

Conceptests and Peer Instruction: A Simple Way to Assess Teaching and Learning in Geoscience Courses

David Steer (steer@uakron.edu) and David McConnell (damb6@uakron.edu), Department of Geology, The University of Akron, Akron, OH

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What are ConceptTests?

Conceptests are higher-order multiple-choice questions that focus on one key concept of an instructor's major learning goals for a lesson.

When coupled with student interaction through peer instruction, conceptests represent a rapid method of formative assessment of student understanding, require minimal changes to the instructional environment and introduce many of the recognized principles of effective teaching that enhance student learning.

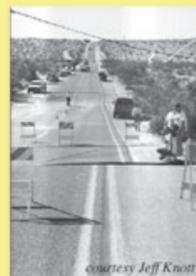
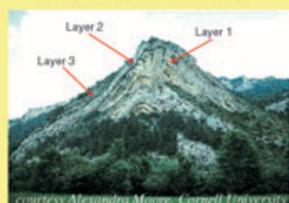
Example Questions and Student Responses

(Numbers in parentheses indicate % of students selecting the answer before/after instruction)

Question asked in Environmental Geology:

Which layer is the oldest in the image shown below?

- a. Layer 1 (42%/52%/70%)
- b. Layer 2 (10%/0%/0%)
- c. Layer 3 (48%/48%/30%)



Question asked in Environmental Geology:

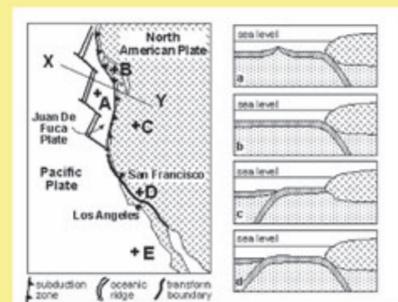
What is the relative displacement shown in the photo?

- a. left lateral (26%/0%)
- b. **right lateral (56%/96%)**
- c. normal (11%/0%)
- d. reverse (7%/4%)

Question used as part of a Physical Geology Lab:

The map below shows the plate configurations along the western margin of North America. Which of the four diagrams on the right best represents a cross section through the outer layers of Earth along the line X-Y?

- a. (40%/60%)
- b. (35%/40%)
- c. (10%/0%)
- d. (15%/0%)



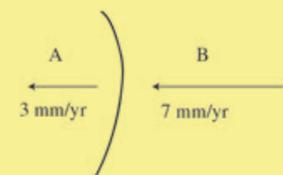
Question posed in Earth Science:

Which rock is most likely associated with plot 4?

- a. andesite porphyry (42%/5%)
- b. **gabbro (7%/74%)**
- c. basalt (10%/12%)
- d. obsidian (42%/5%)

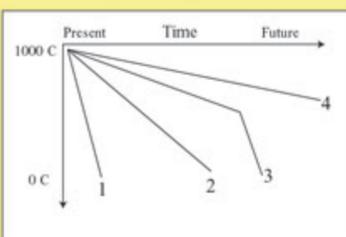
Question used in Environmental Geology:

A and B represent locations of two separate plates. The line represents the boundary between the plates and the arrows represent the directions of motion



What kind of boundary results between A and B?

- a. transform (14%/14%)
- b. **convergent (32%/59%)**
- c. divergent (22%/14%)
- d. none (32%/33%)

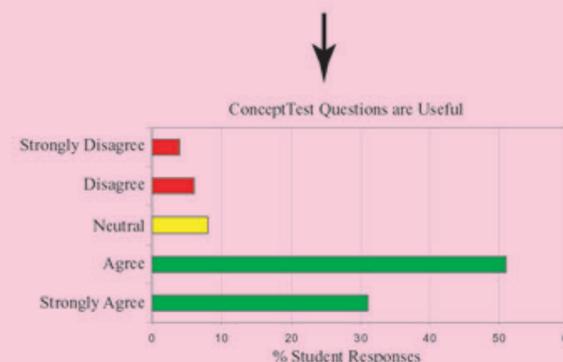


300+ Other Questions Covering ...

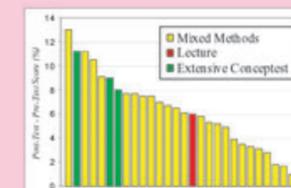
Universe and Solar System, Minerals and Rocks
Earth Structure, Plate Tectonics, Volcanoes, Earthquakes
Structure and Mountain Building, Geologic History
Weathering and Soils, Mass Movement
Water Cycle (general), Oceans and Coasts
Streams and Floods, Groundwater
Glaciers, Atmosphere, Weather,
Climate and the Carbon Cycle

From the Student Viewpoint ...

