ON-RAMPS
to more effective teaching in tectonics

Jigsaws

Teams of students investigate different pieces of a geoscience puzzle, then reorganize into mixed groups where students teach each other about what they have learned and tackle a group question that puts the pieces together.

A simple example

SCENARIO: In an intro or upper level course, have students explore the influence of bedrock structures on slope failure:

1. Divide the class into three teams; give each team a data set on bedrock geology/structures from a different area.
2. After each team analyzes the influence of bedrock structures on slope stability, reorganize the class into mixed groups consisting of one member from each team. Members of each mixed group teach each other about the influence of bedrock structures in their own areas.
3. Mixed groups prepare a composite picture of how bedrock structures influence slope stability & then predict the stability of a new area.

Why add jigsaws to your course?

- Each student is accountable for teaching a new group what their team has learned, so all students must be engaged in analysis, discussion, and speaking the language.
- Students engage deeply with one aspect of a problem (the team assignment) but also learn about a range of aspects when their mixed groups tackle a synthesis question.
- Working in teams and bringing expertise to a group helps prepare students for collaborative professional science.
- If you have wanted to add group work to a course, but have been worried about how to make it work, a jigsaw is a well-structured framework that is straightforward to implement.

How much time does it take?

- Because students need time for both the team assignment and group work, a jigsaw typically takes at least 15-20 minutes. If a jigsaw extends longer than a class session, choose logical breaks to prevent loss of momentum.

Critical steps

- **Prepare students.** Hold students accountable for out-of-class preparation, or provide time to prepare in class. A jigsaw doesn't work if students are not prepared.
- **Verify that students are prepared.** Before reorganizing teams into mixed groups, circulate to make sure that students are prepared to accurately teach their peers.
- **Engage students in an effective mixed group task.** Frame a question or problem for mixed groups that requires components from each team. This critical part of a jigsaw is akin to putting a puzzle together, rather than looking at individual pieces. A group task is critical for making sense of the pieces, providing an incentive for students to learn from one another, and achieving long-term learning gains.

Tips for success

- Design team assignments that are "do-able" for your students. A team assignment doesn't have to be easy, but it must be achievable for most students in the class.
- Recognize that students will know their own team topic well but will learn less about others. Avoid team topics that all students must know equally well in your course.
- Limit the number of team assignments. The more team assignments you have, the longer the peer teaching takes. More than four topics can be difficult.
- Design a mixed group task that goes beyond summarizing the team assignments. Providing groups with a new data set or scenario to analyze is a useful design strategy.
- Set appropriate time limits. Have an additional task ready to give to groups that work at a faster pace than others.
- Lead a follow-up discussion or give a mini-lecture to validate what students have learned.
- Consider a follow-up assignment that holds individual students accountable and allows you to assess individual student learning with respect to the mixed group task.
- Choose a simple jigsaw assignment for your students' first experience, and consider having students prepare in class so that you can guide/monitor their preparation.
- Try using a jigsaw in a smaller class before trying a jigsaw in a larger class, where logistics can be a challenge.

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.

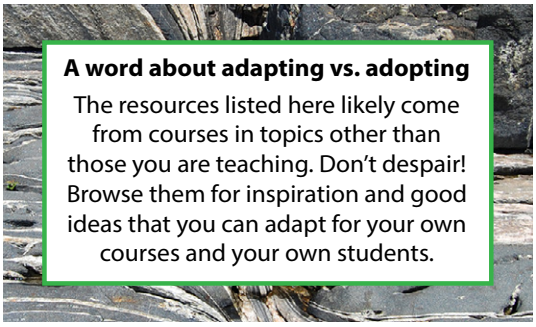
Examples and variations on jigsaws

- **Discovering plate boundaries.** In Dale Sawyer's jigsaw (with variations), each team works with a different world data set (*e.g.*, volcanoes, earthquakes, ocean crust age, bathymetry/topography) to develop categories of plate boundaries based only on their own data set. Mixed groups of specialists establish overall patterns and characteristics by combining data sets and developing a boundary map for a particular plate.
- **In the field.** Divide an outcrop or mapping area into several sections, and assign a team to map, collect data, or make observations in each section. Mixed groups then visit each section, with team members sharing what they have learned. The group then puts together a big picture that accounts for all of the team data. The length could range from one stop on a field trip to a semester project.
- **In a seminar.** Assign teams of students to different papers on the same research problem, rather than having all students read the same paper. Have each student prepare individually outside of class, and allot time at the beginning of the seminar for teams to discuss their team's paper and resolve questions. Each team member then shares the research with a mixed group, and the group analyzes differences in methods, results, conclusions, etc.
- **Samples, maps, photos, graphs.** Have each team analyze a different but related image, map, thin section, sample, data set, etc. Each team member shares observations/analyses with a mixed group, followed by a relevant group task. This is particularly useful for giving students experience with a variety of examples without requiring everyone to do a full analysis on each one.
- **In lab.** Have each team analyze a different graph that shows a model of earthquake recurrence. Team members then share characteristics of their models with a mixed group. Each mixed group then receives data on the recurrence interval for a particular fault and evaluates which of the models best fits the actual fault data.
- **Role playing.** In an earthquake hazards class, have teams prepare an earthquake readiness community plan from a particular viewpoint. After team members share their team ideas, mixed groups put together a full, informed community earthquake readiness plan.
- **Combining with concept sketches.** Build a jigsaw activity around concept sketches created by each team, with each team assessing a different aspects of a particular system.
- **Combining with think-pair-share.** In a lecture class, have students count off by threes, and assign a different focal mechanism solution to each "team". Students analyze their own and then compare with two neighbors from the other "teams". Each trio then carries out a short group task.

Resources on jigsaws

From the NAGT portal *Teach the Earth*

- Pedagogy in Action has a number of modules on teaching strategies, including a jigsaw module that offers detailed advice on how to structure jigsaws, examples of jigsaw assignments in the geosciences, and a list of related books and articles.
- FAQs on Jigsaws offers advice on the questions that faculty commonly have about jigsaws and how to deal with challenges in order to make jigsaws work successfully.
- Jigsaw ideas you can apply in the classroom related to hazards, tectonics, volcanic eruptions, and analyzing multiple datasets.



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 paper on jigsaws

Wedman, J.M., 1996, The effect of jigsaw teams on pre-service teachers' knowledge of reading pedagogy and concerns about group learning in a reading methods course: Reading Improvement, v. 33, no. 2., p. 111-133.

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

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