AGU Heads & Chairs Workshop, October 9, 2020

Tools and Strategies for Finding Programmatic Strengths and Weaknesses

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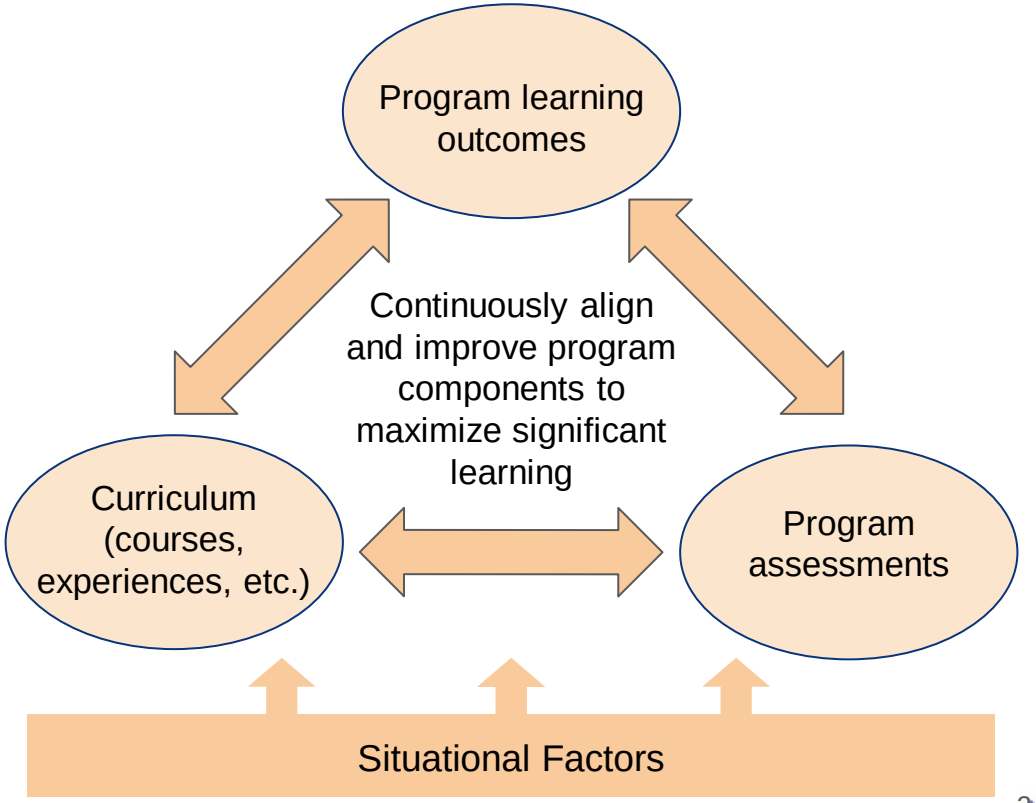
https://nagt.org/index.html

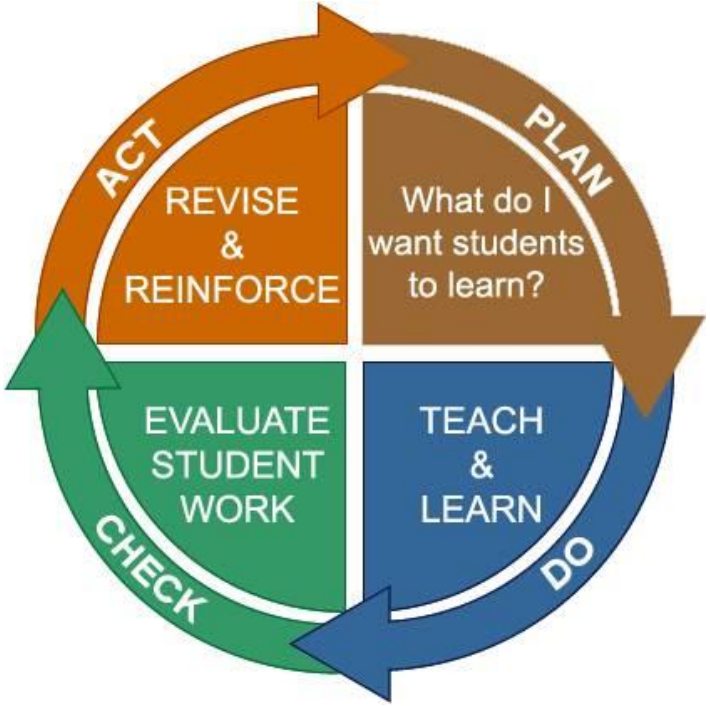
A framework for program design

Adapted from Dee Fink, *Creating Significant Learning Experiences* (Jossey-Bass, 2003), p. 62



Why do we assess our programs?

