LEARNING OBJECTIVES
At the end of this course students should:
• Know the main types of mineral deposit, their economic importance, their environmental impacts, how they form, and an example of each deposit.
• Be able to classify an unknown deposit based upon geologic maps, cross sections and sample suites and to predict where ore minerals might be found.
• Be able to discuss a range of environmental issues as related to the extraction, processing and usage of a variety of mineral resources.
• Demonstrate improved critical thinking, analysis and scientific writing skills.
• Be prepared for an entry-level applied science job.

AUDIENCE: Upper-level undergraduates in Geology (GEOL) and Environmental Policy and Decision Making (EPDM) majors
PRE-REQUISITE COURSES: One course in the Natural Scientific Approaches core, and ENV 101 or permission of the instructor.

AIM: To develop a Mineral Resources course which will augment the current selection of elective courses in geology and EPDM.

TUESDAY LECTURE PERIODS: Traditional lecture format on topics:
- Magmatic, Hydromagmatic, Hydrothermal and Supergene deposits
- Other special topics (REE, Fertilizers, Uranium, Gemstones)
- Environmental impacts of resource exploitation and use

FORMATIVE ASSESSMENTS:
• Gallery walk: students answered questions individually on the blackboard, which were then summarized to the class. Questions concerned students’ experience, prior knowledge and topics of greatest interest.
• Mining Cookies: students completed an economic exercise in chocolate chip extraction from cookies
• Jigsaw: students worked in small groups to learn about different aspects of porphyry deposit formation, then reconfigured into mixed groups to complete a question set. A similar activity was used to learn about uranium mining in Navajo Nation.
• Debates: on seafloor mining, proposed AK Pebble mine
• Think-pair-share in class
• Summarize take-home point of lecture

THURSDAY LECTURE PERIODS: Read academic papers on case study example of the week’s deposit type.
• All students read the paper and completed a small pre-class exercise (formative assessment) in class
• In class the assigned student presented the paper with a particular focus on a pertinent figure
• Assigned student then led a class discussion

SUMMATIVE ASSESSMENTS:
• Two lecture-based exams
• Four homeworks
• In-class assignments
• Group project

ACTIVITY SESSIONS
• TWO-HOUR LAB PERIOD: Used for a variety of activities, related to the deposit-type of the week. Activities included:
  - Introduction to ore and gangue minerals
  - Cu porphyry samples
  - Superfund sites exercise
  - Stream table experiments to investigate placer deposit formation
  - Global distribution and international flow of resources
  - Jigsaw exercise on uranium mining in the Navajo Nation

• Guest lectures from experts in the field:
  - Dr. Eric Cheney (Emeritus faculty at University of Washington)
  - Robert Laddaw (Exploration Geologist)

• Documents concerning different aspects and points of view on the mining industry:
  - “The Hole Story”
  - “Butte, America”
  - “Mine Your Own Business”
  - “Red Gold”

• Summative Assessments:
  - Reflections on/reactions to each documentary
  - Extracting the social history from a series of folk songs about lead mining in NE England
  - Graded lab exercises

FIELD TRIPS
Field trips included:
• A self-guided trip to the Ruston Smelter exhibit. Descriptions, pictures and artifacts exhibiting life working in the smelter and living in the immediate area. Newspaper articles describing the extent of the air pollution produced by the smelter and documentation of the long campaign by the local people to have the smelter closed down. Finally a video of the demolition of the smelter stack, which visitors trigger using a blasting detonator.
• A self-guided trip down to the Ruston Yacht Club to examine the slag which was produced as a by-product of the smelting process and now forms the platform upon which the Yacht Club sits.
• A trip with Dr. Eric Cheney to the Marenakos Rock Center in Preston, WA. Explored the building stone industry and discussed desirable characteristics of rocks with respect to their intended use.

Students also took field trips in their research groups to carry out the field portion of their project data collection.

GROUP RESEARCH PROJECT
• Students worked in groups to plan and propose their own research projects concerning the remaining environmental impacts of the historical Ruston Smelter on the local environment.
• They self-selected into groups by research topic interest: smelter effects on water, soil or biology.
• Within their interest groups they self-selected into groups of three and used information on the resources available in the department to come up with reasonably sized research projects. These included testing the lasting effects of the smelter on:
  - Water quality along stream profiles and into Commencement Bay
  - As and Pb concentrations in water of three local lakes within different levels of contamination zone
  - Concentration of As and heavy metals in bird feathers collected from Point Defiance over the past century
  - As and Pb concentrations over time in cores of different tree species in Point Defiance park
  - Pb and As levels in soils in the Ruston area with a comparison of those that have been replaced with those that were previously below the cut-off level

• Each individual student put together their own grant proposal including budget. Over the course of the semester, they handed in an introduction/literature review, a methods write-up and a presentation/description of their results. They received feedback on each of these, which they could then use in putting together their final project write-up.

FUTURE CHANGES
• Develop higher-order learning objectives (less of a survey course)
• Split into two courses:
  - Economic Geology: a geology-focused course with petrology and optical mineralogy as prerequisites. For upper level geology majors and graduate students.
  - Focus on geology of mineral deposits.
  - Mineral Resources: a more focused course with mineralogy as a pre-requisite. For geology and environmental science students.

• Invite speakers from the mining industry and hopefully get to take a mine tour. Student research projects for economic geology will have more of a geology focus, while for mineral resources they will focus on remediation.

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