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Geological Sciences
College of Science

Date: July 26, 2016

To: Dr. Alison Baski, Dean, College of Science

cc. Dr. Daniel Lewis
Dr. Robert Kerbs
Dr. Tina Hartney

From: Dr. Jonathan Nourse, Chair
Geological Sciences Department

Subject: Geology Department Response to External Academic Review of Geology MS Program

Please find attached our collective department response to the external evaluators' report on our Geology MS program. These comments are approved by all full-time Geology faculty members who teach graduate courses:

Dr. Jonathan Nourse, Professor, Department Chair, and Graduate Coordinator

Dr. Jeffrey Marshall, Professor

Dr. Jascha Polet, Professor

Dr. Stephen Osborn, Associate Professor

Dr. Nicholas Van Buer, Assistant Professor

Dr. Bryan Murray, Assistant Professor

We hope to discuss this with you soon, as there is some urgency given the proposed tuition increase for the self-support part of our graduate program.

Geology Department Response To External Evaluators' Report

July 26, 2016

We appreciate the constructive and insightful review by the external evaluators. Among many positive attributes, they commend our Geology MS program for its development of a talented and diverse cohort of graduate students, the focus upon niches of water, geophysics, and earth exploration highly relevant to southern California needs, and recruitment/retention of highly qualified, hard-working faculty members. They emphatically reaffirm that a written scientific thesis as a culminating experience is the standard for all reputable Geology MS programs and an expectation of industry employers. However, funding of the thesis courses, which by their very nature are low-enrollment and labor-intensive, requires new approaches that we address in detail in this response.

A primary focus of the review was to offer possible solutions to financial issues encountered as a result of the implementation of Master's program in a self-support mode. The evaluators recognize that "the extra cost has an unintended consequence of inhibiting growth and restricting access to the program for highly qualified, underrepresented students with limited finances. This is in conflict with two of the most important aspirations of the University: accessibility and inclusion for its student body." The fee increases for 2016-17 that were proposed to bring the self-support program to fiscal solvency are currently causing financial distress to our diverse graduate student cohort, threatening existence of the program.

To directly address the reviewers' recommendations, the Department proposes to move the CEU portion of the Geology MS program instruction to state-support, as per the original memo from the CSU Chancellor approving the MS proposal. We provide data showing that integrated SFR for the combined Geology MS and BS programs has exceeded the state-mandated SFR target each of the past four years, and therefore the Department has proven itself to be fully capable of supporting the MS program.

Below we address the six recommendations presented by the evaluators:

Recommendation #1: Find a way to make the program fully state-supported.

The crux of the issue, posed by Provost Alva during the May 3 meeting with the external evaluators and Department Chair Jon Nourse, is how to pay for the 600-level thesis courses that are essential to the program. It was made clear that these supervisory courses are too expensive with their inherent one-on-one faculty instructional requirement. The simplest solution is to follow the model of most

science Master's programs in the CSU: teach sufficient large-enrollment GE courses with high student/faculty ratios (SFR) to balance out the lower SFR graduate courses. Below, we show how this can be accomplished.

There are two approaches to quantifying the true financial impact of low-enrollment graduate classes. We present two analyses based on enrollment-workload-SFR data from the first four years of the Geology MS program. The first analysis (**Table 1**) shows the additional GE enrollments needed to raise the SFR of the grad program to the higher level budgeted for our existing state-supported BS program, ***assuming that the MS program is a stand-alone entity***. The second analysis (**Table 2**) shows the SFR that would have been achieved ***if the MS program had been integrated into the state-supported BS program from its inception***.

Table 1. Student Faculty Ratio Analysis: Geology MS Program 2012-16

400, 500, and 600 Level Graduate Courses Treated as Stand-Alone Program Required to Achieve Same SFR as that Budgeted for Geology BS Program

Academic Year	Budgeted SFR for State-Support BS Program	Graduate FTES Taught	Graduate Faculty WTUs Paid	FTEF (Full Time Equivalent Faculty)	SFR for Stand-Alone MS Program	FTES needed to Achieve Budgeted SFR	Additional FTES provided by hypothetical GE course	GE course enrollment needed	Additional WTUs needed assuming GE class size of 82 to 110	Number of GE Courses Needed	Average GE class size	Recalculated FTEF with extra GE courses	Recalculated SFR with extra GE courses
2012-13	23.2	57	77	5.1	11.1	144	87	326	16	4	82	6.2	23.2
2013-14	23.1	62	100	6.7	9.3	179	116.9	438	16	4	110	7.7	23.1
2014-15	22.4	78	117	7.8	10.0	204	126.3	474	20	5	95	9.1	22.4
2015-16	23.3	72	102	6.8	10.7	189	116.8	438	20	5	88	8.1	23.3

Table 2. Student Faculty Ratio Analysis: Geology MS Program 2012-16

500 and 600 Level CEU Graduate Courses Integrated Into State-Supported Geology BS Program

Academic Year	Budgeted SFR for State-Support BS Program	Total UG + Grad FTES Taught	Total Faculty WTUs Paid	FTEF (Full Time Equivalent Faculty)	Actual SFR Achieved by Combined BS + MS Program	FTES needed to Achieve Budgeted SFR	Additional FTES provided by hypothetical GE course	GE course enrollment needed	Additional WTUs needed assuming GE class size of 82 to 112	Number of GE Courses Needed	Average GE class size	Recalculated FTEF with extra GE courses	Recalculated SFR with extra GE courses
2012-13	23.2	492	270	18.0	27.3	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2013-14	23.1	507	317	21.1	24.0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2014-15	22.4	502	306	20.4	24.6	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2015-16	23.3	518	330	22.0	23.5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Enrollment Data from Table 2 of Self Study Report
FTES, WTU, and SFR Data from Department Chair Records

Table 1 Discussion:

The four-year analysis summarized in Table 1 shows that the SFR achieved by our 400, 500, and 600 level graduate courses was low compared to the SFR target required for our BS program. This is a typical result for all science-based MS programs in the CSU. To compensate for the FTES deficit caused by low enrollment courses, we calculate the additional FTES required by higher enrollments in hypothetical GE courses. The numbers reveal that 4 or 5 additional GE courses per academic year would have been sufficient to achieve the target SFR.