- Identify places for improvement that will lead to better outcomes for students
- Highlight areas of success
- Be thoughtful and data-driven when making changes
- Look for relationships between changes made and outcomes



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Answer the following questions in the chat:

1. What do you feel your program/department is assessing well?
2. What would you like to improve in your program/departmental assessment?
3. What tools do you currently use for assessment?

What should we be assessing?

- Your program learning outcomes define what you should be assessing
- What are the learning outcomes for your degree program?
  - Type an example in the chat
- If you don’t think your outcomes describe meaningful learning in your program then it’s time to revisit them!

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Types of knowledge:
Which are important in your program?

- Factual knowledge
  - Terms, specific details
- Conceptual knowledge
  - Classifications and categories
  - Theories, models, structures
- Procedural knowledge
  - Subject-specific techniques, skills, methods, algorithms
  - Criteria for determining when to use procedures
- Metacognitive knowledge
  - Self knowledge
  - Strategic knowledge

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Graduates from this program should be able to…..

Strong program learning outcomes should be:

- Specific
- Measurable or observable
- Describe meaningful learning
- Attainable
- Written in clear, understandable language

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Learning outcomes should start with active verbs:

Example verbs: Lower-order thinking skills	
Define	Apply
Identify	Choose
List	Organize
Select	Solve
Recognize	Use
Classify	Produce
Explain	Represent
Summarize	Discuss

Example verbs: Higher-order thinking skills	
Analyze	Create
Evaluate	Develop
Appraise	Hypothesize
Construct	Plan
Design	Support
Differentiate	Generate
Critique	Argue
Predict	Synthesize

Avoid the verb “understand”-- to measure understanding what would you ask

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Example program outcomes

Graduates from the BS Geoscience program will be able to….

- Effectively communicate results of geologic investigations in written, graphic and oral formats
- Articulate the benefits and responsibilities of working as a member of a team
- Describe the processes that operate on or beneath the Earth's surface and the resulting planetary features
- Produce and use field-based measurements to interpret geologic history
- Apply quantitative approaches to the analysis of data sets and to problem solving
- Critically evaluate data, interpretations and conclusions in their own work and the work of others

https://serc.carleton.edu/NAGTWorkshops/departments/degree_programs/learning_goals.html

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Example program outcomes

Graduates from the BS Geoscience program will be able to….

- Effectively **communicate** results of geologic investigations in written, graphic and oral formats
- **Articulate** the benefits and responsibilities of working as a member of a team
- **Describe** the processes that operate on or beneath the Earth's surface and the resulting planetary features
- **Produce** and **use** field-based measurements to interpret geologic history
- **Apply** quantitative approaches to the analysis of data sets and to problem solving
- Critically **evaluate** data, interpretations and conclusions in their own work and the work of others

https://serc.carleton.edu/NAGTWorkshops/departments/degree_programs/learning_goals.html

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One outcome (team work) several ways...

1. **Articulate** the benefits and responsibilities of working as a member of a team
2. **Work** effectively as a member of a team
3. **Describe** characteristics of a well-functioning team
4. **Behave** as part of a team, **leading** the team as needed
5. **Assemble** a team with the appropriate expertise to solve a problem

How would you assess each of these?

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Help for writing/ revising learning outcomes

Traveling Workshops Program

- Expert facilitators work (virtually for now) with your department
- Upcoming application deadlines: **October 15**, January 15, March 15

https://nagt.org/nagt/profdev/twp/index.html

On the Cutting Edge
Strong Undergraduate Geoscience Teaching

NAGT's *On the Cutting Edge* Professional Development Program

NAGT's core professional development program includes workshops, webinars, conferences, online resource collections and other efforts that support geoscience educators. These activities provide opportunities for faculty to learn more about pedagogy, to share their classroom and professional experiences and teaching materials, and to discuss what works and what's needed in geoscience education.

