ACTIVE LECTURES IN CLASSROOMS OF ALL SIZES

Short Course Workshop held at 2012 annual GSA meeting
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8:00 AM - 12:00 PM

Conveners:

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Lecture Tutorials

What it is:
Fifteen-minute worksheets aimed at reducing misconceptions that students complete in groups in class after an introductory lecture.

Implementation:
- Give a short, introductory lecture.
- Students pair up and complete a Lecture Tutorial worksheet.
- Briefly review select questions.

A Few Selected Resources:
Lecture Tutorials on the Starting Point website:
http://serc.carleton.edu/NAGTWorkshops/teaching_methods/lecture_tutorials/index.html
Lecture Tutorials for Introductory Geology. 2nd ed. Karen M. Kortz and Jessica J. Smay, W.H. Freeman, 188 pp, 2012.
Increasing student learning in introductory geoscience courses using Lecture Tutorials. Karen M. Kortz, Jessica J. Smay, and Daniel P. Murray, Journal of Geoscience Education, v. 56, p. 280-290, 2008.

ConcepTests (or Peer Instruction)

What it is:
Conceptual multiple-choice questions posed to the students who can vote on an answer, and discuss their votes with each other.

Implementation:
- Ask a ConcepTest question
- Students think about the answer and vote
- 40-70% should have the correct answer
- Students pair up and discuss, if necessary
- Students vote again

The question should:
- Focus on a single concept
- Have good multiple-choice answers
- Be clearly worded
- Be of intermediate difficulty
- Not be terminology-intensive

A Few Selected Resources:
FLAG (Field-tested Learning Assessment Guide) http://www.flaguide.org .
ConcepTests on Starting Point: http://serc.carleton.edu/introgeo/conceptests/index.html
McConnell et al. (2006) Using ConcepTests to Assess and Improve Student Conceptual Understanding in Introductory Geoscience Courses. Journal of Geoscience Education, 54(1), 61-68.

Think-Pair-Share

What it is:
A thought-provoking question is posed to students who think about the answer then discuss it with their neighbors.

Implementation:
• Ask a question
• Students think about or write down their answer (usually 1-2 minutes)
• Students pair up
• Students share their thoughts with each other and discuss the answer
• Instructor can ask for responses from some, all, or no pairs

The question should:
• Be open-ended
• Promote student engagement
• Be clearly worded

A Selected Resource:
Think-Pair-Share on Starting Point http://serc.carleton.edu/introgeo/interactive/tpshare.html

Minute Papers (In-Class Writing)

What it is:
A strategy to encourage students to conceptualize, organize, and reflect on what they are learning.

Implementation:
• In the last five or so minutes of class, hand out a notecard and pose an open-ended question.
• Have the students turn in the card as they leave the class.
• You do not have to read every response carefully, but look for themes and patterns.
• Write down the key themes or patterns.
• The next day in class, share with the students what they said to you.

The question should:
• Be open-ended
• Challenge the students to integrate facts, ideas, and perspectives that extend their learning
• Allow the students to self-reflect on their learning (promote metacognition) (optional)

A Few Selected Resources:
Interactive Lectures: http://serc.carleton.edu/introgeo/interactive/index.html
Teaching Strategies (Muddiest Point):
http://astronomy101.jpl.nasa.gov/teachingstrategies/teachingdetails/?StrategyID=1
Teaching Tips:
http://honolulu.hawaii.edu/intranet/committees/FacDevCom/guidebk/teachtip/teachtip.htm

Lecture Tutorials

Developed by Karen M. Kortz and Jessica J. Smay

What are Lecture Tutorials?

Lecture Tutorials are short worksheets that students complete in class to make lecture more interactive. They are designed specifically to address misconceptions and other topics with which students have difficulties. They pose questions of increasing conceptual difficulty to the students, cause conflict with alternative conceptions, and help students construct correct scientific ideas. Research shows that Lecture Tutorials increase student learning more than just lecture alone.

How to Use Lecture Tutorials Step-By-Step

1. **Lecture on the material as usual.** You can also just give an introduction of the background information that students need to know before beginning the Lecture Tutorial.
2. Optional: Pose several well-designed, multiple-choice questions, such as ConcepTest questions, for the students to gauge their understanding of the material. This also helps you see where the students are, and it helps to introduce the Lecture Tutorial.
3. **Have the students split into groups of 2-3 and work on the Lecture Tutorials**. Wander around the room and answer their questions. In a large class, direct student groups to ask questions to other groups in the class, so they do not sit there stuck, waiting for you.
4. **Review some of the main points** of the Lecture Tutorial.
5. Optional: Pose new multiple-choice questions to check if the students have the expected understanding of the information.
6. **Continue with lecture.**

Helpful Hints
- **Begin using Lecture Tutorials during the very first week** of the semester so they become used to interacting.
- **Have the students introduce themselves to their partner/group the first couple of times** using Lecture Tutorials. You may also want to require the students to change groups..
- **Complete the Lecture Tutorials on your own before class** .
- **At the beginning, to help motivate students, advise them that they are in charge of their own learning, and the Lecture Tutorials will help them learn.** Also inform them that materials on the Lecture Tutorials will be on the exams (and make sure it is!).
- **Wait for most students, but not necessarily all students, to finish the Lecture Tutorial** before continuing. If some students do not finish, direct them to finish it on their own.
- **When debriefing after the Lecture Tutorial, do not answer every question**, or students will wait for your answer! Instead, pick a few questions that students had difficulties with.
- **Include (and possibly emphasize) questions relating to Lecture Tutorials on your exams.** The Lecture Tutorials are designed to give students practice answering higher level questions. It is a good idea to use suggested question in the Instructors Manual.

