Physical Science, Geology, General Science SAC Discipline Review

Portland Community College
Submitted May 28th 2010
Prepared by
Eriks Puris & Melinda Hutson

Executive Summary

When people think of “science”, they think about physics, chemistry, and biology. Few think of the Earth sciences. And yet, the Earth sciences provide key understanding for dealing with issues of environmental change, natural hazards, resources, and sustainability in the world today. This has been recognized by the National Science Foundation, which is emphasizing the importance of understanding the Earth sciences in its Earth Science Literacy Initiative: “We need governments that are Earth science literate.”

The Physical Science, Geology, General Science (PSGGS) SAC spans the disciplines of astronomy, geology, meteorology and oceanography and is the second smallest LDC science SAC at the college with a campus wide FTE of 217.4 in 2008-2009. In spring of 2010 the two full-time faculty and 14 part-time faculty taught a total of 34 course sections with 20% of the sections being taught by full-time faculty. The 14 courses offered by the PSGGS SAC prepare students for transfer to four year institutions, provide foundational knowledge for science careers, support PCC programs in GIS, Aviation Science and Emergency Management, appeal to members of the community interested in Earth science, and create informed citizens.

The PSGGS SAC creates science education that is relevant and accessible to students. Our courses build learning skills and prepare students for academic success in science and related fields. Our SAC has a number of strengths: 1) we support our students in the classroom; 2) we improve in response to assessment; and 3) we incorporate the contributions of our diverse faculty. The PSGGS SAC needs more full-time faculty to manage and improve existing course offerings while it prepares for future growth. Ideally, new full-time faculty will have strengths in meteorology, oceanography, astronomy and distance learning, to complement the strengths of existing faculty and allow development of expertise in new areas. The PSGGS SAC needs to improve student access to field based learning, needs to improve course descriptions, outcomes and assessment and needs to enhance intercampus communication. The PSGGS SAC recommends hiring four full-time faculty and hiring dedicated lab techs with Earth science backgrounds at Sylvania and Rock Creek. The PSGSS SAC recommends building an additional lab room at Sylvania, and the building and stocking of new lab facilities at Cascade and Southeast Center. The PSGGS SAC recommends the following curriculum improvements: revise the course descriptions to explicitly include the number of lab credits, revise the CCOGs to meet the new statewide general education course outcomes, institutionalize field based learning by revising CCOGs to include field based learning outcomes, and the creation of independent study courses. A final suggestion is a name change to the Geology and General Science SAC. The most important need of the PSGGS SAC is the hiring of additional full-time faculty.
Physical Science, Geology and General Science Program Review

Executive Summary ........................................................................................................ 1

0. Who We Are ............................................................................................................. 3

1. The Discipline .......................................................................................................... 4
   A. Introduction and Goals ......................................................................................... 4
   B. The Discipline within PCC .................................................................................. 5

2. Curriculum ................................................................................................................. 11
   A. Evaluating the Curriculum .................................................................................. 11
   B. Changes to Course Content and Outcomes ....................................................... 11
   C. Assessment of Course Outcomes ....................................................................... 12
   D. PCC Core Outcomes ............................................................................................ 15
   E. Distance Learning ................................................................................................ 17
   F. Curricular Changes to Address College Initiatives ............................................. 18

3. Student & Community Needs ................................................................................... 20
   A. Effect of Student Demographics on Instruction .................................................. 20
   B. Instructional and Curricular Changes to Meet Student and Transfer Institution Needs .... 20
   C. Enrollment Patterns ............................................................................................. 20
   D. Facilitating Access and Diversity ........................................................................ 21

4. Faculty ....................................................................................................................... 23
   A. Current Faculty .................................................................................................... 23
   B. Instructor Qualifications ...................................................................................... 25
   C. Professional Development .................................................................................... 26

5. Facilities & Support .................................................................................................. 27
   A. Classrooms and Laboratory Space ....................................................................... 27
   B. Library .................................................................................................................... 28
   C. Instructional Support ............................................................................................ 29
   D. Advising ................................................................................................................ 30
   E. Scheduling ............................................................................................................. 31

6. Recommendations for Improvement ........................................................................ 33
   A. Strengths ............................................................................................................... 33
   B. Areas in Need of Improvement ........................................................................... 34
   C. Recommendations ............................................................................................... 35

Appendixes ..................................................................................................................... 37
0. Who We Are

We are the Physical Science, Geology, General Science SAC (PSGGS SAC).

We are the second smallest LDC science SAC at the college with two full time instructors.

We cover the largest disciplinary range of any science SAC; the subjects we teach include astronomy, geology, meteorology, and oceanography.

We teach courses listed under two course codes: G Geology and GS General Science\(^1\), and these courses break into four major groups:

- **G201, G202, G203, G291** Lecture/lab course on physical geology and historical geology.
- **G207, G208, G209** Lecture courses on Pacific Northwest geology, volcanoes and earthquakes.
- **G160, G161, G200** Field based geology courses.
- **GS106, GS107, GS108, GS109** Lecture/lab survey courses of geology, astronomy, oceanography and meteorology.

We are growing SAC. **Our FTE has increased by over 100% since 00-01.**

When the senior full-time instructor began teaching at PCC in fall 1996 **2 full-time and 1 part-time instructors** were sufficient to teach all the G & GS courses at PCC, in spring 2010 **2 full-time instructors and 14 part-time instructors** were required to teach all the G & GS courses at PCC. The percentage of course sections taught by full-time faculty has fallen from 70% in 1996 to 20% in 2010.

Our courses prepare LDC students for transfer to four year institutions and for further study in the fields of astronomy, geology, meteorology and oceanography.

Our courses support the CTE programs in Aviation Science, Emergency Management and GIS.

We offer access to science for students who feel that biology is too squishy and that physics and chemistry are too sterile and abstract.

Our courses promote student engagement in sustainability, sense of place and lifelong learning.

Last program review in 2001 (see Appendix 1).

---

\(^1\) the college sometimes files information related to G & GS courses under physical science for example in the printed course catalog, instructor qualifications and on the institutional effectiveness web site.
1. The Discipline

A. Introduction and Goals

The Physical Science, Geology, General Science SAC offers courses within the broad ranging discipline of Earth sciences. The Earth sciences discipline uses scientific methods to investigate physical aspects of our natural environment with the goal of understanding how our Earth works. The study of the Earth sciences has important societal implications for natural hazards (e.g. hurricanes, earthquakes, volcanoes) resources (e.g. Earth materials and energy resources) and global change (climate change, changing biogeochemical cycles). Traditionally the Earth sciences have been subdivided into the disciplines of geology (study of the solid earth and its surface), oceanography (study of the oceans) meteorology (study of the atmosphere) and astronomy (study of celestial objects). Currently these traditional boundaries are blurring and there is more stress on an integrated approach stressing Earth systems and the interrelatedness of the solid Earth, its waters, atmosphere, life and the astronomical setting of our solar system. Along with this increased appreciation of the interrelated nature of the Earth sciences there is a growing awareness of the degree of human impact on the Earth and its systems.

Our Disciplines Goals

1. Prepare students for future success in college level courses.
2. Engage students in active learning by requiring students to make their own observations and measurements in the classroom and field, use this information to develop and test concepts and then apply this learning to problem solving.
3. Introduce students to the scientific understanding of their physical environment (Earth, atmosphere, ocean and space).
4. Make science and scientific thinking accessible to students.
5. Promote scientific literacy and application of scientific information to solving societal issues related to the Earth sciences (e.g. geologic hazards, earth resources, global change).

While these goals were not clearly formulated in the previous program review in 2001 (see Appendix 1) there have been no major changes to our SAC's goals since the last program review. At this point there are no plans for major changes in the goals of our discipline. Future avenues of development for our SAC include: 1) placing a greater effort on the exploration and use of learner based pedagogies, 2) integrating the Earth systems approach to Earth science into the curriculum and 3) stressing how understanding past global change provides a context for achieving future sustainability.
B. The Discipline within PCC

The mission of Portland Community College is to provide “access to an affordable, quality education in an atmosphere that encourages the full realization of each individual’s potential. The college offers opportunities for academic, professional, and personal growth to students of all ages, races, cultures, economic levels, and previous educational experiences.” The many ways that the Physical Science, Geology, General Science SAC supports the mission of the college is addressed specifically in the rest of section 1B, but indirectly throughout this entire program review document.

The PSGGS SAC addresses the values of PCC in the following ways:

• Quality, lifelong learning experiences that helps students to achieve their personal and professional goals

PSGGS courses help students achieve personal and professional goals in a variety of ways. First, our courses are required prerequisites for further study in a number of areas, including geology, environmental science, biology (at PSU at least), and the aviation science and new GIS certificates, and as electives for the Emergency Management certificates. Additionally, students working to attain degrees in other fields generally require science credits to achieve their degrees. The PSGGS program contains a great breadth of science topics, which allows students to find classes that are particularly relevant or interesting to them. During personal conversations with students, and in course evaluations, we get feedback that the students now view the world around them in a completely different way than they did before. One student joked that all of her friends were getting tired of her pointing out geologic features and hazards every time they went for a drive. Students also report an increased awareness of the complexity of environmental issues. According to questionnaires filled out at the beginning of several PSGGS courses, many students choose to take further PSGGS courses out of interest, rather than because they are required.

• An environment that is committed to diversity as well as the dignity and worth of the individual

The PSGGS SAC recognizes the worth of each individual in our courses. Our students range in age from high school students to retirees returning to college out of general interest. Several faculty report being cognizant of potential gender, ethnic, and religious issues, and spend time during the start of the term working to form integrated and harmonious groups for group work and labs. Faculty members have worked with OSD to ensure that all students receive equivalent experiences in our courses. Several years ago, a mobility-impaired student took a G202 course requiring a field component. He had access to a van and driver, so he and the instructor worked out an option to examine features that would be accessible by van and wheelchair. In many past classes, faculty have come up with alternatives for field exercises for students lacking transportation. These include doing observations and experiments using the environment on campus, and providing suggestions about appropriate geologic field areas accessible by public transit.

• Continuous professional and personal growth of our employees and students

The PSGGS SAC encourages its members to pursue professional development opportunities and to
participate in discussion or demonstrations of new pedagogies when feasible. PSGGS faculty (both full- and part-time) frequently attend the regional National Association of Geoscience Teachers (NAGT) conferences which are held each summer. These conferences give us a chance to interact with faculty at other institutions across the Pacific Northwest and to learn both about new pedagogies as well as the in-depth geology of the area where the conference is being held. Professional development also allows instructors to expand their disciplinary breadth for example Eriks Puris attended the Cosmos in the Classroom 2007 conference on astronomy teaching and was recently accepted to the Centers for Ocean Science Education Excellence (COSEE) Community College Faculty Institute to be held this summer in Newport Oregon. During Fall 2009 inservice, several Sylvania geology instructors, including full-time instructor Melinda Hutson attended a workshop on Process Oriented Guided Instruction and Laboratory (POGIL), which has been used successfully by chemistry at Sylvania in helping students learn course material while developing higher-order thinking skills. Members of the PSGGS SAC are experimenting with incorporating POGIL into our courses. In the Fall of 2009, the national conference of the Geological Society of America (GSA) was held in Portland. Sylvania part-time instructor Frank Granshaw obtained National Science Foundation (NSF) funding to allow PCC to host a session on community college geoscience. Almost all of the PSGGS instructors (full-time and part-time) attended portions of this session. The session was followed by a focus group meeting/reception at Sylvania attended by four NSF staff members, a group of presenters, the two PSGGS full-time instructors (Eriks Puris and Melinda Hutson), part-time instructor Frank Granshaw, the Sylvania campus president and Sylvania’s Dean of Science and Engineering. An outcome of this event is that NSF will be holding a workshop in Virginia on the role of two-year colleges in Geoscience education this summer. At present, part-time instructor Frank Granshaw plans on attending this workshop. Finally, during the 2009-2010 academic year, full-time instructor Melinda Hutson has been participating via internet with the Sylvania pedagogy book club.

• Effective teaching and student development programs that prepare students for their roles as citizens in a democratic society in a rapidly changing global economy

By the nature of the content in most of our classes, PSGGS courses challenge students to think critically about natural resources and hazards. We discuss the complexity involved in climate change and the trade-offs inherent in different forms of energy production. These issues come up even in courses where they might not be expected to. For example, GS107 (Astronomy) inevitably compares the surface temperatures of Venus, Earth, and Mars, which leads to a discussion of the greenhouse effect and climate.

• Academic Freedom and Responsibility - creating a safe environment where competing beliefs and ideas can be openly discussed and debated

The PSGGS SAC is committed to supporting the academic freedom of its members to teach to their individual strengths as instructors. The PSGGS SAC is also committed to providing open supportive classroom environments where students can explore new ideas with confidence. Faculty are cognizant of the fact that many of our students come from conservative backgrounds which take a literal interpretation of the Bible. These students can become upset when presented with the age of the universe, geologic time, and evolution. Faculty in the PSGGS SAC try to gently and respectfully discuss the difference between the scientific method and issues of faith. Many of us have had long discussions where we begin by letting students know that we respect their beliefs, but that we are teaching a class that includes scientific explanations that best fit experimental and
observational data. We politely tell the student that we are not trying to change their beliefs, but that if they choose to stay in the class, they will have to be willing to participate fully in that class. We gently recommend that if they are not comfortable in the class, then a different class may be a better option.

• **Sustainable use of our resources**

All of the PSGGS courses introduce students to some aspect of resources or the history of past global changes in our environment, which provides a context for assessing possible sustainable futures.

• **Collaboration predicated upon a foundation of mutual trust and support**

The PSGSS SAC supports collaborative learning within the classroom, collaboration between its members and collaborations between its members and the rest of the PCC community. One example of this is that part-time instructor Karen Carroll (Cascade) has met several times with full-time instructor Melinda Hutson (Sylvania) during the past year to discuss development of courses at the Cascade campus. At present, full-time instructor Melinda Hutson has been meeting with chemistry instructor Jim Schneider about the possibility of having students simultaneously take a chemistry class and G291 (Rocks and Minerals), with integration of the material in the two classes.

• **An agile learning environment that is responsive to the changing educational needs of our students and the communities we serve**

The PSGGS SAC encourages its members to experiment as they teach which leads to learning environments that evolve as student needs change. We have a high participation of part-time instructors in PSGGS SAC meetings, where discussion of these various pedagogical experiments can be compared and possible solutions to problems developed.

• **Accountability based upon an outcomes-based approach in education**

The PSGGS SAC utilizes a wide variety of assessment instruments to determine whether students are meeting the stated course outcomes, as discussed in section 2C of this document.

• **The public’s trust by effective and ethical use of public and private resources**

The PSGGS SAC honors the trust that the public has put into education and strives to live up to this trust by teaching effectively and ethically to engage students in science and encourage them to become life-long learners and informed voters.
The PSGGS SAC addresses the goals of PCC in the following ways:

Goal 1 – Access: We will improve access to quality lifelong learning opportunities through the effective use of technology, affordable classes and the strategic location of facilities.

We introduce students to science, scientific thinking and the use of scientific information in evaluating societal issues in an engaging environment which stresses the real world applicability of knowledge gained in the classroom. Our courses are particularly effective at capturing the interest of students who have science and/or math anxiety issues. We introduce students to the STEM pipeline who have been underexposed to science and math in high school and have never been encouraged to consider science as a possible career choice. The PSGGS courses have been designed to be offered without any prerequisites other than those required by the college. While this does lead to some repetition of introductory material between courses (which reinforces core material), this has the advantage of increasing student access by allowing students to take courses in any sequence that fits their schedule or interests. Our courses are taught during the day, at night, and on weekends at the Sylvania, Rock Creek, and Cascade campuses and at Southeast Center. Many of our courses are also available as telecourses or on-line classes (see Section 2E).

Goal 2 – Student Success: We will promote success for all students through outstanding teaching, student development programs, and support services in all that we do.

- **Professional Technical Education:** The PSGGS SAC supports the following CTE programs by providing required and elective courses: Aviation Science (GS 109 required), Emergency Management and GIS certificates (electives).

- **Transfer preparation:** The PSGGS SAC supports all degree seeking students by providing a wide variety of courses that satisfy the general science requirement: GS 106 (geology), GS 107 (astronomy), GS 108 (oceanography), GS 109 (meteorology), G 201 (physical geology with emphasis on rocks and minerals, earthquakes, volcanoes, and mountain building), G 202 (physical geology with an emphasis on surface process such as landslides), G 203 (historical geology, which includes geologic time, evolution, and fossils), and G291 (rocks and minerals, with an emphasis on economic resources). In addition, some of these classes are specifically required for transfer to baccalaureate programs at other institutions. While it is not surprising that students majoring in Geology or Environmental Science are required to have G 201 and G 202, the PSGGS SAC has learned that several of the students in G201 this term identified their reason for taking the course as “require for the Biology major at PSU”.

- **College readiness:** As discussed in Sections 2C and 2D, the PSGGS courses include a wide range of pedagogies and assessment vehicles which serve to enhance student-based learning. Students hone a wide variety of skills that will help them succeed in college or future employment, including critical thinking, organization, writing, speaking, and good group communication skills. Additionally, because of the breadth of topics covered, our GS courses are ideally suited for students who intend to become K-12 teachers. Finally, our courses are truly interdisciplinary classes. One of the comments often heard in PSGGS courses is that students didn’t realize how much chemistry, physics, and biology they were going to encounter when they signed up for the classes.

- **Community education/continuing education:** At the beginning of each term, we ask our students why they chose to take the particular class that they are in rather than another science
class. We’ve found that students sign up for PSGGS classes for a variety of reasons, many of which involve fulfilling a science requirement, and a few with the erroneous belief that our classes will be easier than biology, chemistry or physics. But it is not uncommon to find a few students (sometimes senior citizens) who are taking one of our classes solely for personal interest and enrichment. Many of the students who take one of our multi-day field trip courses (G 160, G161, G 200) fall into the personal enrichment category, as they are taking the class to learn more about the reasons why a particular region of Oregon has the beautiful and diverse scenery that it does.

Goal 3 – Diversity: We will enrich the educational experience by committing to the development of diversity in our student body, faculty and staff.

The diversity of students taking PSGGS courses reflect the diversity of PCC as a whole (see Section 3A and Appendix 9). As mentioned in the “values” section above, PSGGS faculty have been able to make accommodations to allow our classes to be accessible to students with a wide range of abilities. In terms of gender and ethnicity, Earth science programs tend to produce graduates that are primarily of European ancestry, with an excess of male graduates over female graduates. The PSGGS SAC has a better gender balance at present than most college/university geology programs, including PSU (tenure-track faculty there consist of 8 male professors, including the two most recent hires, and 2 female professors; the three fixed-term faculty are all male). A look at the “Faculty” page for Geology at University of Oregon shows that their department has 13 male faculty to 3 female faculty. Here at PCC, the two full-time faculty are of opposite genders. The fourteen part-time faculty consist of 8 male instructors and 6 female instructors. Three of our part-time instructors are also originally from other countries (England, Iraq and Austria), giving our SAC a slight international flavor. Until our SAC can expand the number of full-time positions, we are restricted to local geologists to fill our instructional needs. Based on the ethnicity of the current student body in geology at PSU, OSU, and UO, the pool of geologists from which we can pull part-time faculty will remain dominantly of European ancestry.

Goal 4 – Continuous Improvement: We will develop, safeguard and allocate our resources (human, financial, capital, and technological) to ensure through planning and assessment the delivery of relevant, quality programs and services.

As discussed extensively in the values section above and in Sections 2A through 2F and Section 4C, the PSGGS SAC has been fairly active in the areas of professional development, use of technology, multiple pedagogies, and curricular revisions. We are constantly striving to serve our students and the college to the best of our abilities. While a fair number of our part-time instructors already participate regularly at SAC meetings and professional development opportunities, we would like to see improvement in this area. We have been experimenting with a PSGGS SAC group in MyPCC’s MyGroup area to see if that will increase our part-time faculties’ connectedness to the SAC.

Goal 5 – Cultivating Partnerships: We will effectively respond to the educational needs of our students and communities through strategic alliances with business, government agencies and educational institutions.

We work with a number of programs, including UCORE (Undergraduate Catalytic Outreach & Research Experiences administered by UO), IDES (Increasing Diversity in the Earth sciences administered by OSU), the PBTB (Portland Bridges to Baccalaureate Program administered jointly by PCC & PSU) and Oregon Space Grant (a NASA program) to provide research opportunities for our students.
As many of our part-time faculty have graduated from local colleges and universities (particularly PSU), we have a good level of communication between PCC and PSU regarding educational or research opportunities for our students. Through the local chapter of the National Association of Geoscience Teachers (NAGT), many PSGGS faculty have made contacts at regional college and universities outside of the Portland area. Many of us are able to give informed responses to students when asked about a particular baccalaureate program or a department in the Pacific Northwest.

Goal 6 – Community: We will facilitate growth and development of our district communities by accepting a leadership role and serving as a key educational resource to the community.

The PSGGS courses serve the community in a number of ways. We are educating voters and future voters about a range of complex issues associated with the growth and development of their communities. Most of our classes deal with some sort of economic or environmental issue, such as the complexity associated with global climate change, or landslide hazards and mitigation effects. A common theme in field reports is surprise that a flood, earthquake, or landslide hazard is part of a student’s immediate neighborhood. As discussed in Section 2Cii, this can affect how or where a student chooses to live. Many of our classes include a field component, which often are short field trips within the community to visit local landmarks such as Mt. Tabor. PSGGS faculty are surprised to find out that many of the students in our classes have not traveled around the Portland area and are not familiar with local features. Full-time faculty Eriks Puris reports that on trips to Rocky Butte, he finds that less than a third of his students will have visited this landmark.
2. Curriculum

A. Evaluating the Curriculum

There are no well-established national Earth science course guidelines; despite this there is a large degree of uniformity between academic departments teaching Earth science. This uniformity exists both in which courses are taught and in the content of individual courses. An example of this is the introductory level the G201 Physical Geology (Internal Processes), G202 Physical Geology (Surface Processes) and G203 Historical Geology sequence which is taught at PCC and most Oregon Universities and Community Colleges (see Appendix 4). Most introductory Earth science texts are very similar ensuring that all text driven Earth science courses have the same course content. A recent development is the attempt to develop nation wide standards for Earth Science Literacy. An example is the NSF funded Earth Science Literacy Institute, which in May of 2009 published a set of 9 big ideas and supporting ideas that every American should know. The 9 big ideas are listed in Appendix 2: a full report including the supporting ideas can be found at http://www.earthscienceliteracy.org/es_literacy_22may09.pdf.

The PSGGS SAC will monitor future developments in the field of Earth Science Literacy and plans on consulting this document and similar documents for ocean and atmosphere literacy when it takes up the revision of its CCOGs.

B. Changes to Course Content and Outcomes

Since the last program review in 2001 the CCOGs for our courses have undergone several changes. The current CCOGs are given in Appendix 5.

The PSGGS SAC joined the rest of PCC in converting our CCGs to CCOGs by including course outcomes. Soon it was discovered that part-time instructors found the content descriptions of the new CCOGs to be insufficiently detailed to give them meaningful guidance in designing their courses. In response the SAC enhanced the content descriptions to be more detailed and useful to the part-time instructors. Further changes unfurled when it was discovered that an instructor at Columbia Gorge Community College was teaching creation science and arguing that the following phrase from the CCOGs “Alternate theories are of course welcome to be discussed, but...” gave him license to teach creation science. The PSGGS SAC responded by eliminating the “Alternate theories” language from the CCOGs and replacing it with the following statement:

• Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.