This program is run in collaboration with SERC and builds on the legacy of the original NSF-funded program including many of its program elements as well as its design philosophy and workshop model.

Professional Development Events ↓

On the Cutting Edge Professional Development Opportunities & Resources

Earth Educators' Rendezvous
Annual conference aimed at improving undergraduate Earth education. Events will include workshops, oral and poster sessions, plenary talks, and working groups.

Teach the Earth
Teach the Earth is a portal to thousands of resources from dozens of Earth Education website Resources include classroom activities, course descriptions and syllabi, information about pedagogical strategies, topical collections, and more.

Traveling Workshops Program
The NAGT Traveling Workshops Program brings national leaders in geoscience education to your campus or regional event to help faculty develop stronger courses or departments or a mixture of both.

NAGT Supported Webinars
The NAGT supports numerous webinars that vary in topic depending on the collaborating program or project. You can register for upcoming webinars or browse the past webinar archives by clicking here.

Early Career Geoscience Faculty
These workshops, for tenure-track early career faculty, include sessions on effective teaching strategies, course design, establishing a research program in a new setting, working with research students, balancing professional & personal responsibilities, and time management.

Activity Review
NAGT coordinates regular peer review of community and project contributed teaching materials. This process identifies a collection of exemplary teaching materials that are a great starting point when looking for new activities to add to your classes.

Desired Workforce Skills: General Skills

Association of American College & Universities Essential Learning Outcomes:

- Inquiry and analysis
- Critical and creative thinking
- Written and oral communication
- Quantitative literacy
- Information literacy
- Teamwork and problem solving
- Civic knowledge and engagement (local and global)
- Intercultural knowledge and competence
- Ethical reasoning and action
- Foundations and skills for lifelong learning
- Synthesis and advanced accomplishment across general and specialized studies

https://www.aacu.org/essential-learning-outcomes

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Desired Workforce Skills: Geoscience Skills

Future of Undergraduate Geoscience Education Employers Workshop and Survey:

- Critical thinking & problem solving
- Data collection and interpretation
- Evaluate data quality
- Work with uncertainty, non-uniqueness
- Apply skills in new scenarios
- Systems thinking
- Quantitative skills
- Written and oral communication
- Evaluation of literature
- Temporal and spatial thinking
- Field skills
- GIS
- Work as part of a team
- Time management
- Understand societal relevance
- Computer programming
- Manage large datasets
- Ethics
- Leadership

https://www.jsg.utexas.edu/events/future-of-geoscience-undergraduate-education/

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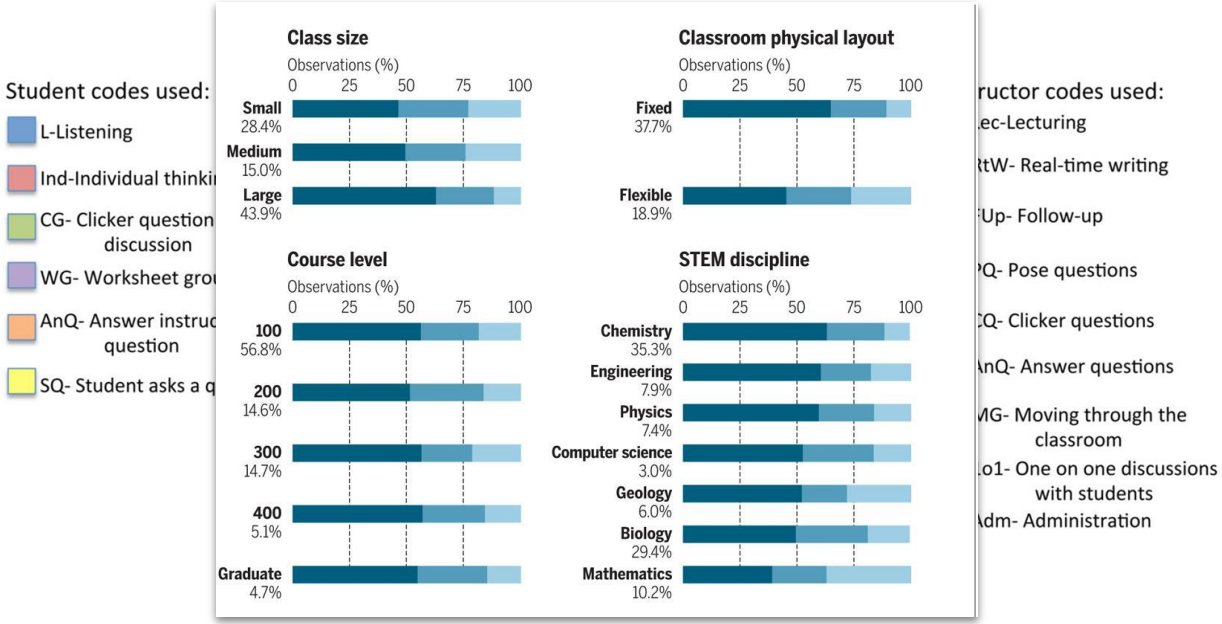
Program outcomes related to *teaching*

