ON-RAMPS

to more effective teaching in tectonics

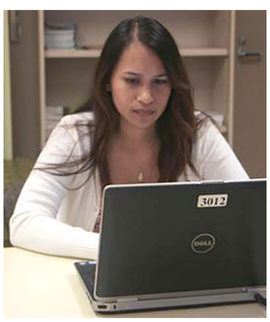
A just-in-time approach

Just prior to class, students submit responses to questions on key concepts. You review responses before class begins and adjust in-class activities to build on their current understanding and ideas.

A simple example

SCENARIO: The next topics in class are stress and strain. Students commonly struggle with these concepts, so you:

1. Ask students to do a short reading from the textbook that defines stress, strain, etc.
2. Ask students to repond to several short questions (*e.g.*, *How do you use the words stress and strain in everyday life? How do geologists' definitions differ from everyday usage? How are stress and strain related?*) and submit responses electronically a few hours before class.
3. Before class, read and compile student responses, assessing for thoroughness rather than correctness. Use this "just-in-time" information to adjust what you will do in class.
4. Share compiled responses in class, and engage students in discussion or other activities to address misconceptions and learning gaps.



Why add a just-in-time approach?

- A just-in-time approach effectively links timely pre-class preparation by students with in-class activities designed to incorporate student responses on the pre-class preparation.
- Students engage with concepts before a class, which helps them take more responsibility for their own learning, motivates them to think in advance about a concept in thoughtful ways, and prepares them to interact productively in class.
- You find out what students know in time to make adjustments for class and engage students in activities to help them learn the concepts more effectively.
- Research across science disciplines shows that a just-in-time approach works. Students learn more, improve their study skills, and achieve higher grades.

How much time does it take?

- **In-class time:** 5 minutes (*e.g.*, reviewing terms) up to a full class period (*e.g.*, applying a concept).
- **Pre-class prep time:** Reading, grading, and compiling responses before class takes 1-3 minutes per student.
- **First time prep:** Creating questions that challenge students and give you insight into their thinking can take quite a bit of time, but you can reuse questions in the future. Read more about getting started.

Tips for success

- Phrase questions to allow students to express their understanding in a way that goes beyond what they can look up, or that elicits an individual, idiosyncratic response based on prior experience.
- Limit the number of questions (1 to 3), and use questions that are consistent in format and style and that are quick to assess.
- Collect responses online via email or a course management system.
- Set a deadline that is close to the start of class but that also gives you enough time to go through student responses. An hour prior to class is common.
- Don't spend time commenting directly to individuals. Instead, comment in class on compiled responses. Automatic grading may or may not be appropriate.
- Make sure that students know how they will be evaluated. You want to find out what students know, and students are more likely to provide honest responses that reveal pre-/misconceptions if they know they are being assessed on thoroughness and thoughtfulness, rather than correctness.
- Review responses and integrate them into class discussions and activities right away.
- Set student expectations that these activities are a core part of their learning process by using them regularly and including them in the course grade.

The On-Ramps Project provides quick-start guides for faculty interested in incorporating successful and easily implemented teaching strategies to improve student learning in the broad field of tectonics. The Project was funded by NSF grant EAR1841227 and grew out of a recommendation in the 2018 community vision document Challenges and Opportunities for Research in Tectonics.

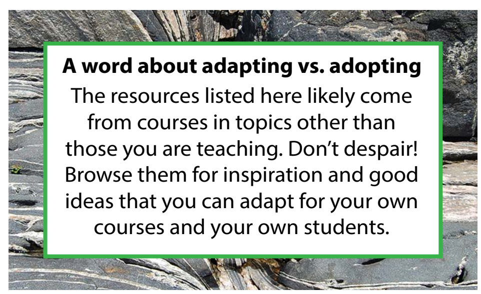
Examples of just-in-time approaches

- **Assess prior knowledge.** Ask questions that assess students' abilities to recall concepts from another course (*e.g.*, math skills, mineral/rock identification). Review in class before using recalled concepts in a new context in your tectonics course (*e.g.*, using trig to calculate dip, discussing rock type and the interior of the Earth).
- **Ask students to reflect on the reading.** Add one or more simple questions that probe student understanding or interest. For example, *What do you want to talk more about and why?* or *What surprised you the most and why?* or *What confused you and why?* Most responses will likely be things that you already plan to include, but you can shift the emphasis based on the responses.
- **Interpret a figure.** Provide a figure or graph (*e.g.*, a plot of terrace heights vs. ^{3}He exposure ages), and ask students to describe what the graph shows and offer several suggestions for possible causes. Have students brainstorm their ideas at the start of class.
- **In the field.** Prior to a field trip, provide an outcrop photo, aerial image, or Google Earth image of a site to be visited. Ask students to list their observations, the features they could measure, or the processes they see operating. Use responses to brainstorm field approaches or to split students into groups to collect data as a jigsaw.
- **In a lab.** As homework, ask students to read lab procedures and describe how they would set up a table for data collection. During lab, compile students' responses and, together, decide on a common procedure.
- **Match concepts with applications.** Ask students to list examples of geologic features that are linear vs. planar, and then consider how they would measure them. Correct any misconceptions prior to introducing how to plot features on stereonets.
- **Explore real-time data.** Have students visit the USGS Earthquake website and describe a recent earthquake. Use their earthquakes to define the difference between hazard and risk or to introduce focal mechanisms.
- **Explore with Google Earth.** Ask students to place pins in Google Earth marking examples of a specific geologic feature (*e.g.*, triple junction). Use your discussion of each site during class as a way of teaching relevant geologic topics (*e.g.*, active tectonics) or addressing common points of confusion.
- **Build complexity.** Ask questions that require a variety of cognitive levels, from recall to application to synthesis. Consider increasing complexity within a single question set or over the course of the semester.

Resources on just-in-time approaches

From the NAGT portal *Teach the Earth*

- Description of Just-in-time Teaching (JiTT):
  - Getting started using JiTT.
  - Designing effective JiTT questions
  - Reviewing student responses.
  - Using student reponses to develop classroom activities.
- A just in time approach can be used to introducing math concepts. See The Math you Need When You Need It, for additional resources.
- Just in time approaches can be used as a starting point for a jigsaw, case study, or discussion.



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 the just-in-time approach

Luo, Wei, 2008, Just-in-Time teaching (JiTT) improves students' performance in classes - Adaptation of JiTT in four geography courses: Journal of Geoscience Education, v. 56, no. 2, p. 166-171.

Novak, G. M., 2011, Just-in-time teaching: New directions for teaching and learning; Issue 128, p. 63-73.

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

Just-in-time approaches On-Ramp authors: Anne Egger and Christine Regalla.

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