It is possible to immediately increase our FTES generation by boosting enrollments in our existing GE courses such as Water in a Changing World,

Earthquake Country, Earth, Time, and Life, and Natural Disasters. This can be done by utilizing larger classrooms and scheduling a couple of additional large GE sections. In addition, we have proposed a new GE Area E course for the semester conversion, GSC 1010: Planet Earth, A Citizen's Guide (see attached Expanded Course Outline). That course proposal has been approved by the Senate GE committee, and has excellent potential for being universally popular given its emphasis on Earth stewardship, disaster preparedness, water conservation, global climate change, recycling, etc. GSC 1010 is therefore expected to create a significant new revenue stream and increase the SFR.

Table 2 Discussion:

The analysis of Table 2 considers the hypothetical scenario of the SFR analysis if the 500 and 600 level classes had been integrated into a combined state-supported program from the beginning, as is the case for all other MS programs in the College of Science. The results are quite revealing. When all GSC courses taught by full-time faculty, part-time lecturers, and GTAs are included in the calculation, the Geology Department actually ***exceeded*** its state-mandated SFR target each of the past four years. High enrollments in our existing GE classes plus the effect of burgeoning enrollments in many of our core and elective classes have led to an overall Geology SFR that compares favorably to all other Science departments, even when including the MSc program.

At first glance, it would appear that higher FTES are not needed to sustain the Geology MS program. In reality, the higher SFR taught by hard-working Geology faculty has generated a surplus in the instructional budget that we have utilized to augment the high-impact practices that are essential to the success of our instructional and research mission. Equipment purchases, service contracts, and our popular field trips have all been possible through careful management of these funds. Thus, to sustain these activities, it will be important to teach additional GE sections, although not at the level implied by Table 1.

Recommendation #2: "Fewer grad students is better."

The current high number of graduate students as compared to relatively few graduate faculty is a consequence of the intense pressure on the Department to grow enrollments in the MS program to generate tuition revenue. We agree with the evaluators that this is not sustainable, even though graduate faculty have, up until this time, successfully managed to advise these high numbers of students through work overloads and sheer dedication. Our two youngest tenure-track faculty members hired in 2014 and 2015 are alleviating matters somewhat, and addition of two more faculty members during the next 2-5 years will provide more relief. Nevertheless,

after 4 years of program implementation, most of us would agree that supervision of 3 or 4 graduate students at a given time is a more optimal target.

Recommendation #3: Provide more communal work and research space to the department.

We have been proud of our ability to nurture a cohesive and self-supportive cohort of graduate students each year by providing a communal work space equipped with state-of-the-art computers, software, and other office amenities the students need to work on their research. Unfortunately, the original graduate work space was converted to an expanded Department Office upon hiring additional administrative support staff, and the workroom on loan from the Kinesiology Department since March 2015 was very recently reallocated to CEEMAST. The Geology Department has no remaining space to provide graduate students or house their computers. The Department Chair is currently seeking a shared arrangement with another department, so that our graduate students have a common space to work and GTAs have a place to hold office hours.

We urge the university to conduct a space audit to reallocate underutilized areas. Given the tremendous growth of the Geology BS program during the past 8 years, with concomitant implementation of the MS program, we request additional space to accommodate research needs of current and future faculty hires and their students. As the evaluators note, we are "bursting at the seams."

The amount of space required by our graduate student cohort is minimal, and the benefits are significant. From our direct experience, the communal student work area has fostered a greater community spirit, shorter time to degree for students who can conduct their research on campus, enhanced interaction between undergraduate and graduate students (also leading to increased interest in joining the MS program by our undergrads), and improved mentoring by faculty due to the increased presence of the grad students on campus. A graduate student research area is particularly important for students from low-income backgrounds who commonly cannot afford their own computer and software licenses, and have no suitable study space where they live.

Recommendation #4: Hire at least two new geoscience faculty members in the next 2-5 years.

Last spring (April, 2016) we submitted two tenure-track faculty search requests to Dean Jersky:

(1) Assistant Professor of Earth System Science/Global Environmental Change

This hire is aligned with the University's strategic interests in sustainability and water management, and would strengthen our BS program in two popular emphasis areas: Geophysics/Earth Exploration and Environmental Resources. Directly

relevant classes include Blue Planet, Meteorology, and Exploring Earth's Oceans. A new faculty member is needed to develop graduate courses in Global Climate Change, Atmospheric Science, and Urban Sustainability, and to supervise our growing cohort of environmentally-inclined MS students. Significant grant opportunities exist in the area of Climate Change.

(2) Assistant Professor of Remote Sensing/GIS /Natural Hazards Assessment

This hire is aligned with the University's strategic goals of developing industry partnerships, utilizing digital technology, and improving urban environment. The new person would strengthen our BS program in the emphasis areas of Geophysics/ Earth Exploration and Environmental Resources. Relevant existing classes include GIS Applications, Natural Disasters, Engineering Geology, and Living in Earthquake Country. Graduate courses would be developed in Remote Sensing, Geomatics, and Neotectonics. We also expect enhanced collaboration with the geotechnical industry and scientists from the Jet Propulsion Laboratory. GIS is a highly marketable skill in local industry.

Neither position was approved during the recent round of search allocations that we know were severely constrained by the state budget. The Geology Department will continue to make the case for these hires next year. Position 1 in particular has broad appeal, and aims to hire a new faculty member to develop and teach the new GE Area E class, "Planet Earth: A Citizen's Guide," described earlier.

