Tracking Student Progress With a Mineralogy/Petrology Concept Inventory

Alison Jolley, Sara Harris, and Mary Lou Bevier
Department of Earth and Ocean Sciences.
Measure the progression of student abilities through core introductory geology courses into upper level geology courses

Instructors of upper level courses have noted pre-requisite skills that are lacking
Upper level students have noted that core concepts and skills are not always clear to them
• Identify learning goals that instructors rated both crucial & consistently difficult for students
• Create test questions to assess these particular goals
• Improve questions based on faculty comments
• Validate the tests through one-on-one interviews to ensure students understand and interpret questions as intended
• Administer the tests (Sept. 2010–April 2011 complete, continue next year)
• First introductory geology courses for majors in 2nd year (Mineralogy & Petrology)
• Specific upper level Petrology courses in 3rd year (Igneous Petrology & Metamorphic Petrology)

Course Sequence:

EOSC 220 – Intro Mineralogy

EOSC 221 – Intro Petrology

and/or

EOSC 321 – Igneous Petrology

EOSC 322 – Metamorphic Petrology
Results – General

• Small learning gain in Mineralogy (53% to 67% average score)
• Similar learning gain in Petrology, with a lower pre- and post-average score (42% to 58%)
• Good retention over the Winter Break (similar scores on all questions that were asked on the Mineralogy Post and Petrology Pre)
Calcite (CaCO₃) and rhodochrosite (MnCO₃) form a complete solid solution series, which means that Mn can substitute for Ca in the chemical structure in any proportion and vice versa. What is the % Ca of mineral ‘X’ on this line?

a) 20%
b) 25%
c) 50%
d) 75%
e) 80%
Results – Lithospheric Concepts

- Identification gets **WORSE** and recognition of physical/chemical boundaries gets **BETTER**
- Overall scores on both are poor, and are considered to be fundamental concepts by instructors

**Layers of Lithosphere**: Which part of the Earth is referred to as the lithosphere?
- a) Lower mantle and core
- b) Upper mantle
- c) Crust and upper mantle
- d) Crust
- e) Lower mantle

**Phys/Chem Boundaries**: Which two adjacent layers on/in Earth are physically different in their material properties but chemically are **THE SAME**?
- a) Atmosphere/crust
- b) Atmosphere/lithosphere
- c) Crust/upper mantle
- d) Upper mantle/lower mantle
- e) Lower mantle/outer core
Results – Solid Solution Diagrams

• Students are not yet proficient, but average scores do improve throughout the year

Answer ALL of the questions a through e relating to the diagram below. The following questions ALL refer to a cooling system (decreasing temperature) beginning at point A.

a) What is the % Forsterite of the liquid at point A?
b) At what temperature do the first crystals form?
c) What % Forsterite are the first crystals?
d) At what temperature has the liquid completely crystallized?
e) What % Forsterite is the last drop of liquid?

Histogram of Solid Solution Scores

[Histogram showing distribution of scores for different groups: 220 Post, 221 Pre, 221 Post]

[Diagram showing phase diagram with temperatures and compositions for liquid, solid, and liquidus-solidus phases]
Conclusions

- Strong improvements on some key concepts
- Persistent low scores on other key concepts
- Valuable insights for instructors to help inform future course plans
- Still much to learn!

Future Assessment Plans

- Revise tests for 2011–2012
- Implementation for 2011–2012:
  - Pre– & Post– tests for 220 & 221
  - Diagnostics for 321 & 322