- You can also set goals related related to teaching, such as use of active learning strategies
- Assess using structured classroom observations and/or peer evaluations
- COPUS (Classroom Observation Protocol for Undergraduate STEM) is easy to learn
- Can set benchmarks based on data across all STEM disciplines or...

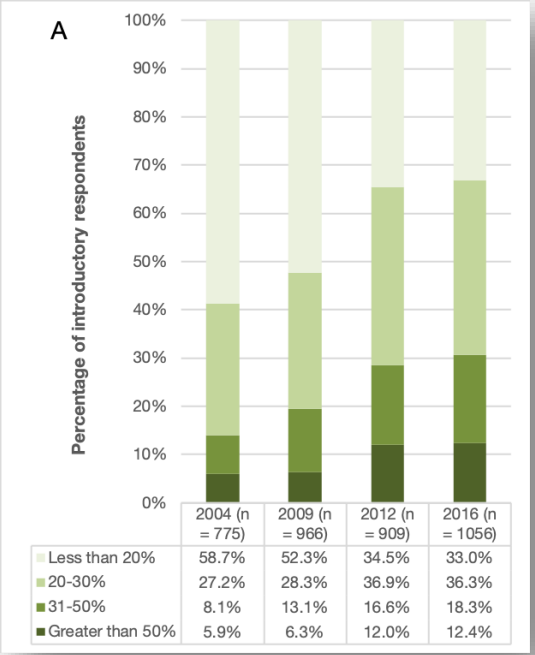


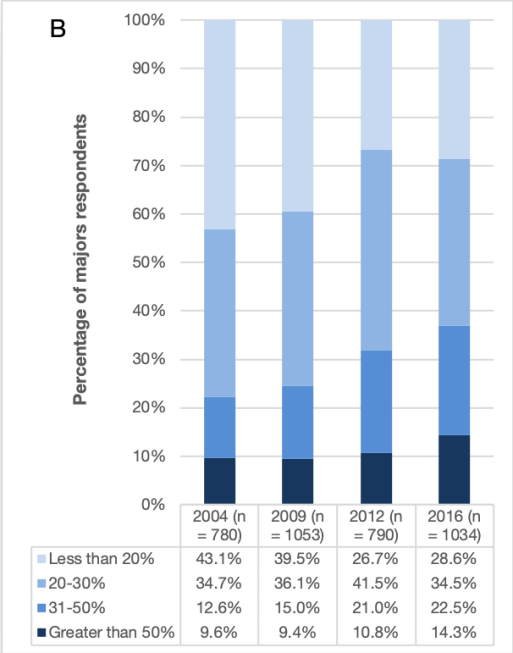
Stains et al., 2018

Teaching data in the geosciences

National Geoscience Faculty Survey (NGFS)

- Has reached ~25% of faculty
- Can see trends over time
- Use of active learning has increased; can assess your own faculty against this benchmark