• “Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).

• Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as absolute truth, but as the most widely accepted explanation for our observations of the world
Instructors will not teach that “creation science” is anything other than pseudoscience.

• Because "creation science", "scientific creationism", and "intelligent design" are essentially religious doctrines that are at odds with open scientific inquiry, the Geology/General Sciences SAC at Portland Community College stands with such organizations such as the National Association of Geoscience Teachers, the American Geophysical Union, the Geological Society of America, and the American Geological Institute in excluding these doctrines from our science curriculum.

Recent feedback from a science department chair indicates that further changes may be desirable to more clearly establish our position against teaching creation science, namely eliminating from the third bullet “but as the most widely accepted explanation for our observations of the world around us.”, and changing the wording inside the parentheses to read “(such as geologic time and evolution)”. The SAC is considering this suggestion. The evolution of our CCOGs will undoubtedly continue; the recent adoption of the long gestating state wide general education outcomes is a case in point. The G & GS courses are in the first group of courses which the EAC curriculum committee will be reviewing for compliance to the new standards, the PSGGS SAC will be revising our course outcomes for submission to the curriculum committee in Fall of 2010.

The three to four credit conversion had a negligible impact on our SAC since most of our lecture/lab courses where already four credits which matched how these courses are taught at Oregon Universities. This does however bring up an issue involving students who transfer to out of state institutions, occasionally members of the PSGGS SAC get e-mails from these students requesting that we confirm for their registrar that our courses contain a lab component. The problem arises because our current course catalog descriptions (Appendix 3) do not clearly indicate that our lab courses do in fact include a lab component. The SAC recommends the following wording, based on catalog descriptions at U of O, be added to all G & GS classes that include a lab component: “Weekly lectures, three hour laboratory.”

The SAC would like to stress that in addition to SAC level changes to course content, course content also evolves on the level of specific courses taught by individual instructors. An aspect of this evolution especially germane to G&GS courses is the gaining of local knowledge. All of our courses are greatly enriched by including local examples, and as an instructor’s knowledge of our region increases the local examples become a much more important part of their teaching; local examples can be used to introduce ideas and concepts, as case studies, test cases for the application of concepts and topics for student research. This local knowledge can have a strong seasonal aspect; the ocean currents, storms and stars of the Fall are not the same as those of the Spring.

C. Assessment of Course Outcomes

1. Are assessments that address the course outcomes described in the Course Content and Outcome Guides (CCOGs)?
Methods for assessing course outcomes are described in the PSGGS CCOGs (see Appendix 5). The CCOGs provide a general statement of how to assess outcomes, giving our diverse teaching faculty a full range of flexibility in assessment strategies. Below is an example from the CCOG for G201.

G201: “At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, laboratory write-ups, research papers, small group problem solving of questions arising from application of course concepts and concerns to actual experience, oral presentations, or maintenance of a personal work journal.”

ii. Describe evidence that students are meeting course outcomes.

Our course outcomes vary from course to course (see CCOGs in Appendix 5), but in each there are outcomes related to understanding and utilizing the course material, particularly as related to hazards and hazard mitigation. There are also broader outcomes related to skills needed for future academic success. For example, one of the outcomes for G201 is “After completion of this course, students will be prepared for future study in geology or related fields.”

The PSGGS faculty receive immediate feedback about whether or not students are meeting course outcomes when students successfully complete the course assessment vehicles listed in section 2Ci. One example is the assessment of critical learning that was conducted this past winter (see Appendix 8). Final course grades and course evaluations also provide information regarding how well PSGGS faculty have met course outcomes.

A number of PSGGS faculty have reported anecdotal evidence for student success. In most of the G 201 or GS 106 courses (both of which include rock and mineral identification), students have come to class with a rock that they have found and tentatively identified. The students are looking for affirmation of their conclusions from their instructor, and in almost all cases, the students have correctly identified their rock. The most recent example of this was a student taking G201 Spring 2010 with full-time instructor Melinda Hutson. The student had brought in a large rock, which she believed was composed of chert and represented fossilized wood. The young woman was correct on both accounts. Another memorable incident was during Winter 1997, when a student in G202 (which includes landslide hazards) announced during lab that she and her husband had just bought a piece of land and were planning on building a house. The student had just realized that the site where they were planning to build was on the toe of a landslide and directly beneath an over steepened and unstable slope. As a result of taking that class, the couple chose to relocate the site for their new home.

A number of our students have gone on to receive Bachelor’s or graduate degrees in geology or related subjects. Several of the PSGGS instructors who have been at PCC for a long time have received commencement announcements/invitations from former students. A couple of recent students come to mind. Jacob Selander took geology from full-time instructor Melinda Hutson before going on to the University of Oregon, where he received his B.S. in 2004. He then went on to receive an M.S. from University of North Carolina in 2008, and briefly taught GS 108 at Rock Creek before starting a Ph.D. program at U.C. Davis in 2009. Another example is Guleed Ali, a former student of full-time instructor Eriks Puris, who ran into Eriks at the October 2009 Geological Society of American meeting in Portland. Guleed is currently a graduate student at the University of Arizona and recently published a refereed journal article on the dating of uplift in eastern California. Finally, Thomas (TJ) Schepker took G 201, G 202, G 203, G 208, and G 209 from full-time instructor Melinda Hutson. He has gone on to receive a
Bachelor’s degree at Portland State University, where he is continuing towards a Master’s degree specializing in meteorites. He has already given abstracts and poster presentations at three professional conferences.

The PSGGS SAC has been working on using a national assessment vehicle to determine how well our students are performing compared to those at other institutions. A search made in Fall 2009 revealed that few assessment vehicles exist for our field, and one of the major options, the Geoconcept Inventory Test had gone off-line as it is undergoing major revisions. The decision was made by the SAC to use the Student Attitudes About Earth Science Survey (SAESS), which is one of the few tests that spans the breadth of Earth science disciplines. The SAESS is an on-line 10 minute survey containing 35 Likert scale statements relating to a variety of categories including real world connections and quantitative understanding. Pre and post instructional responses are compared to “expert” responses to see if students have developed more expert-type attitudes. See Appendix 7 for a brief description of how the University of British Columbia (UBC) department of Earth and Ocean Sciences (EOS) uses the SAESS to quantify student attitudes and for the list of statements which students respond to when taking the SAESS. Use of the SAESS at PCC was piloted in Fall of 2009 in two GS 108 (Oceanography) classes followed by an effort to evaluate all G &GS students during Winter 2010. We collected pre and post responses from 276 of the 730 students taking G &GS courses during Winter 2010. The response rate of 38% was lower than what the SAC had hoped for and indicates that the SAC has to become more sophisticated in how it implements on-line assessment surveys and in how it encourages part-time instructors to participate in assessment. Processing of the results was delayed because the UBC Earth Science Department, which runs the SAESS surveys, moved buildings during the winter of 2009/2010 and then ground to a halt during the Olympics. In late May of 2010 we finally received the results of SAESS surveys and are just beginning to analyze them.

iii. Identify/give examples of assessment-driven changes made towards improving attainment of course-level outcomes.

Campus-wide assessment of critical thinking (see Appendix 8) revealed that students could identify landforms, but not analyze why they formed where they did. This has led to a change in our course textbooks for the G 201, G 202, and G 203 class from a fairly typical vocabulary and detail oriented text to two texts that stress the “how” and “why” of geology in an overall big picture setting. The books are designed to engage students in critical thinking. The degree to which memorization of vocabulary is downplayed is demonstrated by the new text for G 201 and G 202, which lacks the traditional list of “key terms” at the end of each chapter.

Both full-time instructors (Eriks Puris and Melinda Hutson) have had sporadic contact over the years with students who have transferred from PCC to the geology program at PSU. Both full-time instructors noticed early in their careers at PCC, that students were indicating that the introductory mineralogy class (one of the first they encounter) was especially challenging. Both full-time instructors have altered the way they teach G 201 to expand mineral and rock identification and to emphasize the basic chemistry involved in mineralogy. Recent student feedback has indicated that PCC students felt that we had done a good job of preparing them for introductory mineralogy and petrology classes. In fact, our students felt better prepared than their peers who had taken G 201 at PSU.
D. PCC Core Outcomes

The courses in the PSGGS SAC cover an extremely broad range of topics, from astronomy to various aspects of geology to meteorology and oceanography. Our courses include a mixture of lecture/lab courses, lecture only courses, and field-based courses. As such, although all of our courses address the six PCC core outcomes, some are more heavily weighted towards a particular outcome than others. The strategies used to determine how well students are meeting core outcomes have (with one exception—see Appendix 8) been left to the individual instructors.

**Communication:** All of our lab courses require that students work in groups, communicate with each other, and then communicate their results to the instructor in writing. All of the field-based courses require some sort of written report associated with the field experience. A number of years ago one of these field reports won a library award at the Sylvania campus. It synthesized library research on the geologic history of the Columbia Gorge with observations made during an instructor-led field trip through the Gorge. From conversations during PSGGS SAC meetings, it is clear that instructors have experimented with a variety of written, oral, and poster presentations as assessment instruments. For example, in many of his classes, part-time instructor Frank Granshaw has students create poster presentations supporting a hypothesis, and places them around the Sylvania lab room to create a display similar to that which would be present at a professional conference. As another example, the students taking G201 with full-time instructor Melinda Hutson Spring 2010 will be working in groups to create and present PowerPoint presentations designed to educate their peers on a topic related to either earthquakes or volcanoes. Students are already aware that they will be evaluated by their peers, who will be answering a series of questions regarding the content, mechanics, and effectiveness of the presentations.

**Community and Environmental Responsibility:** All of the PSGGS courses deal with some aspect of a very large range of hazards, including mineral resources, energy, groundwater pollution, hurricanes, overfishing, global climate change, volcanic eruptions, earthquakes, and even giant impacts and supernova explosions. Our classes discuss how scientific information is obtained and evaluated, and the limits of this information in addressing the issues associates with these hazards. For example, several of our classes (GS106, G201, G208, G209) discuss how to prepare for earthquakes and/or volcanic eruptions when accurate prediction of whether or not one of these hazards is imminent on a useful human time scale (days) is not presently possible and isn’t likely to be so in the foreseeable future.

**Critical Thinking and Problem Solving:** All of our courses are science classes. The scientific method involves creating a hypothesis (a problem to be solved), gathering and evaluating data, and revising the hypothesis. This could be considered a definition for critical thinking and problem solving. All of our lecture/lab classes have laboratory exercises that involve examining data, applying concepts learned in class, and coming to some sort of conclusion regarding the meaning of the data. The lecture only class and the field trip classes do not have a laboratory, but generally involve exercises and homework that require putting together disparate pieces of information to come to a correct conclusion to a problem. The PSGGS SAC assessed the level of student learning and critical thinking for all sections of GS106 and G202 during Winter 2010 (see Appendix 8) as part of a campus wide assessment of critical thinking. We received a positive response from Sylvia Gray regarding our assessment vehicle and report. She stated in an e-mail on May 17, 2010 that “this is an ideal project” and “I will be pointing people to it as a model in the future.”
**Cultural Awareness:** One of the messages that students receive in all of our classes is that science is a way of examining the world around us, that there are limits to scientific knowledge, and that real scientists aren’t anything like the scientists portrayed by the media. In various discussions of processes and hazards, instructors in the PSGGS SAC inevitably wind up discussing how cultural differences come into play. One major example of this is the theory of plate tectonics, which is fundamental to all geosciences and is covered in almost all of our courses. This theory grew out of a hypothesis known as continental drift that was formulated during the early 1900s. Almost all geoscience textbooks cover continental drift and the evidence that all of the continents had once been part of a supercontinent known as Pangaea that had broken into separate continental pieces that had moved over time. Among the reasons that this hypothesis was widely ignored is that most of the compelling evidence (matching fossils, rock types, glacial deposits) for the hypothesis was found in South America, Africa, and Australia, whereas most of the geologists were men who had restricted their study to rocks and fossils in North America and Europe.

**Professional Competence:** Students who successfully complete a PSGGS class will have obtained a variety of skills (critical thinking, communication, broadened world view) that will help them to continue in an academic program or to go on to a defined profession.

**Self-Reflection:** Many of our classes ask students to do some sort of self-reflection. Eriks Puris (full-time instructor Rock Creek) has had his GS108 student keep a weather journal which includes personal observations and reflection on weather. Melinda Hutson (full-time instructor Sylvania) had students (after learning about the unpredictability of volcanic precursors) reflect on how they would respond if they were put into the situation of the people who were evacuated from the area around Mt. St. Helens in 1980, given the uncertainty about when or if a volcanic eruption would occur. All of the field trip reports that we ask students to write include a component of summary self-reflection on what they’ve learned and how their thinking about their surroundings has been affected.

The core outcomes mapping matrix for the PSGGS SAC is attached as Appendix 6. It includes not only a matrix for the college outcomes, but a matrix for the SAC core outcomes. Neither of the two full-time instructors remembers when or how this matrix was generated, and we have not had time to revise it. We did examine it and discuss it and concluded that it did need revision. We do not see any reason for mapping levels to be different from course to course for several of the core outcomes, and also feel that the mapping levels are too low in many cases. For example, G202 is listed as having a mapping level of 2 for community and environmental responsibility, even though this class deals with the issues of groundwater pollution, human causes of landslides and landslide mitigation measures, the problems of shoreline erosion and how human efforts to control erosion have unintended consequences to other areas of a shoreline, and the geologic record and causes of global climate change.
E. Distance Learning

The G/GS SAC has been teaching a variety of distance learning classes for nearly 15 years. These fall into four separate categories:

**Telnet courses:** Part-time instructor Frank Granshaw developed and taught telnet versions of the general science sequence at a time when the GS courses (GS106, GS108, and GS109) were offered only at the Sylvania campus. Real-time televised lectures were transmitted to students across the district, including to Rock Creek, Cascade, and Southeast campuses. Students had to come to Sylvania once per week for lab. Telnet courses were offered from around 1993 to 1996.

**Telecourses:** GS107 (Astronomy) has been offered as a telecourse continuously for over a decade. Students watch televised episodes of a commercially-available program about astronomy, and come to either Rock Creek or Sylvania for orientation and labs. Part-time instructor Amy Odman currently teaches this course over the summer.

**Fully on-line courses:** For the past three years, the geology classes that do not include a laboratory section (G207, G208, G209) have been taught as on-line courses. Part-time instructor Ken Sutton developed these course (originally in WebCT) and continues to teach them (using Blackboard).

**Hybrid on-line courses:** Starting in 2007, part-time instructor Frank Granshaw developed on-line versions of GS106, GS108 and GS109. All of these classes were developed with the lecture material delivered via a web platform (WebCT/Blackboard) and on-campus labs taught at Sylvania. For the past two years, one of the courses (GS106-Geology) was offered as a fully on-line course, with kits for home labs. This year (2009-2010) these courses are being team-taught by part-time instructors Frank Granshaw, Jill Betts and Gretchen Gebhardt. The team teaching approach has been useful for increasing class size while keeping instructor workload to a manageable level. Having input from multiple instructors has improved the course content and provided a means of passing experience from one part-time instructor to another. The home lab component has not been successful and the course developer has recommended a return to the hybrid format.

The main concerns about distance learning in the future revolve around three things: 1) We are concerned regarding the fact that part-time instructors are developing and maintaining the on-line classes. For example, while Jill Betts and Gretchen Gebhardt are capable of teaching the on-line classes developed by Frank Granshaw, neither of them, nor the full-time instructors in the PSGGS SAC have the computer skills to make changes in the instructional modules themselves, should new information need to be added. 2) The platform in which the classes are currently delivered (Blackboard) has a sufficient number of technical glitches that the college is considering a new platform. Each time the college switches from one platform to another (such as from WebCT to Blackboard), the instructional materials have to be adapted to the new platform. 3) For completely on-line courses, it is difficult to create the sense of community that can quickly be established in a classroom setting. Both Ken Sutton and Frank Granshaw have reported that there is noticeable decrease in civility among students in the completely on-line courses. Students feel freer to write inflammatory comments on a discussion board than they would be to have a face-to-face altercation with another student. There is also no way to tell if the same person is doing all of the assignments.
F. Curricular Changes to Address College Initiatives

By the fact that these are science courses, and because of the subject matter being covered, the classes taught by the PSGGS SAC have addressed many of the college initiatives for some time. We are currently trying to increase the level of awareness of the link between local conditions and the rest of the world, as well as to improve the level of critical thinking involved in our classes.

Service Learning: At present, there is no service learning component to any of the G or GS courses.

Internationalization: Most of our classes discuss geologic hazards and their effects on communities in other countries, as well as possible effects on a global scale. For example, a class of G201 students recently watched a film about the evidence and hazards associated with a potential earthquake along the Cascadia subduction zone. As was pointed out in the film and followed up in a class discussion, a complete rupture of this fault would be virtually identical to the Sumatran earthquake that devastated the Indian Ocean in 2004, killing approximately 300,000 people as far away as the coast of Africa. Should a similar rupture occur along the Cascadia fault zone, ground shaking and fires would devastate several major cities along the fault zone simultaneously, including Vancouver and Victoria in British Columbia, Seattle, Portland, and Sacramento. Several of these cities are important ports for incoming goods from Asia. A huge tsunami would cause extensive damage and loss of life along the entire Pacific Northwest coastline. As with the Sumatran tsunami of 2004, a tsunami that resulted from a rupture of the Cascadia fault zone would cross long distances, hitting the coasts of Japan, Taiwan, Hawaii, and Australia. Those countries would also experience damage to port cities. The economy of the entire Pacific Basin would be affected. A number of our courses (GS 106, GS107, GS109, G202, and G203 in particular) include aspects of global climate change and may discuss policy issues related to climate change. All of our classes have the potential to include an international component if the instructor chooses to include one. For example, GS107 (Astronomy), which at first glance seems far removed from international politics, can include discussions of the missions which are currently returning data on the solar system and universe. In many cases, the missions involve the space agencies of other countries, such as the European Space Agency (ESA), Japan’s space agency (JAXA), the French space agency (CNES), and the Russian and Chinese space agencies. To cite one specific case: all of our recent information about Saturn and its moons comes from a joint NASA/ESA mission. ESA built the probe that landed on Titan and gave us the only visible light images of the surface of this moon. NASA’s equipment stayed in orbit.

Inquiry-based learning: All of our classes use inquiry-based learning at some level. Most of our classes have laboratory sections associated with them, which gives students a chance to apply knowledge learned in “lecture”. In many of the classes, the “lecture” is integrated with laboratory exercises or consists of lecture interspersed with small group activities based on active learning techniques. Several instructors also run field trips with their classes and we have three field trip classes (G160, G161, and G200) which ask students to make observations and measurements in the field and interpret the results. As discussed in section 2D above, all sections of GS106 and G202 participated in an exercise to evaluate critical thinking skills of our students during Winter 2010. Debriefing the results of this exercise has suggested changes that would make a similar exercise more effective as a tool for inquiry-based learning. Finally, the SAC has adopted new textbooks for the G201/G202/G203 sequence which are far more focused than the existing textbooks on the “how” and “why” of geology rather than on the terminology associated with it.
Sustainability: Geology is taught as a systems science, with numerous examples of interactions between the lithosphere (rocky portion of the planet), hydrosphere, atmosphere, and biosphere. Many of our courses are designed to address resources and the human impact on those resources. GS106, G201, and G291 deal specifically with rocks and minerals, including the formation of resources such as coal, oil, and ore bodies. G202 examines surface processes and looks at a number of sustainability issues, particularly in the chapter on groundwater. Our courses continually address local issues related to sustainability, for example the spread of radioactive material from the Hanford Nuclear Plant through the groundwater system towards the Columbia River (G202, GS106) and the increasing rates of coastal erosion in Oregon and their possible links to global warming (G202, GS108). G203 (Historical Geology) includes impact craters, as they were important during the early history of the Earth and are implicated in mass extinctions. This Spring the G203 class at Rock Creek examined the recent hypothesis that an impact 13,000 years ago led to the demise of the Clovis people and the Pleistocene Megafauna in North America. The section of G203 taught at Sylvania in Winter 2008 had homework assignments which examined two large impact structures (Vredefort and Sudbury) that occurred approximately 2 billion year ago. Each was large enough to generate local hydrothermal systems and concentrate economically valuable minerals. Both are major mining districts today, and neither represents a renewable resource.
3. Student & Community Needs

A. Effect of Student Demographics on Instruction

While students taking geology and general science courses are broadly representative of PCC as a whole there are some differences. Compared to lower division transfer (LDT) students in 2008-09 a “typical” student taking geology courses tended to be younger (71.8% vs. 68.0% between 18 and 30), was as likely to be female (56.7% vs. 56.5% female), was less likely to be non-white (16.0% vs. 26.7%) and more likely to be full time (59.5% vs. 46.0%) and degree seeking (92.7 vs. 83.1%). In the same year a “typical” general science students when compared to LDT students tended to be younger (79.5% vs. 68.0% between 18 and 30), was slightly less likely to be female (51.7% vs. 56.5% female), was less likely to be non-white (16.0% vs. 26.7%) and much more likely to be full time (72.8% vs. 46.0%) and degree seeking (95.6 vs. 83.1%). For details see appendix 9. The large percentage of young, full time, degree seeking students indicates that the PSGGS SAC should continue in its mission to prepare students for transfer to 4 years schools.

B. Instructional and Curricular Changes to Meet Student and Transfer Institution Needs

Since our courses are closely aligned with courses at Oregon Community Colleges and Universities our credits transfer easily and we have not had to make any curricular changes to ensure transferability. We have developed and implemented class room assessment vehicles such as PowerPoint presentations, poster presentations, and documented self guided field trips which involve student directed research and develop skills that the students will utilize when they continue their education at four year institution; skills such as critical thinking, researching, organizing, writing, presenting and public speaking. Roughly 10 to 20% of the students in our G201/2/3 courses self identify themselves as potential geology majors during student questionnaires filled out at the beginning of the term. One response to this has been to increase the time spent in lab describing, identifying and interpreting minerals and rocks coupled with a more rigorous discussion of the physical chemistry used in investigating minerals and rocks. Feedback form students who have transferred to PSU indicate that they feel that they are better prepared for mineralogy, which is the first major’s class at PSU, than their peers which completed G201/2/3 at PSU.

To enhance student learning we are in the process of changing pedagogy from information transfer to inquiry based active learning while still having the necessary content to ensure transferability.

C. Enrollment Patterns

Our FTE almost doubled between the last program review and 08-09 (see graph below), given current trends by then end of 09-10 we will undoubtedly have grown by over 100% since the last program review.
In the last two years, the college has grown by 20.5 percent in total headcount and 39 percent in FTE\(^2\) this coupled with the projected 33% growth of the 5 county area served by PCC over the next ten years from 1.5 million people today\(^3\) to over 2.0 million people by 2020\(^4\) suggest that PCC will have a significant rise in enrollment in the near future. At this time the PSGGS SAC is unprepared for the oncoming tide of rising enrollment, the hatches are not battened and the life boats are not set.

D. Facilitating Access and Diversity

Many of the strategies used by the PSGGS SAC to facilitate access and diversity have been addressed in other places in this document, particularly in section 1B, where access (Goal 1) and Diversity (Goal 3) were discussed within the sections on PCC values and goals.


