ON-RAMPS
to more effective teaching in tectonics

Interactive lecture

Several times during a lecture, pose a question to the class, give students time to work individually and then discuss answers with a neighbor. Poll the class for answers.

A simple example

SCENARIO: You have just spent 15 minutes lecturing on earthquake focal mechanisms. To give students a chance to apply what they have learned:

1. Show students a focal mechanism from a recent earthquake (*e.g.*, from IRIS Recent Earthquake Teachable Moments). Give students time to figure out, on their own, what type and sense of slip produced the earthquake.

2. Ask them to consult with 1-2 neighbors to compare answers and agree upon an answer and explanation.

3. Ask for responses from the small groups, and discuss the answers as a class.

Why add interactive lectures to your course?

- After 15 minutes of lecture, student attention drifts. A brief activity re-focuses and re-engages the class.

- Every student has time to arrive at an answer, not just those who think quickly. All students are engaged because everyone is held accountable for answering questions.

- The instructor can call on any student without putting an individual on the spot because each student has had time to think and confer with their peers.

- Student responses allow instructors (and students) to assess how well everyone in the class is learning, not just the students who always raise their hands.

- Collecting individual answers is an option not only for assessment but to help ensure that everyone is engaged during the individual thinking time.

How much class time does it take?

- Interactive lecture activities can range from as little as 1-2 minutes for short questions to 15-20 minutes for extended activities.

Tips for success

- Divide the outline of your lecture into logical chunks no more than 15 minutes long, each followed by an interactive component.

- Plan questions ahead of time rather than winging it. Avoid trivial questions, but choose ones that students can answer successfully. Avoid trick questions and ones that you suspect only a few students will be able to answer.

- Write the question on the board or have it on a PowerPoint slide so that students can refer to it.

- Give students adequate time for both individual and small-group tasks. Groups of 2-3 minimize free riding.

- Walking around and eavesdropping while they're working (even up and down a lecture hall) can tell you when students are working and when they are winding down.

- Be sure that students know in advance how you will elicit answers from the class so that they are prepared to respond, especially if you plan to call on individuals.

- To get student responses, you can call on individual students or groups or have students vote by show of hands or with clickers and then discuss the results.

- **Commonly used structures for interactive lecture:**

  - **Think-pair-share:** students answer a question or perform a task on their own and then discuss with one or two neighbors before sharing with the whole class.

  - **Write-pair-share (AKA one-minute write):** students spend one minute writing a response to a question before pairing up and sharing.

  - **Multiple choice questions:** students answer multiple choice questions designed to assess understanding of specific lecture concepts.

More examples & variations on interactive lecture

- **Interactive demonstrations.** Rather than simply doing a demo as part of a lecture, describe for the students what you are going to do (but not what will happen when you do the demo), and do a think-pair-share to have them to predict what is going to happen and why. After running the demo, do another think-pair-share and ask students to talk about which aspects of the model represent the real world well and which don't, plus what insights the model provides into real-world processes.

- **Calculations/estimations/graphs.** After lecturing about a particular technique for determining uplift rates, do a think-pair-share with new numbers or a new graph and have students apply what they have just learned. Choose an example that will also allow you to make a new point as you discuss the students' results.

- **Photos, maps, samples.** Before you lecture about a concept, do a think-pair-share and have students describe what they see in a photo, map, or sample that you provide. After lecturing, ask them to look at the same item with new eyes and talk about what they see differently now.

- **ConcepTests:** After introducing a key concept in a lecture segment, use one or more multiple choice questions to determine whether students can apply the concept. Students respond individually first, then discuss with a partner and respond again. Not all multiple choice questions make good ConcepTest questions. The best questions engage students in tasks that involve higher order thinking skills - applying what they have just learned, predicting, interpreting, etc., rather than defining or recalling.

- **Options for large classes.** Interactive lecture works even in large classes with auditorium seating, because students only need to talk with one or two other people. Involving everyone in reporting answers can be accomplished using clickers or, if each student has a set of cards with numbers or letters, by having each student hold up a card.

Resources on interactive lecture
From the NAGT portal *Teach the Earth*

- Terrific video of Greg Hancock (William and Mary) describing think-pair-share at a faculty workshop and delivering two examples, with great advice on implementing the technique successfully with students.

- Another video showing Greg Hancock using think-pair-share with his students in the classroom.

- Web resources for using a variety of interactive lecture techniques, with links to "how-to" pages, tips for implementing, references, and research underpinnings.

- Web resources on using interactive lecture demonstrations.

- Web resources on using think-pair-share.

- Example of a specific interactive lecture assignment for a class.

A word about adapting vs. adopting
The resources listed here likely come from courses in topics other than those you are teaching. Don't despair! Browse them for inspiration and good ideas that you can adapt for your own courses and your own students.

Research papers on interactive lecture

Meltzer, David E. and Manivannan, Kandiah, 2002, Transforming the lecture-hall environment: The fully interactive physics lecture: American Journal of Physics, v. 70, p. 639-654.

Prather, Edward E., Rudolph, Alexander L., Brissenden, Gina and Schlingman, Wayne M., 2009, A national study assessing the teaching and learning of introductory astronomy. Part I. The effect of interactive instruction: American Journal of Physics, v. 77, p. 320-330.

More On-Ramp pdfs & resources: serc.carleton.edu/onramps/index.html

- What are On-Ramps?
- Interactive lectures
- Brainstorming
- Concept sketches
- Jigsaws

- Compelling discussions
- Quantitative skill-building
- A just-in-time approach
- Case studies
- Re-thinking coverage & linearity

- Gallery Walk
- Flipping the classroom
- Designing effective courses