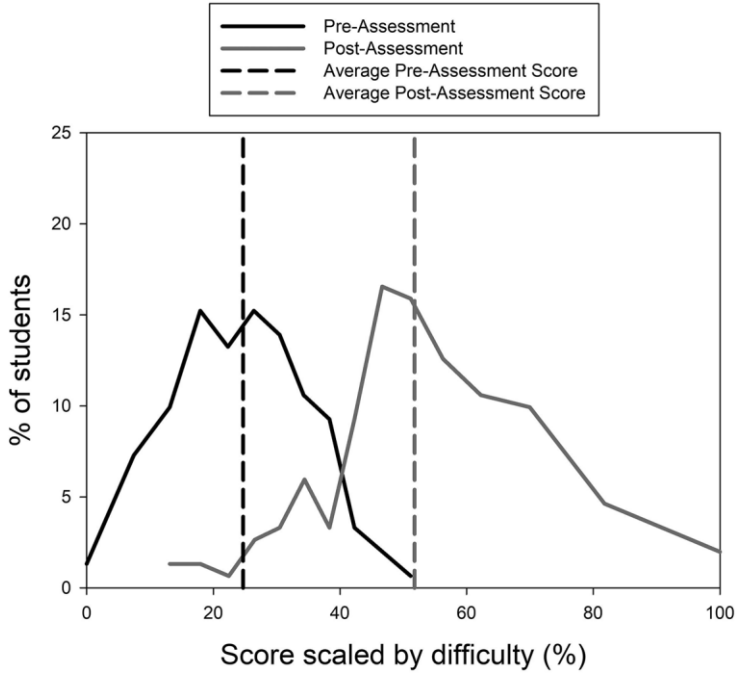
https://serc.carleton.edu/NAGTWorkshops/CE_geo_survey/index.html

Other NGFS data and published research

- McFadden, Viskupic & Egger (2019) Faculty self-reported use of quantitative and data analysis skills in undergraduate geoscience courses, *Journal of Geoscience Education*, DOI: 10.1080/10899995.2019.1700595
- Viskupic, Egger, McFadden & Schmitz (2020) Comparing desired workforce skills and reported teaching practices to model students' experiences in undergraduate geoscience programs, *Journal of Geoscience Education*, DOI: 10.1080/10899995.2020.1779568
- Beane, McNeal & Macdonald (2019) Probing the National Geoscience Faculty Survey for reported use of practices that support inclusive learning environments in undergraduate courses, *Journal of Geoscience Education*, 67:4, 427-445, DOI: 10.1080/10899995.2019.1621714

Tools for assessing student outcomes

1. Professional licensure exams (ASBOG)
2. Disciplinary and skills-specific assessments
3. Student portfolios
4. Reflections and exit interviews
5. Alumni and employer feedback