\(^3\) Source: [http://quickfacts.census.gov/qfd/states/41000.html](http://quickfacts.census.gov/qfd/states/41000.html) accessed 5/24/10

The courses taught by the PSGGS SAC appeal to students who have self-identified themselves on introductory class questionnaires as either having little interest in science or a fear that science is too complex and difficult for them to learn. It is not uncommon for students to comment that they had already tried and failed a course in biology or chemistry and were choosing a particular PSGGS class in the hopes of “passing the class” and fulfilling their science requirement. End of term feedback and registration by students in additional PSGGS classes provides evidence that students are surprised to find that they’ve enjoyed science and are now viewing the world around them in a different light. For example a student in a fall 2009 GS108 (Oceanography) course taught by full-time instructor Eriks Puris responded to the question: What is the most interesting thing you learned in this class? In the following way “I learned I don’t hate science and that is pretty interesting for me cause I always thought I did. I actually like science now. Another interesting thing is how everything is connected. Ocean, land, sun, moon etc. it all plays a part in why things are the way they are and why they happen.” It is clear that our courses are providing an entry point for students in to science.

One memorable example took place in a G208 (volcanoes) course taught in 1998 by full-time instructor Melinda Hutson. A student in the class (Allison Vetter) indicated that she intended to major in English. The class included a field trip to the south side of Mt. St. Helens, which turned out to be a life-altering experience for Ms. Vetter, and a slightly hair-raising experience for her instructor (Allison froze while crossing a suspension bridge and had to be talked across). Ms. Vetter changed her major to geology, took G 201, G 202, and G203 from Melinda Hutson, and went on to graduate from the Geosciences department at the University of Oregon.

As mentioned elsewhere, PSGGS courses are taught at multiple campuses and via Distance Learning at a wide range of times, with multiple sections offered each term, making it easy for students to find a time and place that suits their time constraints. The lack of prerequisites, other than those required by the college, means that students can mix and match classes to suit their interests.

In the last year, faculty have worked with the Portland Bridges to Baccalaureate Program (between Portland Community College and Portland State University) and the Increasing Diversity in Earth Sciences Program (administered by Oregon State University) to give students from underrepresented groups in the Earth Sciences access to undergraduate research experiences.
4. Faculty

A. Current Faculty

i. Size, distribution and composition of faculty:

Currently there are two full-time and 14 part-time faculty distributed across the district in the following way: at Sylvania there is one full-time faculty and five part-time faculty; at Rock Creek there is one full-time faculty and five part-time faculty; at Cascade there are three part-time faculty; and at Southeast Center there is one part-time faculty. The senior full-time faculty member is Melinda Hutson who has been teaching at PCC for 14 years, has a Ph.D. in Planetary Science and has disciplinary strengths in geology, geophysics, and meteoritics (the study of meteorites). The junior faculty member is Eriks Puris who has been teaching at PCC for 6 years, has a Ph.D. in Geophysical Sciences and has disciplinary strengths in geology and geochemistry.

The part-time faculty bring a broad range of experience and expertise to our SAC. While many are just beginning their careers at PCC many have been here for over five years and two have been teaching at PCC for over 20 years. Our part-time faculty is dominated by instructors with training and work experience in geology. Many of our instructors bring valuable Earth science related work experience to their roles as instructors including Kyle Dittmer (meteorology), Jill Betts (hydrology), Martin Acaster (environmental geology), Talal Abdulkareem (petroleum geology), Gretchen Gebhardt (park ranger) and Ken Sutton (computer systems).

The SAC is unaware of any rationale for the size, composition and distribution of the current faculty; rather it appears the result of unplanned development over time.

ii. Quantity and quality of faculty needed to meet the needs of the department:

Our SAC has disciplinary, campus representation and instructional staffing needs. To support the disciplinary breadth of our SAC would require the addition of faculty with expertise in the following areas: astronomy, meteorology, oceanography and distance learning ideally all at the Ph.D. level. To have one full-time faculty member at each campus at which PSGGS courses are taught would require the addition of full-time faculty at both Cascade and Southeast Center. To meet the stated PCC goal of 70% of sections taught by full-time instructors would require the hiring six more full-time faculty.

iii. Faculty turnover and changes anticipated for future:

Both of the PSGGS full-time faculty are in mid-career and plan to continue teaching at PCC for the foreseeable future. Both full-time faculty were blessed with twins during Fall 2006 and Winter 2007 (all four children are now 3+ year old toddlers), which resulted in some juggling of their teaching

---

5 In Spring 2010 the PSGGS SAC taught 34 sections, with both full-time instructors teaching 3 sections apiece. Adding six instructors would bring the total number of full-time instructors to 8, if each full-time instructor teaches three sections this would mean that 24 sections would be taught by full-time instructors. 24/34=70.6%.
schedules. This presented a greater challenge for full-time instructor Melinda Hutson, who initially went to half-time for a year and then took a leave of absence for a year to meet the demands and challenges of raising young twins who were in the process of developing immune systems in a household with two working parents.

Both of the PSGGS full-time faculty have been active in the past leading field trips and/or teaching field-based courses (e.g., G 160, G 161). In the last three years, full-time instructor Melinda Hutson has developed some medical issues that currently prevent her from guiding field trips and other field based learning experiences. It is possible that she may be unable to return to field based teaching for the remainder of her career.

It is more difficult to predict how the part-time faculty will change over the future. While two of our part-time instructors have remained at PCC for over twenty years, we’ve had part-time instructors who have taught for only one term before moving on to another position. Since full-time instructor Melinda Hutson started in 1996, the average length of time that a part-time instructor remains at Sylvania has been about three years. Full-time instructor Eriks Puris estimates that part-time instructors stay slightly longer at Rock Creek, perhaps on the order of four years.

iv. Reliance on adjunct faculty and how the background and experience of part-time faculty and full-time faculty compare:

The PSGGS SAC currently relies heavily on part-time instructors. Our program and course offerings have expanded dramatically since full-time instructor Melinda Hutson began in Fall 1996. At that time, two full-time instructors and one part-time instructor were sufficient to teach all of the G and GS courses offered at PCC. In our previous program review in 2001 (see Appendix 1), the PSGGS SAC commented on the expansion of our program and recommended that PCC hire two new full-time faculty (one for Sylvania and one for Rock Creek). This recommendation was not acted on, which is why roughly 80% of PSGGS courses are currently being taught by part-time faculty.

Both of the PSGGS full-time faculty have Ph.D.s, and arrived at PCC with prior teaching experience at the community college level (6 years for Eriks Puris; 4 years for Melinda Hutson). In contrast, none of our current part-time faculty have Ph.D.s. Many arrive at PCC fresh from earning a Master’s degree with little or no teaching experience. For some of our instructors, teaching at PCC is a brief stop on the way to further education or a full-time career elsewhere. Four specific examples come to mind: 1) Jacob Selander (see Section 2Cii) taught for one term at Rock Creek between finishing his Master’s degree and starting a Ph.D. program; 2) Christy Confar taught two terms at Sylvania before obtaining a full-time position at a geotechnical firm; 3) Daina Hardisty taught for two years at Sylvania before leaving for full-time faculty positions, first at Lower Columbia Community College, and then at Mt. Hood Community College; and 4) Alex Ruzicka taught at Sylvania for one year before moving to Portland State University where he is currently going through the tenure process. Only one of these four instructors had taught at a community college before arriving at PCC.

We currently have a good mix of enthusiastic part-time instructors who bring a broad range of experiences and areas of expertise to our discipline (see section 4Ai). However, PSGGS full-time faculty Melinda Hutson received feedback from her department Chair that he had recently finished classroom observations on PSGGS part-time instructors, and that some of the newly hired early career part-time instructors showed potential, but were currently in need of improving their instructional skills. Teaching
PSGGS courses and interacting with the PSGGS SAC at meetings and professional development activities helps early career part-time instructors become proficient and engaging teachers.

**v. How the faculty composition reflects the diversity and cultural competency goals of the institution:**

This was addressed in Section 1B (Goal 3). As noted there, geology programs across the country produce graduates that are predominantly of European ancestry and male. Faculty at geology departments across the country reflect that fact and are dominated by male faculty of European ancestry. The current mix of PSGGS faculty at PCC is more diverse than is typical for our field, with a gender mix that is roughly balanced, and the presences of three faculty with origins in other countries (England, Iraq and Austria). The PSGGS SAC is limited in its ability to alter the ethnic diversity of its faculty by the limited pool of applicants that apply for our part-time positions.

**B. Instructor Qualifications**

At the Fall 2008 PSGGS SAC meeting the SAC approved new instructor qualifications, however an examination of the academic resources web page as part of this program review has revealed that the academic resources web page has not been updated to reflect these changes. The SAC chair (Eriks Puris) will follow up on this by working with the curriculum office to resubmit the changes.

The **old** instructor qualifications for both the G & GS courses required:

- a) A masters in the Subject area; OR
- b) A bachelor’s degree in the subject area plus 30 graduate credit hours in the field; OR
- c) A bachelor’s in the subject area plus reasonable work experience.

The **new** instructor’s qualifications for GS courses are:

- a) A masters in the subject area; OR
- b) A master’s degree in a related field plus 30 graduate credit hours in the subject area.

The **new** instructor’s qualifications for G courses are:

- a) A masters in the subject area; OR
- b) A bachelor’s degree in the subject area plus 30 graduate credit hours in the subject area and be pursuing a master’s degree in the subject area.

The decision to allow qualify instructors with a bachelor’s that are pursuing a master’s degree was made to facilitate interaction with the PSU geology department which has provided successful part-time instructors in the past.
C. Professional Development

The professional development activities described in section 1B have improved how our SAC teaches. Faculty attending the regional National Association of Geoscience Teachers (NAGT) meetings return with photographs to include in their lectures, rock samples for use in labs and information and professional contacts that allow for continued development. A presentation at the 2008 NAGT meeting in Yakima introduced the SAC to the Student Attitudes About Earth Science (SAESS) assessment tool that we are currently using to assess student learning experiences in our courses. The Cosmos in the Classroom series of conferences introduced members of our SAC to the use of lecture tutorials, which are small group activities designed to engage students in active learning by confronting them with common misconceptions. The SAC has since adopted a textbook based on this approach. The many SAC members who have attended Process Oriented Guided Inquiry (POGIL) workshops frequently break up their lectures with short group based guided inquiry activities that challenge and engage students. Thanks in part to these professional development activities the “straight lecture” format of teaching, which dominated instruction by this SAC at the time of the last program review in 2001, is now largely a thing of the past.

To further improve our teaching and faculty the PSGGS SAC has begun to incorporate professional development activities into its meetings during inservice days. The Spring 2009 meeting was held at the National Weather Service offices in Portland, to introduce our faculty to NWS operations in Portland. Many of our GS108 classes take field trips to NWS in Portland; this hopefully encouraged more instructors to consider this option. The Fall 2008 SAC meeting which was held at South East Center to introduce the SAC to the lab space, lab equipment and lab equipment storage challenges facing part-time faculty teaching at Southeast Center also featured a field trip to near by Mount Tabor led by Martin Streck of the PSU geology department to discuss current research that indicates that the Boring Volcanic Field was active more recently than previously thought; previous work indicated that volcanism ceased 500,000 years ago, while recent dating suggests that the field was active as recently as 50,000 years ago. In Fall 2009 our inservice day coincided with the national meeting of the Geologic Society of America (GSA), which was being held in Portland that year. To allow our members to attend the GSA meeting we scheduled a lunchtime SAC meeting at a venue close to the convention center where the GSA meeting was being held. In Spring 2010 our SAC meeting was held at the Down Town Center to acquaint our SAC members with one of PCC ‘s newest facilities.
5. Facilities & Support

A. Classrooms and Laboratory Space

Geology and General Science classes are currently being taught at the Sylvania, Rock Creek, and Cascade campuses, as well as at the Southeast Center. To adequately discuss how classroom, laboratory space, computers, and equipment impact student success requires discussion each of these locations individually.

**Sylvania:** The single existing laboratory room (ST 317) has not been significantly upgraded in the memory of anyone still working in the Physical Science Department at Sylvania. In 2004, the third floor of the ST building was part of a major remodel resulting from passage of a bond measure. During discussions of how office and lab space would be remodeled, the division Dean at the time told full-time faculty Melinda Hutson that the Geology/General Science lab room (ST 317) would not be included in the remodel. No clear answer was given as to why, and the PSGGS faculty were left with the impression that it was simply because our program had been overlooked. At that time, all of the Chemistry labs were remodeled and the Physics lab was expanded by incorporating the space from an adjacent classroom.

In the past year, full-time faculty Melinda Hutson has received a number of comments about the inadequacies of our lab room from both the department Chair and the division Dean. Both had examined the room and stated that although it met the letter of the law, it is not ADA friendly, with narrow access lanes. There is no way to improve this without physically expanding the room or significantly reducing the number of students (currently the standard 24 students in all PSGGS lab sections) by removing tables. The lighting in the room is terrible. In a classroom observation of full-time instructor Melinda Hutson, interim-Dean Dieterich Steinmetz stated “The lighting in this room needs to be upgraded; the lights must be off for the PowerPoint, but this puts the instructor in the dark.” Although not mentioned, a separate problem is that while the lights are too bright for projection onto the screen in front, they are not bright enough for writing to be visible on the blackboard, regardless of the color chalk used. Two changes could be made that would have a huge impact on the visibility of lecture materials to students: 1) Put the center row of lights on a separate switch, and the outer two banks of lights on dimmers; 2) replace the blackboard with a white board.

The number of PSGGS courses at Sylvania are currently outstripping the capacity of the single laboratory room (ST 317) there dedicated to geology and general science. Three sections of PSGGS courses have spilled over into the adjacent Physics lab (ST 304). Each of the labs (Geology/General Science, Chemistry, and Physics) are designed to provide the space and equipment needed for experiments appropriate to their respective programs; for instance the sinks are significantly smaller in the Physics lab than in the Geology/General Science Lab, which is a problem particularly for oceanography and meteorology classes. Use of ST 304 by PSGGS classes is also suboptimal in two significant ways: 1) it prevents the Physics program from expanding their lab based classes; and 2) materials for PSGGS have to be transported from ST 317 to ST 305 for an individual class and then returned when the class is over. The laboratory space has become so tight that a section of GS 107 (Astronomy) was taught Fall 2009 and is scheduled to be taught again Fall 2010 in a conventional classroom, in a separate building, far from any laboratory facilities and equipment that would enable students to make their own measurements and observations. Rather than examine obtaining data in hands on experiments, students are provided with data to analyze.
Sylvania is also the only campus that still has two classes with large (48 students) lecture sections of PSGGS classes feeding multiple lab sections (see Section 5E). All other sections at Sylvania and at other campuses have standard class sizes of 24 students which allows the instructor to switch as necessary from lecture to laboratory experiments when appropriate to reinforce concepts and help students engage in active learning. Without additional laboratory space, it is impossible to divide the two large lecture sections (one Geology class and one General Science class each term) into smaller (24 students) classes comparable to all of the others.

In our last program review (Appendix 1) the PSGGS SAC recommended either enlarging or building new lab space for Sylvania. It was mentioned that we needed a larger space to set up experiments using large water model equipment, such as the stream tables which are important components of many of our G and GS classes (particularly G202, GS 106, GS 108, and GS 109). In this review, we will be recommending (see Section 6), simple renovations of the existing PSGGS lab (ST 317) and the addition of a new and somewhat larger PSGGS lab.

**Rock Creek:** In our last program review (Appendix 1) the PSGGS SAC recommended the creation of a new lab room for G and GS classes at Rock Creek. This was done in 2003 as the result of the passage of a bond measure. The room was initially built with plenty of cabinets, but without sufficient shelving. Over time, this problem has been partially remedied by using the Geology and General Science equipment budget to build shelves. However, more shelves are still needed.

Many of the PSGGS labs use computers. At Rock Creek, the computer room is shared with Chemistry, limiting future growth in both programs. At one point, it was suggested that the computers be updated with netbooks, which do not have screens sufficiently large to display the maps and charts used extensively by our program.

**Cascade:** There is no dedicated space for PSGGS classes at Cascade; classes are taught in Physics labs. With both the Physics and Geology/General Science programs expanding, a space crunch is under way. There is limited equipment for PSGGS classes and no permanent storage space. A dedicated lab space with equipment and storage space is badly needed for the existing program, much less for an expanding one.

**Southeast Center:** There is no lab space available at Southeast Center for PSGGS classes. All classes are taught in regular classrooms without sinks (which makes teaching oceanography in particular very difficult). There is very little equipment for Geology and General Science courses and insufficient storage for the limited PSGGS teaching materials. Storage issues were partially remedied after the PSGGS SAC brought the matter to the attention of the Dean at Southeast in response to part-time instructor complaints at the Spring of 2008 SAC meeting.

### B. Library

Many of the assessment vehicles used in PSGGS classes, e.g., poster presentations, PowerPoint presentations, guided research projects, and field trip reports require students to do extensive research. For example, PCC has a library Prize competition. One of the winners of the 2005 competition was Angela LoSasso, a student taking G 203 from full-time faculty Melinda Hutson at Sylvania (the report is
on-line at [http://www.pcc.edu/library/news/prize/geologic.pdf](http://www.pcc.edu/library/news/prize/geologic.pdf). That term, students were required to take an instructor-led field trip through the Columbia Gorge, and to prepare for the trip by researching the history of the region. A final paper synthesizing the background information and illustrated with images from the field trip was required. This past year a student taking GS 108 (oceanography) from full-time faculty Eriks Puris created a poster on sea horses. Eriks and the student submitted the poster to the PCC Library for the competition and got a puzzled response. The various people that Eriks spoke with didn’t seem to know what to do with a poster. Poster presentations are a common method of presenting research in our field. For example, several PCC students have been involved in research projects through UCORE (see section 1B). All of the research results are presented as posters (e.g., PCC student Matthew Gibson’s research on arsenic contamination in the Willamette Basin at [http://www.uoregon.edu/~msiuo/undergrad/ucore/09Gibson.pdf](http://www.uoregon.edu/~msiuo/undergrad/ucore/09Gibson.pdf)).

While a lot of material is available on-line, it is not uncommon for needed references to be books or journal articles. We need expanded coverage of the geology of the Pacific Northwest (e.g., in 2009, the Geological Society of America published a huge volume entitled *Volcanoes to Vineyards: Geologic Field Trips through the Dynamic Landscape of the Pacific Northwest*). For our recent assessment of critical thinking (Appendix 8), part of the project was to see how students figured out where to go to look for specific geologic features. Several students reported looking for field trip information in the library (e.g., *Hiking Oregon’s Geology*).

There is constantly new information in our field. For example, a student taking G203 this term just brought in the June 2010 issue of *Scientific American* (which is not yet available on line), to show the instructor an article about a new discovery which changes our view about the interior of the Earth, the growth of continents, and the evolution of the Earth’s magnetic field. Both students and faculty benefit from having access to current research. PCC’s library system already has on-line access to *Science* and *Nature*, but the access to *Nature* is accompanied by an embargo on the previous year’s articles. As both of these journals are designed to report current cutting edge ideas, not being able to access the past year of one of them is a large handicap. While it might be expensive, having access to current issues of *Nature* would benefit all of the sciences, not simply Geology and General Science. There are two additional periodicals that would benefit students taking PSGGS classes at PCC: 1) *Earth*, formerly known as *Geotimes* and published by AGI (information at [http://www.earthmagazine.org/](http://www.earthmagazine.org/), not to be confused with an earlier magazine using the same name which was carried by PCC); 2) *Geology* which is published by GSA (information at [http://geology.gsapubs.org/](http://geology.gsapubs.org/)).

**C. Instructional Support**

Clerical, technical, administrative and tutoring support for PSGGS classes is very uneven, depending on the departmental structure at each campus where the classes are offered.

At Sylvania, Geology and General Science are grouped together with Chemistry and Physics into the Physical Science Department. The current department Chair is chemist Jim Schneider. The department has its own tutoring room with computers in AM 107. Tutors are hired for each discipline (Physics, Chemistry, Geology/General Science) by the department. The department also has lab tech support for chemistry and physics labs, but no dedicated lab tech support for Geology/General Science. Such a person is needed to help organize and maintain the materials used in PSGGS classes. As an example, when full-time faculty Melinda Hutson started at Sylvania in 1996, the extensive collection of
rocks, minerals, and fossils were a disorganized mess, with material in boxes with helpful labels such as "use for G201". It took two years for the faculty member with the support of a volunteer amateur geologist to organize, box and shelve all of these materials. Several attempts have been made to paint or affix labels to individual rocks and minerals, but these always erode off after being handled by students. Full-time faculty Melinda Hutson was on an unpaid leave last year. Upon returning, she discovered that minerals that look visually similar (e.g. halite and calcite) had been mixed together. The current department lab tech does not have the type of specialized knowledge required to recognize this sort of problem or to be able to accurately return samples that someone has pulled out and left on a cart without any additional information.

At Rock Creek, Geology and General Science are included with Physics in the department of Physics and Geology, chaired by physicist Laura Fellman. Full-time faculty Eriks Puris spends one office hour per week tutoring in the Rock Creek Student Learning Center. Geology students with UCORE experience (see section 1B) also tutor there as part of their obligation to UCORE. As with Sylvania, there is no dedicated lab tech support of PSGGS classes. Currently an effort is underway to organize the lab equipment for G & GS courses in labeled shelf spaces. This project took large step forward when additional shelving was installed in May 2010.

PSGGS classes at Cascade are part of the Physics/Environmental and General Science department, chaired by physicist Tony Zable. There is no department at Southeast Center: PSGGS classes are part of the Southeast credit programs headed by interim Dean Deborah Miller. Neither of the two full-time faculty preparing this program review document is familiar with the administrative, tutoring, or technical support available at these locations.

With the PSGGS program spread widely across PCC and with classes taught by so many part-time instructors, it has been difficult to maintain good communication between campuses. We have been fortunate in having about half of our part-time instructors attend most of our SAC meetings. We also utilize the MyGroups feature of MyPCC to provide links to useful sites for pedagogy (e.g., links to Starting Point-Teaching Entry Level Geoscience; National Association of Geoscience Teachers; Digital Library for Earth System Education) and for student research opportunities (e.g., links to UCORE; Oregon Space Grant). Copies of SAC files including agendas and minutes are posted in our MyGroups site as well.

D. Advising

The PSGGS SAC has not had much interaction with PCC’s Academic Advising Department. Students occasionally comment that an advisor recommended that they take one of our courses. On the other hand, PSGGS faculty are often asked to act as advisors regarding geology or environmental science programs at other universities or colleges, particularly Portland State University. Fortunately, we have been able to answer many of our students’ questions, as a number of our part-time instructors have been students at local universities, and full-time instructor Melinda Hutson’s husband is faculty in the Department of Geology at PSU.

The PSGGS SAC has a good history of success working with the Office for Students with Disabilities (OSD). Besides the fairly common requests for extended distraction-free testing sites, and classroom accommodations (furniture, note takers, signers), we have had some experience creating
alternative field-based learning experiences for students with mobility difficulties (see section 1B). One of the issues currently being discussed in our SAC is the creation of virtual field trips and how they compare to actually “being there”. We are also wrestling with how to create meaningful laboratory and field experiences for students who are vision impaired.

E. Scheduling

The PSGGS SAC teaches classes at multiple campuses, at a broad variety of times (including weekends), and over the internet, thereby providing broad student access to our discipline. Lecture-only classes (G 207, G 208, G209) are taught either in one 2 hour and 50 minute block, or twice a week in classes that are 1 hour and 20 minutes long). Lecture-lab classes (GS 106, GS 107, GS 108, GS 109, G 201, G202, G203, G291) are taught with both lecture and laboratory sections either in two 2 hour and 50 minute blocks per week, or with two 1 hour 20 minute lectures and one 2 hour 50 minute laboratory section per week. With two exceptions at Sylvania (discussed below), all of our classes contain 24 students, and the laboratory rooms are designed to hold 24 students.

