Curriculum Design Exercise

The following lists were transcribed from an exercise conducted at the June, 2009 Building Strong Geoscience Departments workshop on Strengthening Your Geoscience Department. One group did the exercise (on building curriculum from skills, goals, content, experience and values) on the morning of June 3 and another group did it that afternoon. In each case, participants were asked to list three important geoscience-specific skills, three important general skills, three important experiences, three central concepts or critical content, three goals and three values that are or should be stressed in their undergraduate geosciences programs. The lists were compiled and organized by the workshop participants.

This document contains the lists from the afternoon group.

Afternoon – Content

Top of poster, left to right:

Surficial Processes (linked right to cycles, down to physical geology, and through physical geology to geologic time, earth materials and plate tectonics):

- Connections between rocks and other materials and plate tectonics
- Interconnectedness of earth systems
- Surficial processes, exp. Heat transfer and climate change, energy resources, too
- Weathering and erosion
- Geochemical cycles
- Surface processes
- Earth as a set of systems
- Earth systems

Cycles

- Water/rock carbon cycles
- Function of (small) delta eas???
- Hydrology
- Geochemistry
- Hydrologic/geochemical cycles
- Global hydro and geochemical cycles

Physical geology

Geologic time

- Deep time
- Deep time/rates of geologic change
- Deep time, rates of change
- Geologic time
- Deep or Geologic time
- Earth history as recorded in stratigraphy
- An understanding of deep geologic time and rates of change
- General sense of rates of geologic processes
- Understanding of geologic time and the time scale
- Geologic time
- (somewhat related to this group):
- Sedimentology
- Sed/strat

Earth materials

- Mineralogy/petrology
- Resources (energy, minerals, water)
- Earth materials
- Earth materials
- Petrology
- Min/Pet
- Earth materials (i.e. rocks and minerals)
- Earth materials/solid earth processes (min/rocks/ EQ/tectonics. . .)

- Basic knowledge of eartrh science, i.e. intro geology or Physical Geology

Plate tectonics
- Plate tectonics
- Plate tectonics as a paradigm for geosciences
- Plate tectonics – underlying mechanism for producing almost all of geology
- Plate tectonics and global change
- Tectonics
- Plate tectonics
- Plate tectonics
- Plate tectonics
- Plate tectonics
- Plate tectonics
- Plate tectonics
- An understanding of Plate tectonics (the theory, evidence, current state, , ,) and general Earth evolution through time
- Plate tectonics as a paradigm
- Being able to articulate the rock cycle
- Articulating the basic elements of plate tectonics

(this connects to structural geology)

Structural Geology
- Structural geology
- Structural geology
- Stress/strain of earth materials

Historical geology (connected to organic evolution)
- Historical geology
- Historical geology – the history of Earth and Life on Earth can be reconstructed from geologic data

Organic evolution
- Organic evolution
- Evolution
- Natural selection
- Understanding organic evolution

Human/physical interaction (connects to climate-related)
- Environmental geology
- An ecological world view
- Environmental impacts of human activity
- Human/earth interaction

Climate-related
- Climate
- Climatic change
- Climate change
- Understanding climate change (past changes, current state, understand models and predictions)

Techniques

- Statistics
- GIS
- Computer skills relevant to major track or theme

Afternoon – General skills

Clusters on the poster aren't labeled. There are seven of them, and the following list proceeds from top left to middle (left to right) to lower middle and bottom middle and then the large field on the right which is organized around communication skills:

Cooperation

- Ability to work/cooperate with others
- Ability to work well independently or as a team member
- Work in teams

Literature

- Literature research
- Accurately use sources and citations
- Be able to do literature search/understand scientific papers
- Find, read, and understand journal articles
- Being able to recognize the contribution of a piece of primary literature
- Perform a bibliographic search and write a solid technical paper

Designing research

- Design a simple project from scratch
- Formulating/testing a hypothesis
- How to formulate and tackle a research question
- Propose and carry out a research project under faculty guidance
- Be able to operate analytical equipment

