# Transfer Innovations Project Final Report
# Joint Earth Sciences/Geography 'First Year Outcomes/Transferability'

## October 2007

***Project 5: Alternate Transfer/Articulation Project***

*Submitted to:*
**British Columbia Colleges and Universities Earth Sciences Articulation Committee (BCCU-ESAC)**
**And The**
**British Columbia Geography Articulation Committee (BCGAC)**

*Submitted by TIP Subcommittee Members*

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## EXECUTIVE SUMMARY

At the May 2002 joint Geology/Geography Articulation meeting a subcommittee was struck to review transfer issues surrounding the articulation of introductory physical geology, historical geology and physical geography courses. This subcommittee consisted of representatives from the Geology and Geography Articulation committees. The subcommittee was to document similarities and differences in course content and learning outcomes and to report to the May 2003 Geology and Geography Articulation meetings.

### Methodology

The British Columbia Council on Admissions and Transfer (BCCAT) approved a Transfer Innovations Project (TIP) application to financially support the subcommittee's activities. This TIP grant enabled the subcommittee members to travel to the Lower Mainland for meetings in March 2003 and January 2006 to discuss the project.

### Findings

- ✓ Geology and geography are two different disciplines and should be treated as such even though the object of study, the Earth, is the same. The two disciplines come from complimentary perspectives, but have different foci, and prepare students for different futures.
- ✓ While the extent of overlap between geology and geography is not great enough to be considered as a single subject, we recognize that some overlap is necessary.
- ✓ Students completing both geography and geology courses at sending institutions may lose credits at receiving institutions that offer only a combined geology/geography course.

### Recommendations

For ease of transfer, the subcommittee respectfully recommends that:

1. Post-secondary institutions offering separate introductory geology and geography courses and post -secondary institutions that offer an introductory combined geology/geography course endorse the learning outcomes (core and supplemental topics) described herein.
2. Receiving institutions grant full transfer credit for these courses from other BC post-secondary institutions whose course learning outcomes parallel the learning outcomes described herein.
3. When designing or modifying introductory geology, geography or combined geology/geography courses, all post-secondary institutions try to incorporate these learning outcomes.
4. Periodic review of these learning outcomes be carried out by Geology and Geography Articulation subcommittees or a joint committee.

5. At institutions where transfer credit is given for only one introductory geology or geography course, the optimal solution would be for students to receive unassigned credit for the second course taken at another institution to recognize the post-secondary learning the student has undertaken

## BACKGROUND AND OBJECTIVES

There has been a long history of transfer problems involving introductory geography and geology courses in the BC post-secondary system. In an effort to clarify these problems, a joint articulation meeting was held in Prince Rupert (May 2002) between the British Columbia Colleges and Universities Earth Sciences Articulation Committee (BCCU-ESAC) and the British Columbia Geography Articulation Committee (BCGAC). At this meeting it was agreed that a Transfer Innovations Project would be applied for from BCCAT by a subcommittee composed of members from both Articulation committees.

A joint subcommittee was struck with representation from universities, university-colleges and colleges (see Appendix D).

## TERMS

**Geology**: in this report the term "**geology**" refers to the study of the Earth, the rocks of which it is composed and the changes it has undergone or is currently undergoing. It is interchangeable with "**Earth science**", which includes physical geology and geophysics, the history of the Earth, stratigraphy and paleontology, mineralogy, petrology, mining and petroleum geology. The term "**geoscience**" is a newer version of Earth (geo) science that also includes the study of Earth's oceans.

A typical introductory two-course sequence includes Physical Geology and Historical Geology.

**Physical Geography**: is a subfield of geography that focuses on the scientific study of the earth's systems; specifically physical geography investigates patterns, processes, spatial phenomena, and interrelationships among and within the hydrosphere, biosphere, atmosphere, and lithosphere of the Earth at a variety of spatial scales. Physical Geography can be divided into the following broad sub-disciplines: biogeography, geomorphology, climatology and meteorology, hydrology, soils, and sometimes oceanography.

Typical approaches to teaching introductory physical geography involve more than one term of instruction that include information about phenomena and processes describing interactions between the lithosphere, hydrosphere, atmosphere, and biosphere at varying spatial scales. Field and lab skills which

develop proficiency with observation, measurement, and mapping techniques appropriate to the sub-discipline are also usually included.