Almost three hour blocks of time are a long time for a student to focus on a lecture or one laboratory activity. Through experimentation, PSGGS faculty have found that integrating lecture and laboratory components with frequent changes back and forth between the two is pedagogically superior to running lectures (whether once or twice per week) separately from laboratory exercises, and leads to higher levels of student engagement and a more robust understanding of the material. Integrating lecture and laboratory also prevents the situation which has occurred in the past where one week’s lectures are related to another week’s lab exercises. This can result from a badly placed holiday or a snow day, delays in lecture from student questions/discussions, or an absence by an instructor in either lecture or lab due to illness). For the reasons cited above, the PSGGS SAC recommended having classes at Sylvania move from separate lecture/lab components to and integrated lecture/lab similar to that taught at Rock Creek.

There is still one section of geology and one section of general science each term at Sylvania each of which has a lecture section of 48 students held in a regular classroom, which divides into two separate lab sections of 24 students using the Sylvania G/GS lab (ST 317). The geology lecture is always taught on Monday and Wednesday during the middle of the day, with two lab sections on Tuesdays. This prevents students in this class from easily taking Tuesday/Thursday classes in other subjects. The general science lecture is always taught on Tuesday and Thursday mornings, with two lab sections on Thursdays. The students in this class either have a solid block of class from 9:00 am – 1:50 pm with a 40 minute break, or they have a 3 hour and 40 minute break between their lecture and lab. Either way, they have a very long Thursday. The major obstacle to changing the scheduling of these classes is a lack of available laboratory space (see section 5A).

Scheduling at Rock Creek and Sylvania has been fairly stable over the last several years, with the same instructors teaching a sequence of courses in the same time slot each term, which is advantageous for students because once a student finds a time and an instructor that works for them, they can continue with the same format for the next quarter. At Rock Creek, part-time slots are back to back (e.g., 2 hour 50 minute class followed by a 40 minute break followed by another 2 hour 50 minute class), making teaching at Rock Creek efficient for part time-instructors who have to travel long distances to reach PCC.
Both Rock Creek and Sylvania schedule multiple sections of G and GS classes each term, so that students who have put off their science requirement to the end can complete it in one quarter (there was one student at Rock Creek who took three GS courses in one term, but only had to be on campus two days a week).

Changes in scheduling at one campus or the expansion of a non-PSGGS program may affect class enrollments at either the campus making the changes or another campus. When G207, G208, and G209 began to be offered at Cascade, enrollments in those courses at Hillsboro Center dropped sufficiently that the sequence was cancelled. At the same time, expansion of Aviation Science at Southeast makes the offering of GS 108 there highly desirable. The G207, G208, G209 sequence at Rock Creek had been taught for six years on Friday afternoons. It was noticed in Winter 2010 that enrollment had dropped. The sequence was switched to Friday morning and enrollment went back up.

Because most of the PSGGS classes include a laboratory component, there are no wait lists for our classes. Wait lists are an important tool for monitoring the demand for our classes. We have been told many times that this is just a “banner thing”. It is a “thing” that we would like to find a way around.

Most of the PSGGS classes would benefit greatly from having a field component. Currently, there is no organized method for providing this. Instructors generally end up “donating” time to the college to run field trips on weekends. Besides being unfair to faculty (particularly part-time faculty), scheduling field trips on weekends can lead to problems for students with weekend jobs or other commitments, and this has shown up on course evaluations. There are some short field trips that can be done during a 2 hour 50 minute block, but most require longer periods of time. The PSGGS SAC is cognizant of these problems and has suggested either listing a field trip day in the class schedule (and compensating for this by dropping out other days), or requiring students to co-register for a 1-credit G200 field course. This is an issue that is still being discussed by the SAC.
6. Recommendations for Improvement

A. Strengths

The PSGGS SAC creates:

- **science education that is relevant to students.** The Earth science we teach is visible to the students in the world around them and is made tangible by field based learning. Earth science concepts can be used to help solve societal issues involving natural resources, natural hazards and global change.

- **science education that is accessible to students.** Our courses span a broad range of Earth science disciplines allowing students to choose science courses that interest them. Our courses have no prerequisite (past the standard LDC prerequisites) allowing students to choose the sequence in which they take our courses. Our courses are taught in multiple time slots across multiple campuses and on-line allowing students to choose course times that fit their schedule. Our courses offer a broad array of students an entry point to the STEM pipeline.

- **science education that builds learning skills.** Our courses incorporate projects which require students to make observations and measurements, research and synthesize information, develop and apply concepts and utilize various formats to communicate the results of their work to their instructors and peers. These learning skills prepare students for transfer to four year institutions.

- **science education that prepares students for science.** Our courses give students foundational knowledge in the Earth sciences which enables them to successfully transfer to four year programs in Earth sciences, biology, environmental science and other science related fields. Increasingly we are placing students in undergraduate research programs such as UCORE, IDES and Baccalaureate to Bridges which allow students to work with scientists as they gain hands on research experience.

- **science education that supports students.** Our courses are taught in supportive collaborative environments that stress group work and the potential of each student to succeed in learning science. This approach leads to increased student interest in science and to students taking additional courses in Earth science and the other sciences.

- **science education that improves in response to assessment.** Our SAC continues to learn about assessment and how it can be used to improve instruction. The campus wide assessment of critical thinking is causing instructors to rethink how they teach landscape hazards such as landslides, refine their course assignments and a has contributed to the SAC switching to an new inquiry based text for G201 and G202.

- **science education that incorporates the contributions of a diverse faculty.** The part-time faculty bring a broad array of professional and cultural experiences to their science classrooms and to the SAC as a whole. Their active participation in SAC meetings, assessment and course development enriches and expands our discipline.
B. Areas in Need of Improvement.

The PSGGS SAC needs:

- **more full time faculty.** Currently the PSGGS program offers too many courses across too many disciplines on too many campuses for the two full-time faculty to effectively manage and improve while preparing for future growth of the discipline fueled by the continual growth of PCC.

- **more faculty expertise in meteorology, oceanography, astronomy and distance learning.** While the current full time faculty provides disciplinary strength in geology and planetary science, there is no permanent in house expertise in meteorology, oceanography, astronomy and distance learning. Further development of inquiry based learning experiences in these disciplines and modalities would be greatly aided by having in house expertise in these fields, in addition the level at which our SACs could support the Aviation Science Program and Distance Learning would be greatly enhanced.

- **more lab rooms, lab equipment and instructional support.** Current course offerings are outstripping the current capacity of laboratory class rooms, equipment and instructional support. Sylvania and Rock Creek need to expand their existing lab spaces while dedicated lab spaces need to be established and stocked with equipment at Cascade and South East Center. Hiring dedicated instructional support with training in the earth sciences would greatly increase the ability of the PSGGS SAC to maintain, improve and expand the lab components of its courses.

- **to improve student access to field based learning.** Currently there is a lack of consistency across the campuses as to the level at which field based learning is incorporated into G & GS courses. At this time the inclusion of a field based component to G & GS courses is at the discretion of the instructor and is contingent upon the varying levels of support that each campus provides for field trips.

- **to improve course descriptions, outcomes and assessment.** The course descriptions of lab courses need to be modified to clearly indicate that these courses include a lab component. The CCOGs need to be revised in response to the recent (November 2009) state wide changes in general education course outcomes. This provides the SAC with an opportunity to strengthen its commitment to active learning and student based pedagogies while stressing the importance of field based learning to our discipline. The SAC needs to build on its positive experience with the district wide assessment of college core outcomes and more fully integrate assessment into all of its activities.

- **to enhance intercampus communication.** The lack of full-time faculty at Cascade and Southeast Center has hindered the development of consistent lines of communication between the campuses. The two full-time faculty are rarely informed of developments at Cascade and Southeast in regards to course offerings, scheduling and hiring leading to minimal SAC guidance of the evolving G & GS offerings at these campuses.
C. Recommendations

PSGGS SAC recommendations

- **Increase Full Time Faculty:** The PSGGS SAC recommends hiring four new full-time faculty, ideally at the following campuses with the following strengths:
  1) Rock Creek: meteorology
  2) Sylvania: oceanography
  3) Cascade: geology
  4) Southeast: distance learning

The SAC realizes that this won’t happen any time soon but would like to emphasize that adding these four faculty would: create a faculty capable of supporting the breadth of our discipline, provide a full-time faculty presence at each campus at which G &GS courses are taught, would provide full-time faculty support for distance learning and would bring the fraction of sections taught by full-time faculty up to about 45% which is still well below the stated PCC goal of 70%. The SAC suggests the following hiring strategy: expand the disciplinary breadth and support existing faculty by hiring first at both Rock Creek and Sylvania, then build on the increased strength of the SAC by expanding to Cascade and Southeast Center. The SAC does not recommend hiring a new faculty member with a split appointment between Cascade and Southeast Center, in our experience split appointments rarely work out well for the new hire and have a tendency of leaving multiple parties less than satisfied.

- **Additional Facilities and Equipment:** The PSGGS SAC recommends building an additional lab room at Sylvania and building and stocking new lab rooms at Cascade and Southeast. The PSGGS SAC also recommends the establishment of a district wide network of web accessible weather stations; this would provide GS109 students across the district with a common learning experience and symbolically link the PSGGS discipline across the campuses.

- **Additional Lab Tech Support:** The PSGGS SAC recommends the hiring of lab tech support with an Earth science background to support our discipline at both Sylvania and Rock Creek. One possibility is to hire part time lab techs that also teach as part-time instructors with in the PSGGS SAC.

- **Institutionalize Field Based Learning:** The PSGGS SAC recommends that field based learning become more fully incorporated into our curriculum. This could be done at a variety of levels; more support for individual instructors who take their classes on field trips, the teaching of more sections of G200, the incorporation of field based learning outcome in to the CCOGS of all G & GS courses.

- **Improve Student Access to Research Experience:** The PSGGS SAC recommends the creation of G and GS independent study courses to give students additional opportunities to pursue research while still attending PCC.

- **Update and Revise Course Descriptions and CCOGs:** The PSGGS SAC recommends that the course descriptions for lab courses be amended to clearly indicate that these courses include lab credit. The PSGGS SAC recommends that as the CCOGs are being revised to meet the new state wide outcomes for general education that they also be modified to incorporate field based learning outcomes.
Change the name of the SAC: Referring to our SAC as the Physical Science, Geology and General Science SAC is a mouthful, is inaccurate and leads to confusion. The SAC recommends a name change to the Geology and General Science SAC which is less of a mouth full, more accurate and less likely to cause confusion.
Appendixes

1) 2001 Geology and Physical Science SACC Program Review

2) Earth Science Literacy

3) Descriptions of Geology and General Science Courses from the PCC Catalog

4a) G Courses Taught at Oregon Community Colleges

4b) GS Courses Taught at Oregon Community Colleges

5) CCOGs

6) Core Outcomes Mapping

7) SAESS

8) Learning Assessment of Core Outcomes

9) Demographic Data
Appendix 1 2001 Geology and Physical Science SACC Program Review

Program Review

Geology and Physical Science SACC

April 2001
Appendix 1 2001 Geology and Physical Science SACC Program Review

We offer many choices of courses in the physical and earth sciences in order to meet the needs of college transfer students as well as degree/certificate students or those simply attending classes for enrichment. We offer currently two sequences of GS 106-7-8-9 courses at Rock Creek and one lecture format with three lab sections at Sylvania. No courses are currently being taught at Cascade, but this is addressed later in this report.

We have computer and internet access for students but this too needs upgrading and is addressed later. The faculty members are interested in not only keeping their students current but also themselves, and attend seminars and conferences dealing with technology, resources, and information regarding the sciences. We try and keep our students informed on current employment opportunities and further educational opportunities in the sciences.

The majority of our students are “non-science majors” and so we try and encourage them to be interested in the subjects in our SACC and have some success in gaining science majors through our teaching. According to the college’s program review data handbook, enrollments in our courses are stable and not likely to be increased until we get more physical space. This is addressed later on too.

With the continued support of the college administration, we can maintain the various methods of instruction that we use effectively to our students: computer-aided, field trips, lab activities with appropriate equipment and supplies (whose budgets are frequently under attack) and lab demonstrations that show the practicality and relevance of our courses. Where feasible we use slides, videos, CD’s, live TV broadcasts, and the internet to show our students scientific phenomena on location whether it be ancient history or currently in progress. Some of our faculty design and implement new computer software for student use.

Our CCG’s are currently being revised according to college policy to CCOG’s. They are placed on file in the curriculum office as soon as they are completed and approved.

We have added two new courses to our curriculum: G 209, Earthquakes; and G 200, Principles of Geology: Field Geology. One course has been revised: G 208, Volcanoes and their activity.

We would like to make the following recommendations for the improvement of our program, not necessarily in priority order:

1. Add a daytime trailer sequence in G 201-202-203 at Sylvania in order to facilitate student flexibility, and stagger the courses to be out-of-sync with the current 2 daytime sections and one night section. Growth is otherwise difficult because existing sections are full.

2. Add a night sequence of G 201-202-203 at Rock Creek. Currently there are two day sections (staggered sequence) there.

3. Distance learning courses: G201-202-203, these courses need at least two 8-hour lab days or equivalent and/or some on-line lab work as these are courses with a significant lab component.

4. Add summer courses at Sylvania such as: GS courses and G 207, G291. Add summer courses at Rock Creek such as G 207 or G291.

5. Install a dedicated 48-student lecture/lab combination room for geology and GS courses at Sylvania with a networked computer lab linked to the front podium system with at least 8 work stations and a server. This would include a computer projection system. This shall be close to the storeroom facility where the lab materials are being housed. This will reduce the 72-student sections to 48, which is an infinitely more practical number. The lab sections will still be necessarily 24.

6. Add a trailer sequence of GS 106-7-8-9 during the daytime with courses out-of-sync with the current sequence being taught at Sylvania.

7. Remodel, enlarge and/or build a new lab prep/storage facility at Sylvania in the ST building.

8. We need a full-time faculty position for GS (and possibly some G courses) at both Sylvania and Rock Creek. More sections and more courses demand more full-time faculty.
9. Build a new lab room at Rock Creek. (This is going to happen with our bond measure passing. So we will have 2 labs available for G and GS courses. New staff is still an issue.)

10. Update and appropriate equipment and supply budgets to keep up with increased enrollment, increased number of sections and new courses offered. At least $2000. Per year per campus for supplies and more for equipment. (Note: lists have been submitted to the college at Rock Creek per our bond measure passing and new facilities being built. Hopefully we can equip the new rooms with this funding.)

11. We need larger facility for water-models such as wave-tanks in classrooms and in storage areas. (These models are used in Meteorology, Geology, and Oceanography).

12. Install a dome with better roof access at Sylvania for the telescope in the ST building. Also add some sort of enclosure for a wind-screen and light shield. Also purchase a Meade 12” or Celestron C-11 Schmidt-Cassegrain telescope with computer-driven capability and hookup for TV monitor with filters.

13. Build a dome-structure for the 12” telescope at Rock Creek as a permanent home. (as opposed to having to assemble it and move it every use.)

14. Field trips are an integral part of our courses. We need at least $2500. Per year at Sylvania and the same amount at Rock Creek.

15. Install a solar-observatory (Mt. Hood Community College type) at Rock Creek or Sylvania with a mirror/lens projection system.

16. Install a working seismograph and weather station at Sylvania hooked up to a lab server linked with weather stations at Cascade and Rock Creek. (to be installed).

17. Install a roof-mounted camera on the ST building at Sylvania for 180-degree all sky coverage and link to server in lab.

18. Purchase Brunton and GPS units with appropriate computer software for GIS units to be incorporated into existing lab coursework and/or on field trips.

19. We currently have no GS or G courses being taught at the Cascade campus. It would seem appropriate to add one section (sequence) of each with the appropriate equipment and supplies in concert with the links at Sylvania and Rock Creek.

Funds for professional development are scarce in our budgets. We are in need of attending workshops and conferences out-of-state which prove to be costly. We need to be updated so we can keep our students current.

The college determines hiring qualifications for staff. We don’t.

We have no advisory committees for this SACC.

There is an additional benefit to having the equipment/facilities portion of the above list fulfilled by the college; that is, we can use them as resources for elementary, junior high, and high school classes in our district to come out and participate with. Or, alternatively, link with them via the internet. This would add to our visibility in the community as a resource.
Appendix 2 Earth Science Literacy

The NSF funded Earth Science Literacy Initiative (http://www.earthscienceliteracy.org/) has codified the underlying understandings Earth sciences into 9 BIG IDEAS and supporting concepts that each American should know. To see how each BIG IDEA is related to supporting concepts please see: http://www.earthscienceliteracy.org/es_literacy_22may09.pdf.

BIG IDEA 1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.

BIG IDEA 2. Earth is 4.6 billion years old.

BIG IDEA 3. Earth is a complex system of interacting rock, water, air, and life.

BIG IDEA 4. Earth is continuously changing.

BIG IDEA 5. Earth is the water planet.

BIG IDEA 6. Life evolves on a dynamic Earth and continuously modifies Earth.

BIG IDEA 7. Humans depend on Earth for resources.

BIG IDEA 8. Natural hazards pose risks to humans.

BIG IDEA 9. Humans significantly alter the Earth.
Appendix 3 Descriptions of Geology and General Science Courses from the PCC Catalog

COURSE DESCRIPTIONS

**GS 106 Physical Science (Geology) 4.00** Covers minerals, rocks, volcanism, earthquakes, plate tectonics, erosion and deposition by wind, glaciers and streams, weathering, fossils and geologic history. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**GS 107 Physical Science (Astronomy) 4.00** Surveys astronomy to include historical development of the universe, earth as a planet, earth's moon, planets of the solar system, the sun, stars and galaxies. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**GS 108 Physical Science (Oceanography) 4.00** Includes the chemical, biological, physical and geological nature of the oceans. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**GS 109 Physical Science (Meteorology) 4.00** Covers characteristics of our atmosphere, air pressure and winds, atmospheric moisture, large air masses, violent storms, the effect of oceans on weather, and climates. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**COURSE DESCRIPTIONS**

**G 160 Geology: Oregon Coast 1.00** Designed to introduce the relationships between the biology and geology of the Oregon Coast.

**G 161 Geology: Malheur Region 2.00** This field trip experience is designed to introduce the relationships between the biology and geology of the Malheur geographical area.

**G 200 Field Studies** Introduces basic concepts in geology through field experience. Includes both lecture and field components. Content varies based on site location. Students may repeat for credit with different sites. Prerequisite or concurrent enrollment: G 201 or instructor permission.

**G 201 Physical Geology 4.00** Introduces physical geology which deals with minerals, rocks, internal structure of the earth and plate tectonics. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**G 202 Physical Geology 4.00** Introduces physical geology which deals with mass wasting, streams, glaciers, deserts, beaches, groundwater, and use of topographic maps. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**G 203 Historical Geology 4.00** Introduces historical geology which deals with geologic time, fossils, stratigraphic principles, and the geologic history of the North American continent. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**G 207 Geology of the Pacific Northwest 3.00** Introduces the regional geology of the Pacific Northwest with emphasis on Oregon geology. Includes basic geologic principles, earth materials and geology of Pacific Northwest provinces. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**G 208 Volcanoes and Their Activity 3.00** Covers the origin, activity, products, classification and hazards of volcanoes. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**G 209 Earthquakes 3.00** Covers the nature and origin of earthquakes, the characteristics of seismic waves, how earthquakes are measured, the hazards of earthquakes and the historical and geological record of earthquakes. Prerequisite: WR 115, RD 115 and MTH 20, or equivalent placement test scores.

**G 291 Elements of Rocks and Minerals 4.00** Introduces the study of rocks and minerals that includes their classification, origin and identification. Recommended for persons interested in rock and mineral collecting, mining and prospecting. Prerequisite: WR 115, RD 115, MTH 20 or equivalent placement test scores.
## Appendix 4a G Courses Taught at Oregon Community Colleges

<table>
<thead>
<tr>
<th>Course</th>
<th>PC</th>
<th>BMCC</th>
<th>COCC</th>
<th>ChemCC</th>
<th>ClackCC</th>
<th>ClatCC</th>
<th>CGCC</th>
<th>KCC</th>
<th>LC</th>
<th>LBCC</th>
<th>MHCC</th>
<th>OCCC</th>
<th>RCC</th>
<th>SOCC</th>
<th>TBCC</th>
<th>TVCC</th>
<th>UCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>G100 Fundamentals of Geology</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G101 Intro to Geology</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G102 Intro to Geology</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G103 Intro to Geology</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G119 Rocks &amp; Minerals</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G124 Natural History/Parks &amp; Monuments</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G142 Geology of PNW Volcanoes, Mountains and Glaciers</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G143 Pacific Northwest Rocks and Minerals</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G144 Geology of PNW Rivers, Streams and Deserts</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G145 Geology of the Pacific</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G146 Rocks and Minerals</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G147 Basic Geology</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G148 Volcanoes &amp; Earthquakes</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G148C Volcanoes and Their Activity</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G160 Geology: Oregon Coast</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G161 Geology: Malheur</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G165 Regional Field Geology</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G198 Special Studies</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G200 Field Studies</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G201 Physical Geology</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>G202 Physical Geology</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>G203 Historical Geology</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>G204 Geology: Oregon Coast</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>G205 Geology: Malheur</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>G206 Geology: Pacific</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G207 Geology: Malheur</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G208 Volcanoes and Their Activity</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G209 Earthquakes</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G213 Geology of the National Parks</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G214 Prehistoric Life</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G215 Prehistoric Life</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G220 General Geology</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G226 Geologic Hazards and Natural Catastrophes</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G280 Geology/CWE</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G291 Elements of Rocks and Minerals</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G298 Independent Study: Geology</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G299 Special Studies: Geology</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- PCC: Portland Community College
- BMCC: Blue Mountain Community College
- COCC: Central Oregon Community College
- ChemCC: Chemeketa Community College
- ClackCC: Clackamas Community College
- ClatCC: Clatsop Community College
- CGCC: Columbia Gorge Community College
- CCC: Klamath Community College
- LCC: Lane Community College
- LBCC: Linn-Benton Community College
- MHCC: Mount Hood Community College
- OCCC: Columbia Gorge Community College
- RCC: Central Oregon Community College
- SOCC: Blue Mountain Community College
- TBCC: Chemeketa Community College
- TVCC: Clackamas Community College

*note: Lane Community College offers G147 under the title National Parks Geology
*note: Southern Oregon Community College teaches G145 under the title Regional Field Geology
*note: Southern Oregon Community College teaches G146 under the title Geology of Southwestern Oregon

DATA from 2009-2010 Catalogs except for Treasure Valley Community College which is based on the 2007-2009 catalog.
## Appendix 4b GS Courses Taught at Oregon Community Colleges

<table>
<thead>
<tr>
<th>Course</th>
<th>PCC</th>
<th>BMCC</th>
<th>COCC</th>
<th>ChemCC</th>
<th>ClackCC</th>
<th>ClatCC</th>
<th>CGCC</th>
<th>KCC</th>
<th>LCC</th>
<th>LBCC</th>
<th>MHCC</th>
<th>OCCC</th>
<th>RCC</th>
<th>SOCC</th>
<th>TBCC</th>
<th>TVCC</th>
<th>UCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>GS104 Physics</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS105 Chemistry</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS106 Geology</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS107 Astronomy</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS108 Oceanography</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS109 Meteorology</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS110 Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS111 Forensic Science</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS113 Intro Geology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS120 Rudiments of Meteorology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS125 Computations in Science</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS141 Earth, Our Planet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS142 Earth Revealed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS143 Earth’s Oceans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS147 Oceanography</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS151 Energy in Society</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS152 Science, Technology and Society</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS153 Intro to Cosmology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS160 Observational Astronomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS161 Field Biology of Oregon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS170 Field Ecology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS198 Special Studies</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS 199 Special Studies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS280 Co-op Ed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GS288 Independent Study: General Science</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Note:** Clackamas Community Colleges GS 104, GS105, GS106 are entitled Earth Science and don’t match description of GS104, GS105, GS106 at other colleges.
- **Note:** Rogue Community College offers GS161 under the title Regional Field Studies: Crater Lake
- **Note:** Rogue Community College offers GS170 under the title Regional Field Geology

DATA from 2009-2010 Catalogs except for Treasure Valley Community College which is based on the 2007-2009 catalog.
Appendix 5: CCOGs

Course Content and Outcome Guide for G 160

Date: 09-NOV-2009

Posted by: Curriculum Office
Course Number: G 160
Course Title: Geology: Oregon Coast
Credit Hours: 2
Lecture hours: 10
Lecture/Lab hours: 20
Lab hours: 0
Special Fee: $6

Course Description

Geology: Oregon Coast Designed to introduce the relationships between the biology and geology of the Oregon Coast.