The Geology Department also has four pending search requests submitted to the cluster hiring initiative. These include the following specialties and cluster areas: (a) a Hydrologist to contribute to the Hydrology-Agricultural Water Use cluster, (b) a GIS-Remote Sensing specialist to be included in the multi-department GIS cluster, (c) a multi-disciplinary Director for the Science, Technology, and Society cluster, and (d) a Planetary Scientist with a Department of Physics and Astronomy cluster to focus on exploration of our Solar System and Exoplanets. Cluster areas (a) and (b) incorporate components of Positions 1 and 2 proposed above.

Recommendation #5: Retain the written MS thesis requirement.

We wholeheartedly agree that a full Master's thesis is essential to the program. In our discipline, industry, government agencies, and PhD granting institutions all expect that MS graduates will be able to conduct independent research, think critically, write a formal scientific document describing their research, and defend their work orally. That is the minimum standard for an MS degree.

We have developed clear guidelines for students (p. 8 of Self Study; see also https://www.cpp.edu/~sci/geological-sciences/masters-program/path-to-

graduation.shtml) to ensure that the thesis does not become a bottleneck. In addition, we have proposed a new core course for the semester conversion "GSC 4100: Writing and Speaking in the Geosciences" to provide essential training for graduate students applicable to their thesis endeavor.

Recommendation #6: Support the Geology MS program.

We acknowledge the pressure on the University to reduce costs of its graduate programs. We also fully understand the financial challenges posed by small programs. A key question here is whether the Geology MS program has potential to thrive in areas of strategic interest to the university. We believe it does. With its focus on water, risk assessment/hazard mitigation, and geotechnical issues of importance to the local urban community, our graduate program should be a showcase for Cal Poly Pomona. Including areas of climate change and GIS in future hires will only make it stronger by expanding our existing interdisciplinary collaborations with faculty from the Departments of Civil Engineering, Environmental Biology, Plant Science, Geography, and Regenerative Studies. Implementation of the new freshman-level GE course "Planet Earth: A Citizen's Guide" should fuel additional student interest in the Geology BS and MS programs.

Summary:

We reiterate our request to move the CEU portion of the Geology MS program instruction to state-support beginning Fall quarter of 2016. We simply ask to be afforded the same opportunity as other graduate programs in the College of Science (Departments of Biology, Kinesiology, Chemistry, and Computer Science) and other Geology programs in the CSU. That is, we propose to subsidize our lower-enrollment classes with other higher enrollment classes. The analysis in Table 2 clearly indicates that in effect, the Department has already been doing this. To bolster the revenue of the combined BS+MS program we request a modest increase in our FTES target.

An increase of 50 or so FTES annually is immediately feasible through enhanced enrollments in our existing popular GE classes such as GSC 110: Water in A Changing World, GSC 195: Earthquake Country, GSC 112: Earth, Time, and Life, and GSC 350: Natural Disasters. After the semester conversion we plan to teach large sections of the new GE Area E course, GSC 1010: Planet Earth, A Citizen's Guide. This course would be developed and taught by a new tenure-track hire in the area of "Earth System Science." It will bring in significant new revenue to sustain the Geology graduate program and fund high-impact practices that are signature to both the BS and MS programs (field trips, thesis research, and purchase/maintenance of equipment).

This summer, the College of Extended University has proposed a dramatic tuition increase for our 500 and 600 level classes http://www.cpp.edu/~sci/geological-sciences/docs/ProgramCosts2016to17v2.pdf as a mechanism to bring the graduate program into fiscal solvency for the 2016-17 academic year. Our returning and incoming graduate students are expressing their financial anguish and claims of inequity. Their common question of: ***"Why are we required to pay double the tuition rate of a typical MS student in Biology, Kinesiology, Chemistry, and Computer Science, or Geology students at other CSUs?"*** is difficult for us to answer in light of the financial analysis presented above in Table 2. Likewise, it is troubling that indirect costs required by CEU to teach the 500 and 600 level classes constituted 38% to 79% of the annual program deficit between 2012 and 2016 (Tables 8 and 9 of the Self Study). These high costs are difficult to justify given that our state-supported BS program is sufficiently financially robust to incorporate such courses.

Conversion of the Geology MS program back to state-support would require a memo to Christine Mallon of the CSU Chancellor's office, accompanied by data showing that the program is financially sound and has sustainable demand. In our Self-Study and this response to the program evaluators' report we have shown that the Geology MS program is vibrant and has excellent potential for advancing Cal Poly Pomona's strategic goals related to ***water management, environmental sustainability, ecologic health, community responsibility, urban-metro environment, and industry partnerships.*** Through the sustainable path outlined in this document, we contend that our graduate program has a very strong future and will continue to provide great added value to the University and the local community.

Comments/explanations appear below in red bold, italic, underlined font

Basic Course Information: **GSC 1010**

- **Course Title (up to 100 characters):** Planet Earth: A Citizen's Guide
- **Units:** 1
- **C/S Classification #**: C-2
- **Component (select one):** Lecture
- **Instructional Mode (select all appropriate choices):** Face-to-face,
- **Grading Basis (select one):** Graded Only
- **Repeat Basis (select one):** May be taken only once
- **Cross listed Course (if offered with another department):**
- **Dual Listed Course (If offered as lower/upper division or undergraduate/graduate):**
- **Major course/Service course/GE Course (Select all appropriate choices):** major course, GE course Area E

I. Catalog Description

Development of knowledge pertinent to Earth stewardship and global citizenship, with emphasis on building and maintaining a habitable earth. Survey of issues such as climate change, environmental and natural hazards, water resource development and conservation, and/or environmental sustainability, and their social, emotional, financial, psychological and physiological impacts.