**Overlap**: in this report the term "overlap" refers to common areas that are covered in both geology and geography courses. Specifically, these are areas like plate tectonics, rocks and minerals, surface landforms that originated from volcanic, glacial, wind or water activity and weathering and erosion processes and products.

## ACTIVITIES

Robbie Dunlop applied for, and was awarded, $5000 funding through BCCAT to complete this as an articulation project by September 30 2003. Additional subcommittee members, their affiliations and areas of instruction, are listed in Appendix D.

The **objectives** for this project were:

1. To document individual learning outcomes for introductory physical geology, historical geology and physical geography courses at universities, university colleges and colleges within the B.C. transfer system;
2. To produce a report detailing the similarities and differences in the content of these courses, and to circulate it to all members of the Earth Sciences and Geography Articulation Committees prior to the 2003 Articulation Committee meetings; and
3. To prepare recommendations for improving transfer of introductory physical geology, historical geology and physical geography among B.C. post-secondary institutions.

The **deliverables** for this project were:

1. An analysis of the present transfer difficulties for students involving introductory geology and geography courses;
2. A report detailing common learning outcomes that are desirable for these courses;
3. Evidence of formal acceptance by institutions that the information is correct;
4. Provision of information in format for BC Transfer Guide;
5. Provision of print and e-media versions of report.

The subcommittee first met in White Rock in March 2003 to:

1. Clarify the difference between geography and geology course material.
2. Identify transfer problems.
3. Make recommendations for ease of transfer.

A draft report of the subcommittee findings was compiled and presented by subcommittee representatives to both the Geology and Geography Articulation

Committees at their separate May 2003 meetings. Articulation members were asked to review the draft and email their concerns or comments to their subcommittee representatives.

A second meeting was held in Vancouver in January 2006. The goals of this meeting were to:

1. Review the state of the project and discuss the direction the project should take.
2. Discuss revisions to be made to the 2004 draft using suggestions from Articulation members
3. Formulate a timeline for completion of the project

During this meeting it was agreed that learning outcomes for introductory geology, geography and combined geology/geography courses would be a useful addition to the TIP report. Three subcommittees were formed to create core and supplemental learning outcomes for these courses (see Appendices A, B and C).

It was decided that the 2004 draft would be revised using suggestions received from member institutions and that this revised document would be emailed to the Earth Science and Geography Articulation Committees for comments prior to May Articulation meetings.

## FINDINGS AND RECOMMENDATIONS

### *1. Clarify the difference between Geography and Geology course material.*

The subcommittee compared the definitions and practices of geography and geology and evaluated the materials for existing overlap between introductory physical geology, historical geology and physical geography courses. The subcommittee examined course outlines, schedules, and lab manuals from the majority of institutions across the province. Course details included the distribution of time assigned to teach similar topics in each discipline, the level of detail (as shown by course outlines), the resources used (textbooks, etc.) and the types of activities done during lab time and fieldtrips. These course details were distinctly different for geology and geography courses.

The subcommittee agreed that historical geology was different enough from both physical geology and physical geography that there were no overlaps in course materials.

When course details were examined, geography and geology appeared as two distinct disciplines. The subcommittee agreed that although they come from complimentary perspectives, they have different foci, and prepare students for different futures, even though the object of study in both cases is the Earth.

The subcommittee agreed that these introductory courses necessarily have some overlap as the same broad concepts form the foundation of each discipline. Reviewing these concepts is necessary to create an understanding of the disciplines and ensure the background needed by introductory students exists, so that higher-level knowledge can occur in later courses, (note that even at this introductory level, generally each discipline has a distinctly different focus).

The subcommittee questioned whether trying to cover the objectives of both introductory physical geology and physical geography within a combined geology/geography course would dilute the content, leaving students unprepared for subsequent courses in their discipline when they transferred to other institutions.

***2. Identify transfer problems.***

Both Articulation Committees continue to work together to tackle transfer issues between institutions and disciplines. Success has occurred, in many cases, by dealing with issues on a course to course basis.

A remaining problem involves UVic's Education Faculty's practice of not granting credit for geography as a lab science course, although this is not an issue for UVic's School of Earth and Ocean Sciences (SEOS).