Addendum to Course Description

Geology: Oregon Coast (G160) is a one-term course that explores the geologic history of the Oregon Coast and the relationships between geology and the plants and animals of the Oregon Coast. Students will go on a three-day field trip to the Oregon Coast to get hands-on experience of concepts covered in the lecture portion of the class.

Intended Outcomes for the course

After completion of this course, students will:
A. Apply an understanding of basic ecological principles to the plant and animal species living on the Oregon Coast to appreciate the complexity of factors that influence the "web of life" and our place within it.
B. Apply a basic knowledge of geological processes that formed this region to the impact this geology has on the biological organisms found here
C. Use scientific field research equipment
D. Communicate effectively orally and in writing
E. Successfully apply basic geological concepts in future coursework.

Course Activities and Design

The material in this course will be presented in a classroom lecture/discussion format with an accompanying field trip. Other educationally sound methods may be employed such as research papers and small group work.
Outcome Assessment Strategies

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, research papers, group projects, oral presentations, or maintenance of a personal field journal.

Course Content (Themes, Concepts, Issues and Skills)

A. Collaborate with peer - work effectively in groups.
B. Analyze soil or water samples using field laboratory kits
C. Describe the geologic history of the Oregon Coast
D. Describe the rock units that form the bedrock of the Oregon Coast
E. Define the following terms: graywacke, blueschist, turbidite, pillow lava, estuary
F. Describe the relationship between different dune environments and the plants found in those environments
G. Discuss human impact on the Oregon Coast
H. Measure strikes and dips of folded rock layers
I. Discuss the formation of marine terraces and sea stacks
J. Define the following terms: anticline, syncline, symmetric and asymmetric folds
Appendix 5: CCOGs

Course Content and Outcome Guide for G 161

Date: 15-SEP-2006

Posted by: Curriculum Office
Course Number: G 161
Course Title: Geology: Malheur Region
Credit Hours: 2
Lecture hours: 20
Lecture/Lab hours: 0
Lab hours: 0
Special Fee:

Course Description

This field trip experience is designed to introduce the relationships between the biology and geology of the Malheur geographical area.

Addendum to Course Description

Geology: Malheur Region (G161) is a one-term course that explores the geologic history of the Malheur and Great Basin geographical areas and the relationships between geology and the plants and animals of these areas. Students will go on a four-day field trip to Malheur to get hands-on experience of concepts covered in the lecture portion of the class.

Intended Outcomes for the course

After completion of this course, students will:

A. understand the basic geological processes that formed this region and the impact this geology has on the biological organisms found here
B. be able to use scientific field research equipment
C. have the ability to communicate scientific concepts effectively through written and oral reports
D. be prepared for future study in geology or related fields

Course Activities and Design

The material in this course will be presented in a classroom lecture/discussion format with an accompanying field trip. Other educationally sound methods may be employed such as research papers and small group work.

Outcome Assessment Strategies
At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, research papers, group projects, oral presentations, or maintenance of a personal field journal.

Course Content (Themes, Concepts, Issues and Skills)

A. Collaborate with peers - work effectively in groups.
B. Analyze soil or water samples using field laboratory kits
C. Describe the geologic history of the Malheur and Great Basin geographical areas
D. Describe the volcanic processes that formed Diamond Craters
E. Discuss the geologic formations associated with hydrothermal activity
F. Describe the relationship between the geology and the biological organisms in desert environments
G. Discuss human impact on the Malheur region
Appendix 5: CCOGs

Course Content and Outcome Guide for G 200

Date: 25-FEB-2010

Posted by: Eriks Puris
Course Number: G 200
Course Title: Field Studies:
Credit Hours: 1 TO 4
Lecture hours: 0
Lecture/Lab hours: 20-80
Lab hours: 0
Special Fee: $24

Course Description

Field Studies Introduces basic concepts in geology through field experience. Includes both lecture and field components. Content varies based on site location. Students may repeat for credit with different sites. Prerequisite or concurrent enrollment: G 201 or instructor permission.

Addendum to Course Description

It is recognized by the geology/general science SAC that different field trip sites differ in complexity. Additionally, an instructor may choose to concentrate on a few of the major processes that have shaped a particular location, rather than all of the processes (major and minor). Thus the breadth and depth of geological knowledge attained by a student will vary depending on the chosen site and the goals of the instructor. A student will spend 20 hours per credit in a combination of lecture/study and field observation/exercises to adequately master the outcomes and content offered by a particular site.

Intended Outcomes for the course

After completion of this course, students will:

- understand the basic geological processes that formed the geologic site covered during the course
- be able to use scientific field research equipment (equipment varies by site)
- have the ability to communicate scientific concepts effectively through written and oral reports
- be prepared for future study in geology or related fields
Course Activities and Design

The material in this course will be presented in a classroom lecture/discussion format with an accompanying field trip. Other educationally sound methods may be employed such as research papers and small group work. Curriculum materials for a specified site will be approved by the geology/general sciences SAC before the site-specific course is offered.

Outcome Assessment Strategies

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, research papers, group projects, oral presentations, or maintenance of a personal field journal.

Course Content (Themes, Concepts, Issues and Skills)

Course content varies based on location

Content common to any location includes:

- Collaborate with peers - work effectively in groups
- Describe the geologic history of the study area
- Identify the rocks found in the study area
- Discuss human impact on the study area
- Describe the relationship between the geology and the biological organisms in the study area
- Describe the geologic processes that are typified by the study area
Appendix 5: CCOGs

Course Content and Outcome Guide for G 201

Date: 08-OCT-2008

- **Posted by:** Curriculum Office
- **Course Number:** G 201
- **Course Title:** Physical Geology
- **Credit Hours:** 4
- **Lecture hours:** 30
- **Lecture/Lab hours:** 0
- **Lab hours:** 30
- **Special Fee:** $12

**Course Description**

Introduces physical geology which deals with minerals, rocks, internal structure of the earth and plate tectonics. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**Addendum to Course Description**

Physical Geology G201 is intended for both geology majors and nonmajors, and is the first term of a year of beginning college geology. Physical Geology is concerned with earth materials and geologic processes acting on the earth. G201 deals mainly with rocks and minerals, and introduces students to internally-driven geologic processes. This course can be used to partly fulfill graduation requirements for the Associate Degree, and has been approved for block transfer. The text and materials have been chosen by the faculty and the emphasis of the course will be the viewpoint of the author(s). This includes the concepts of geologic time and the evolution of the Earth.

Regarding the teaching of basic geologic principles (such as geologic time and the theory of evolution), the Portland Community College Geology Department stands by the following statements about what is science:

A. Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.

B. “Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).

C. Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as
absolute truth, but as the most widely accepted explanation for our observations of the world around us.

D. Because “creation science”, “scientific creationism”, and “intelligent design” are essentially religious doctrines that are at odds with open scientific inquiry, the Geology/General Sciences SAC at Portland Community College stands with such organizations as the National Association of Geoscience Teachers, the American Geophysical Union, the Geological Society of America, and the American Geological Institute in excluding these doctrines from our science curriculum.

Students are expected to be able to read and comprehend college-level science texts and perform basic mathematical operations in order to successfully complete this course.

Lab B Notes: The lab for this course has been approved as "Lab B". This means that Faculty effort in preparation and evaluation generally occurs outside of scheduled class hours. Class format is a combination of Faculty lectures and demonstrations, guided student interactions and supervised student application of lectures. Students produce written work such as lab notebooks, reports, and responses in writing to assigned questions, and the Instructor is expected to comment on and grade this written work outside of schedule class hours. This evaluation will take place on a regular basis throughout the term.

Intended Outcomes for the course

After completion of this course, students will:

A. be able to demonstrate an understanding of the nature and origin of volcanism and earthquake phenomena
B. understand how human activity creates hazard situations and have an appreciation for volcanic and earthquake risks to the Pacific Northwest
C. have an understanding of the theory of plate tectonics and its role in the formation of rocks, minerals and economic deposits
D. be able to define the common minerals and rock types that make up the Earth's crust.
E. have the ability to communicate scientific concepts effectively through written reports
F. be prepared for future study in geology or related fields

Course Activities and Design

The material in this course will be presented in a combination of lecture/discussion and laboratory exercises. Other educationally sound methods may be employed such as guest lectures, field trips, research papers, and small group work.

Outcome Assessment Strategies

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, laboratory write-ups, research papers, small group problem solving of questions arising from application of course
Course Content (Themes, Concepts, Issues and Skills)

A. Distinguish between rocks and minerals
B. Describe the major types of materials that make up the Earth's crust and explain how each material relates to the rock cycle
C. Describe and use the properties involved in mineral identification
D. Classify commonly occurring minerals
E. Classify commonly occurring igneous, sedimentary and metamorphic rocks
F. Develop an understanding of the origin, activity, structure, and kinds of volcanoes
G. Describe the relationship of volcanoes and earthquakes to plate tectonics
H. Understand how earthquakes are generated
I. Use three earthquake records to locate the epicenter of an earthquake
J. Describe how earthquakes can be used to study the interior of the Earth
K. Discuss the evidence supporting the theory of plate tectonics
L. Examine weathering and the formation of soils (this topic may be covered in either G201 or G202 at the discretion of the instructor)
M. Develop an understanding of the kinds and origins or geologic structures (this topic may be covered in either G201 or G202 at the discretion of the instructor)
N. Examine the role of plate tectonics in shaping the surface of the Earth
O. Describe the structure and composition of the interior of the Earth

Topics to be covered include:

A. Minerals
   1. Chemistry and bonding
   2. Structure of atoms
   3. Identification (color, luster, streak, hardness, cleavage, fracture, other features)
   4. Terrestrial abundances of elements
B. Igneous Rocks
   1. Formation and crystallization of magma (partial melting, Bowen’s reaction series)
   2. Classification (texture and chemistry)
   3. Intrusive rock structures (neck, dike, sill, batholith)
   4. Relationship to plate tectonics
C. Volcanoes and Volcanism
   1. Relationship between magma chemistry and gas content and type of eruption
   2. Eruptive styles (effusive vs. pyroclastic)
   3. Volcanic Features associated with basaltic volcanism (shield volcano, cinder cone, columnar jointing, fire fountaining, lava channels/tubes, pillow lavas)
   4. Volcanic Features associated with andesitic/rhyolitic volcanism (composite cones/stratovolcanoes, calderas, domes)
   5. Volcanic hazards (lahars, gas emissions)
D. Weathering (may be taught in G202 instead)
1. Mechanical weathering (frost wedging, abrasion, exfoliation)
2. Chemical weathering (dissolution/solution, oxidation, hydration)
3. Factors that affect weathering rates
4. Products of weathering (sand, clay, iron oxides/hydroxides)
5. Soil structure
6. Types of soils (pedocals, pedalfers, laterites)

E. Sedimentary Rocks
1. Sediment transport and texture (grain size and shape)
2. Sedimentary structures (bedding (planar, graded, cross), mudcracks)
3. Lithification (compaction and cementation)
4. Classification of sediments (clastic/detrital: clay, silt, mud, sand, gravel vs. chemical)
5. Classification of sedimentary rocks (clastic/detrital: shale, mudstone, siltstone, sandstone, arkose, greywacke, breccia, conglomerate vs. chemical: limestone, chert, coal, evaporates)
6. Introduction to sedimentary depositional environments (may be left out)

F. Metamorphic Rocks
1. Conditions promoting metamorphism (heat, pressure, fluids)
2. Types of metamorphism (contact, regional)
3. Causes of foliation
4. Common metamorphic rocks (slate, phyllite, schist, gneiss, marble, quartzite, hornfels)
5. Relationship to plate tectonics

G. Structural Geology (may be taught in G202 instead)
1. Stress and strain
2. Folds (syncline, anticline, dome, basin)
3. Faults (normal, reverse, strike-slip)
4. Strike and dip
5. Mountain building and relation to stress
6. Relationship to plate tectonics

H. Earthquakes
1. Epicenter vs. focus
2. Seismic waves (P, S, surface)
3. Magnitude scales vs. Intensity scale
4. Locating an earthquake epicenter
5. Earthquake hazards
6. Relationship to plate tectonics

I. Earth’s Interior
1. Chemical layers of Earth (crust, mantle core) vs. Mechanical layers (lithosphere, asthenosphere, lower mantle/mesosphere, outer core, inner core)
2. Using seismic waves to explore Earth’s interior

J. Plate Tectonics
1. Alfred Wegener and evidence for continental drift
2. Magnetic reversals and sea-floor spreading
3. Using hot spots to determine plate motions
4. Rifting and the origin of ocean basins
5. Features associated with each type of plate boundary (divergent, convergent, transform)
6. Ophiolites
7. Subduction and related volcanism
8. Continental collisions and relationship to mountain building
9. Convection as a driving force of plate tectonics
Appendix 5: CCOGs

Course Content and Outcome Guide for G 202

Date: 08-OCT-2008

Posted by: Curriculum Office
Course Number: G 202
Course Title: Physical Geology
Credit Hours: 4
Lecture hours: 30
Lecture/Lab hours: 0
Lab hours: 30
Special Fee: $12

Course Description

Introduces physical geology which deals with mass wasting, streams, glaciers, deserts, beaches, groundwater, and use of topographic maps. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

Addendum to Course Description

Physical Geology G202 is intended for both geology majors and nonmajors, and is the second term of a year of beginning college geology. Physical Geology is concerned with earth materials and geologic processes acting on the earth. G202 deals mainly with surficial geologic processes. This course can be used to partly fulfill graduation requirements for the Associate Degree, and has been approved for block transfer. The text and materials have been chosen by the faculty and the emphasis of the course will be the viewpoint of the author(s). This includes the concepts of geologic time and the evolution of the Earth.

Regarding the teaching of basic geologic principles (such as geologic time and the theory of evolution), the Portland Community College Geology Department stands by the following statements about what is science:

A. Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.

B. “Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).

C. Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as
absolute truth, but as the most widely accepted explanation for our observations of the world around us. Instructors will not teach that “creation science” is anything other than pseudoscience.

D. Because “creation science”, “scientific creationism”, and “intelligent design” are essentially religious doctrines that are at odds with open scientific inquiry, the Geology/General Sciences SAC at Portland Community College stands with such organizations as the National Association of Geoscience Teachers, the American Geophysical Union, the Geological Society of America, and the American Geological Institute in excluding these doctrines from our science curriculum.

Students are expected to be able to read and comprehend college-level science texts and perform basic mathematical operations in order to successfully complete this course.

**Lab B Notes:** The lab for this course has been approved as "Lab B". This means that Faculty effort in preparation and evaluation generally occurs outside of scheduled class hours. Class format is a combination of Faculty lectures and demonstrations, guided student interactions and supervised student application of lectures. Students produce written work such as lab notebooks, reports, and responses in writing to assigned questions, and the Instructor is expected to comment on and grade this written work outside of schedule class hours. This evaluation will take place on a regular basis throughout the term.

**Intended Outcomes for the course**

After completion of this course, students will:

A. be able to demonstrate an understanding of the variety of landscapes produced by erosion, transport and deposition of geologic materials
B. understand how human activity creates hazard situations and have an appreciation for landslide risks to the Pacific Northwest
C. be able to discuss the factors influencing flooding and coastal erosion
D. have the ability to communicate scientific concepts effectively through written reports
E. be prepared for future study in geology or related fields

**Course Activities and Design**

The material in this course will be presented in a combination of lecture/discussion and laboratory exercises. Other educationally sound methods may be employed such as guest lectures, field trips, research papers, and small group work.

**Outcome Assessment Strategies**

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, laboratory write-ups, research papers, small group problem solving of questions arising from application of course
Course Content (Themes, Concepts, Issues and Skills)

A. Identify and classify the landforms associated with mass wasting, groundwater, streams, glaciers, deserts and shorelines
B. Understand how landforms are related to the processes of erosion, transport and deposition
C. Describe the materials that make up landforms associated with mass wasting, groundwater, streams, glaciers, deserts and shorelines
D. Examine weathering and the formation of soils (this topic may be covered in either G201 or G202 at the discretion of the instructor)
E. Develop an understanding of the kinds and origins or geologic structures (this topic may be covered in either G201 or G202 at the discretion of the instructor)
F. Examine the role of plate tectonics in shaping the surface of the Earth
G. Discuss hazards associated with mass wasting, groundwater, streams, glaciers, deserts and shorelines

Topics to be covered include:

A. Weathering (may be taught in G201 instead)
   1. Mechanical weathering (frost wedging, abrasion, exfoliation)
   2. Chemical weathering (dissolution/solution, oxidation, hydration)
   3. Factors that affect weathering rates
   4. Products of weathering (sand, clay, iron oxides/hydroxides)
   5. Soil structure
   6. Types of soils (pedocals, pedalfers, laterites)
B. Structural Geology (may be taught in G201 instead)
   1. Stress and strain
   2. Folds (syncline, anticline, dome, basin)
   3. Faults (normal, reverse, strike-slip)
   4. Strike and dip
   5. Mountain building and relation to stress
   6. Relationship to plate tectonics
C. Mass Movement
   1. Causes of mass movement (gravity, slope angle, angle of repose, slope composition, vegetation, water)
   2. Types of mass movement (falls, flows, slides, slumps)
   3. Features associated with mass movement (talus, evidence of creep, scarp)
   4. Prevention of mass movement
   5. Triggers (storms, earthquakes, fires, land use)
D. Streams
   1. Hydrologic cycle
2. Stream topography (drainage basin, divide, tributaries, distributaries, gradient, graded stream)
3. Stream erosion (base level, abrasion, hydraulic lifting, dissolution, waterfalls)
4. Drainage patterns (dendritic, radial, rectangular, trellis)
5. Channels (braided stream, meandering stream, cut bank, point bar, flood plain, terraces)
6. Transport (competence, capacity, dissolved load, suspended load, bed load, saltation)
7. Deposition (alluvial fan, delta, channel deposits, flood plains)

E. Groundwater
1. Groundwater movement (hydraulic gradient, zone of aeration, zone of saturation, water table, porosity, permeability, aquifer, aquiclude, artesian systems)
2. Springs and geysers
3. Groundwater pollution/depletion (subidence, saltwater intrusion, cone of depression)
4. Karst topography (sinkholes, blind valleys, disappearing streams)
5. Caves and their features (stalactites, stalagmites, soda straws, columns, dripstone/flowstone)

F. Glaciers
1. Formation and budget of glaciers (snow to firn to glacial ice, zone of ablation/wastage, zone of accumulation, firn line/snow line)
2. Classification of glaciers (alpine glaciers, valley glaciers, continental ice sheets)
3. Glacial flow (plastic deformation and basal slip)
4. Erosional features (cirque, tarn, horn, arête, u-shaped valley, hanging valley, fjord)
5. Glacial sediments and sedimentary features (drift, till, erratic, moraine, drumlin, outwash, eskers)
6. Introduction to ice ages (evidence for past ice ages, possible causes of last ice ages)

G. Deserts
1. Types of deserts (subtropical created by global air circulation, rain-shadow)
2. Water erosion and deposition and related features (alluvial fan, pediment, bajada, arroyos, playa)
3. Wind erosion and deposition and related features (deflation, deflation basins, desert pavement, ventifacts, yardangs, dunes, loess)

H. Coasts
1. Waves (wavelength, wave base, wave motion, breaker, wave refraction, longshore current, rip current)
2. Erosion and erosional features (headlands, wave-cut platform, marine terrace, sea cave, sea arch, sea stack)
3. Deposition and depositional features (beach, spit, berm, baymouth bar, tombolo, groins, jetties, breakwaters, barrier islands)
4. Relationship to plate tectonics (passive vs. active margins)
5. Features associated with sea level changes (estuary, fjord)
6. Causes of sea level changes (glaciers, rate of sea-floor spreading, human-induced global warming)
Appendix 5: CCOGs

Course Content and Outcome Guide for G 203

Date: 08-OCT-2008

Posted by: Curriculum Office
Course Number: G 203
Course Title: Historical Geology
Credit Hours: 4
Lecture hours: 30
Lecture/Lab hours: 0
Lab hours: 30
Special Fee: $12

Course Description

Introduces historical geology which deals with geologic time, fossils, stratigraphic principles, and the geologic history of the North American continent. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

Addendum to Course Description

Historical Geology is intended for both geology majors and nonmajors, and is the third term of a year of beginning college geology. This course can be used to partly fulfill graduation requirements for the Associate Degree, and has been approved for block transfer. The text and materials have been chosen by the faculty and the emphasis of the course will be the viewpoint of the author(s). This includes the concepts of geologic time and the evolution of the Earth.

Regarding the teaching of basic geologic principles (such as geologic time and the theory of evolution), the Portland Community College Geology Department stands by the following statements about what is science.

A. Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.
B. “Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).
C. Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as absolute truth, but as the most widely accepted explanation for our observations of the world around us.
D. Because “creation science”, “scientific creationism”, and “intelligent design” are essentially religious doctrines that are at odds with open scientific inquiry, the Geology/General Sciences SAC at Portland Community College stands with such organizations as the National Association of Geoscience Teachers, the American Geophysical Union, the Geological Society of America, and the American Geological Institute in excluding these doctrines from our science curriculum.

Students are expected to be able to read and comprehend college-level science texts and perform basic mathematical operations in order to successfully complete this course.

**Lab B Notes:** The lab for this course has been approved as "Lab B". This means that Faculty effort in preparation and evaluation generally occurs outside of scheduled class hours. Class format is a combination of Faculty lectures and demonstrations, guided student interactions and supervised student application of lectures. Students produce written work such as lab notebooks, reports, and responses in writing to assigned questions, and the Instructor is expected to comment on and grade this written work outside of schedule class hours. This evaluation will take place on a regular basis throughout the term.

**Intended Outcomes for the course**

After completion of this course, students will:

A. be able to demonstrate an understanding of the principles and methods used in interpreting the past history of the Earth
B. understand geologic time and the methods used in its determination
C. be able to discuss the geologic changes that have occurred in North America throughout geologic time
D. be able to discuss how the fossil record changes throughout geologic time
E. have an understanding of the theory of plate tectonics and its role in the changing surface of the Earth
F. have the ability to communicate scientific concepts effectively through written reports
G. be prepared for future study in geology or related fields

**Course Activities and Design**

The material in this course will be presented in a combination of lecture/discussion and laboratory exercises. Other educationally sound methods may be employed such as guest lectures, field trips, research papers, and small group work.