(as with non-GE courses this section is limited to 50 words)

II. Required Coursework and Background

Co-requisite: GSC 1010A

None ***(Lower Division GE courses should have no prerequisites that are not also GE areas)***

III. Expected Outcomes

List the knowledge, skills, or abilities which students should possess upon completing **the course**. ***(one can either include the GE SLOs explicitly or implicitly here. This list should include outcomes that are very specific to your course and program, too)***

Upon successful completion of this course, students will be able to:

1. Describe the general context and scientific basis for global issues such as climate change, environmental sustainability, natural resource management, and preparation for/mitigation of natural hazards.
2. Analyze the physical, mental, emotional-psychological, intellectual, spiritual, financial, social, and environmental factors involved with global sustainability issues.
3. Develop a well-informed, balanced perspective on global sustainability to address such

issues as a responsible citizen.
4. Promote activities that encourage Earth stewardship through balanced dissemination of knowledge on global sustainability issues.

Explain how the course meets the description of the GE Subarea(s). ***(this is a very important section that will need to convince the GE Committee that the course is a General Education course and that it belongs in the requested GE Area. It is required for ALL GE courses)***
This course provides students skills for lifelong learning and self-development as responsible citizens of Planet Earth. Earth science issues such as global climate change, environmental sustainability, water and energy resource management, and natural hazards provide context for exploring psychological, social, financial, physical and environmental impacts. An underlying theme is promotion of Earth stewardship with the general goal of building and maintaining a habitable Earth.

Describe how the course meets each of the associated GE Student Learning Outcomes (GE SLOs) listed below.

These are the Expected SLOs for the selected GE subarea(s): ***(Be sure to include ALL GE SLOs that are mapped to your area – use the SLOs as sub-headings and put your responses below them, as has been done here).***

1a) Write effectively for various audiences.

Students will use written words to describe issues of relevance to sustaining a habitable Earth. Homework assignments require a short written summary statement describing the work submitted. Quizzes and examinations contain short answer and/or essay questions that require students to describe their knowledge of specific course content in written words. (See also Course SLOs 1, 2, and 3 above and discussion of meaningful writing component in Part IX below)

4a) Analyze the factors that contribute to individual well-being (such as physical, mental, nutritional, emotional, intellectual, spiritual, financial, social, or environmental).

The well-being of Earth's inhabitants is generally controlled by the global environment in which they live. Through intellectual discussion of global sustainability issues, this course focuses on emotional-psychological, social, financial, physical and environmental impacts of efforts made to achieve sustainability. (See also Course SLO 2 above)

4b) Demonstrate activities, techniques, or behaviors that promote intellectual or cultural growth.

Through guest lectures and evaluation/discussion of movies this course emphasizes activities, techniques, and/or behaviors related to Earth stewardship that ultimately promote intellectual or cultural growth of Earth's citizens. (See also Course SLOs 3 and 4 above)

4c) Engage in communities (campus, regional, etc.) or participate in civic activities for the betterment of personal and public life.

An underlying theme of this course is promotion of Earth stewardship with the general goal of building and maintaining a habitable Earth. Education of the campus and

regional community with regard to global sustainability issues is accomplished through responsible civic engagement.

(See also Course SLO 4 above)

IV. Instructional Materials

Provide bibliography that includes texts that may be used as the primary source for instruction, and other appropriate reference materials to be used in instruction. The reference list should be current, arranged alphabetically by author and the materials should be listed in accepted bibliographic form. ***(If you include more than a possible textboook as reference materials in this section, group them as intended for different uses such as primary reading for students, background reading for other instructors. Again, for primary resources an example could be important historical materials such as "On The Origin of Species" or "Silent Spring").***

Faculty are encouraged to make all materials accessible. Indicate with an asterisk those items that have had accessibility (ATI/Section 508) reviewed. For more information, http://www.cpp.edu/~accessibility

Primary Texts may vary with instructor and over time. Examples of possible texts and articles are listed below:

1. Hyndman, Donald and Hyndman, David, 2012, *Natural Hazards and Disasters* (4th Edition); Brooks/Cole Publishing Co, 555 p.

2. Rozzi, R., Chapin, F. Stuart, Callicott, J. Baird, Pickett, S.T.A. Power, Mary E., Armesto, Juan J. (Editors), 2015, *Earth Stewardship: Linking Ecology and Ethics in Theory and Practice, Springer*, 457 p.

3. *Earth Stewardship: science for action to sustain the human-earth system*, Chapin et al. 2011, Ecosphere

4. *Earth Stewardship: A Strategy for Social-Ecological Transformation to Reverse Planetary Degradation*, Chapin et al. 2011, Journal of Environmental Studies and Sciences

Additional Primary instructional resources include the web sites listed below:
http://www.earthstewardshipesa2014.com/ Earth Stewardship Initiative
http://www.stewards-earth.org/ Stewards of the Earth
http://www.esa.org/esa/science/earth-stewardship/ Ecological Society of America Earth Stewardship site
http://www.earthstewards.org/ Earthstewards Network, nonprofit international organization devoted to bringing positive change to our planet through the grassroots efforts of people

Secondary resources might include:
1. Carey, Stephen S., 2011, *A Beginners Guide to the Scientific Method, 4th edition*, Wadsworth, Inc.,

2. Rawles, J. W., 2009, *How to Survive the End of the World as We Know It: Tactics, Techniques, and Technologies for Uncertain Times*, Plume Press, 336 p.
3. Willers, W. B., 1991, *Learning to Listen to the Land*, Island Press, 295 p.
4. Friedmen, W., 2008, *Hot, Flat, and Crowded: Why We Need a Green Revolution and How it Can Renew America*, Farrar, Strauss, and Giroux, 438 p.

Lectures, lecture notes, homework assignments, and current papers on the diverse topics will also be made available on BlackBoard* by the instructor.

