transform energy from its “raw” form to useable electricity and liquid fuels. In the process, they will learn the benefits and risks of different forms of energy use.

These technologies will be the basis for studying three global issues of contemporary importance: population, global climate change, and biodiversity. (Criteria E2, C3, C4, C5, C6, C7)

- Students will interrelate energy, resources, and population with the needs of a society for food, shelter, clothing, and an acceptable quality of life. Students will look at ways in which wastes and pollution can be minimized.
- Students will interrelate the biodiversity of various ecosystems with the threat of global warming. Technical, economical, and political issues will be addressed.
- Students will explore possible solutions by assessing the physical and economic constraints and the political and ethical dimensions of decision making. The concept of sustainability will be used to discuss the allocation of resources in a manner that provides food, employment, and a meaningful life for all people.

C. Assessment Methodologies

List and describe the assessment methodologies that will be used to determine the extent to which students have achieved the learning outcomes listed in Section III.

The following assessment methods address the GE Area F educational objectives (E), the Area F criteria (C), and the learning objectives listed in Section III (L).

1. Three homework assignments on the topics
   i. Mapping,
   ii. Population/energy/resources,
   iii. Climate change/biodiversity.

   The homework will emphasize basic factual information from the reading/lecture and assess whether students have learned to access and interpret global maps.

   Objectives and criteria E1, C1, C2, C3, L1, L2, L3, L4, L5, L6.

2. Two short essays (approximately 2000 words) on the general topics
   i. Population/energy/resources,
   ii. Climate change/biodiversity.

   Specific topics (which will have to be tightly focused) will need to be approved in advance by the activity instructor. Essays should draw upon knowledge from Area B courses, from information presented in this course, and should make use of mapping.

   Objectives and criteria E1, C3, C4, C8, L1, L3, L7, L8, L9.

3. A major report (approximately 10,000 words) done as a group project with 2 or 3 other students. Groups will be formed of students from different colleges and majors to broaden the group’s total expertise and knowledge. The project should investigate the causes of a global issue, including both technical and nontechnical dimensions, and the possible approaches to dealing with it. The report should demonstrate multidisciplinary thinking.

   Objectives and criteria E2, C5, C6, C7, C8, L1, L3, L8, L9, L10


5. A final exam with fill-in-the-blank and short answer questions plus a longer essay question.

The homework, essays, and group project will be handled in the activity sections and graded by the activity instructor. The exams will be given in lecture and will be the same for all students.

The writing assignments (essays and major report) will be approximately 35% of the grade.
IV. Consultation

A. Attach signed concurrence memos from any other departments that will be affected by the new course or its prerequisites.

NA

B. List all courses that already cover any significant part of the planned subject matter of this course either within the department or from other departments. Explain why duplication of subject matter is necessary. Attach signed concurrence memos from any other departments with which there will be significant duplication.

Many courses touch upon a portion of the planned subject matter. As far as we can judge, none have a significant overlap. Certainly, none approach the subject matter in the interdisciplinary, capstone fashion of this course.

V. Resources (in consultation with the College Dean/Associate Dean)

A. Explain the impact of this new course on allocation of current/new resources.

   Equipment (List new equipment needed, and amount and source of funds.) None

   Supplies (List new supplies needed, who will need to purchase the supplies [i.e., students, department], and amount and source of funds.) None

   Facilities (List type of teaching environment needed.)
   “Smart Room” lecture hall seating 150 or more with computer projector and ethernet access.

   Faculty (List faculty members who will initially teach the course, and explain how the time needed for them to teach this course will be made available.)

   The following faculty have expressed an interest in teaching this course and had input into this proposal. Because it will be team taught, three will teach the initial offering. Those three have not yet been determined.

   Faculty  College  Rank
   Walt Bremer  Architecture  Professor
   David Braun  Engineering  Assoc. Professor
   Alypios Chatziioanou  Engineering  Professor
   Doug Cerf  Business  Professor/Assoc. Dean
   David Chipping  Science and Math  Professor
   Dianne DeTurris  Engineering  Assist. Professor
   Bud Evans  Liberal Arts  Lecturer
   Eugene Jud  Engineering  Lecturer
   Brian Kesner  Architecture  Professor
   Randy Knight  Science and Math  Professor
   Richard Lee  Architecture  Assist. Professor
   Brook Muller  Architecture  Assist. Professor
   Tim O’Keefe  Agriculture  Professor
   John Phillips  Agriculture  Professor
   Tom Ruehr  Agriculture  Professor
   Tal Scriven  Liberal Arts  Professor

   Time to teach the course will be through the willingness of deans and department chairs.

   Library or Information Technology (List new periodicals required for initiation and conduct of the course, and number of new volumes of books required; estimate the costs involved. List computer facilities and software needed, and amount and source of funds.)

   None

B. For Department and College Planning Purposes:

   Estimated number of students in one section of this course? 150 in lecture/25 in activity sections
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<th>Estimated number of sections offered:</th>
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<td>each quarter:</td>
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<td>each year: 2 lecture sections (fall and spring), each with 6 activity sections</td>
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VI. Approval Signatures

The colleges acknowledge that this proposal will establish a course with college-level prefixes. These signatures do not constitute final approval by the colleges. Final approval, by signature of the College Dean, will be subsequent to approval by the College Curriculum Committee.

College of Agriculture:

College of Architecture and Environmental Design:

College of Business:

College of Engineering:

College of Liberal Arts/Humanities Program:

College of Science and Math:

College Curriculum Chair:

College Dean:

(This signature is the Dean's guarantee that s/he will provide any additional resources needed to support this course.)

Vice Provost for Academic Programs: