

Research on Geoscience Learning

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Strategies for Research and Scholarship

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I am planning to talk about:

- What is research on learning?
- Why conduct research on learning?
- How is research on learning compare to traditional geoscience research?
- How does one get started conducting research on learning?

Are there other topics you would like us to address?

Brainstorm:

- What is research on geoscience learning?



What is research on learning?

- Geoscience education research:
 - Identify and understand learning in geoscience
 - Determine how learning is brought about
- Geoscience education includes:
 - Geoscience content
 - Social science
 - Pedagogy (teaching methods)



What is research on learning?

- Curriculum and Instruction research:
 - The links between classroom experiences and learning
- Application of research to developing and implementing new educational tools or materials to enhance learning



What is research on learning?

- Geocognition research:
 - The cognitive processes underpinning perception, understanding, learning
- Other factors that influence learning, such as:
 - Metacognition
 - Affective domain
 - Place-based learning



Example topics

- Investigating the role of illustrations and animations in learning
- Determining the effects of spatial visualization skills
- Developing and assessing strategic earth science teacher preparation
- Tracing the novice-expert continuum from pre-college to professional geoscientists

Example topics

- Developing instruments to assess student learning
- Measuring the effectiveness of teaching strategies
- Investigating the connection between the affective domain and learning
- Determining causes of misconceptions

Why research learning?

- To explore the fascinating realm of human learning
- To become a better teacher
- To level the playing field
 - E.g. Figure out how to help strugglers thrive
 - E.g. Increasing representation of women and minorities in STEM disciplines
- Your reasons?

Brainstorm:

- How is research on learning similar to and different from traditional geoscience research?



Similarities to geoscience research

- Working to answer significant and interesting questions
- Testing multiple working hypotheses
- Collecting data via observations
- Interpreting large, incomplete data sets (sometimes using statistical analyses)
- Exploring causal relationships within a complex system, inferring process and cause from observed behaviors

Similarities to geoscience research

- Collaborate with scientists in other fields
- Data only good if instrument is calibrated/valid and reliable
- Better if you collaborate
- Test hypotheses with experiments
- Qualitative vs. quantitative

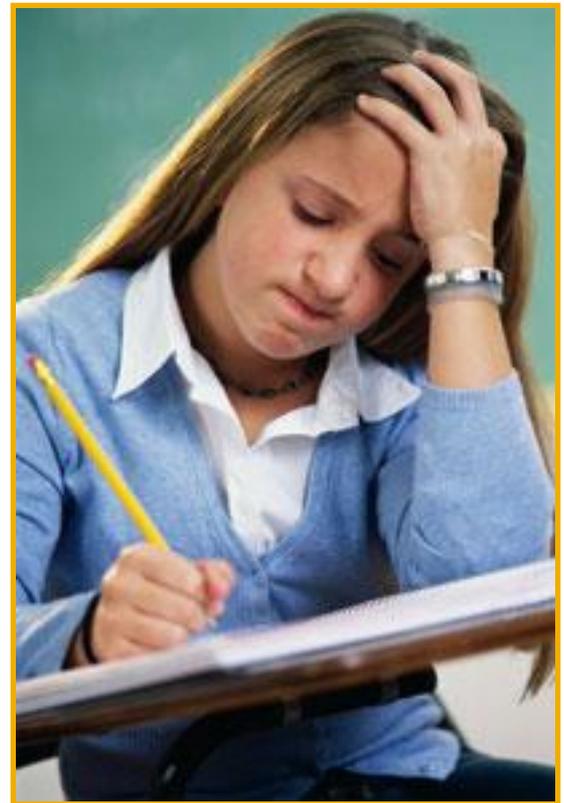
Differences from geoscience research

- Human subjects!
 - IRB (Institutional Review Board): your ethical watchdog
 - So many possible confounding factors....
- Your classroom is your laboratory
- How you collect data
 - Instruments used



Getting started: ideas

- Identify a question that intrigues you: what do you want to know about the learning process?
- Watch your students:
 - Where do they struggle?
 - Why are they struggling?
 - Who is struggling? With what?