V. Minimum Student Materials

List any materials, supplies, equipment, etc., which students must provide, such as notebooks, computers, internet access, special clothing or uniforms, safety equipment, lockers, sports equipment, etc. Note that materials that require the assessment of a fee may not be included unless the fee has been approved according to University procedures.

notebook	Computer
graph paper	Internet service
flame resistant lab coat	e-mail
safety glasses or goggles	specific software (e.g. Office, Adobe Creative Suite or AutoCad, Stereonet)*
face mask	flash drive
gloves	printer
dissecting tools	cell phone
transportation to off campus learning sites	camera
Standard writing materials	calculator
	I-clicker

VI. Minimum College Facilities

List the university facilities/equipment that will be required in order to offer this class, such as gymnastic equipment, special classroom, technological equipment, laboratories, etc.

External Support

Library Services	Vivarium
Animal Care Facility	Biodiversity Collections
Graphic Services	COS Instructional Support Center
Information Technology (IT) Services	Stockroom
Classroom Management System (e.g. BB)	Instructional Support Technician's assistance
poster printing	Equipment Technician's assistance
copier	Field Vehicle
scanner	Consortia (OSI-boat; DSC-housing)*
specialized software (e.g. MatLab, SPSS)*	
computer cluster	
file server	

Physical Space & Major Equipment

lecture room with seating for 40 students	fume hood
computer laboratory with # stations and seating for # students	sufficient plug-ins to support numerous electrical devices
wet lab (benches/sinks/gas/air) with seating for # students	computers (#) or tablets (#) for intermittent in class use by students
modular tables and chairs	refrigerator
smart classroom (computer/projector)	freezer
microphone	microscope(s)*
overhead screen	balance(s)*
white board/dry erase markers	incubator
adjustable lighting	periodic chart
Student Response System (receiver, etc.)	
live feed camera	

VII. Course Outline

Describe specifically what will be included in the course content. This should not be a repetition of the course description but an expansion that provides information on specific material to be included in the class, e.g. lecture topics, skills to be taught, etc. This should not be a week-by-week guide unless all instructors are expected to follow that schedule.

The following list is a representative sample of the topics that may be discussed during the class meetings:

- Course logistics and introduction to the global sustainability concepts
- The Earth system: linkages between humans and the lithosphere, hydrosphere, biosphere, atmosphere
- Natural disasters—Causes and occurrences
- Preparation for and mitigation of natural disasters: related psychological, social, cultural, and financial impacts
- The science behind global climate change
- Population dynamics and strained global resources (food, water, energy)
- Preservation of soils and sustainable agriculture
- Water resources: location, development, preservation, and management issues
- Conventional vs. alternative energy resources: related economics and politics
- Recycling efforts: history and recent advances
- Building and maintaining a habitable Earth
- The politics and economics of global sustainability
- Importance of a well-informed community
- Student presentations and discussion of assigned readings

VIII. Instructional Methods

Describe the type(s) of method(s) that are required or recommended for the instruction of this course (lectures, demonstrations, etc.). Include any method that is essential to the course, such as the use of particular tools or software.

lecture	field studies
problem-solving	case studies
discussion	internship
seminar	service-learning
individual instruction	simulations
small group activities	on-line tutorials
peer instruction	observation
creating and presenting a talk/speech	original research/inquiry
creating and presenting a poster	inquiry-based learning
creating and leading a lesson	project-based learning
laboratory exercises/hands on practice	classroom research experience
experimentation	assigned readings (textbook, journals, etc.)
demonstrations	outlining (readings, papers, activities, etc.)
invited speakers	collecting (organisms, objects, data)
panel presentation	journaling
review, evaluation, critique	interviews
project (by individual, group, and/or class)	modeling
study groups	role play
recording (videotape/review)	

IX. Evaluation of Outcomes

Describe the methods to be used to evaluate students' learning, i.e. written exams, term papers, projects, participation, quizzes, attendance, etc.

(In this section be sure to describe the students 'work products' including the nature of these assignments)

Students' learning of course content is evaluated **via classroom/group activities, summaries of assigned readings, special lecture evaluations, and quizzes.** Suggested weighting in grade calculations is 20% activities, 30% reading summaries, 30% lecture evaluations, 20% quizzes. Classroom activities will graded on basis of level of participation and attendance; the other evaluation methods will be scored using standard numerical methods and/or rubrics. Instructor will provide verbal commentary during classroom discussions and student presentations, and may provide written suggestions on submitted work products.

Classroom Activities involve whole class or small group discussions of environmental or Earth sustainability issues. These discussions may follow special guest lectures or student presentations of reading summaries. Learning gain will occur through interactions between students, peers and instructor.

Assigned Readings. Teams of 2-3 students are assigned readings from textbooks or articles, Topics include selected aspects of global climate change, environmental sustainability, water and energy resource management, or natural hazards. An oral report to the class will serve as basis for discussion on related psychological-emotional, social, financial, physical and environmental impacts or the general class theme of building and maintaining a habitable Earth. Written summaries will be submitted after each presentation

Evaluation of Special Lectures. Each student must attend four special lectures during the course of the term on a topics related to global climate change, environmental sustainability, water and energy resource management, or natural hazards. A written synopsis of key points presented, as well as an evaluation of the speaker shall be submitted after each lecture

Quizzes are structured written assignments with a time limit that require students to demonstrate the knowledge gained in class to describe and explain environmental processes or discuss the pros and cons of Earth sustainability issues. Types of questions may include short essays, multiple choice, match-up, short answer, label drawings or diagrams, calculations, an illustrate environmental processes or features with drawings. At least one quiz question will be written in nature and repeated later in the term to assess student improvement and knowledge gained.

Describe the meaningful writing assignments to be included.

(To meet the expectations of GE as 'meaningful' the writing assignment must be critiqued by the instructor and either returned for revision & re-submission OR explicitly lead to improvements in future assignments. The assignment can be for one specific type of audience such as another scientist. A single course need not include writing for multiple audiences.

