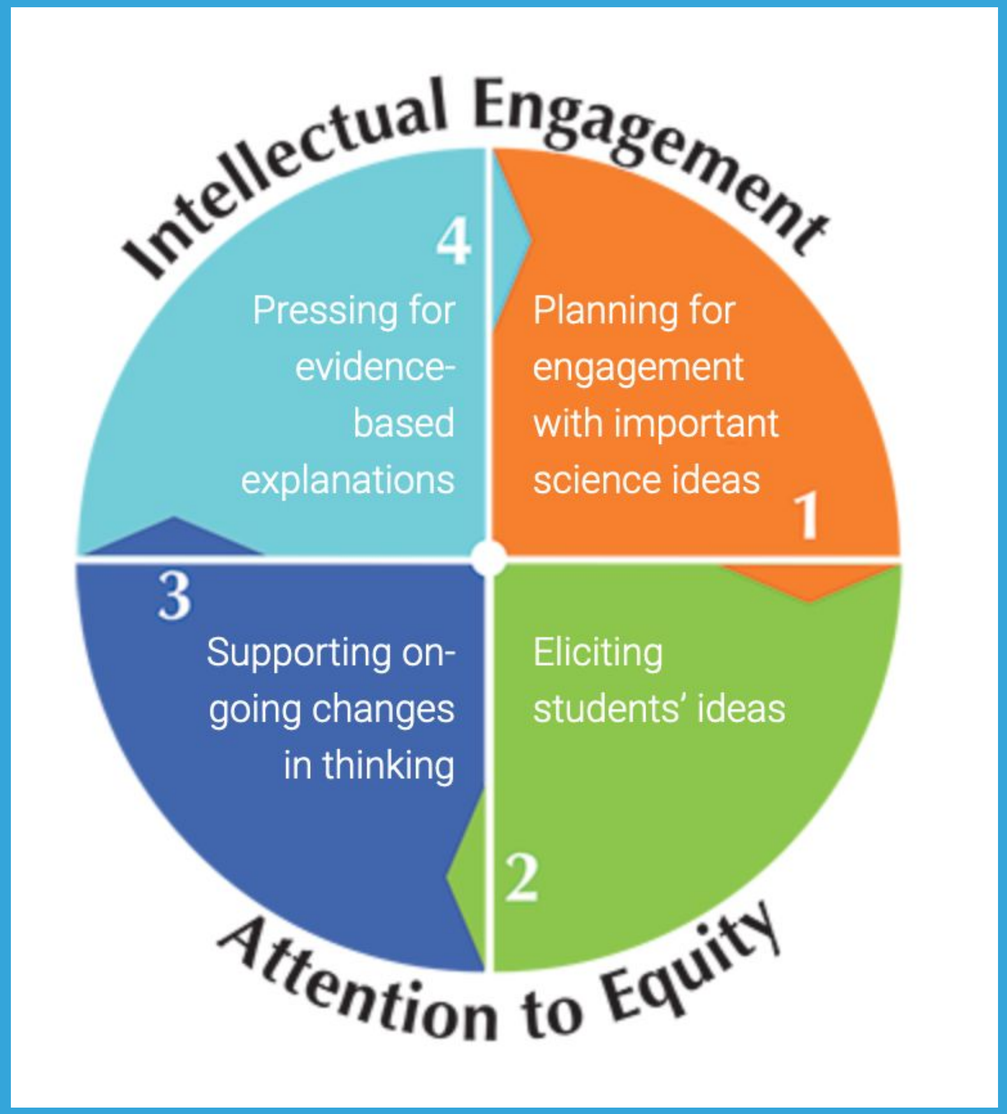
Towards a more inclusive geosciences: Teaching strategies and policies to support all students

- Framework papers
- Specific GER / ER research examples
- Understanding Science Framework - Lisa White
- Applications in the Classroom - Phoebe Cohen
- Breakout rooms
- Q&A