Using ConcepTests

Excerpts from: Field-tested Learning Assessment Guide – Classroom Assessment Techniques, Arthur B. Ellis, Clark R. Landis, and Kathleen Meeker. http://www.flaguide.org/cat/contests/contests7.php

Introduction of ConcepTests:

ConcepTests can be used in virtually any course. If possible, instructors should start to introduce ConcepTests the first day of class and may wish to mention the use of this and/or other collaborative learning methods in their syllabus. Students are sometimes resistant to change and may resent the introduction of a new format later in the course. If ConcepTests are used throughout the course, this format will seem natural to the class and the instructor. While many classes embrace the method upon its first use, it is not uncommon for an instructor and class to need to work through several ConcepTests before both are comfortable with the method and the class learns that they are expected to participate.

Presentation:

It is straightforward to build ConcepTests into the planning of a lecture. They can be presented to the class verbally and/or with the questions and possible answers written on a blackboard or overhead transparency. Pre-prepared ConcepTests can also be presented using PowerPoint presentations. The number of ConcepTests used during any one lecture can vary substantially. In a typical 50-minute lecture, instructors have used anywhere from one to about half-a-dozen ConcepTests.

Demonstrations are traditionally presented with an introduction telling students what they will observe. A ConcepTest requiring students to predict the outcome is a convenient way to engage students and involve them in the demonstration. After discussion, the instructor does the demonstration and the students can determine whether or not their predictions were correct. ConcepTests can also be constructed around computer-based animations or film clips.

Grading:

Although ConcepTests are typically not themselves graded, instructors have found that a helpful element for the successful use of ConcepTests is an absolute grade scale, in which they guarantee at the very start of a course that a given level of course performance ensures a particular final grade (e.g., 85% and up guarantees an "A"; 70% a "B," etc.). This grading policy encourages students to help one another without fear of jeopardizing their grade, and it also enables students to track their progress in real time.

Creating ConcepTest and Think-Pair-Share Questions

Summarized and modified from: McConnell, 2009

Example Question Ideas
• What is the best analogy
• What term doesn't belong on this list
• Predict the outcome
• Before and after questions
• Classify an object/phenomena
• Identify key features by observation
• Summarize the principal concepts
• Infer the geology behind a news article
• Predict the outcome of a demonstration

• What term is missing from this ordered list
• Use known procedures to solve problems
• Convert text to an illustration and vice versa
• Recognize a pattern in a series of examples
• Identify relationships between multiple features
• Draw a conclusion from presented information
• Describe the differences between related
    phenomena

Possible Words to Help Get Started
• Comprehension
    summarize, describe, interpret, contrast, predict, associate, estimate, extend
• Application
    apply, demonstrate, complete, illustrate, solve, examine, modify, relate, change, classify, use
• Analysis
    analyze, separate, order, explain, classify, arrange, divide, compare, select, explain, infer

Summarized and modified from:
GEOSCIENCE CONCEPT INVENTORY: Suggestions for Question Review and Development, Julie Libarkin, MSU

Rules for writing a concept question
The field of test development provides us with a number of "rules" for writing assessment questions. These rules significantly increase the likelihood that a question will have satisfactory construct, content, and communication validity. Some of these rules are summarized below. *Note:* Exceptions to these rules can be found, so view these as guidelines rather than strict laws.

Rules related to writing STEMS
1. <u>Structure the stem as a question when at all possible.</u> Use: "What is obsidian?", rather than the completion form of "Obsidian is_____". If you use a completion form, keep the blank at the end.
2. <u>Use unambiguous and simply worded stems.</u> Use as few sentences as possible.
3. <u>Use appropriate vocabulary.</u> Avoid technical language for non-majors, for example.

Rules related to writing RESPONSE OPTIONS
1. <u>Use plausible response options.</u> Make sure that the distracters are meaningful to the students.
2. <u>Use 3 to 5 response options.</u> More than five options adds no value and may actually produce confusion. Three responses are enough to limit high scores from guessing.
3. <u>Avoid TYPE K format questions.</u> TYPE K: A list of statements is provided, and responses are a combination of statement choices. As in: a) I; b) II; c) III; d) I and III.
4. <u>Avoid absolutes and complexity in response options.</u> Do not use "All of the Above", "None of the Above", and complex response format (e.g., "a and c, but not b").
5. <u>Keep the lengths of response options similar.</u> The longest or shortest answer is often the correct one.