Students will have multiple opportunities to demonstrate effective writing, with feedback provided through instructor comments. Each reading assignment requires a written synopsis describing key points of the article or book chapter. Quizzes contain short answer and/or essay questions that require students to describe their knowledge of specific course content in written words. At least quiz question will be written in nature, evaluated by the instructor, and repeated later in the term to assess student improvement and knowledge gained. This process also enables students to use the feedback to improve their technical writing.

Describe how these evaluation methods align to the course and program outcomes, as appropriate. ***(Alignment with the Program is OPTIONAL at this time.)***

Alternatively, you may use a matrix to align the methods to the outcomes.

Below is a Matrix indicating how assessment methods align to course learning outcomes.

Student Learning Outcome (see detailed list in Part III above)	Methods of Assessment			
	Quizzes	Special Lecture Evaluations	Reading Summaries	Classroom Activities
#1: Describe the general context and scientific basis for global issues such as climate change, environmental sustainability, natural resource management, and preparation for/mitigation of natural hazards.	X		X	
#2: Analyze the physical, mental, emotional-psychological, intellectual, spiritual, financial, social, and environmental factors involved with global sustainability issues.	X	X	X	X
#3: Develop a well-informed, balanced perspective on global sustainability to address such issues as a responsible citizen.		X	X	X
#4: Promote activities that encourage Earth stewardship through balanced dissemination of knowledge on global sustainability issues.		X		X

Describe how these evaluation methods align to the associated GE Learning Outcomes listed below. Alternatively, you may use a matrix to align the methods to the outcomes. ***(A matrix is totally acceptable)***

Below is a matrix indicating how assessment methods evaluate the GE learning outcomes:

GE Learning Outcome (see Part III above)	Methods of Assessment			
	Quizzes	Special Lecture Evaluations	Reading Summaries	Classroom Activities
#1a: Write effectively for various audiences	X	X	X	
#4a) Analyze the factors that contribute to individual well-being	X	X	X	X
#4b) Demonstrate activities, techniques, or behaviors that promote intellectual or cultural growth.			X	X
#4c) Engage in communities or participate in civic activities for the betterment of personal and public life.	X	X	X	X

X. Department / College Required ECO Information. (OPTIONAL)

Comments/explanations appear below in red bold, italic, underlined font

Basic Course Information: **GSC 1010A**

- **Course Title (up to 100 characters):** Planet Earth: A Citizen's Guide Activity
- **Units:** 2
- **C/S Classification #**: C-2
- **Component (select one):** Lecture
- **Instructional Mode (select all appropriate choices):** Face-to-face,
- **Grading Basis (select one):** Graded Only
- **Repeat Basis (select one):** May be taken only once
- **Cross listed Course (if offered with another department):**
- **Dual Listed Course (If offered as lower/upper division or undergraduate/graduate):**
- **Major course/Service course/GE Course (Select all appropriate choices):** major course, GE course Area E

I. Catalog Description

Activities directed toward educating regional or campus communities about response to / recovery from challenges posed by Earth's environment. Enhancement of skills to evaluate such challenges, engage in related conversations, and promote community awareness. Participation in events such as Earth Day, California Shake-Out, and disaster preparedness drills. Promotion of water conservation and waste recycling. Outdoor field trips.

(as with non-GE courses this section is limited to 50 words)

II. Required Coursework and Background

Corequisite: GSC 1010

(Lower Division GE courses should have no prerequisites that are not also GE areas)

III. Expected Outcomes

List the knowledge, skills, or abilities which students should possess upon completing **the course**. ***(one can either include the GE SLOs explicitly or implicitly here. This list should include outcomes that are very specific to your course and program, too)***

Upon successful completion of this course, students will be able to:

1. Participate in field trips to acquire experience and perspective on global issues such as climate change, environmental sustainability, natural resource management, and preparation for/mitigation of natural hazards.
2. Appreciate through active learning the physical, mental, emotional-psychological, intellectual, spiritual, financial, social, and environmental factors involved with global sustainability issues.

3. Promote community efforts to encourage citizens to make well-informed, responsible decisions on global sustainability and natural hazards.
4. Engage in activities to encourage Earth stewardship through balanced dissemination of knowledge on global sustainability issues.

Explain how the course meets the description of the GE Subarea(s). ***(this is a very important section that will need to convince the GE Committee that the course is a General Education course and that it belongs in the requested GE Area. It is required for ALL GE courses)***
This course provides students skills for lifelong learning and self-development as responsible citizens of Planet Earth. Earth science issues such as global climate change, environmental sustainability, water and energy resource management, and natural hazards provide context for exploring psychological, social, financial, physical and environmental impacts. An underlying theme is promotion of Earth stewardship with the general goal of building and maintaining a habitable Earth.

Describe how the course meets each of the associated GE Student Learning Outcomes (GE SLOs) listed below.

These are the Expected SLOs for the selected GE subarea(s): ***(Be sure to include ALL GE SLOs that are mapped to your area – use the SLOs as sub-headings and put your responses below them, as has been done here).***

1a) Write effectively for various audiences.

Students will use written words to describe issues of relevance to sustaining a habitable Earth. Assigned paper reports require a written summary statement describing key points of the reading. Field trip reports require documentation of site visits in written words. (See also Course SLOs 1, and 4 above and discussion of meaningful writing component in Part IX below)

4a) Analyze the factors that contribute to individual well-being (such as physical, mental, nutritional, emotional, intellectual, spiritual, financial, social, or environmental).

The well-being of Earth's inhabitants is generally controlled by the global environment in which they live. Through experiential learning and intellectual discussion of global sustainability issues, this course focuses on emotional-psychological, social, financial, physical and environmental impacts of efforts made to achieve sustainability. (See also Course SLO 2 above)

4b) Demonstrate activities, techniques, or behaviors that promote intellectual or cultural growth.