**Outcome Assessment Strategies**

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, laboratory write-ups, research papers, small group problem solving of questions arising from application of course
concepts and concerns to actual experience, oral presentations, or maintenance of a personal work journal.

**Course Content (Themes, Concepts, Issues and Skills)**

A. Discuss the evidence supporting the theory of plate tectonics  
B. Explore the geologic and fossil record for each of the major geologic eons and eras  
C. Discuss the evidence supporting the theory of evolution  
D. Describe and use the geologic time scale  
E. Explore the basic concepts involved in radiometric dating  
F. Discuss the principles used in relative dating  
G. Examine common invertebrate fossils  

Topics to be covered include:

A. Plate Tectonics (may be covered in G201)  
   1. Alfred Wegener and evidence for continental drift  
   2. Magnetic reversals and sea-floor spreading  
   3. Using hot spots to determine plate motion  
   4. Rifting and the origin of ocean basins  
   5. Features associated with each type of plate boundary (divergent, convergent, transform)  
   6. Ophiolites  
   7. Subduction and related volcanism  
   8. Continental collisions and relationship to mountain building  
   9. Convection as a driving force of plate tectonics  
B. Geologic Time  
   1. Uniformitarianism  
   2. Principles of relative dating (horizontality, superposition, cross-cutting relations, inclusions, faunal succession)  
   3. Unconformities (angular unconformity, disconformity, nonconformity)  
   4. Correlation  
   5. Radiometric Dating (isotopes, half-life, parent and daughter isotopes)  
   6. Other absolute dating techniques (tree-rings, varves, lichenometry)  
   7. Geologic time scale  
C. Statigraphy  
   1. Stratigraphic units (formation, group, etc.)  
   2. Time-rock unit  
   3. Evidence for changing sea level  
   4. Fossils and evidence for evolution  
   5. Index fossils  
D. Precambrian  
   1. Divisions of Precambrian time (Hadean, Archean, Proterozoic)  
   2. Formation of the Earth and Moon as members of the solar system  
   3. Speculation on the conditions on the Earth during the Hadean
4. Archean crust  
5. Origin of continents  
6. Granulite gneiss/greenstone belts  
7. Crustal provinces of North America and assembly of Laurentia and Rodinia during the Proterozoic  
8. Wilson cycles  
9. Early atmosphere  
10. Precambrian ice ages  
11. Origin of Life  
12. Indirect evidence of Life through carbon isotopes in Isua formation ~ 3.8 by ago  
13. Cyanobacteria in 3.5 by Australian cherts  
14. Stromatolites  
15. Prokaryotic vs. eukaryotic cells  
16. Ediacaran Fauna  

E. Paleozoic  
1. Divisions of the Paleozoic  
2. Transgressions and Regressions (Sauk, Tippecanoe, Kaskaskia, Absaroka)  
3. Orogenies (Taconic, Caledonian, Acadian, Antler, Ouachita, Allegheny/Hercynian)  
4. Assembly of Pangea  
5. Clastic wedges  
6. Cyclothems  
7. Cambrian Explosion  
8. Burgess shale  
9. Trilobites  
10. Brachiopods vs. Mollusks  
11. Foraminifera  
12. Paleozoic Reefs (archeocyathids, corals, sponges, bryozoans)  
13. Emergence of Fish (jawless, jawed, ray- and lobe-finned)  
14. Emergence of amphibians and reptiles (amniotic egg)  
15. Plants invade land  
16. Great Permian Extinction  

F. Mesozoic  
1. Divisions of the Mesozoic  
2. Orogenies (Sonoma, Nevadan, Sevier, Laramide)  
3. Breakup of Pangea  
4. Cretaceous transgression  
5. Dinosaurs, marine reptiles, and flying reptiles  
6. First birds and mammals  
7. Angiosperms (flowering and deciduous plants)  
8. K-T extinction  

G. Cenozoic  
1. Divisions of the Cenozoic  
2. Alpine-Himalayan Belt  
3. Laramide orogeny  
4. Colorado Plateau
5. Basin and Range
6. Pleistocene ice ages
7. Radiation of mammals
8. Human origins
Appendix 5: CCOGs

Course Content and Outcome Guide for G 207

Date: 08-OCT-2008

Posted by: Curriculum Office
Course Number: G 207
Course Title: Geology of the Pacific N.W.
Credit Hours: 3
Lecture hours: 30
Lecture/Lab hours: 0
Lab hours: 0
Special Fee:

Course Description

Introduces the regional geology of the Pacific Northwest with emphasis on Oregon geology. Includes basic geologic principles, earth materials and geology of Pacific Northwest provinces. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

Addendum to Course Description

Geology of the Pacific Northwest (G207) is a one-term introductory course in geology. The purpose of this course is to acquaint the student with basic geologic principles and the general geology of the Pacific Northwest. The emphasis is on the geology of Oregon and Washington. This course can be used to partly fulfill graduation requirements for the Associate Degree, and has been approved for block transfer. The text and materials have been chosen by the faculty and the emphasis of the course will be the viewpoint of the author(s). This includes the geologic time scale and the evolution of the Earth.

Regarding the teaching of basic geologic principles (such as geologic time and the theory of evolution), the Portland Community College Geology Department stands by the following statements about what is science:

A. Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.

B. “Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).

C. Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as
absolute truth, but as the most widely accepted explanation for our observations of the world around us. Instructors will not teach that “creation science” is anything other than pseudoscience.

D. Because "creation science", "scientific creationism", and "intelligent design" are essentially religious doctrines that are at odds with open scientific inquiry, the Geology/General Sciences SAC at Portland Community College stands with such organizations such as the National Association of Geoscience Teachers, the American Geophysical Union, the Geological Society of America, and the American Geological Institute in excluding these doctrines from our science curriculum.

Students are expected to be able to read and comprehend college-level science texts and perform basic mathematical operations in order to successfully complete this course.

**Intended Outcomes for the course**

After completion of this course, students will:

A. be able to identify the physiographic provinces of the Pacific Northwest on a map  
B. be able to discuss the geologic processes that produced the geology of each of the physiographic provinces of the Pacific Northwest  
C. have an understanding of the theory of plate tectonics and its role in shaping the Pacific Northwest  
D. be able to define the major rock types that make up the Earth's crust.  
E. have the ability to communicate scientific concepts effectively through written reports  
F. be prepared for future study in geology or related fields

**Course Activities and Design**

The material in this course will be presented in a lecture/discussion format Other educationally sound methods may be employed such as guest lectures, field trips, research papers, and small group work.

**Outcome Assessment Strategies**

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, research papers, small group problem solving of questions arising from application of course concepts and concerns to actual experience, oral presentations, or maintenance of a personal work journal.

**Course Content (Themes, Concepts, Issues and Skills)**

A. Locate the physiographic provinces of the Pacific Northwest on a map  
B. Explore the rock types and geologic features of each of the physiographic provinces of the Pacific Northwest  
C. Identify and describe the major features of the Earth's surface and interior
D. Describe the major types of materials that make up the Earth's crust and explain how each material relates to the rock cycle
E. Describe the geologic processes and features that occur at plate boundaries
F. Describe the impact of surficial processes on landscapes and geologic materials
G. Identify the role of volcanism and faulting in the development of the High Lava Plains and the Basin and Range Provinces
H. Describe the roles of flood-type volcanism, catastrophic flooding, and glaciation in the development of the Columbia Plateau
I. Compare the geologic histories of the Western Cascades, High Cascades, and North Cascades provinces
J. Discuss the formation of the Puget Sound and Willamette Valley
K. Describe the role of accretion and crustal deformation in the development of the Klamath Mountains and Blue Mountains
L. Describe the role of subduction in the development of the Coastal ranges and the Cascades
M. List the major divisions of the standard geologic time scale

Topics to be covered include:

A. Physiographic Provinces
   1. Landscape, climate, and vegetation of the Pacific Northwest
   2. Physiographic provinces of the Pacific Northwest

B. Earth’s Surface Composition and Structure
   1. Regolith vs. bedrock, sources of regolith, variations in depth of regolith
   2. The three rock types; common examples, processes of formation
   3. Occurrence of rocks, cover vs. basement, horizontal vs. folded and faulted strata, types of intrusions, structure of mountain ranges, geologic maps
   4. Rock cycle; internal process vs. surficial processes, energy sources for internal and surficial processes.
   5. Continental crust vs. oceanic crust; differences in composition and thickness

C. Historical Geology
   1. Principles of relative and absolute dating
   2. Fossils, faunal succession, stratigraphic correlation
   3. Past environments; sedimentary evidence for past geographies and climates
   4. Geologic time scale

D. Plate Tectonics
   1. Basic idea of plate tectonics, evidence for plate motion, difference between continental and oceanic crust, internal structure of the earth, heat loss
   2. Creation and destruction of oceanic crust at ridges and trenches, age of oceanic crust
   3. Geologic activity and structure at each type of plate boundary (transform, convergent, divergent), cause of earthquakes, volcanism and topography at plate boundaries
   4. Hot spots, hot spot tracks, oceanic vs. continental hot spots, causes of hot spots

E. Coastal Provinces; Coast Ranges and Olympic Mountains
   1. Major topographic features, drainages, rock units and geologic structures
2. Paleogrophy of Tertiary coast
3. Coastal processes, evidence for uplift
4. Modern tectonic setting, accretion, evidence for prehistoric subduction zone earthquakes

F. Lowland Provinces; Puget Sound and Willamette Valley
   1. Major topographic features, drainages, rock units and geologic structures
   2. Glaciation and ice age floods

G. The Volcanic Arc: Cascade Mountains Province
   1. Major topographic features, drainages, rock units and geologic structures
   2. Subduction zone volcanism
   3. Tertiary plate tectonic setting of the Pacific Northwest
   4. Old cascades vs. young cascades, uplift of Cascade Mountains
   5. Volcanic hazards

H. Extension and Hot Spots: Basin and Range, Columbia River Plateau and High Lava Plain
   1. Major topographic features, drainages, rock units and geologic structures
   2. Timing of basin and range extension, formation of fault block mountains
   3. Flood basalt volcanism, vs. silicic volcanism
   4. Hot Spot volcanism

I. Accreted Terranes: Kalamath Mountains, Blue Mountains and North Cascades
   1. Major topographic features, drainages, rock units and geologic structures
   2. Accretion of exotic terranes, stacking of terranes, stitching by plutons
   3. Mesozoic plate tectonic setting of the Pacific Northwest

J. Edge of the Craton: Okanagan Highland and Rocky Mountains
   1. Major topographic features, drainages, rock units and geologic structures
   2. Cratonic sediments, fold and thrust belts
   3. Paleozoic plate tectonic setting of the Pacific Northwest
 Appendix 5: CCOGs

Course Content and Outcome Guide for G 208

Date: 08-OCT-2008

Posted by: Curriculum Office
Course Number: G 208
Course Title: Volcanoes and Their Activity
Credit Hours: 3
Lecture hours: 30
Lecture/Lab hours: 0
Lab hours: 0
Special Fee: 0

Course Description

Covers the origin, activity, products, classification and hazards of volcanoes. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

Addendum to Course Description

Volcanoes and Their Activity (G208) is a one-term introductory course in volcanology, which is a branch of the science of geology. The student will develop an understanding of the types, origin, activity, products, and hazards of volcanoes. This course can be used to partly fulfill graduation requirements for the Associate Degree, and has been approved for block transfer. The text and materials have been chosen by the faculty and the emphasis of the course will be the viewpoint of the author(s). This includes the geologic time scale and the evolution of the Earth.

Regarding the teaching of basic geologic principles (such as geologic time and the theory of evolution), the Portland Community College Geology Department stands by the following statements about what is science.

A. Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.
B. “Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).
C. Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as absolute truth, but as the most widely accepted explanation for our observations of the
Students are expected to be able to read and comprehend college-level science texts and perform basic mathematical operations in order to successfully complete this course.

**Intended Outcomes for the course**

After completion of this course, students will:

A. be able to demonstrate an understanding of the nature and origin of volcanism  
B. have an understanding of the theory of plate tectonics and its role in volcanism  
C. be able to classify the major rock types associated with volcanism  
D. understand how human activity creates hazard situations and have an appreciation for the volcanic risks to the Pacific Northwest  
E. have the ability to communicate scientific concepts effectively through written reports  
F. be prepared for future study in geology or related fields

**Course Activities and Design**

The material in this course will be presented in a lecture/discussion format. Other educationally sound methods may be employed such as guest lectures, field trips, research papers, and small group work.

**Outcome Assessment Strategies**

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, research papers, small group problem solving of questions arising from application of course concepts and concerns to actual experience, oral presentations, or maintenance of a personal work journal.

**Course Content (Themes, Concepts, Issues and Skills)**

A. Describe the relationship of volcanoes to plate boundaries  
B. Classify the types of rocks created by volcanic processes  
C. Contrast pyroclastic and effusive eruption styles  
D. Examine the effect of silica content on eruption style  
E. Discuss a number of historical volcanic eruptions and determine the major cause of human destruction for each case
F. Explore the methods used to forecast volcanic eruptions
G. Classify the features that occur in volcanic landscapes
H. Define the different kinds of plutons
I. Discuss the hazards associated with the Cascade volcanoes
J. Define the following terms: shield volcano, composite volcano, cinder cone, lahar, pyroclastic flow, pahoehoe, aa
K. Discuss the effects of volcanic eruptions on climate

Topics to be covered include:

A. Global Volcanic Activity
   1. Number and geographic distribution of active volcanoes
   2. Major historic volcanic eruptions and their impact on society (e.g. Tambora, Krakatau, Vesuvius, Mount Saint Helens)
   3. Active vs. dormant vs. extinct volcanoes

B. Volcanic Eruptions
   1. Different styles of volcanic eruptions: effusive vs. explosive, Icelandic, Hawaiian, Strombolian, Vulcanian, Plinian and caldera type; lava flows, lava domes, eruption columns, pyroclastic flows, lahars, lateral blasts, landslides
   2. Phreatic eruptions vs. magmatic eruptions; submarine eruptions; sub glacial eruptions
   3. Sizes of volcanic eruption, VEI

C. Volcanic Features
   1. Volcanic systems: volcanoes, vents, fissures and magma chambers
   2. Types of volcanoes: cinder cones, domes, shield volcanoes, stratovolcanoes, lava plateaus, calderas, maars, tuff rings
   4. Volcanic features in the Portland area, Cascades, Columbia River Basin and eastern Oregon

D. Products of Volcanic Eruptions
   1. Chemistry of magmas: major elements and volatiles; physical properties of magmas: freezing temperature and viscosity; relationships between magma chemistry and physical properties
   2. Relationship between cooling rate and igneous rock textures
   3. Description and classification of igneous extrusive rocks: rhyolite, dacite, andesite, basalt, scoria, pumice, obsidian, vesicles, porphyritic texture
   4. Description and classification of igneous intrusive rocks: granite, granodiorite, diorite, gabbro, peridotite
   5. Lava flow features: pahoehoe vs. aa, lava tubes, Cooling columns, tree casts, pillows, palagonite breccias etc.; identifying lava flow tops and bottoms in the field
   6. Pyroclastic products: ash, lapilli, cinders, bombs, tuffs, welded tuffs, flow tuffs
   7. Gases: types, quantity; sources: meteoric vs. magmatic.
   8. Lahars: dynamics, distance and speed of flow, temperature; causes
   9. Pyroclastic flows: dynamics, distance and speed of flow, temperature, deposits, causes
10. Lateral blasts: dynamics, distance and speed of flow, temperature, deposits, causes
11. Landslides: dynamics, distance and speed of flow, temperature, deposits, causes

E. Causes of Volcanic Eruptions
1. Migration of magmas to shallow magma chambers, cooling and differentiation of magma chambers, differences between mafic and felsic magma chambers
2. Role of exsolved gasses in driving volcanic eruptions

F. Plate Tectonics and Volcanism
1. Basic idea of plate tectonics, evidence for plate motion, difference between continental and oceanic crust, internal structure of the earth, heat loss and plate tectonics
2. Creation of oceanic crust at mid ocean ridges, volcanism and hydrothermal activity at mid ocean ridges, cause of melting at mid ocean ridges, types of magmas produced
3. Destruction of oceanic crust at subduction zones, volcanism associated with subduction zones, cause of melting at subduction zones, types of magmas produced
4. Hot spots and associated volcanism in oceanic and continental settings, cause of melting, types of magma produced,
5. Relationships between tectonic setting, cause of melting, magma type produced and eruption style

G. Living with Volcanoes
1. Volcanic hazards: lava flows, volcanic gases, eruption columns, ash falls, pyroclastic flows, lahars, landslides, lateral blasts.
2. Volcanic hazard mapping: use of volcanic deposits to determine past eruptive behavior and frequency of volcanoes, identifying hazard zones
3. Preparing for volcanic eruptions; personal disaster kits, volcano monitoring, evacuation plans, effective communication of scientific information, education of public
4. Predicting volcanic eruptions: monitoring precursors (earthquakes, deformation, gas emissions): possible triggers
5. Case studies of volcanic eruptions including successful (e.g. Mt. Pinatubo) and unsuccessful (e.g. Nevado del Ruiz) societal responses with an emphasis on Cascade volcanoes
6. Resources associated with volcanoes: geothermal energy, hot springs, tourism, volcanic soils, mineral deposits, diamonds

H. Global Impacts of Volcanism
1. Climate changes associated with historic eruptions, causes of these changes
2. Flood basalt volcanism: Columbia River Basalts and other large igneous provinces
3. Possible links between volcanism and mass extinctions
4. Volcanic degassing as a possible source of the atmosphere and ocean
Appendix 5: CCOGs

Course Content and Outcome Guide for G 209

Date: 08-OCT-2008

Posted by: Curriculum Office
Course Number: G 209
Course Title: Earthquakes
Credit Hours: 3
Lecture hours: 30
Lecture/Lab hours: 0
Lab hours: 0
Special Fee:

Course Description

Covers the nature and origin of earthquakes, the characteristics of seismic waves, how earthquakes are measured, the hazards of earthquakes and the historical and geological record of earthquakes. Prerequisite: WR 115, RD 115 and MTH 20, or equivalent placement test scores.

Addendum to Course Description

Earthquakes (G209) is a one-term introductory course in earthquakes/seismology, which is a branch of the science of geology. The student will develop an understanding of the causes, activity, effects, and hazards of earthquakes as well as an understanding of the various methods of measuring the size/energy of an earthquake. The course will use case studies of historical earthquakes to examine ways to minimize earthquake damage, with emphasis on earthquakes in the pacific northwest. This course can be used to partly fulfill graduation requirements for the Associate Degree, and has been approved for block transfer. The text and materials have been chosen by the faculty and the emphasis of the course will be the viewpoint of the author(s). This includes the geologic time scale and the evolution of the Earth.

Regarding the teaching of basic geologic principles (such as geologic time and the theory of evolution), the Portland Community College Geology Department stands by the following statements about what is science.

A. Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.

B. “Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).
C. Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as absolute truth, but as the most widely accepted explanation for our observations of the world around us. Instructors will not teach that “creation science” is anything other than pseudoscience.

D. Because "creation science", "scientific creationism", and "intelligent design" are essentially religious doctrines that are at odds with open scientific inquiry, the Geology/General Sciences SAC at Portland Community College stands with such organizations such as the National Association of Geoscience Teachers, the American Geophysical Union, the Geological Society of America, and the American Geological Institute in excluding these doctrines from our science curriculum.

Students are expected to be able to read and comprehend college-level science texts and perform basic mathematical operations in order to successfully complete this course.

**Intended Outcomes for the course**

After completion of this course, students will:

A. be able to demonstrate an understanding of the nature and origin of earthquake phenomena
B. understand how human activity creates hazard situations and have an appreciation for the earthquake risks to the Pacific Northwest
C. have an understanding of steps that individuals and a community can take to prepare for an earthquake
D. have the ability to communicate scientific concepts effectively through written reports
E. be prepared for future study in geology or related fields

**Course Activities and Design**

The material in this course will be presented in a lecture/discussion format. Other educationally sound methods may be employed such as guest lectures, field trips, research papers, and small group work.

**Outcome Assessment Strategies**

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, research papers, small group problem solving of questions arising from application of course concepts and concerns to actual experience, oral presentations, or maintenance of a personal work journal.

**Course Content (Themes, Concepts, Issues and Skills)**

A. Describe what is meant by "earthquake".
B. Define the following terms: focus, epicenter, refraction, reflection.
C. Describe the different types of seismic waves.
D. Describe the relationship of earthquakes to plate tectonics.
E. Define the following terms: strain accumulation, creep, foreshock, main shock, aftershock, interplate earthquake, intraplate earthquake.
F. Describe how a seismograph works.
G. Locate an earthquake epicenter using travel-time curves and three seismic records.
H. Describe how earthquakes can be used to study the interior of the earth.
I. Locate underground faults and describe crustal structure using a seismic profile.
J. Classify the different types of faults that result from earthquakes.
K. Define the following terms: strike-slip, dip-slip, oblique-slip, hanging wall, foot wall.
L. Describe the landforms produced along faults.
M. Describe the causes of earthquakes.
N. Define the following terms: compression, dilation, elastic rebound, compressive stress, tensile stress, fault-plane diagram.
O. Identify the different types of seismic waves on a seismogram and determine the motion along the fault from the first motion of the p-wave.
P. Describe the relationship between earthquakes, volcanoes and tsunamis.
Q. Define the following terms: soil liquefaction, slickensides, sand boils, elastic sills.
R. Discuss a number of historical earthquakes and determine the major cause of destruction for each case.
S. Describe the events that precede earthquakes.
T. Describe the evidence for past earthquakes along the Cascadia subduction zone.
U. Describe steps that an individual can take to protect against earthquake damage.
V. Describe methods for making buildings and other structures more earthquake resistant.

Topics to be covered include:

A. Global Earthquake Activity
   1. Major historic earthquakes and their impact on society (e.g. San Francisco 1906, Mexico City 1985, Nisqually 2001 etc.)
   2. Number and geographic distribution of major historic earthquakes
B. Observational Seismology
   1. Eyewitness observations during earthquakes
   2. Effects of earthquakes; ground rupture, ground displacement, fault scarps, sand boils, liquefaction, damage to buildings and structures
   3. Mercalli intensity scale
   4. Foreshocks and aftershocks
C. Faults and Earthquakes
   1. Relationship between faults and earthquakes, elastic rebound theory of earthquakes
   2. Stress (compressive, tensional, shear) and strain (brittle, ductile and elastic)
   3. Types of faults: strike slip, dip slip, oblique slip, right lateral, left lateral, normal, reverse, thrust and detachment, footwall vs. hanging wall, relation between fault type and stress
   4. Small scale features of faults; slickensides, fault gauge, mineralization.
5. Geomorphology of faults; scarps, shutter ridges, sag ponds, linear valleys, faceted spurs
6. Evidence for cumulative displacement along faults
7. Causes of earthquakes not associated with faults; landslides, volcanic eruptions, atomic tests

D. Instrumental Seismology
1. Seismometers; principles of operation, sensitivity
2. Seismograms; identification of P, S and surface waves
3. Properties of waves; wavelength, amplitude, period, wave speed, particle motion
4. Behavior of waves; constructive and destructive interference, standing waves, refraction, reflection
5. Interpretation of P, S and surface waves, typical velocities of each
6. Use of P-S wave gap to determine distance to earthquake, pinpointing the point of origin of an earthquake by triangulation, epicenter vs. focus
7. Use of first motion studies to determine the sense of motion along a fault, use of 'beach ball diagrams' to represent fault plane solutions
8. Determining the magnitude of an earthquake; Richter magnitude vs. moment magnitude
9. Frequency of various size earthquakes, depth distribution of earthquakes

E. Mechanics of Faults
1. Creep and asperities, stick-slip models of faults
2. Earthquakes triggered by earthquakes; changes in stress and strain caused by earthquakes

F. Earthquakes and the Earth's Internal Structure
1. Refraction and reflection of seismic waves, application to determining subsurface structure and thickness of crust
2. Velocity of seismic waves through different materials, effects of pressure and temperature on seismic velocity
3. Variation of seismic velocity with depth; evidence for the low velocity zone
4. Shadow zones as evidence for the outer and inner core.