Scribner & Harris, 2019

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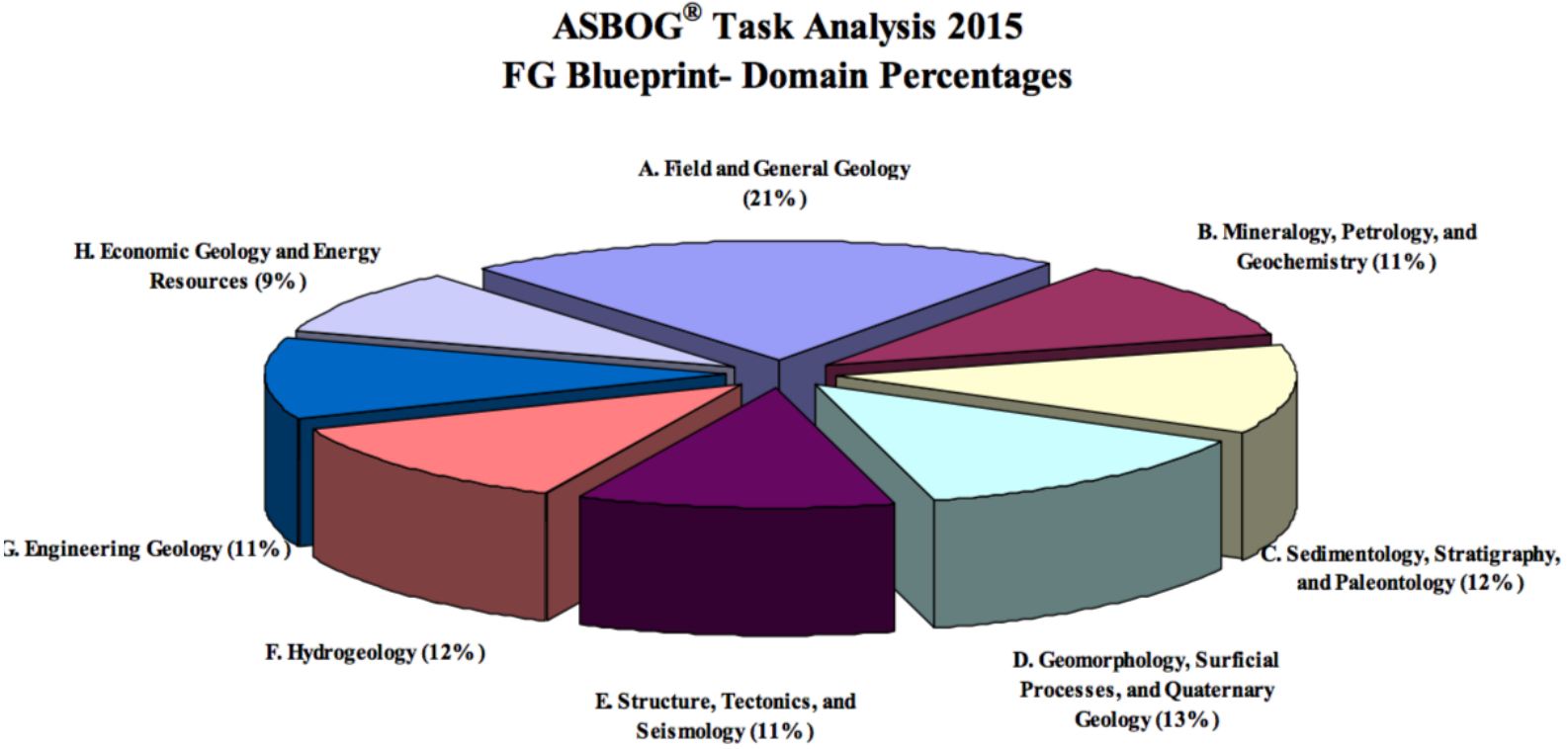
Licensure exams: ASBOG



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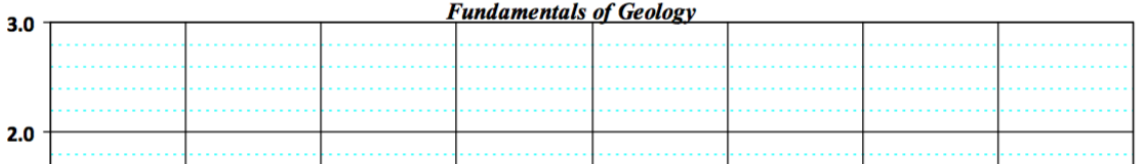
ASBOG Curriculum Performance Assessment Tool



Caveats:

- This will only work for you if a lot of your students take the ASBOG exam most years
- The exam costs >$200, so will limit the number of students would take it for assessment purposes
- The tasks focus on professional geology, which may or may not align well with the goals of your program

Graduation Year	General	Mineralogy	Sedimentology	Geomorphology	Structure	Hydrogeology	Engineering	Economic
1990-2010	0.34	-0.34	-0.18	0.55	0.4	-0.11	0.17	0.09
2011-2013	0.01	0.35	0.34	0.33	0.38	-0.51	0.7	-0.67
2014-2016	0.44	0.3	0.27	0.66	0.78	0.3	0.62	0.26
2017-2018	0.21	-0.09	0.25	0.72	0.51	0.05	0.47	-0.15

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Answer in the chat:

Have you used ASBOG’s Curriculum Performance Assessment Tool?

If so, what have you found useful?

If not, is it something you think you might use? Why or why not?