Through participation in classroom discussions and engagement in field work, students model activities, techniques, and/or behaviors related to Earth stewardship that ultimately promote intellectual or cultural growth of Earth's citizens. (See also Course SLOs 3 and 4 above)

4c) Engage in communities (campus, regional, etc.) or participate in civic activities for the betterment of personal and public life.

An underlying theme of this course is promotion of Earth stewardship with the general goal of building and maintaining a habitable Earth. Education of the campus and

regional community with regard to global sustainability issues is accomplished through responsible civic engagement. For example field work activities, might include participation in the "Great California Shakeout," promotion of Earth Day events, disaster preparedness drills, voter registration drives, demonstrations of groundwater flow models. (See also Course SLO 4 above)

IV. Instructional Materials

Provide bibliography that includes texts that may be used as the primary source for instruction, and other appropriate reference materials to be used in instruction. The reference list should be current, arranged alphabetically by author and the materials should be listed in accepted bibliographic form. ***(If you include more than a possible textboook as reference materials in this section, group them as intended for different uses such as primary reading for students, background reading for other instructors. Again, for primary resources an example could be important historical materials such as "On The Origin of Species" or "Silent Spring").***

Faculty are encouraged to make all materials accessible. Indicate with an asterisk those items that have had accessibility (ATI/Section 508) reviewed. For more information, http://www.cpp.edu/~accessibility

Primary Texts may vary with instructor and over time. Examples of possible texts and articles are listed below:

1. Hyndman, Donald and Hyndman, David, 2012, *Natural Hazards and Disasters* (4th Edition); Brooks/Cole Publishing Co, 555 p.

2. Rozzi, R., Chapin, F. Stuart, Callicott, J. Baird, Pickett, S.T.A. Power, Mary E., Armesto, Juan J. (Editors), 2015, *Earth Stewardship: Linking Ecology and Ethics in Theory and Practice, Springer*, 457 p.

3. *Earth Stewardship: science for action to sustain the human-earth system,* Chapin et al. 2011, Ecosphere

4. *Earth Stewardship: A Strategy for Social-Ecological Transformation to Reverse Planetary Degradation,* Chapin et al. 2011, Journal of Environmental Studies and Sciences

Additional Primary instructional resources include the web sites listed below:
http://www.earthstewardshipesa2014.com/ Earth Stewardship Initiative
http://www.stewards-earth.org/ Stewards of the Earth
http://www.esa.org/esa/science/earth-stewardship/ Ecological Society of America Earth Stewardship site
http://www.earthstewards.org/ Earthstewards Network, nonprofit international organization devoted to bringing positive change to our planet through the grassroots efforts of people

Secondary resources might include:
1. Carey, Stephen S., 2011, *A Beginners Guide to the Scientific Method, 4th edition,* Wadsworth, Inc.,

2. Rawles, J. W., 2009, *How to Survive the End of the World as We Know It: Tactics, Techniques, and Technologies for Uncertain Times*, Plume Press, 336 p.
3. Willers, W. B., 1991, *Learning to Listen to the Land*, Island Press, 295 p.
4. Friedmen, W., 2008, *Hot, Flat, and Crowded: Why We Need a Green Revolution and How it Can Renew America*, Farrar, Strauss, and Giroux, 438 p.

Lectures, lecture notes, homework assignments, and current papers on the diverse topics will also be made available on BlackBoard* by the instructor.

V. Minimum Student Materials

List any materials, supplies, equipment, etc., which students must provide, such as notebooks, computers, internet access, special clothing or uniforms, safety equipment, lockers, sports equipment, etc. Note that materials that require the assessment of a fee may not be included unless the fee has been approved according to University procedures.

notebook	Computer
graph paper	Internet service
flame resistant lab coat	e-mail
safety glasses or goggles	specific software (e.g. Office, Adobe Creative Suite or AutoCad, Stereonet)*
face mask	flash drive
gloves	printer
dissecting tools	cell phone
transportation to off campus learning sites	camera
Standard writing materials	calculator
	I-clicker

VI. Minimum College Facilities

List the university facilities/equipment that will be required in order to offer this class, such as gymnastic equipment, special classroom, technological equipment, laboratories, etc.

External Support

Library Services	Vivarium
Animal Care Facility	Biodiversity Collections
Graphic Services	COS Instructional Support Center
Information Technology (IT) Services	Stockroom
Classroom Management System (e.g. BB)	Instructional Support Technician's assistance
poster printing	Equipment Technician's assistance
copier	Field Vehicle
scanner	Consortia (OSI-boat; DSC-housing)*
specialized software (e.g. MatLab, SPSS)*	
computer cluster	
file server	

Physical Space & Major Equipment

lecture room with seating for 40 students	fume hood
computer laboratory with # stations and seating for # students	sufficient plug-ins to support numerous electrical devices
wet lab (benches/sinks/gas/air) with seating for # students	computers (#) or tablets (#) for intermittent in class use by students
modular tables and chairs	refrigerator
smart classroom (computer/projector)	freezer
microphone	microscope(s)*
overhead screen	balance(s)*
white board/dry erase markers	incubator
adjustable lighting	periodic chart
Student Response System (receiver, etc.)	
live feed camera	

VII. Course Outline

Describe specifically what will be included in the course content. This should not be a repetition of the course description but an expansion that provides information on specific material to be included in the class, e.g. lecture topics, skills to be taught, etc. This should not be a week-by-week guide unless all instructors are expected to follow that schedule.