Things related to technology

- Visualization skills
- Reading non-verbal texts
- Problem solving
- Good problem solving skills
- Basic computer skills – spreadsheets, graphing, etc.
- Analysis of data sets using spreadsheets
- Analyze data – tabulate, calculate, graph, using EXCEL
- Ability to visualize in 4 dimensions
- Analyze/visualize a simple set of observations
- Should be able to use basic technology such as computer software to prepare documents

Critical thinking

- Think critically
- Separate observations from interpretations
- Should be able to make a critical analysis of related events/phenomena
- Critical thinking
- Critical analysis
- Critically analyze scientific literature
- Good ability to analyze/synthesize observations and apply principles (critical thinking)

Quantitative skills

- Some degree of quantitative analysis (problem-solving)
- Perform basic statistical analysis and apply appropriately
- Mastery of basic math/computer skills
- Quantitative skills for problem solving
- Basic math skills
- Students should have quantitative data analysis skills and understand how these skills are useful in solving scientific problems
- Solve quantitative problems – know how to approach solving problems
- Quantitative analysis

Communication

- Communicate effectively (written, oral, visual)
- Be able to communicate complex scientific information in written and oral form
- Scientific literacy – critical reading, writing and speaking skills
- Public presentation – oral, written
- Write an effective research paper
- Develop/have good oral and written communication skills
- Communicate findings in writing and presentations
- Oral presentation ability/experience
- Oral and written communication skills
- Organize and present verbal presentation
- Writing scientific paper
- Write a short research paper
- Present the results of a project
- Science writing
- Scientific writing
- Writing
- Ability to clearly and concisely convey ideas (orally and written)
- Writing
- Write a quality report or research paper
- Effective written communication
- Write clearly and concisely
- Communicate ideas orally
- Ability to present a GSA-style oral presentation using PowerPoint
- Write a short research paper
- Clear writing skills
- Should be able to write a report on a scientific experiment
- Write a competent research paper

Apply knowledge/skills to current events

Afternoon – geoscience-specific skills
Four circles across the top: field equipment, measuring, sampling, GIS
Around the margins: compass use, cross section, 4D thinking, landscape, interpretation, identification
All these lead into a central field of Mapping. Double arrow to landscape and interpretation; other arrows just lead into Mapping in the center

Field equipment
- Basic field competency
- Use hand lens
- Use of survey equipment
- Field observation/interpretation

Measuring
- Measure physical parameters (strike and dip, water depth and velocity, etc.)
- Take environmental measurements

Sampling
- Field sampling
- Collect water samples for analysis
- Design a sampling project
- Basic laboratory techniques

GIS and other computer software
- Basic GIS ability
- Use GIS
- Apply, have facility with basic GIS software; download/convert/manipulate data to suit needs
- Perform assigned tasks using appropriate computer software

Compass use
- Use a brunton correctly
- Use of a brunton
- Use a brunton compass
- Measure strike/dip
- Use Brunton (or equivalent) to make various measurements
- A use of a compass in the field
- Measuring strike and dip of plane with Brunton

Cross section, strat section
- Be able to create a geologic map and cross-section
- Create a geologic cross-section
- Be able to correlate rocks between sections
- Describe strat column
- Should have constructed a cross-section
- Mapping and analyzing spatial data in 3-D

4D thinking
- Think in 4 dimensions
- Visualize geologic problems/setting/processes in 4D

Landscape

- Visualize landscape characteristics by looking at maps (online and paper)
- Ability to use a stereoscope to interpret the geologic landscape
- Accurately interpret landscape and spatial information

Interpretation

- Sequencing events
- Using the principle of superposition
- Construct a hypothesis for the geologic history of an area based on geologic data
- Interpret geologic data from field processes

