

## Earth and Environmental Science Department Outcomes Assessment

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The Earth and Environmental Science Department wants to enable student learning of geographic processes, geologic processes, and underlying liberal arts and scientific thinking. We serve several audiences. First are the majors in geography, geology, earth science, and environmental science. These students require understanding of the discipline and its processes as well as developing specific skills. We also serve education majors for adolescence and elementary levels. These students need the understandings and skills of our traditional majors, but are restricted in content course work by education course requirements set by the School of Education. The Department also provides two vital parts of the campus core curriculum, through social science offerings and the laboratory science requirement. The skills we teach, and students learn, in these courses, intertwine the needs of the major with those of a well-educated student of the liberal arts. Our goals, outcomes and outcomes measures are geared to meet these overlapping needs of our students.

Over the last few years, the faculty have emphasized graph and diagram interpretation to accomplish two major learning skills. One is to strengthen our students understanding of concepts; the other is to foster liberal arts thinking. We have found some improvement in student interpretation, but we are not sure if overall understanding of earth science, geology, or geography has advanced.

On that basis, the Earth and Environmental Science Department has established more detailed goals, outcomes and outcomes measures for most of our core courses. The outcomes will be measured by including uniform questions in all instructors' exams for each course.

### Human Geography Goals:

Goal 1. Students will understand and interpret implications of associations among phenomena in places. They will understand how social values, political regulations, and economic relationships lead to varying cultural landscapes and patterns of population movements.

Outcome: Students will explain the Demographic Transition and its implications for the modern world.

Measure: Students will be able to draw the graph of the DT and explain its components. Students will explain how the DT has changed in its applicability to the modern world.

These skills and concepts involve geographic understandings as well as liberal arts thinking, including graph drawing and interpretation and understanding how social and economic factors both change over time and change in their influence over time.

We are aiming for 70 percent of students to be able to draw and explain the graph of the Demographic Transition. We expect that 50 percent will be able to explain why its applicability has changed in the modern world. Once we identify more precisely student misconceptions we will address them more directly in the following semester as we teach the Demographic Transition.

Goal 2. Students will recognize and interpret at different scales relationships among patterns and processes.

Outcome: Students will be able to compare and contrast commercial and subsistence agriculture.

Measures:

1. Students will be able to explain why specific types of crops and animals are raised under varying environmental and economic and social conditions.
2. Students will be able to explain the differences between intensive and extensive land use; under what conditions each is appropriate.

We expect that 80 percent of students will be able to master the second measure, but around 60 percent the first. The second involves basic understandings, while the first involves higher order thinking as well as more knowledge of interconnection of the mechanics of farming, economics, and the physical environment.

Once again, as we identify more precisely student misconceptions, we will address them more directly in the following semester as we first teach about farming.

Goal 3. Students learn to use maps and spatial data to pose and solve problems.

Outcome 1. Students will explain how raw materials, market and transportation factors influenced the location of the iron and steel industry (or some other industry).

Measures:

1. Students will locate these factors on maps.
2. Students will explain how the technology of iron and steel manufacture influences the relative locational importance of these factors of production.

Outcome 2. Students will understand the location of the modern steel industry.

Measures:

1. Students will locate modern steel plants on maps.

2. Students will explain how modern market factors and technology have resulted in the current location and size of steel plants.
3. Students will explain how the integrated steel plant has generally been rusted away.

The expectation is that about 60 percent of the students will be able to understand these processes and explain them. The department will include uniform questions in exams administered to all Ggr 1 classes.

We suspect that in order to understand these processes students will need

- a) To work on map identification skills
- b) To understand the role of raw materials, coal, coke, iron ore, limestone...
- c) To explain how changes in technology and marketing have led to changes in location and scale of operations.

By paying attention and identifying particular weaknesses and misconceptions, the faculty will make adjustments in our curriculum when we teach the course in the future.

### Geology 1 and Earth Science 2

Goal: Students should understand the materials that make up the earth's crust and interior and how these materials are formed.

Outcome: Students should understand the reasoning for the classification of rocks and be able to provide examples.

Measures:

1. Students will be able to compare and contrast intrusive and extrusive igneous rocks; students will be able to compare and contrast felsic and mafic rocks.
2. Students will be able to explain why the classification scheme for igneous rocks is not appropriate for sedimentary or metamorphic rocks.

Measure one involves understanding processes and being able to compare and contrast. We expect 75 percent will be able to meet this measure.

Measure two requires an understanding of basic geologic processes and their operations. This involves a higher level of thinking and a broader perspective and less emphasis on memorization. We expect 50 percent will be able to meet this measure. At present we do not know how to change our curriculum or our teaching so that a larger proportion of students will succeed.

## Earth Science 1

Goal 1: Students should understand the interrelations of the major realms of the earth: atmosphere, hydrosphere, cryosphere, lithosphere, and biosphere.

Goal 2: Students will be able to explain the basic processes of the atmosphere. They will be able to interpret their depiction graphically and on maps (i.e., read a weather map). Reading a weather map involves liberal arts skills and understandings. Truly understanding the workings of cold fronts and their relation to the jet stream involves greater depth of investigation of the operations of the atmosphere as understood in earth science.

Outcome: Students will be able to explain the interconnections of air masses, fronts and wave cyclones and their movements. They will be able to include these explanations with the symbolism and coding used by meteorologists as on a weather map.

### Measures:

1. Students will be able to draw a temperature profile of the atmosphere. This skill involves understanding the relation between altitude and temperature. It can be accomplished by pure memorization, but some students begin to understand the reasoning behind temperature change.
2. Students will explain the two processes involved in moist air rising and how these contribute to the greater likelihood of storms in moist air than dry air.
  - a. This is extremely difficult for students, as it involves the comprehension of rate of change of two opposing processes. But, even if students cannot explain the whole, many will be able to explain the components, including heat transfer with condensation and evaporation and adiabatic cooling and warming.
3. Students will be able to complete a station report, including correctly writing the barometric pressure. This skill involves the letting go of the importance of decimal points and the understanding of a universally-accepted code.
4. Students will be able to explain why a hurricane is most dangerous when it makes landfall and why it loses strength as it moves over land. This conceptualization involves combining traditional geography with processes discussed over the semester in class. Thus it necessitates an agglomeration of concepts.

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