G. Plate Tectonics and Earthquakes
1. Basic idea of plate tectonics, evidence for plate motion, difference between continental and oceanic crust, internal structure of the earth, heat loss and plate tectonics
2. Types of plate boundaries: stresses associated with each, first motions of earthquakes observed at each, depths of earthquakes associated with each type of plate boundary

H. Living with Earthquakes
1. Primary hazard from earthquakes; ground shaking, ground deformation, liquefaction
2. Secondary hazards from earthquakes; landslides, tsunamis, fire
3. Construction of earthquake hazard maps
4. The methods of paleoseismology, the reoccurrence intervals of faults
5. Preparing for earthquakes, personal preparedness, societal preparedness
6. The design of earthquake resistant buildings, the retrofitting of existing buildings
7. Predicting earthquakes, possible precursors, periodicity, seismic gaps
8. Successes and failures of earthquake prediction in China and Parkfield, CA.
I. Earthquakes in the Pacific Northwest
   1. Historic earthquakes in the Pacific Northwest
   2. Tectonic setting of the Pacific Northwest and the possibility of large earthquakes
   3. Evidence for prehistoric subduction zone earthquakes in the Pacific Northwest
   4. Comparison of causes, effects and frequency of shallow, deep and subduction zone earthquakes
   5. "Silent" earthquakes in the Pacific Northwest
Appendix 5: CCOGs

Course Content and Outcome Guide for G 291

Date: 08-OCT-2008

Posted by: Curriculum Office
Course Number: G 291
Course Title: Elements of Rocks and Minerals
Credit Hours: 4
Lecture hours: 30
Lecture/Lab hours: 0
Lab hours: 30
Special Fee: $12

Course Description

Introduces the study of rocks and minerals that includes their classification, origin and identification. Recommended for persons interested in rock and mineral collecting, mining and prospecting. Prerequisite: WR 115, RD 115, MTH 20 or equivalent placement test scores.

Addendum to Course Description

Elements of rocks and minerals is an introductory, one-term course for non-majors in geology. The purpose of this course is to acquaint the student with the occurrence and mechanisms of formation of common rocks and minerals and to enable students to identify these materials in the field. This course can be used to partly fulfill graduation requirements for the Associate Degree, and has been approved for block transfer. The text and materials have been chosen by the faculty and the emphasis of the course will be the viewpoint of the author(s). This includes the concepts of geologic time and the evolution of the Earth. Alternative theories are of course welcome to be discussed, but the emphasis of the course shall be as stated above.

Lab B Notes: The lab for this course has been approved as "Lab B". This means that Faculty effort in preparation and evaluation generally occurs outside of scheduled class hours. Class format is a combination of Faculty lectures and demonstrations, guided student interactions and supervised student application of lectures. Students produce written work such as lab notebooks, reports, and responses in writing to assigned questions, and the Instructor is expected to comment on and grade this written work outside of schedule class hours. This evaluation will take place on a regular basis throughout the term.

Intended Outcomes for the course

After completion of this course, students will:
A. understand how to identify a mineral or rock in the field
B. be able to discuss the properties that distinguish gems from ordinary minerals
C. have an understanding of the theory of plate tectonics and its role in the formation of rocks, minerals and economic deposits
D. be able to define the common minerals and rock types that make up the Earth's crust.
E. have the ability to communicate scientific concepts effectively through written reports
F. be prepared for future study in geology or related fields

Course Activities and Design

The material in this course will be presented in a combination of lecture/discussion and laboratory exercises. Other educationally sound methods may be employed such as guest lectures, field trips, research papers, and small group work.

Outcome Assessment Strategies

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods may include one or more of the following tools: examinations, quizzes, homework assignments, laboratory write-ups, research papers, small group problem solving of questions arising from application of course concepts and concerns to actual experience, oral presentations, or maintenance of a personal work journal.

Course Content (Themes, Concepts, Issues and Skills)

A. Distinguish between rocks, minerals and gems
B. Describe the major types of materials that make up the Earth's crust and explain how each material relates to the rock cycle
C. Describe and use the properties involved in mineral identification
D. Classify commonly occurring minerals
E. Classify commonly occurring igneous, sedimentary and metamorphic rocks
F. Understand the effect of atomic structure on the properties of minerals
G. Discuss the role of plate tectonics in the formation of minerals and rocks
H. Explore the various mechanisms for creating ore deposits
I. Describe the interaction of light with gems
J. Examine the sources and used of industrially strategic minerals and metals
Appendix 5: CCOGs

Course Content and Outcome Guide for GS 106

Date: 08-OCT-2008

Posted by: Eriks Puris
Course Number: GS 106
Course Title: Phys Sci (Geology)
Credit Hours: 4
Lecture hours: 30
Lecture/Lab hours: 0
Lab hours: 30
Special Fee: $12

Course Description

Covers minerals, rocks, volcanism, earthquakes, plate tectonics, erosion and deposition by wind, glaciers and streams, weathering, fossils and geologic history. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

Addendum to Course Description

The purpose of this course is to gain knowledge and appreciation of geology through lecture/discussion sessions and laboratory experiences. It is a one-term survey course that may be included as part of the years sequence in physical science for college transfer credit.
The course will have as many of the following components as feasible: lectures, discussions, lab activities, videos, slides, CDs, live television, field trips, and computer-aided instruction.
The text and materials for the course have been chosen by the faculty, and viewpoints shall be that of the author(s). This includes the topics of relativity, the geologic time scale, evolution of the Earth and its atmosphere, the solar system, the galaxy, and the universe.
Regarding the teaching of basic geologic principles (such as geologic time and the theory of evolution), the Portland Community College Geology Department stands by the following statements about what is science.

- Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through
scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.

- “Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).
- Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as absolute truth, but as the most widely accepted explanation for our observations of the world around us. Instructors will not teach that “creation science” is anything other than pseudoscience.
- Because "creation science", "scientific creationism", and "intelligent design" are essentially religious doctrines that are at odds with open scientific inquiry, the Geology/General Sciences SAC at Portland Community College stands with such organizations such as the National Association of Geoscience Teachers, the American Geophysical Union, the Geological Society of America, and the American Geological Institute in excluding these doctrines from our science curriculum.

Students are expected to be able to read and comprehend college-level science texts and perform basic mathematical operations to successfully complete this course.

**Lab B Notes:** The lab for this course has been approved as "Lab B". This means that Faculty effort in preparation and evaluation generally occurs outside of scheduled class hours. Class format is a combination of Faculty lectures and demonstrations, guided student interactions and supervised student application of lectures. Students produce written work such as lab notebooks, reports, and responses in writing to assigned questions, and the Instructor is expected to comment on and grade this written work outside of schedule class hours. This evaluation will take place on a regular basis throughout the term.

**Intended Outcomes for the course**

- Complete the course successfully in order to transfer to a university and continue the study of geology and/or related subjects.
- Acquire the vocabulary needed to read and analyze articles in newspapers/magazines relating to geology (research) and understand them.
- Explain and compare the different types of minerals and igneous, sedimentary, and metamorphic rocks and the processes by which they are formed.
- Decode topographic maps using the map scale, symbols, and features shown on the map.
- Describe and compare mass wasting, stream processes, glaciers, groundwater systems, coastal processes and wind erosion.
- Explain plate tectonics and the evidence we have for it.
- Contrast and compare the different types of folds and faults.
Course Activities and Design

The laboratory is not separated from the lecture but will usually be correlated in such a way as to reinforce the materials being discussed in the lecture session. It is necessary for the student to successfully complete the laboratory section of the course in order to earn a grade for the course. Math will occasionally be used for solving simple ratio problems, as will be the use of maps and graphs.

Outcome Assessment Strategies

The instructor will choose from the following methods of assessment: exams, quizzes, lab exercises, written reports, oral presentations, group projects, class participation, homework assignments, and field trips. The instructor shall detail the methods being used to the students at the beginning of the course.

Course Content (Themes, Concepts, Issues and Skills)

(NOTE: the topics may be chosen in any order by the instructor)

- Explain rock and mineral classification and identification
- Explain how these materials form and how they are related to each other
- Describe the major types of landscapes that make up the earth’s surface and how they are formed
- Describe the earth’s internal structure and the processes shaping it
- Explain the relationship between the processes that shape landscapes and those that shape internal structure.
- Explain the relationship between the processes that shape landscapes and structure and those that form crustal materials
- Explain how geologic histories are constructed
- Identify the major parts of and events in the geologic calendar
- Discuss the personal and societal relevance of these topics

Topics to be covered include:

Geologic materials

- Minerals – Properties, classification, and chemistry
- Igneous rocks – Identification and classification
- Magmas and magmatic cooling – Volcanism and intrusion
- Sediments and weathering
- Sedimentary rocks – Identification and classification
- Lithification
- Metamorphic rocks – Identification and classification
- Metamorphism- settings and processes

**Landscapes and landscaping processes**

- Global topography and structure
- Topographic and geologic maps
- Mass wasting and related landscapes
- Streams and related landscapes
- Glacial systems and related landscapes
- Groundwater systems and related landscapes
- Crustal deformation and related structures (folds and faults)
- Earthquakes and plate tectonics

**Historical geology**

- Fossils and stratigraphy
- Relative and absolute dating techniques
- Geologic time scale; major events in Earth history
Appendix 5: CCOGs

Course Content and Outcome Guide for GS 107

Date: 08-OCT-2008

Posted by: Curriculum Office
Course Number: GS 107
Course Title: Phys Sci (Astronomy)
Credit Hours: 4
Lecture hours: 30
Lecture/Lab hours: 0
Lab hours: 30
Special Fee: $12

Course Description

Surveys astronomy to include historical development of the universe, earth as a planet, earth's moon, planets of the solar system, the sun, stars and galaxies. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

Addendum to Course Description

Physical Science (Astronomy) GS107 is a one-term introductory course in which distance-learning methods are used together with three required four-hour laboratory meetings and a separate orientation session. The distance-learning methods include televised video and Web Course tools (WebCT). The video is accompanied by a textbook and telecourse student guide. Homework projects currently involve the use of supplemental exercises on stellar properties that require the use of a computer. In addition, students perform nighttime observations of stars and the Moon, by tracking the position of one star and the Moon over one four-hour period and over the course of a week. These observations familiarize the student with the night sky and help reinforce concepts learned in the videos and text readings. Using WebCT, students take weekly quizzes, and can easily communicate with the instructor and other students in class. A calendar module in WebCT keeps students abreast of what they should be doing when. Students can also track their scores on graded assignments using WebCT. This course can also be taught as a standard, in-class course, as are GS 106, 108, and 109 with three hours per week in lecture/discussion, and three hours per week in lab.

The text and materials have been chosen by the faculty and the emphasis of the course will be the
viewpoint of the author(s). This includes relativity, the geologic time scale, and the evolution of the Earth, our solar system, our galaxy, and the universe at large.

Regarding the teaching of basic geologic principles (such as geologic time and the theory of evolution), the Portland Community College Geology Department stands by the following statements about what is science.

A. Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.

B. “Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).

C. Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as absolute truth, but as the most widely accepted explanation for our observations of the world around us. Instructors will not teach that “creation science” is anything other than pseudoscience.

D. Because "creation science", "scientific creationism", and "intelligent design" are essentially religious doctrines that are at odds with open scientific inquiry, the Geology/General Sciences SAC at Portland Community College stands with such organizations such as the National Association of Geoscience Teachers, the American Geophysical Union, the Geological Society of America, and the American Geological Institute in excluding these doctrines from our science curriculum.

Students are expected to be able to read and comprehend college-level science texts and perform basic mathematical operations to successfully complete this course.

**Lab B Notes:** The lab for this course has been approved as "Lab B". This means that Faculty effort in preparation and evaluation generally occurs outside of scheduled class hours. Class format is a combination of Faculty lectures and demonstrations, guided student interactions and supervised student application of lectures. Students produce written work such as lab notebooks, reports, and responses in writing to assigned questions, and the Instructor is expected to comment on and grade this written work outside of schedule class hours. This evaluation will take place on a regular basis throughout the term.

**Intended Outcomes for the course**

After completion of this course, students will:
A. Be able to demonstrate an understanding of the nature and origin of astronomical phenomena
B. Have an understanding of the contents of our solar system
C. Become familiar with the motions of stars and the moon in the nighttime sky, by performing lab and field activities
D. Develop an ability for self-paced work
E. Be prepared for future study in astronomy or related fields

Course Activities and Design

The material in this course will be presented through televised video with accompanying reading assignments, in three laboratories and a required orientation session, and through supplemental computer activities. Students will be encouraged to work together on an observing project, but will be required to demonstrate mastery of the course content by taking in-class exams. Alternatively, the course can be a standard, in-class course as described above.

Outcome Assessment Strategies

At the beginning of the course, the instructor will detail the methods used to evaluate student progress and the criteria for assigning a course grade. The methods include one or more of the following tools: on-line quizzes, in-class examinations, and homework assignments, and laboratory assignments.

Course Content (Themes, Concepts, Issues and Skills)

A. Describe astronomical distance and size scales.
B. Describe the apparent motion of astronomical objects (planets, stars) caused by the rotation and revolution of the Earth.
C. Describe the historical development of astronomy.
D. Describe the properties of light.
E. Describe the properties of the sun and other stars.
F. Describe how stars evolve.
G. Describe the properties of the Milky Way galaxy and other galaxies.
H. Describe the global properties of various planets in the solar system, including the Earth and it’s moon.
I. Describe the properties of meteorites, comets, and asteroids.
Appendix 5: CCOGs

Course Content and Outcome Guide for GS 108

Date: 08-OCT-2008

Posted by: Eriks Puris
Course Number: GS 108
Course Title: Phys Sci (Oceanography)
Credit Hours: 4
Lecture hours: 30
Lecture/Lab hours: 0
Lab hours: 30
Special Fee: $12

Course Description

Includes the chemical, biological, physical and geological nature of the oceans. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

Addendum to Course Description

The purpose of this course is to develop an understanding of the chemical, biological, physical, and geological processes related to the ocean, and include historical perspectives. It is a one-term survey course that may be included as part of the year’s sequence in physical science for college transfer credit. The course will have as many of the following components as feasible: lectures, discussions, lab activities, videos, CDs, slides, and computer aided instruction. It is necessary to successfully complete the lab part of the course in order to pass the course.

The faculty has chosen the text and lab materials and the viewpoints shall be that of the author(s). This includes the topics of relativity, the geologic time scale, and the evolution of the Earth, solar system, and the galaxy and universe.

Regarding the teaching of basic geologic principles (such as geologic time and the theory of evolution), the Portland Community College Geology Department stands by the following statements about what is science.

- Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.
“Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).

Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as absolute truth, but as the most widely accepted explanation for our observations of the world around us. Instructors will not teach that “creation science” is anything other than pseudoscience.

Because "creation science", "scientific creationism", and "intelligent design" are essentially religious doctrines that are at odds with open scientific inquiry, the Geology/General Sciences SAC at Portland Community College stands with such organizations such as the National Association of Geoscience Teachers, the American Geophysical Union, the Geological Society of America, and the American Geological Institute in excluding these doctrines from our science curriculum.

Students are expected to be able to read and comprehend college-level science texts and perform basic mathematical operations to successfully complete this course.

**Lab B Notes:** The lab for this course has been approved as "Lab B". This means that Faculty effort in preparation and evaluation generally occurs outside of scheduled class hours. Class format is a combination of Faculty lectures and demonstrations, guided student interactions and supervised student application of lectures. Students produce written work such as lab notebooks, reports, and responses in writing to assigned questions, and the Instructor is expected to comment on and grade this written work outside of schedule class hours. This evaluation will take place on a regular basis throughout the term.

**Intended Outcomes for the course**

1. Complete the course successfully in order to transfer to a university and continue the study of oceanography or related courses;
2. Acquire the vocabulary in order to read articles in newspapers and magazines relating to oceanography (research) and understand them;
3. Analyze and compare the physical, chemical, geological, and biological processes that occur in the world’s oceans;
4. Explain human history with reference to the world’s oceans and our part in using and abusing the resources from the oceans.

**Course Activities and Design**

The laboratory is not separate from the lecture, but will usually be correlated in such a way as to reinforce the materials being discussed in the lecture section. It is necessary for the student to
successfully complete the laboratory portion of the course in order to earn a grade in the course. Math will be used to solve ratio, percentage, and simple algebraic problems. Also included are the designing, reading, and interpreting of graphs.

**Outcome Assessment Strategies**

The instructor will choose from the following methods of assessment: exams, quizzes, lab exercises, written reports, oral reports, group projects, class participation, homework assignments, and field trips. The instructor shall detail the methods to be used to the students at the beginning of the class.

**Course Content (Themes, Concepts, Issues and Skills)**

(note: topics may be selected in any order by each instructor)

- Explain the nature and history of oceanography as a science
- Discuss the structure and evolution of the earth’s ocean basins and coastlines.
- Discuss the mechanics of waves, currents, and tides.
- Describe the major chemical and physical properties of seawater and the interaction of these properties.
- Discuss marine biology in terms of habitats and zones, life in the oceans.
- Discuss how humans impact the marine environment in terms of resources from the sea and marine pollution.
- Other topics as desired by the instructor.

**Topics to be covered include:**

**Oceanography as a science**

- The scientific method as it applies to oceanography
- Major divisions of oceanography
- Brief history of oceanography

**Marine geology**

- Major seafloor features and bathymetric mapping
- The earth’s internal structure and structure of oceanic crust
- Surficial processes related to the oceans – Mass wasting, stream flow, groundwater, glaciers, wind, waves, and ocean currents
- Tectonic processes related to the oceans – Volcanism, crustal deformation, and plate tectonics.
• Major rock types
• Seafloor sediment – Classification, formation, and distribution

Physical oceanography

• Seawater - Physical properties, measurement, and geography
• Surface and deep ocean currents – Mechanics, measurement, and geography
• Waves – Basics physics and types
• Tides – Mechanics, measurement, and prediction

Marine biology

• Marine organisms and adaptation
• Marine organisms and ecological relationships – Food webs, energy flow, and populations
• Marine environments – Types, physical conditions, inhabitants and adaptations, ecological relationships.
• Human impact – The impact of resource extraction from and contamination of marine environments.
**Appendix 5: CCOGs**

**Course Content and Outcome Guide for GS 109**

**Date:** 08-OCT-2008

- **Posted by:** Curriculum Office
- **Course Number:** GS 109
- **Course Title:** Phys Sci (Meteorology)
- **Credit Hours:** 4
- **Lecture hours:** 30
- **Lecture/Lab hours:** 0
- **Lab hours:** 30
- **Special Fee:** $12

**Course Description**

Covers characteristics of our atmosphere, air pressure and winds, atmospheric moisture, large air masses, violent storms, the effect of oceans on weather, and climates. Prerequisite: WR 115, RD 115 and MTH 20 or equivalent placement test scores.

**Addendum to Course Description**

The purpose of this course is to develop an understanding of our atmosphere, weather, and climate, including historical perspectives. It is a one-term survey course that may be included as part of the year’s sequence in physical science for college transfer credit.

The course will have as many of the following components as feasible: lectures, discussions, lab activities, videos, CD’s, slides, live television and computer reports, and computer-aided instruction. It is necessary to successfully complete the lab part of the course in order to pass the course.

The text and materials for this course have been chosen by the faculty and viewpoints shall be that of the author(s). This includes the topics of relativity, the geologic time scale, evolution of the Earth and its atmosphere, the solar system, the galaxy and the universe.

Regarding the teaching of basic geologic principles (such as geologic time and the theory of evolution), the Portland Community College Geology Department stands by the following statements about what is science.
A. Science is a fundamentally non-dogmatic and self-correcting investigatory process. A scientific theory is neither a guess, dogma, nor myth. The theories developed through scientific investigation are not decided in advance, but can be and often are modified and revised through observation and experimentation.

B. “Creation science,” also known as scientific creationism, is not considered a legitimate science, but a form of religious advocacy. This position is established by legal precedence (Webster v. New Lenox School District #122, 917 F.2d 1004).

C. Geology instructors at Portland Community College will teach the generally accepted basic geologic principles (such as geologic time and the theory of evolution) not as absolute truth, but as the most widely accepted explanation for our observations of the world around us. Instructors will not teach that “creation science” is anything other than pseudoscience.

D. Because "creation science", "scientific creationism", and "intelligent design" are essentially religious doctrines that are at odds with open scientific inquiry, the Geology/General Sciences SAC at Portland Community College stands with such organizations such as the National Association of Geoscience Teachers, the American Geophysical Union, the Geological Society of America, and the American Geological Institute in excluding these doctrines from our science curriculum.

Students are expected to be able to read and comprehend college-level science texts and perform basic mathematical operations to successfully complete this course.

**Lab B Notes:** The lab for this course has been approved as "Lab B". This means that Faculty effort in preparation and evaluation generally occurs outside of scheduled class hours. Class format is a combination of Faculty lectures and demonstrations, guided student interactions and supervised student application of lectures. Students produce written work such as lab notebooks, reports, and responses in writing to assigned questions, and the Instructor is expected to comment on and grade this written work outside of schedule class hours. This evaluation will take place on a regular basis throughout the term.

**Intended Outcomes for the course**

A. Complete the course successfully in order to transfer to a university and continue the study of meteorology or related courses.

B. Acquire the vocabulary needed to read articles in newspapers/magazines relating to weather and climate (research) and understand them;

C. Explain and compare the various types of weather systems such as: anticyclones, midlatitude cyclones, tropical cyclones, thunderstorms, tornadoes, and hurricanes.

D. Describe the practical effects of weather and forecasting on human activities now and in the past; and do the same for world climates in the past, present, and future.
Course Activities and Design

The laboratory is not separate from the lecture, but will usually be correlated in such a way as to reinforce the materials being discussed in the lecture section. It is necessary for the student to successfully complete the laboratory section of the course in order to earn a grade in the course. Math will be used to solve ratio, percentage, and simple algebraic problems. Also included are the design, reading, and interpreting of graphs.

Outcome Assessment Strategies

The instructor will choose from the following methods of assessment: exams, quizzes, lab exercises, written reports, oral presentations, group projects, class participation, homework assignments, and field trips. The instructor shall detail the methods to be used to the students at the beginning of the course.

Course Content (Themes, Concepts, Issues and Skills)

A. Explain the nature and history of meteorology as a science
B. Discuss the structure and dynamics of the earth’s atmosphere.
C. Discuss the basic physical principles of energy
D. Explain how solar and gravitational energy drive weather
E. Describe the different facets of the hydrologic cycle and atmospheric circulation
F. Outline the details of weather observation
G. Discuss weather systems and major theories used to explain and predict the behavior of these systems
H. Outline the details of weather forecasting
I. Discuss climate, climate zones, and the factors that shape them
J. Explain how and why climate changes
K. Discuss humans impact weather and climate change
L. Other topics as desired by the instructor.