***3. Make recommendations for ease of transfer.***

Considerations:

There have been changes in transfer patterns during the last 10 years (students now transfer laterally into other colleges, university colleges, or between universities and do not just transfer from colleges to universities).

The transfer process should be efficient, flexible, and allow transfer with no loss of credits, so students receive recognition for their learning experience.

For ease of transfer, the subcommittee respectfully recommends that:

1. Post-secondary institutions offering separate introductory geology and geography courses and post -secondary institutions that offer an introductory combined geology/geography course endorse the learning outcomes (core and supplemental topics) described herein (Appendices A-C).
2. Receiving institutions grant full transfer credit for these courses from other BC post-secondary institutions whose course learning outcomes parallel the learning outcomes described herein.
3. When designing or modifying introductory geology, geography or combined geology/geography courses, all post-secondary institutions try to incorporate these learning outcomes.

4. Periodic review of these learning outcomes be carried out by the geology and geography Articulation subcommittees or a joint committee. Given that changes to geology and geography in general, and introductory courses in particular, will continue over time, it will be important that these learning outcomes be reviewed on a regular basis, and updated as appropriate. It will be necessary for these reviews to involve both Earth Science and Geography Articulation Committees. The optimal solution could have the reviews done at least every 3 years in conjunction with the combined Earth Science and Geography Articulation meeting. A subcommittee formed from members of each group could review learning outcomes prior to the combined meeting, where it would be presented as an agenda item. Any recommendations for change could then be discussed and voted on by the combined members. A decision on what updating approach is to be established will be an agenda item for both the Earth Sciences and Geography Articulation Committee meetings in May 2008.

5. At institutions where transfer credit is given for only one introductory geology or geography course, the optimal solution would be for students to receive unassigned credit for the second course taken at another institution to recognize the post-secondary learning the student has undertaken

# Appendix A – Defining Core and Supplemental Learning Outcomes For Introductory Physical Geography

# Defining Core and Supplemental Learning Outcomes for Introductory Physical Geography

Follow-up to the May 2004
Transfer Innovations Project Final Report,
Joint Earth Sciences/Geography 'First Year Outcomes/Transferability'

*Chris Jackson (University of Northern BC) and Cliff Raphael (College of New Caledonia)*

One of the three key findings of the May 2004, *Transfer Innovations Project, Final Report -Joint Earth Sciences/Geography 'First Year Outcomes/Transferability'* was that Geography and Geology are two different disciplines, coming from different perspectives, with different foci, and preparing students for different futures, even though they both study the same Earth (Dunlop et al., 2004, p.3). Traditionally, geology has focused on understanding the composition, physical properties, history, and structure of the Earth while meeting the certification needs of professional geologists; physical geography has focused on understanding the many interactions of systems at the Earth's surface. A second finding indicated that some overlap between geology and geography is necessary, but the extent of overlap is not great enough to have these considered as a single subject (Dunlop et al., 2004, p. 3). Both physical geographers and geologists will recognize elements of discourse about their disciplines in Michael Wilson's 2002 (p. 3) summary of the situation in geology:

> "Now, however, the Earth Sciences are undergoing a major paradigm shift with the increase in international awareness of Global Change, coupled with new understandings of the interplay between the oceans, the atmosphere and the lithosphere. Thus a newly packaged and vibrant "Earth System Science" is emerging from the fusion of elements of several disciplines, applying the long-term perspective of geology to the growing understanding of modern earth processes."

This situation has led to BCCAT's interest in assessing if core and supplemental content areas for introductory physical geography and introductory geology courses can be determined. Though difficult, representatives of both the Geography and Geology Articulation Committees, who were involved with the 2004 Joint Earth Sciences/Geography 'First Year Outcomes / Transferability' project, are attempting to present these. Through examination of province-wide learning outcomes from post-secondary institutions teaching introductory geology and /or geography (Dunlop et al., 2004), it was determined that most of the course content areas covered by the two disciplines are distinct. The main area of overlap arises between physical geography's introductory geomorphology content and geology's physical geology content. It is in these two content areas, which appear similar on paper, that clear differences in perspective, emphasis, and foci are evident in both what is covered and in the proportion of time spent on different topics and skill development. In an effort to streamline the ensuing discussion we are proposing that we limit our consideration of

the content areas to the geomorphology components of an introductory physical geography course as proposed below. A similar document is being prepared for introductory physical geology.