Identification

- Should be able to make sight-identification of common rocks and minerals
- ID structures/rocks in the field
- Basic rock/mineral ID
- ID of common earth materials (major mins and rocks of Big 3)
- Identify basic rock types in hand specimens
- Identify rocks and minerals
- Identifying major silicate minerals
- Identify basic geologic features (rock types, mineral, structure)
- Use of a petrographic scope
- Identify the basic sed, met, and ig rocks in hand sample
- Ability to identify basic minerals/rocks
- Be able to identify rocks and fossils in the field
- ID earth materials
- Describe an outcrop, rock and fossil
- Identify common minerals, rocks (and fossils)

Mapping

- Read and interpret geologic maps
- Map skills
- Should be able to read a geologic map
- Make a geologic map
- Make a geologic map
- Confident/able to do basic field mapping
- Interpreting geometry of a plane from a geologic map
- Be able to do file work/mapping
- Map geologic field relations
- Create and interpret a geologic map
- Ability to interpret/make a geologic map
- Create a geologic map based on gathered field data
- Use of maps in the field

Miscellaneous

- Make thin sections
- Should be able to determine the density of a solid
- Analyze data and information responsibly and correctly

Afternoon – goals

These are all separate groupings, except at the bottom where research experiences connects (via pipeline) to outcomes (within which are grad school, industry, etc.)

(Incoming) student quality
- Improve student GPA
- Increase quality of majors
- Recruit more quality geo majors
- Increase the number and quality of majors
- (the last two are placed as a link to # of students)

Number of students
- Steady stream of majors (2-3/faculty)
- Increase number of majors
- 10 graduates/year
- Increase retention and recruitment
- Increase number of majors
- Increase number of majors
- Increase number of undergraduates
- 12 majors/year
- Increase number of majors (goal=12-15 majors per year)
- Increase number of majors and minors
- Increase quality of MA program
- Achieve 10 majors/year and maintain or grow over time

Capital/ infrastructure
- Increase number of faculty and staff
- Improve physical facilities
- Reduce teaching load to permit >research time

Visibility
- Increase visibility
- Increase visibility on campus
- Appreciate the importance of geology among non-majors
- Increased visibility for department and students
- Respected locally (campus) and nationally

Curriculum
- Strengthen the capstone experience
- Students can understand a complex data set; can manipulate data with computer software; know what statistical (or other) tests should be done, how to do them and what the results tell them and how the results help to answer a scientific question
- Sensible, intentional integration of content across geology curriculum
- Collaboration across the curriculum
- Transfer knowledge and practice
- Have a stronger field component
- Have a broad knowledge base of the geosciences

- Increase lab/research experiences as parts of coursework (too many lecture only)
- General geosciences education “ready for anything”
- Promote use of scientific method

Societal relevance
- Get a stronger sense of community
- Community involvement
- Social relevance
- Link curriculum to societal issues
- Help educate responsible and productive methods of society
- Provide basics for understanding scientific methods and how they relate to societies
- Improve out-pf-class networking/experiences for students (via social events, department newsletter, department field trips

Environmental/student attitudes
- Excite students about learning
- Challenge students intellectually
- Spark student interest in science
- Appeal more broadly to students interested in the environment
- Get more majors

Research experiences
- Getting students (ug) into research activities earlier
- Introduce students to research earlier in career
- Undergraduate student co-authors on scientific journal articles
- Give every student an appropriate and meaningful senior research experiences
- Involve all students in a research experience

Pipeline
- Provide a cohort of scientifically literate graduates
- All students to have had an appropriate internship

Outcomes
- Prepare students for graduate school
- Prepare students for graduate studies
- Prepared for graduate school and the work force
- Prepare students for graduate research
- Produce students that are sought after by good grad schools
- Graduates go directly to grad school or employment
- Prepare students better for non-academic career paths
- Prepare students for career/grad school
- Provide students with good skill set for employment

Afternoon – Experiences

Presentation/attend professional meetings

- Oral presentation experience
- Presentation at local/national meetings
- Writing intensive experience (prof edits, students revise and resubmit)
- Oral presentation in front of a technical and non-technical audience
- Written summary of a research project (ideally a thesis)
- Giving a talk
- Present their research as an AGU-style talk
- Perform several presentations to larger audiences
- Public speaking
- Presenting in front of a group
- Write a paper in scientific format
- At least one professional presentation or publication
- Opportunity to present data to peers/faculty
- Oral presentation of original research
- Network with professionals at meetings, etc.