Meteorology as a science

A. The scientific method as it applies to meteorology
B. Major divisions and activities of meteorology
C. Short history of meteorology

Atmospheric basics
A. Physical and chemical properties of air
B. Structure of the atmosphere
C. Energy flow and dynamics of the atmosphere

Basics of weather

A. Physics of energy – States and forms of energy, energy conversions, and types and behavior of radiant energy.
B. Flow of energy through the atmosphere
C. Heat and temperature – Basic physics, measurement, and temporal and geographic variation
D. Physics and chemistry of water
E. Water cycling within the atmosphere
F. Humidity
G. Clouds, cloud formation, and precipitation
H. Physics of air – Air pressure and density
I. Movement of air within the atmosphere
J. Measuring and mapping air pressure and winds
K. Types of winds – Micro, meso, global scale

Weather systems

A. Typical global and regional weather patterns
B. Systems, theory, and modeling
C. Global atmospheric circulation within the troposphere
D. Air mass characteristics and development
E. Weather front characteristics and behavior
F. Mid-latitude and tropical cyclone characteristics and development

Weather forecasting

A. Weather data gathering and organization
B. Forecast techniques
C. Climate and climate change
### Appendix 6 Core Outcome Mapping

**CORE OUTCOMES MAPPING**

Mapping Level Indicators:

1. Not Applicable.
2. Limited demonstration or application of knowledge and skills.
3. Basic demonstration and application of knowledge and skills.
4. Demonstrated comprehension and is able to apply essential knowledge and skills.
5. Demonstrates thorough, effective and/or sophisticated application of knowledge and skills.

Core Outcomes:

1. Communication.
2. Community and Environmental Responsibility.
5. Professional Competence.

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Name</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>CO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>GS 106</td>
<td>Physical science – Geology</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>GS 107</td>
<td>Physical science – Astronomy</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>GS 108</td>
<td>Physical science – Oceanography</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>GS 109</td>
<td>Physical science – Meteorology</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>GS 160</td>
<td>Geology: Oregon Coast</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>GS 161</td>
<td>Geology: Malheur Region</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>GS 200</td>
<td>Principles of Geology: Field Geology</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>GS 201</td>
<td>Physical Geology</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>GS 202</td>
<td>Physical Geology</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>GS 203</td>
<td>Historical Geology</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>GS 207</td>
<td>Geology of the Pacific Northwest</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>GS 208</td>
<td>Volcanoes</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>GS 209</td>
<td>Earthquake</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>GS 291</td>
<td>Elements of Rocks and Minerals</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

### SAC GS: Geology (Physical Science)

Core Outcomes:

1. Collect, analyze & interpret data.
2. Function & Communicate well effectively both at the individual level and within team settings.
3. Think in a critical and analytical fashion.

**CORE OUTCOMES MAPPING**

Mapping Level Indicators:

1. Not Applicable.
2. Limited demonstration or application of knowledge and skills.
3. Basic demonstration and application of knowledge and skills.

Core Outcomes:

1. Collect, analyze & interpret data.
2. Function & Communicate well effectively both at the individual level and within team settings.
3. Think in a critical and analytical fashion.

**SAC GS: General (Earth) Science**

Core Outcomes:

1. Collect, analyze & interpret data.
2. Function & Communicate well effectively both at the individual level and within team settings.
3. Think in a critical and analytical fashion.
knowledge and skills.
4. Demonstrated comprehension and is able to apply essential knowledge and skills.
5. Demonstrates thorough, effective and/or sophisticated application of knowledge and skills.

4. Understand the impact of earth science in a global, societal, and environmental context.
5. Understand professional and ethical responsibility.
7. Achieve success in continuing their education towards completion of a two-year degree.

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Name</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>CO6</th>
<th>CO7</th>
</tr>
</thead>
<tbody>
<tr>
<td>GS 106</td>
<td>Physical science – Geology</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>GS 107</td>
<td>Physical science – Astronomy</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>GS 108</td>
<td>Physical science – Oceanography</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>GS 109</td>
<td>Physical science – Meteorology</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>GS 160</td>
<td>Geology: Oregon Coast</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>GS 161</td>
<td>Geology: Malheur Region</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>GS 200</td>
<td>Principles of Geology: Field Geology</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>GS 201</td>
<td>Physical Geology</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>GS 202</td>
<td>Physical Geology</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>GS 203</td>
<td>Historical Geology</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>GS 207</td>
<td>Geology of the Pacific Northwest</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>GS 208</td>
<td>Volcanoes</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>GS 209</td>
<td>Earthquake</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>GS 291</td>
<td>Elements of Rocks and Minerals</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>
Quantifying Student Attitudes in EOS
Alison Jolley, ajolley@eos.ubc.ca

On average, our students do not develop more expert-like attitudes, based on four terms of results from the Student Attitudes about Earth Science Survey (SAESS*).

* See next page

Attitudes don't get better, but they don't get worse either (Fig. 1), which is different from results in the Physics and Chemistry departments at the University of Colorado. The Colorado Learning Attitudes about Science Survey (CLASS) shows that students typically become 10-20% more novice-like after taking introductory courses.

Figure 1: Overall percentage agreement with expert opinion for all students.

Changes in pedagogy at the University of Colorado have significantly improved attitude shifts, and CLASS results now show a result similar to ours – little change overall (http://www.colorado.edu/sei/class/). Can we do even better?

Good news: Although attitudes may not get more expert-like over one course, many students continue to report that their interest level in Earth and Ocean Sciences increased (Fig. 2).

Figure 2: Post-course change in interest level rating.

Mixed news: On average (including intro and upper-level courses), students report increased confidence in their understanding of geologic time (Fig. 3). Interestingly, students in 3rd year majors courses shift away from the expert view on this statement, while students in intro courses shift toward the expert view. An upper-level reality check? Unfortunately, after taking an EOS course, about 25% of students think that learning Earth & Ocean Sciences is about memorization, more than when they started the course (Fig. 4).

Figure 3 (left): On average, more students agree with the expert response to this statement about geologic time after taking an EOS course.

Figure 4 (right): On average, students shift away from the expert response to this statement about memorization after taking an EOS course.
A Problem Exclusive to Universities?

Preliminary results with the Geology department at CU are similar to ours, but introductory geology students at a community college showed positive attitudinal gains. What are they doing differently?

Figure 5: Percent change in student answers from similar introductory geology courses at UBC and a community college in Oregon.

About SAESS

It is a 10 minute survey that is currently offered in over 20 EOS courses each term. The current version of the survey (V3.5) contains 35 Likert scale statements (5 point, strongly disagree to strongly agree) relating to a variety of categories including real world connections and quantitative understanding, as well as a rating scale and free response question on personal interest. The survey is administered online both at the beginning and end of term, with instructors typically offering 1% bonus towards the course grade if students complete both (we need both for the data to be useful, and offering a small reward greatly increases the number of responses).

SAESS Goals:
- Establish students’ beliefs about the nature and relevance of Earth and Ocean Science
- Determine whether students approach Earth and Ocean Science the same way that scientists do
- Reveal the effects of course innovations on student attitudes and interest

SAESS Currently

The project is led by STL F Erin Lane, who has hired an undergraduate research assistant (me!) for the summer (supported by a Skylight Grant) to continue the work on SAESS. Preliminary analysis of two years of data is complete and we are now working on categorizing the responses and writing a paper for publication. Individual summaries for instructors have also been emailed out.

We Need Your Help!

Before we can publish a detailed paper about SAESS, final validation and expert responses for the current version are needed. We have opened up the survey for faculty and grad students to fill out online, so please take 10 minutes to help us out! Log on to http://www.eos.ubc.ca/scripts/courses/saess/survey.html, using the user name saess, the password earth, and select Aoss 102 as the course enrolled. Thank you!

Get Your Students Involved in SAESS

Want to see if your students’ views change over the course of the term? You can use this information to help you decide what to maintain or change for your class in the future.

Email Erin Lane (elane@eos.ubc.ca) if you’re interested.

Contact EOS-SEI: To talk about your course(s) or teaching and learning in general, visit EOS-South 361, or contact Francis Jones (fjones@eos.ubc.ca), Brett Gilley (bgilley@eos.ubc.ca), Erin Lane (elane@eos.ubc.ca), Josh Caulkins (jcaulkins@eos.ubc.ca) or Sara Harris (sharris@eos.ubc.ca). See also http://www.eos.ubc.ca/research/cwset/.
Appendix 7 SAESS

SAESS Survey Statements – Fall 2008

1. Things that I see around me in nature often lead me to think about how the Earth works.

2. Understanding Earth and Ocean Sciences basically means being able to recall something you’ve read or been shown.

3. As Earth and Ocean Scientists learn more, most Earth and Ocean Science ideas we use today are likely to be proven wrong.

4. When I look at a landscape, I sometimes try to figure out how it came to look that way.

5. I investigate the source of the information on the web before I use it for an assignment.

6. How the Earth works does not usually make sense to me; I just memorize what happens.

7. Learning Earth and Ocean Sciences helps me understand the impacts humans have on the environment.

8. Earth and Ocean Science is not as difficult as other sciences.

9. I compare what the media says about Earth and Ocean Science to how I think the Earth works.

10. In learning about the Earth, I usually memorize the definitions rather than make sense of the underlying ideas.

11. If I don’t remember the answer to a question on an exam, there’s nothing much I can do (legally!) to answer the question.

12. Earth and Ocean Science predictions must be certain if we are to use them to make decisions that affect our society.

13. Knowing about how the Earth works is useful in making some decisions in life.

14. I often don’t really understand the underlying ideas behind how the Earth works.

15. I do not expect equations to help my understanding of Earth and Ocean Science ideas; they are just for doing calculations.

16. When I look at a landscape, I have an idea of how long it took to form.

17. Reasoning skills used to understand Earth and Ocean Sciences can be helpful to me in my everyday life.
18. When studying Earth and Ocean Sciences, I relate the important information to what I already know rather than just memorizing it the way it is presented.

19. To understand Earth and Ocean Sciences I discuss it with other students.

20. If an Earth and Ocean finding is in the news, it means that it has been proven to be true.

21. We use this question to discard the survey of people who are not reading the statements. Please select “agree” - option 4 (not “strongly agree”) to preserve your answers.

22. I easily get lost when Earth and Ocean Science explanations involve probabilities or statistics.

23. Even when Earth and Ocean Science investigations are done correctly, the interpretation of the information that is discovered may change in the future.

24. The subject of Earth and Ocean Science has little relation to what I experience in the real world.

25. Spending a lot of time understanding why the Earth behaves the way it does is a waste of time.

26. Equations, used in Earth and Ocean Science are another way to present ideas that we can describe in words.

27. To learn Earth and Ocean Sciences, I only need to memorize terms and their definitions.

28. I cannot learn Earth and Ocean Science if the teacher does not explain things well in class.

29. I study Earth and Ocean Science to learn knowledge that will be useful in my life outside of school.

30. The future of our society depends on Earth and Ocean Science discoveries.

31. To understand Earth and Ocean Sciences, I sometimes think about my personal experiences and relate them to the topic being analyzed.

32. It is important for the government to approve new Earth and Ocean Science ideas before they can be widely accepted by the population.

33. To learn Earth and Ocean Science, I only need to memorize the answers to sample exam questions.

34. When presented in-class with a controversial Earth and Ocean Science idea on a topic I care about, I tend to check what other sources say on the topic.

35. I can usually make sense of how natural processes on Earth act.
Appendix 8:

Learning Assessment of Core Outcomes
Suggested Focus 2009-2010: Critical Thinking and Problem Solving

SAC Name: Physical Science, Geology and General Science
Contact Name, phone, and email: Eriks Puris, x7627, eriks.puris@pcc.edu

1. Please describe your plan of action for 2009-2010 Academic Year:

Geology is a field-based science. Classroom instruction introduces geologic landforms and processes, including those that have taken tens of thousands of lives each year and have impacted the economy in many ways, including the necessity of building hazard mitigation structures. Our SAC has chosen to use a field based project to assess student learning of critical thinking and problem solving. In this project students go out into their local surroundings to find their own examples of landforms which have been discussed in class. Once a student finds a landform it must be documented (described and identified), interpreted (related to the geologic process(es) which created the landform), and assessed (for risk to human land use activities). Students will hand in reports including photographic documentation. This project has been previously used in some G202 Physical Geology courses and during winter quarter of 2010 will be used in all our G202 and GS106 General Science (Geology) courses. We will develop separate rubrics for G202 and GS106, each instructor will then assess their students learning using the appropriate rubric. Finally the instructors will meet to compare results, look for common themes in our students’ learning and assess what was learned from this activity and how what was learned can be used to improve our teaching.

2. When your project is completed, please describe the method(s) you used.

- Six instructors evaluated six separate classes; three G202 classes and three GS106 classes. These classes were taught on the Sylvania and Rock Creek campuses winter quarter 2010.
- The project used for this assessment was not exactly the same for each class, but rather was modified by each instructor to match their particular teaching style.
- We used a common rubric for all the classes which consisted of seven learning objectives scored on the four level scale used by PCC when describing its core outcomes. (see: http://www.pcc.edu/resources/academic/core-outcomes/co-criticalthinking-problemsolving.html accessed 12/4/09.) The rubric is attached below.
- Initially our SAC had planned to develop separate rubrics for the G202 and GS106 classes; however only the rubric designed for G202 was completely developed. Our SAC has only two full time faculty, both of whom were teaching G202 winter 2010 and both of whom worked to develop the rubric for G202; unfortunately the group developing the GS106 rubric was left without full time faculty support and never fully developed a rubric specific to GS106.
- Each instructor was asked to use the rubric in scoring the landscape project. The manner in which each instructor did this varied somewhat.
• All six instructors met 5/7/10 to discuss and review the assessment process. Instructors compared rubric results, examined representative work from one another’s classes and shared their analysis of what they had learned from the assessment process.

• An issue that came to light was the highly variable student response to being asked permission to use their class work for assessment, in many classes all or almost all students granted permission to use their work while in one class only about half the students granted permission to use their work. In one case the instructor forgot to ask for student permission.

• In total 114 student projects were examined in preparing this assessment. Those projects for which students did not give permission were not used.

3. What did you learn?

• Students enjoyed the challenge of applying what they learned in class to the world around them, in the words of one student “I think the best part of this trip was getting outside the realm of the classroom and applying what we learned in class to the outside environment. It may have been tough but I feel it really solidified the education I gained from Geology 202.”

• Many of our students were pleasantly surprised to find that they could indeed identify landforms on their own while other students where alarmed at the large number of geologic hazards they were able to identify.

• The average score on the rubric was 3 out of a possible 4, indicating that on average our students are able to “demonstrate comprehension” and “apply essential knowledge and skill”.

• Of the three major landform categories analyzed in most student projects: stream features, mass wasting features and coastal features, mass wasting features proved most difficult for students to interpret correctly.

• While many students were able to apply what they had learned in class to the landscape around them at a generic level, few were able to make their analysis specific to their individual landform and its surroundings.

• During discussion we discovered that our students could be divided into three groups:
  o Those that had good classroom attendance and “got it”
  o Those that had good classroom attendance but had a hard time applying what they learned to the real world due to being too definition driven in their learning
  o Those that had poor classroom attendance and didn’t “get it”

• An instructor with previous experience using this project in their classes reported higher levels of student achievement this term than in prior terms; in the instructor’s analysis this was due to including the grading rubric in the assignment which had not been done in earlier terms.

• Those instructors who had not previously used the landform identification project found it worthwhile and are likely to use it again in their teaching.

4. What changes, if any, are you making or recommending as a result?
• There was a general sense that the landscape project assignments used by each instructor could be refined and sharpened to elicit more critical thinking by the students.

• Some instructors are considering revising how they teach about slope processes in their classes to put a greater emphasis on analyzing the controls of slope stability and triggers of mass wasting events.
<table>
<thead>
<tr>
<th>Learning Objective</th>
<th>Level 4</th>
<th>Level 3</th>
<th>Level 2</th>
<th>Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Identify, describe and classify landforms in the environment.</strong></td>
<td>All landforms are identified clearly, described accurately and completely with a clear indication of scale and classified correctly.</td>
<td>Most landforms are identified clearly, described accurately and completely with a clear indication of scale and classified correctly.</td>
<td>Some landforms are identified clearly, described accurately and completely with a clear indication of scale and classified correctly.</td>
<td>Landforms are not identified clearly, described vaguely if at all without any indication of scale and classified incorrectly or not classified.</td>
</tr>
<tr>
<td></td>
<td>Landforms descriptions are specific and detailed.</td>
<td>Landform descriptions are somewhat specific and include some detail.</td>
<td>Landform descriptions are generic and lack specific details.</td>
<td>Landform descriptions are fragmentary and hard to follow.</td>
</tr>
<tr>
<td><strong>Infer the geologic process which created a specific landform and describe how this process created the landform over time and will continue to shape the landform in the future.</strong></td>
<td>In all cases the processes which created a landform are inferred correctly.</td>
<td>In most cases the processes which created a landform are inferred correctly.</td>
<td>In some cases the processes which created a landform are inferred correctly.</td>
<td>Processes which created a landform are not inferred correctly or not inferred at all.</td>
</tr>
<tr>
<td></td>
<td>Process descriptions are complete and specific to an individual landform and its surroundings.</td>
<td>Process descriptions are mostly complete and somewhat specific.</td>
<td>Process descriptions are incomplete and generic. The process descriptions could apply to any example of the landform.</td>
<td>Process descriptions are fragmentary and hard to follow.</td>
</tr>
<tr>
<td></td>
<td>Past and future changes of all the landforms are correctly and clearly described and/or illustrated.</td>
<td>Past and future changes of most of the landforms are correctly and clearly described and/or illustrated.</td>
<td>Past and future changes of some of the landforms are correctly and clearly described and/or illustrated.</td>
<td>There is no description of how the landform has changed over time.</td>
</tr>
<tr>
<td>Learning Objective</td>
<td>Level 4</td>
<td>Level 3</td>
<td>Level 2</td>
<td>Level 1</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Evaluate how human activity has impacted the development of a landform and/or how the landform and the processes which create the landform impact human land use in the vicinity of the landform.</td>
<td>In all cases the human impact on the development of the land form is clearly and accurately evaluated.</td>
<td>In most cases the human impact on the development of the land form is clearly and accurately evaluated.</td>
<td>In some cases the human impact on the development of the land form is clearly and accurately evaluated.</td>
<td>The human impact on the development of the land forms is incorrectly evaluated or not evaluated.</td>
</tr>
<tr>
<td></td>
<td>In all cases the impact of the landform and its associated land forming processes on human land use is clearly and accurately evaluated.</td>
<td>In most cases the impact of the landform and its associated land forming processes on human land use is clearly and accurately evaluated.</td>
<td>In some cases the impact of the landform and its associated land forming processes on human land use is clearly and accurately evaluated.</td>
<td>The impact of the landform and its associated land forming processes is incorrectly evaluated or not evaluated.</td>
</tr>
<tr>
<td>Identify a structure designed to manage risk associated with a landscape forming processes, identify the hazard creating risk and what of value is put at risk. Explain how the structure manages risk.</td>
<td>The structure managing risk is clearly identified and clearly and specifically linked to the land forming hazard it manages.</td>
<td>The structure managing risk is somewhat clearly identified and linked to the land forming hazard it manages in a general way.</td>
<td>The structure managing risk is poorly identified and vaguely linked to the land forming hazard it manages.</td>
<td>The structure managing risk is vaguely identified or not at all, no links are made between the structure, landscape forming processes, risk, hazard and value.</td>
</tr>
<tr>
<td></td>
<td>What of value is protected by the structure is clearly and specifically identified.</td>
<td>What of value is protected by the structure is identified in a general way.</td>
<td>What of value is protected by the structure is vaguely identified.</td>
<td>How the structure operates to manage risk is vaguely explained or not explained at all.</td>
</tr>
<tr>
<td></td>
<td>How the structure operates to manage risk is clearly and specifically explained.</td>
<td>How the structure manages risk is explained in a general way.</td>
<td>How the structure manages risk is vaguely explained.</td>
<td>How the structure operates to manage risk is incorrectly explained or not explained at all.</td>
</tr>
<tr>
<td>Learning Objective</td>
<td>Level 4</td>
<td>Level 3</td>
<td>Level 2</td>
<td>Level 1</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Use graphical documentation to clearly describe the landform.</td>
<td>In all cases the landform and it associated landscape forming processes are clearly described using graphical documentation.</td>
<td>In most cases the landform and it associated landscape forming processes are clearly described using graphical documentation.</td>
<td>In some cases the landform and it associated landscape forming processes are clearly described using graphical documentation.</td>
<td>Graphical documentation of the landforms and their associated landscape forming processes is unclear or missing.</td>
</tr>
<tr>
<td>Describe the approach and methodology used to select the landforms for this project.</td>
<td>The method used to select landforms for this project is clearly explained.</td>
<td>The method used to select landforms for this project is partially explained.</td>
<td>The method used to select landforms for this project is vaguely explained.</td>
<td>The method used to select landforms is incoherently explained or not explained at all.</td>
</tr>
<tr>
<td>Demonstrate a personal voice when reflecting upon how this project has altered their view of the physical environment.</td>
<td>The voice used in reflecting upon how this project has altered their view of the physical environment is lively and idiosyncratic.</td>
<td>The voice used in reflecting upon how this project has altered their view of the physical environment displays some personality but is not fully developed.</td>
<td>The voice used when reflecting upon how this project has altered their view of the physical environment is generic and banal.</td>
<td>There is no clear or consistent voice used when reflecting upon how this project has altered their view of the physical environment.</td>
</tr>
</tbody>
</table>
Appendix 9

Student Demographics

Geology & General Science

<table>
<thead>
<tr>
<th></th>
<th>2007-08</th>
<th>2008-09</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geology</td>
<td>14.7%</td>
<td>16.0%</td>
</tr>
<tr>
<td>General Science</td>
<td>17.6%</td>
<td>21.0%</td>
</tr>
<tr>
<td>All PCC Transfer*</td>
<td>26.6%</td>
<td>26.7%</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geology</td>
<td>55.2/44.8</td>
<td>56.7/43.3</td>
</tr>
<tr>
<td>General Science</td>
<td>52.9/47.1</td>
<td>51.7/48.3</td>
</tr>
<tr>
<td>All PCC Transfer*</td>
<td>58.2/41.8</td>
<td>56.5/43.5</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>% 18-30 yrs</td>
<td>% 18-30 yrs</td>
</tr>
<tr>
<td>Geology</td>
<td>72.2</td>
<td>71.8</td>
</tr>
<tr>
<td>General Science</td>
<td>81.7**</td>
<td>79.5</td>
</tr>
<tr>
<td>All PCC Transfer*</td>
<td>68.3</td>
<td>68.0</td>
</tr>
<tr>
<td><strong>Full vs. Part Time</strong></td>
<td>% Full Time</td>
<td>% Full Time</td>
</tr>
<tr>
<td>Geology</td>
<td>66.1</td>
<td>59.5</td>
</tr>
<tr>
<td>General Science</td>
<td>71.5</td>
<td>72.8</td>
</tr>
<tr>
<td>All PCC Transfer*</td>
<td>43.1</td>
<td>46.0</td>
</tr>
<tr>
<td><strong>Degree Seeking</strong></td>
<td>% degree seeking</td>
<td>% degree seeking</td>
</tr>
<tr>
<td>Geology</td>
<td>92.9</td>
<td>92.7</td>
</tr>
<tr>
<td>General Science</td>
<td>95.7</td>
<td>95.6</td>
</tr>
<tr>
<td>All PCC Transfer*</td>
<td>81.8</td>
<td>83.1</td>
</tr>
</tbody>
</table>

*Lower Division Transfer Students

SOURCE: http://www.pcc.edu/ir/program_profiles/index.html