The following list is a representative sample of the topics that may be discussed during the class meetings:

- Course logistics and introduction to the global sustainability concepts
- The Earth system: linkages between humans and the lithosphere, hydrosphere, biosphere, atmosphere
- Being an informed citizen: distinction between science, pseudoscience, and rhetoric
- Strategies for building and maintaining a habitable Earth
- Strategies for promoting community awareness
- Disaster preparedness drills
- Earth Day activity,
- California Shake-Out activity,
- Voter registration drives
- Field trip to water conservation facility
- Field trip to recycling facilities on and off campus
- Field trip to sustainable agriculture site
- Campus field trip to Lyle Center of Regenerative studies
- Student presentations and discussion of assigned readings
- Guest lectures

VIII. Instructional Methods

Describe the type(s) of method(s) that are required or recommended for the instruction of this course (lectures, demonstrations, etc.). Include any method that is essential to the course, such as the use of particular tools or software.

lecture	field studies
problem-solving	case studies
discussion	internship
seminar	service-learning
individual instruction	simulations
small group activities	on-line tutorials
peer instruction	observation
creating and presenting a talk/speech	original research/inquiry
creating and presenting a poster	inquiry-based learning
creating and leading a lesson	project-based learning
laboratory exercises/hands on practice	classroom research experience
experimentation	assigned readings (textbook, journals, etc.)
demonstrations	outlining (readings, papers, activities, etc.)
invited speakers	collecting (organisms, objects, data)
panel presentation	journaling
review, evaluation, critique	interviews
project (by individual, group, and/or class)	modeling
study groups	role play
recording (videotape/review)	

IX. Evaluation of Outcomes

Describe the methods to be used to evaluate students' learning, i.e. written exams, term papers, projects, participation, quizzes, attendance, etc.

(In this section be sure to describe the students 'work products' including the nature of these assignments)

Students' learning of course content is evaluated **via classroom/group activities, summaries of assigned readings, field work, and field trips.** Suggested weighting in grade calculations is 20% activities, 30% reading summaries, 30% field work, 20% field trips. Classroom activities are graded on basis of level of participation and attendance; the other evaluation methods will be scored using standard numerical methods and/or rubrics. Instructor will provide verbal commentary during classroom discussions and student presentations, and may provide written suggestions on submitted work products.

Classroom Activities involve whole class or small group discussions of environmental or Earth sustainability issues. These discussions may follow special guest lectures or student presentations

of reading summaries. Learning gain will occur through interactions between students, peers and instructor.

Assigned Readings. Teams of 2-3 students are assigned readings from textbooks or articles, Topics include selected aspects of global climate change, environmental sustainability, water and energy resource management, or natural hazards. An oral report to the class will serve as basis for discussion on related psychological-emotional, social, financial, physical and environmental impacts or the general class theme of building and maintaining a habitable Earth. Written summaries will be submitted after each presentation

Field Work. Student will directly engage with the campus community on issues of global sustainability, water and energy resource management, or natural hazards preparation and mitigation. Depending on which semester, activities might include participation in the "Great California Shakeout," promotion of Earth Day events, disaster preparedness drills, voter registration drives, demonstrations of groundwater flow models. Each activity requires an oral report to the class that reflects on lessons learned while educating the public.

Field trips. Students or teams of students will attend field trips to on-campus or locally accessible off campus sites that might include the BioTrek Rain Forest, Cal Poly Pomona's water recycling system, the Cal Poly Farm, Chino Basin Water Conservation District, local recycling centers, flood control dams, water storage reservoirs, groundwater spreading grounds, or local sanitary landfills. Field trip reports require a written summary, to be evaluated by instructor.

Describe the meaningful writing assignments to be included.

(To meet the expectations of GE as 'meaningful' the writing assignment must be critiqued by the instructor and either returned for revision & re-submission OR explicitly lead to improvements in future assignments. The assignment can be for one specific type of audience such as another scientist. A single course need not include writing for multiple audiences.

Students will have several opportunities to demonstrate effective writing, with feedback provided through instructor comments. Each reading assignment requires a written synopsis describing key points of the article or book chapter. Field trip reports require a written summary, to be evaluated by instructor. The second field trip report will be submitted after the first is evaluated by the instructor. This process also enables students to use the feedback to improve their technical writing.

Describe how these evaluation methods align to the course and program outcomes, as appropriate. ***(Alignment with the Program is OPTIONAL at this time.)***

Alternatively, you may use a matrix to align the methods to the outcomes.

Below is a Matrix indicating how assessment methods align to course learning outcomes.

Student Learning Outcome (see detailed list in Part III above)	Methods of Assessment			
	Field Work	Field Trip Reports	Reading Summaries	Classroom Activities
#1: Participate in field trips to acquire experience and perspective on global issues such as climate change, environmental sustainability, natural resource management, and preparation for/mitigation of natural	X		X	
#2: Appreciate through active learning the physical, mental, emotional- psychological, intellectual, spiritual, financial, social, and environmental factors involved with global sustainability issues.	X	X	X	X
#3: Promote community efforts to encourage citizens to make well-informed, responsible decisions on global sustainability and natural hazards.		X	X	X
#4: Engage in activities to encourage Earth stewardship through balanced dissemination of knowledge on global sustainability issues.		X		X

Describe how these evaluation methods align to the associated GE Learning Outcomes listed below. Alternatively, you may use a matrix to align the methods to the outcomes. ***(A matrix is totally acceptable)***

Below is a matrix indicating how assessment methods evaluate the GE learning outcomes:

GE Learning Outcome (see Part III above)	Methods of Assessment			
	Field Work	Field Trip Reports	Reading Summaries	Classroom Activities
#1a: Write effectively for various audiences	X	X	X	
#4a) Analyze the factors that contribute to individual well-being	X	X	X	X
#4b) Demonstrate activities, techniques, or behaviors that promote intellectual or cultural growth.			X	X
#4c) Engage in communities or participate in civic activities for the betterment of personal and public life.	X	X	X	X

X. Department / College Required ECO Information. (OPTIONAL)