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Disciplinary and skill-specific assessments

Scribner & Harris (2020) The mineralogy concept inventory: A statistically validated assessment to measure learning gains in und… Journal of Geo… 8, DOI: 10.1…

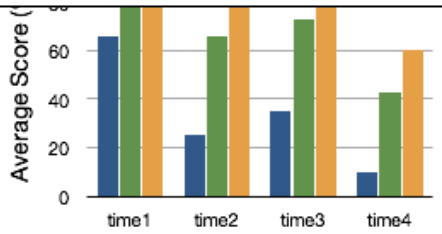
Best used as **pre-/post-** assessments

Dav… damentals in Meteorology Inventory: Validation of a tool assessing basic meteorological conceptual understanding, Journal of Geoscience Education, 68:2, 152-167, DOI: 10.1080/10899995.2019.1629193

VALUE Rubrics define skills at capstone and milestones for critical thinking, quantitative literacy, written communication, etc. (16 total): they a…

In-hou… asses…

Best used as **milestone** & **capstone** assessments



Answer in the chat:

Have you used discipline- or skill-specific assessments? These or others?

If so, what have you found useful?

If not, is it something you think you might use? Why or why not?

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Student portfolios

- Students curate materials to demonstrate and reflect on their achievement of program learning outcomes
- Creation of portfolio could be built into the program over time
- Portfolios evaluated according to a rubric
- Could ask reflection questions as part of an end-of-program survey or capstone course evaluation

Learning Outcomes	Artifacts	Reflection
1. Effectively communicate results of geologic investigations in written, graphic and oral formats	GEOS 313 report GEOS 482 report GEOS 498 group project Senior thesis	PLO 1 reflection
2. Articulate the benefits and responsibilities of working as a member of a team	GEOS 498 group project Internship	PLO 2 reflection
3. Describe the processes that operate on or beneath the Earth's surface and the resulting planetary features	GEOS 314 final exam GEOS 498 group project	PLO 3 reflection
4. Apply quantitative approaches to the analysis of data sets and to problem solving	GEOS 343 problem sets GEOS 425 problem sets GEOS 357 final project	PLO 4 reflection
5. Critically evaluate data, interpretations and conclusions in their own work and the work of others	GEOS 357 final project GEOS 498 group project Senior thesis	PLO 5 reflection

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Answer in the chat:

Have you used student portfolios?

If so, what have you found useful?

If not, is it something you think you might use? Why or why not?

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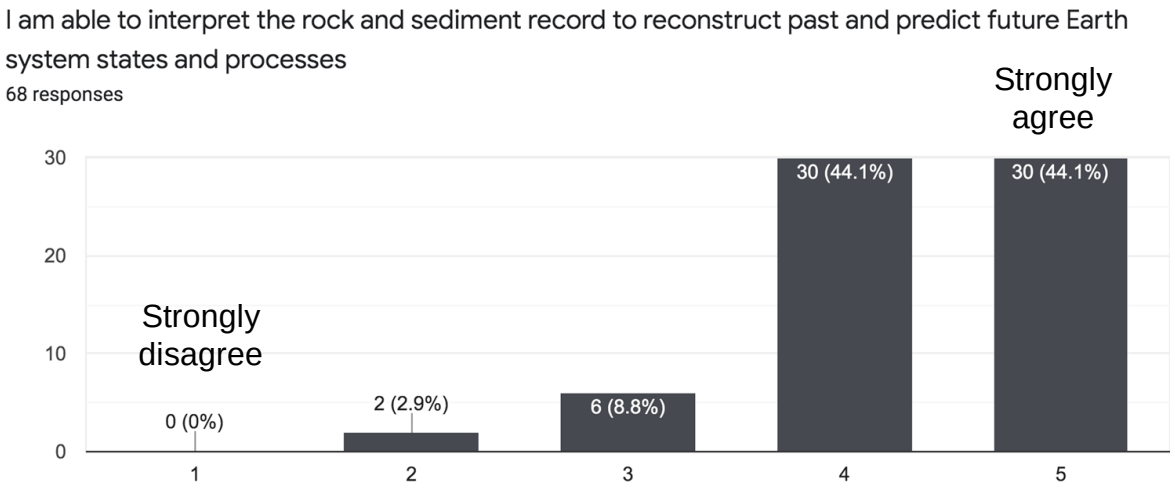
Reflections and exit interviews

- Students reflect on how well the program helped them meet PLOs
- Could be:
  - Survey
  - Knowledge survey
  - Exit interview
  - Curriculum matrix



Reflections and exit interviews

- Students reflect on how well the program helped them meet PLOs
- Could be:
  - Survey
  - Knowledge survey
  - Exit interview
  - Curriculum matrix