Introductory courses can never do justice to an entire field of study. Instructors and programs independently choose content which meet their institution's interpretation of student and societal needs. Consequently, wide ranging information about physical and possibly human systems are potential candidates for inclusion in introductory physical geography courses. Typical approaches involve one or more terms of instruction that include information about phenomena and processes detailing interactions at varying spatial scales between the lithosphere, hydrosphere, atmosphere, and biosphere. Techniques and skills are also typically developed through laboratory and field exercises. Program emphasis varies widely, and upper year institutional specialization impacts content choices in lower years. It is recognised that the core topics indicated below may appear as components in different courses at some institutions depending on their choice of degree specializations. It is also recognised that other elements of interacting systems involving the atmosphere, hydrosphere, biosphere (including various human systems) may be incorporated into introductory physical geography courses at various institutions.

**CORE INTRODUCTORY GEOMORPHOLOGY TOPICS, from a physical geography perspective.**

1. Concept of interacting systems as a way of studying Earth processes and environments.

2. Basic overview of minerals and rocks and their impacts on landscape development.

3. Outline of the key elements of the theory of Plate Tectonics.

4. Plate Tectonics theory applied to various aspects of landscape development and change (e.g. mountain building, volcanic activity, earthquakes, folding/faulting).

5. Chemical and mechanical weathering processes and associated landforms.

6. Principles of erosion and deposition applied to:
    i. fluvial processes and landforms
    ii. glacial processes and land forms
    iii. coastal processes and landforms
    iv. aeolian processes and landforms.

7. Periglacial processes and landforms.

8. Hillslopes and mass wasting processes.

9. Development of skills for the acquisition, analysis and interpretation of geographic data:
    i. Map interpretation skills
    ii. Air photo interpretation skills
    iii. Various graphical and quantitative analysis skills applied to the study of geomorphic concepts
    iv. Field data acquisition skills (terrain analysis, surveying, map and compass use, recognition of dominant surface rocks and minerals, introductory stratigraphy).

**SUPPLEMENTAL TOPIC EXAMPLES** (these may vary widely depending on the course)

- Desert processes and landforms
- Basic soil and soil formation concepts
- World ecosystems

References:

Dunlop, R., M. McColl, C. Jackson, J. Martin, M. Smith, C. Raphael, G. Weary. 2004. *Transfer Innovations Project, Final Report Joint Earth Sciences/Geography 'First Year Outcomes/Transferability'*. submitted to: British Columbia Colleges and Universities Earth Sciences Articulation Committee (BCCU-ESAC) and the British Columbia Geography Articulation Committee (BCGAC). 25pp.

Wilson, Michael C... 2002. *Transfer Innovations Project, Flexible Pre-Major Analysis, Earth Sciences, Final Report*. BC Council on Admissions and Transfer. available on line at http://www.bccat.bc.ca/articulation/projects/EASCflex.pdf

# Appendix B – Defining Core and Supplemental Learning Outcomes for Introductory Physical Geology

## Defining Core and Supplemental Learning Outcomes for Introductory Physical Geology

*Maggie McColl (Malaspina University-College) and Robbie Dunlop (Simon Fraser University)*

Through lectures and laboratory exercises, upon completion of this course, a student should receive a broad foundation of geological knowledge. The Core Topics are considered to be the best choices to prepare a student for continuing on to higher level geology courses such as historical geology, mineralogy, petrology, structural geology, sedimentology and stratigraphy, geophysics, geochemistry and field school. The Core Topics would make up two-thirds to three-quarters of the total teaching hours with the remaining time taken up by Supplemental Topics. The Supplemental Topic Examples introduce flexibility and will allow instructors to concentrate on areas of specialization, local geology and hazards or fieldtrips.

### CORE INTRODUCTORY PHYSICAL GEOLOGY TOPICS

1. Introduction to the Earth Sciences, scientific investigations, methods of science, theories.

2. Planet Earth: Origins, evolution and history (including Solar System).

3. Geologic Time: Geologic Time Scale and stratigraphic principles.

4. *****Earthquakes: Earth's internal structure and processes, seismology.