Getting started: ideas

- Do your homework: find out what has been done and who is currently working on similar questions
 - Read the science education literature (e.g. Journal of Geoscience Education)
 - Go to research on learning sessions at conferences
 - Join the geoscience education research interest email list (run by Julie Libarkin)
 - Read successful educational research proposals

Getting started: resources

- Funding:
 - Can you do a pilot study without funding?
 - If not, how much funding do you need to collect preliminary data (to convince people that your idea is worth pursuing further)?



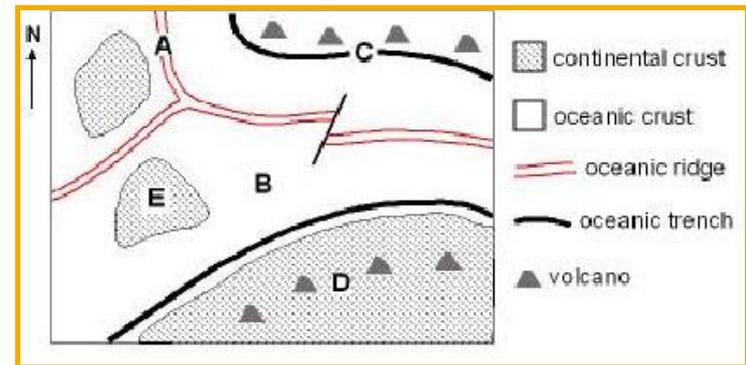
Getting started: resources

- Expertise:
 - Do you have the expertise you need, or will you need to find or recruit collaborators?
 - From Education?
 - From Psychology?
 - From other science departments?
 - From other institutions?
 - Is there someone on your campus (in your department, even) who has submitted a proposal to your IRB?

Your questions?

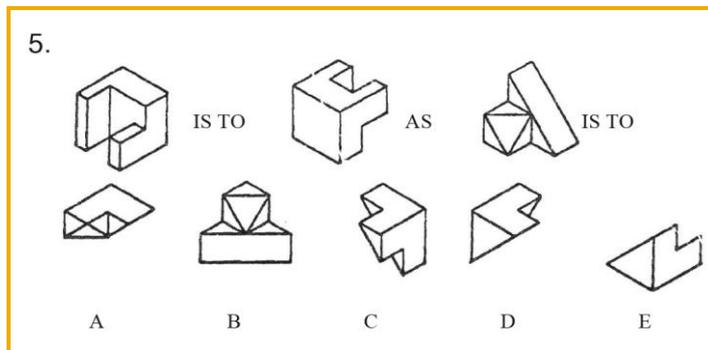
Our current projects: Karen

- Identify and explain student misconceptions
 - Rocks
 - Tectonic plates and boundaries
 - Organismal relationships and cladograms
- Develop and assess pedagogic tools to improve learning
 - Lecture Tutorial worksheets
 - ConcepTest questions
 - Middle-school investigation
 - Intro Geo Textbook
- Assess knowledge
- Disseminate information / lead workshops



Our current projects: Carol

- Spatial thinking in the geosciences:
 - What spatial skills do students bring to geoscience classes?
 - How do geoscience courses affect students' spatial skills?
 - What can instructors do to help students develop their spatial thinking skills?



Name: _____

Rate your confidence not at all \longrightarrow very sure
in your answer: 1 2 3 4 5

Start at: <http://regrolds.asu.edu/blocks/home.htm>. Go through the first few pages of instructions. When you reach a page titled 'Main Menu', select the box for 'Folds'. On the following page, go through the modules for both horizontal synclines and plunging anticlines. Once you have completed these, answer the following question:

Below is an image of a block with folds in it. In the box provided, sketch the block after removing the portion of the block to the right (closest to you) of the cutting plane:

Return to the main menu and go through the Instructions module. On this worksheet, please answer the question asked on the module page illustrated below:

Rotate this block to determine the relative order of events. On the worksheet (2-6), list the four events that formed the blocks in the order they most likely occurred. Show the sequence on the structure below!

Rate your confidence not at all \longrightarrow very sure
in your answer: 1 2 3 4 5

Name: _____

Look at the picture below. Sketch the specified cross sections through the object. While this is obviously a foot rather than a geologic structure, the basic message is exactly the same - any given object may look very different depending on the orientation and location of the slice that you're observing!

Perspective for slice C

Perspective for slices A and B

A B

C

Rate your confidence not at all \longrightarrow very sure
in your answer: 1 2 3 4 5