Research

- Research experience (could be shorter projects)
- Research project
- Independent research
- Research
- Visit or work in a geology research lab
- Read and understand scientific literature
- Take part in a research project or curriculum-related practical experience (internships, etc.)
- Participation in a research internship
- Research experience/generating original data
- Lab experience
- Research experience
- Formulating and testing a hypotheis
- Conduct independent research
- An appropriate internship
- Collect and interpret data
- Conduct/participate in original research – at least have some part in data collection, analysis, etc.
- Research process (ideally generating their own)

Outreach

- Explain geology to a non-geologist
- Work with other students on community service projects

Field

- Describe and interpret stratigraphic section
- Collect field observations and formulate multiple working hypotheses based on those observations
- Make a map

- Conduct field survey, design and implement sampling
- Go underground
- Field camp or mapping experience
- Field trip
- Field mapping
- Reading maps
- Field work
- Field work/prolonged field trip
- Extended field trip (or field experience)
- Field experiences – numerous and at least one "longer" trip
- Field work
- Field experience
- Actively participate (collect data/analyze it) in extended field trip or field course
- Field work
- Interpret earth history from outcrops, cores and landscapes
- Unravel the geologic story of an unfamiliar location
- Field observations and measurements
- Field work (extended field trip)
- Some type of major field experience in geology or earth science (e.g. field camp, extended class field trip, field mapping course)
- Field camp
- Should have been on a geologic field trip
- Should have witnessed first hand a major event or phenomenon such as a volcano, rift, glacier

Instrumentation

- Use analytical equipment
- Use technology to process, model, or integrate data
- Use analytical instrumentation
- Computer modeling
- Experience with analytical equipment/computer modeling and simulation
- Use of "research" equipment to answer a question

Interdisciplinary experience

- Exposure to interdisciplinary science

Overcome adversity

- Deal with disappointment (don't do as well as in high school; find out weaknesses and strengths and deal with them)
- Enthusiastic about choice of major
- Overcome intellectual challenges

Team/group work

- Work in a team

Afternoon – Values

Environmental Literacy

- Appreciation for effects of human actions on earth systems
- Aesthetic appreciation of the earth
- Appreciation for importance of science in public decision-making processes
- Responsibility for self and own actions
- Conservation
- Environmental effects
- Stewardship and public communication

Collegiality/ethical treatment/respect

- Open, honest communication
- Collegiality
- Collegiality
- Collegial and inclusive
- Collegiality
- Sense of community
- Collegiality and development of a departmental community
- Originality
- Respect
- The value of diligence/persistence
- Faculty mentoring
- Equitable decision making
- Value opinions of others
- Honesty
- Inclusivity
- Respect
- Respect others' views
- Respect
- Respect student to student, student to faculty, faculty to faculty
- Respect for other viewpoints/cultures
- Collegiality
- Collegiality
- Collegiality
- Communication among faculty, faculty and students
- Respect for other people and ideas
- Respect and support one another
- Working together to form common goals
- Integrity of scientific endeavor
- Integrity of the scientific endeavor
- Integrity
- Build community

Research

- Doing research and doing it collaboratively and ethically
- Involving undergrads in research

- Ethical treatment of data and interpretation
- Synergism between teaching and research
- Integrity of the scientific endeavor
- Collaboration
- Ethics – accuracy of work and giving credit to others (citations, etc.)
- Moral and ethical use of information
- Value of independent research
- Ethical uses of literature
- Good work ethic

Teaching

- Student-centered
- Interdisciplinary
- Rigorous

Enthusiasm

- Learning is fun
- Positive/can do attitude – desire to be life-long learners
- Have fun
- Positive attitude among students and faculty
- Trust student-student, student-faculty, faculty-faculty