5. *****Plate Tectonics: Development of and evidence for the Theory of Plate Tectonics.

6. Processes at plate boundaries: Deformation and mountain building, magma formation and volcanism.

7. *****Minerals: Definition, classification, physical properties and identification of minerals.

8. *****Igneous Rocks and processes.

9. *****Sedimentary Rocks and processes.

10. *****Metamorphic Rocks and processes.

11. Surficial Processes and Landforms: Glacial, coastal, fluvial; weathering; chemical and mechanical.

12. *****Development of Field Skills and Techniques: Acquisition, presentation, analysis and interpretation of field data.

*** Each of these topics includes a minimum of three hours of lab/field work.**

**SUPPLEMENTAL TOPIC EXAMPLES**

- Regional and local geology and hazards and plate tectonic setting
- Tectonic history of B.C.
- Economic Geology:  Local, regional, Canadian mineral and energy resources
- Geomorphology and Landforms
- Fossils (paleontology)
- Earth Resources
- Environmental Geology
- Ocean Floor: processes
- Planetary geology

# Appendix C – Defining Core and Supplemental Learning Outcomes for Introductory Combined Geology/Geography

# Defining Core and Supplemental Learning Outcomes for Introductory Combined Geology/Geography

*John Martin (Kwantlen University College) and Dan Smith (University of Victoria)*

## CORE INTRODUCTORY COMBINED GEOLOGY/GEOGRAPHY TOPICS

Describe, in broad terms, the sequence of events leading to the formation of Earth and the rest of our solar system, the chemical composition of Earth and its internal (layered) structure

Describe fundamental concepts in Earth science including uniformitarianism, superposition, continental drift theory and sea-floor spreading, and explain how some of these concepts led to the development of plate tectonic theory

Describe the main features of plate tectonic theory and explain the type and intensity of geological events taking place at converging, diverging and transforming plate boundaries

Describe the common rock-forming minerals, including their chemical composition (with an emphasis on the silicate minerals), bonding, and physical properties including cleavage and fracture, streak, hardness and special properties

Identify and classify, in a laboratory setting or test, mineral samples, igneous rock, sedimentary rocks, and metamorphic rocks

Describe the distribution, physical properties and origin(s) of magma (molten rock) and explain how these variables account for the vertical profile and eruptive styles of volcanoes

Describe how magma cools and crystallizes to form igneous rocks and explain how the rate of cooling and chemical composition influence the type of resulting igneous rock

Describe fundamental weathering processes and explain the sequence and significance of weathering processes in the formation of soil and sedimentary rocks

Describe common sedimentary rocks and account for their origin and physical properties

Describe how heat and/or pressure can cause existing rocks to metamorphose

Describe and explain how surface processes, such as mass wasting (slope), fluvial, glacial processes, operate and how such processes modify and sculpt the landscape

Construct isoline/contour maps and apply such maps to interpret patterns; specify location using map coordinate systems

Make measurements of distance, area, slope and derive vertical profiles from topographic maps

**SUPPLEMENTAL TOPIC EXAMPLES**

Explain how the process of Earth's differentiation occurred and why it is significant

Apply plate tectonic theory to account for the creation and modification of landforms, e.g. continents and island arcs, and explain how continental and oceanic geography has changed in the past and how it might change in the future

Apply the geologic time scale to describe the major events of Earth's history

Explain why and how tectonic forces can lead to lithostatic stress, rock deformation, folds and faults

# Appendix D – Subcommittee Members

**Subcommittee Members**

| Name | Institution | Location | Discipline Taught |
|---|---|---|---|
| Robbie Dunlop | Simon Fraser University | Burnaby | geology |
| Christine Jackson | University of Northern British Columbia | Prince George | physical geography/geomorphology |
| Maggie McColl | Malaspina University-College | Nanaimo | geology |
| John Martin | Kwantlen University College | Surrey | combined geology/geography course |
| Cliff Raphael | College of New Caledonia | Prince George | physical geography/geomorphology |
| Mark Smith | Langara College | Vancouver | geology |
| Gordon Weary | Northwest Community College | Terrace | geography from a geology perspective |
| Mary Lou Bevier | University of British Columbia | Vancouver | geology |
| Dan Smith | University of Victoria | Victoria | geography |
| George Spence | University of Victoria | Victoria | geology |