BS Geoscience at Boise State University-- Program Learning Outcomes-- Updated Feb 2018

1 = Introduced; 2 = Developed; 3 = Mastered

		Required Courses for All Students											
	Student Outcomes (students will be able to...)	GEOS 100 Fund. Of Geol.	GEOS 101 Global Env. Sci	GEOS 200 Evol. W. N. Am	GEOS 212 Water in West	GEOS 220 Seeing Unseen	GEOS 242 Comm. In Earth Sci.	GEOS 300 Earth Materials	GEOS 313 Geomor-phology	GEOS 314 Structural Geol	GEOS 315 Sediment. & Stratig.	GEOG 360 Intro to GIS	GEOS 498 Senior Seminar
1	Integrate the behavior of the geosphere, hydrosphere, atmosphere, and biosphere as components of the Earth system	1		1	2	1	1	1	3	3	1	1	1
2	Assess the ways humans affect Earth systems and the way Earth systems impact humans	1		1	2	1	1	1	3	2	1	2	1
3	Interpret geophysical data to infer and model Earth system processes and structure	1		1	1	2	1	2	1	3	2	1	1
4	Interpret the sediment and rock record to reconstruct past and predict future Earth system states and processes	1		2	1	1	1	2	2	3	3	1	1
5	Quantify the occurrence and movement of water in the terrestrial hydrologic cycle, and the interactions among geological, chemical, and biological processes (Hydrology)	1		1	2	1	1	1	2	1	1	1	3
6	Formulate geoscientific research questions and hypotheses and design ways to address and test them	1		2	2	2	1	3	3	3	2	1	3
7	Collect, process, analyze, and interpret a variety of geoscientific data	1		2	2	2	1	3	3	3	3	1	3
8	Synthesize information from the scientific literature to provide context, methodology, and alternative arguments related to geoscience inquiry	1		2	2	2	3	1	2	3	2	1	3
9	Clearly communicate scientific ideas in a variety of formats (verbal, written, graphical) to diverse audiences	1		2	2	2	3	1	3	3	3	1	

Instructions for students:
For each course you took as part of your BS Geosciences degree, indicate which outcomes were introduced (1), developed (2), or mastered* (3), by placing a 1, 2, or 3 in the appropriate cell. If an outcome was not addressed in a course, leave the cell blank. If you did not take a course, leave the entire column blank. Upload your completed matrix to BlackBoard. * Mastered, means mastered at the undergraduate level.

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Answer in the chat:

Have you used reflections and exit interviews?

If so, what have you found useful?

If not, is it something you think you might use? Why or why not?

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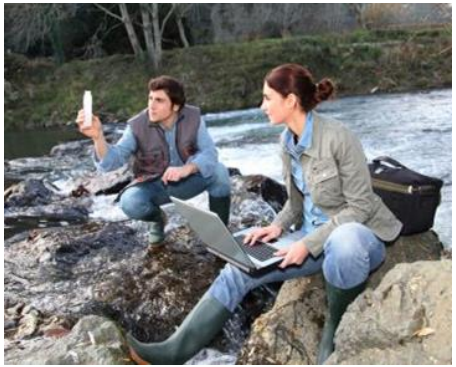
Alumni and employer feedback

- Provides a different perspective on student achievement of learning outcomes
- Best used as a supplement to other assessment means
- Could be:
  - Survey
  - Interviews or focus group
  - Informal feedback



https://serc.carleton.edu/sage2yc/careers/index.html

www.americangeosciences.org

Answer in the chat:

Have you used alumni and employer feedback?

If so, what have you found useful?

If not, is it something you think you might use? Why or why not?

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Final thoughts

- Remember that programmatic assessment is meant to *help* you understand what is working and what needs improvement *in your program*
- You don't need to assess every outcome and every year
  - Consider developing a rotating schedule
- You don't need to evaluate every student's work
  - Consider looking at representative samples
- Many resources available to help:
  - Building Strong Geoscience Departments https://serc.carleton.edu/NAGTWorkshops/departments/index.html
  - Traveling Workshops Program https://nagt.org/nagt/profdev/twp/index.html

Contact us!

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