Three-quarters or more of students in courses taught by instructors who introduced conceptests in lectures at Pennsylvania State University and Washington and Lee University found this teaching method helped them better gauge their level of conceptual understanding



Comparison of difference in improvement in score on Geosciences Concepts Inventory (GCI) between pre- and post-tests at three institutions from this study using conceptests (green bars) and 25 institutions (yellow bars) where instructors utilized a variety of teaching methods. Red indicates control class taught without using conceptests at one of the three institutions piloting the use of conceptests. Note that improvements on GCI in the conceptest classes ranked in the upper third of all classes taught.



From the Instructor Viewpoint ...

The overall reaction of the students to conceptests is one of excitement. Questions are taken seriously. Flash cards are handed out . . . students pay close attention to the lecture in anticipation of when the conceptest question will pop-up.

The class fully participates in the exercise; I have seen no hesitation in students raising their hands . . . Students carefully think about their answers and write decent rationales in defending their choices. Students often crave to know the answers . . . they want to discuss the answer after the exercise. I sense more energy in the class.

I think it has tremendous impact. I could see that the student enjoyed interacting with one another; sometimes there were heated discussions going on.

Why this Works: Good Teaching Practices Applied (Chickering and Gamson, 1987)

1. **Encourage student-faculty contact** - Faculty have opportunity to interact with students as s/he moves around the classroom.
2. **Encourage cooperation among students** - Students talk to one another during peer instruction portion.
3. **Encourages active learning** - Students actively participate in their learning during class which promotes metacognition.
4. **Give prompt feedback** - These formative assessments are used immediately following the introduction of key concepts.
5. **Emphasize time on task** - Well-crafted conceptests focus student attention on critical concepts rather than basic facts.
6. **Communicate high expectations** - The integration of conceptests into lecture sets higher expectations for student performance
7. **Respect diverse talents and ways of learning** - Peer instruction centered on conceptests teaches some students how to think critically, and allows others to explore their depth of understanding.

Where can you find these questions and the pedagogy to use them?



Starting Point discusses pedagogy, implementation and practical considerations for using conceptest questioning to enhance teaching and learning method.

This is the entry page to access several hundred conceptest questions. Questions are cataloged by topic and include assessment data when available.

<http://serc.carleton.edu/introgeo/interactive/conctest.html>

Classroom Procedures

Instructor presents a 10-20 minute lecture.

A conceptest question is posted on the chalkboard or screen.

Students consider the question individually for a short time (30 seconds to 1 minute) and choose an answer.

Students indicate their answers using a variety of methods:

- Students raise their hands as choices are presented by the instructor
- Students hold large colored or lettered answer cards
- Students use an electronic classroom communication system or computer software

The instructor evaluates student responses. The optimal range of correct student responses is 35-70%.

Lastly, the class is polled again. At this point, instructors either select a group spokesperson to provide a brief explanation of the correct answer or the instructor summarizes the response for the class.



A collaborative effort between: MCCONNELL, David A. (1), STEER, David (1), OWENS, Katharine (2), VAN HORN, Stephen (3), KNOTT, Jeffrey (4), BOROWSKI, Walter (5), MCGREW, Heidi (6), DICK, Jeffrey (7), GREER, Lisa (8), and MALONE, Michele (9)

- (1) Department of Geology, Univ of Akron, Akron, OH 44325-4101
- (2) Department of Curricular and Instructional Studies, Univ of Akron, Akron, OH 44325-4205, kowens@uakron.edu
- (3) Geology, Muskingum college, 163 Stormont St, New Concord, OH 43762
- (4) Department of Geological Sciences, California State Univ, Fullerton, P.O. Box 6850, Fullerton, CA 92834
- (5) Department of Earth Sciences, Eastern Kentucky Univ, 521 Lancaster Ave, Richmond, KY 40475
- (6) Department of Geology, Univ of Dayton, Dayton, OH 45469
- (7) Department of Geological and Environmental Sciences, Youngstown State Univ, Youngstown, OH 44555
- (8) Geology Department, Washington and Lee Univ, Washington and Lee University, Lexington, VA 24450
- (9) Department of Geology, Western Washington Univ, Bellingham, WA 98225