TOOLS FOR AMBITIOUS SCIENCE TEACHING



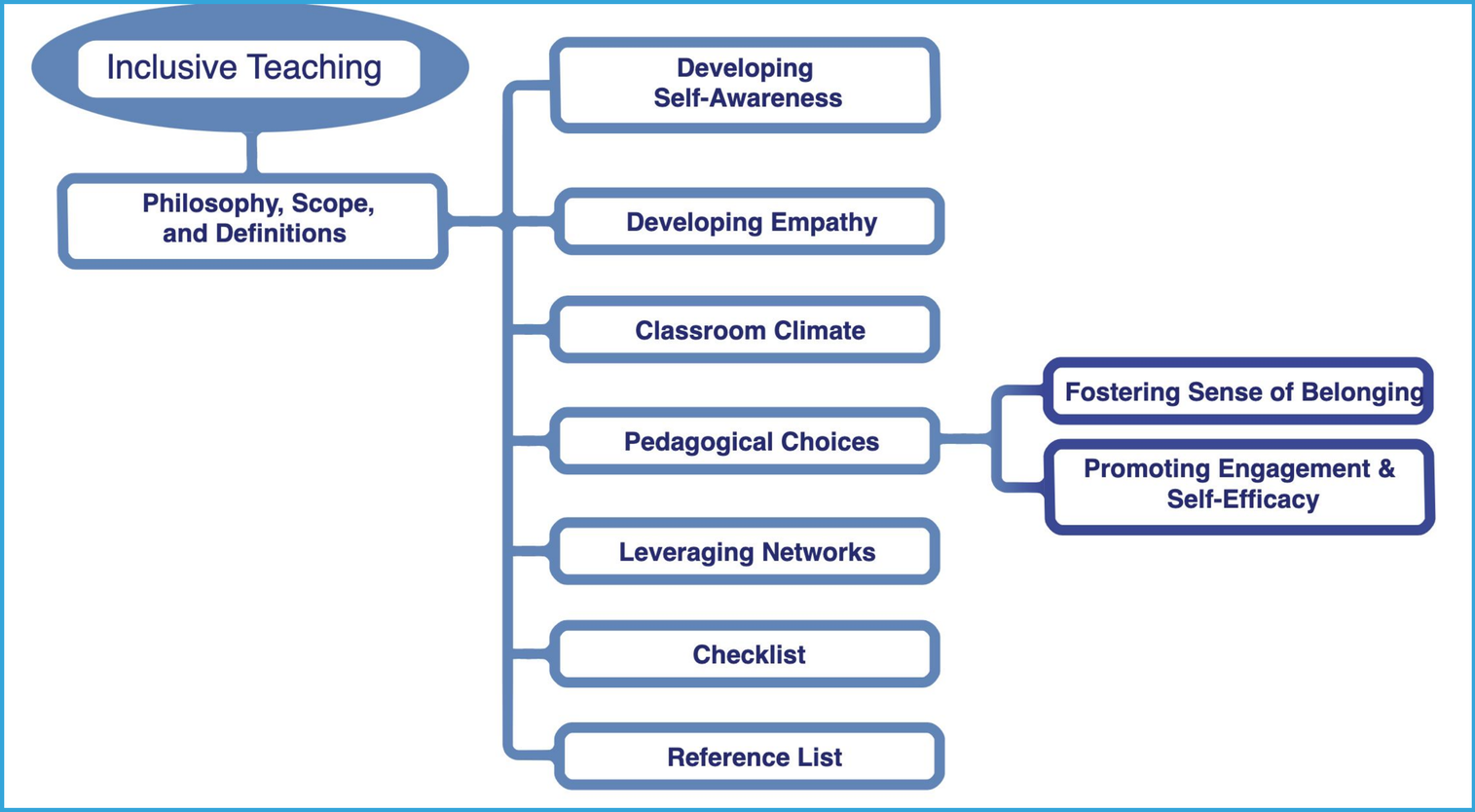
https://ambitiousscienceteaching.org/

Ambitious Science Teaching. **Mark Windschitl, Jessica Thompson, and Melissa Braaten. Harvard Education Press, 2018**

The central role of equity in science teaching and steps to achieve it:

- Situate learning in **familiar** or everyday contexts
- Be **responsive** to students' ideas, experiences, and questions
- Make **explicit** how scientists defend and generate claims for knowing
- Develop and review **norms** for partcipation in class conversations
- Honor students' **sense-making** repertoires
- Request **formative assessments** to encourage students to show what they know

Evidence-Based Teaching Guides: Inclusive Teaching



Dewsbury B, Brame CJ. (2019) Evidence Based Teaching Guide: Inclusive Teaching. CBE Life Science Education. Retrieved from https://lse.ascb.org/evidence-based-teaching-guides/inclusive-teaching/

Evidence-Based Teaching Guides: Inclusive Teaching

− Fostering a sense of belonging

Fostering students' sense of belonging is a key element of an inclusive classroom. This goal can be achieved in many ways, depending on the particular instructor and set of students in the class. Some approaches to fostering a sense of belonging include the following:

- Signaling an identity-safe environment can lessen stereotype threat and improve student performance and participation. Identity safety can be signaled by instructors using inclusive language or by highlighting successes of individuals from stereotyped groups.
- Homework assignments that feature counterstereotypical examples of scientists as a way to introduce course content can increase students' sense of relating to scientists, shift them away from stereotypes about scientists, and improve course grades.
- Women students who encounter female experts in math or math-related disciplines through reading or direct interaction tend to exhibit more positive attitudes about math and may have greater identification with math.
- Interventions designed to help students understand and endorse growth mindset have been shown to improve outcomes for some underserved groups.
- Interventions designed to help students understand adversity as shared, transient experiences can increase sense of social belonging and academic outcomes for some underserved groups.
- Interventions designed to support students' feelings of self-worth and integrity can increase academic outcomes for some underserved students.

Dewsbury B, Brame CJ. (2019) Evidence Based Teaching Guide: Inclusive Teaching. CBE Life Science Education. Retrieved from https://lse.ascb.org/evidence-based-teaching-guides/inclusive-teaching/

Evidence-Based Teaching Guides: Inclusive Teaching

- Increasing course structure through **graded out-of-class** assignments and **in-class active learning** improves outcomes for all students
- Enhancing **cooperation and reducing competition** among students
- Emphasizing the **relevance** of coursework
- Supporting students' sense of **autonomy** by giving students **choice** and control
- Fostering the ability of students to **see themselves doing research**

Dewsbury B, Brame CJ. (2019) Evidence Based Teaching Guide: Inclusive Teaching. CBE Life Science Education. Retrieved from https://lse.ascb.org/evidence-based-teaching-guides/inclusive-teaching/

CBE—Life Sciences Education
Vol. 12, 322–331, Fall 2013

Feature
Approaches to Biology Teaching and Learning

Structure Matters: Twenty-One Teaching Strategies to Promote Student Engagement and Cultivate Classroom Equity

Kimberly D. Tanner

Department of Biology, San Francisco State University, San Francisco, CA 94132

- Giving students opportunities to think and talk about biology
- Encouraging, demanding, and actively managing the participation of *all* students
- Building an inclusive and fair classroom community for *all* students
- Monitoring behavior to cultivate divergent biological thinking
- Teaching *all* of the students in your biology classroom

- *Wait Time (1-2 sec vs 4-5 sec)*
- *Writing time in class*
- *Think-Pair-Share*
- *Do less*
- *Assign reporters in small group work*
- *Learn student names (and pronunciations)*
- *Center group work*
- *Relevant/diverse examples*
- *Do not judge responses*
- *Classroom community norms*

communications
earth & environment

ARTICLE

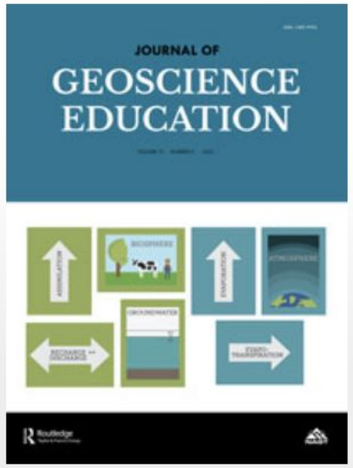
https://doi.org/10.1038/s43247-021-00156-0 OPEN

Perceptions of scientists held by US students can be broadened through inclusive classroom interventions

Sarah L. Sheffield[1✉], Meghan L. Cook[1], Victor J. Ricchezza[1,2], Guizella A. Rocabado[3,4] & Fenda A. Akiwumi[1]

"... I know we talked about a queer scientist, I'm queer, so that's the connection..."—Josh
"I would say it [the intervention] actually made me switch my major"—Jessica
"... K through 12 education, when we learn about scientists, are usually white, male, and rich, and very little do we find out about anybody outside of that bubble."—Pray Tell
"...When you think of the word scientist usually you would think of a tall white man"—Alex
"...Most of them seemed more like normal people than I think...none of them were scientific titans or anything like that. I think in that way I connected more"—Secretariat
"...There were women who were contributing at the time but not being recognized for that work-you know, that was pretty eye-opening to me"—Laura

We **introduced students to individuals with marginalized identities** *who are either scientists or have had a major influence on science and conducted semi-structured interviews with students from the course's previous semesters….participants with marginalized and non-marginalized identities* **broadened their preconceptions of who belongs in science** *and the range of identities among scientists.*



Research

An intervention to address math anxiety in the geosciences

Rachel M. Headley

Received 30 Dec 2020, Accepted 11 Apr 2022, Published online: 02 May 2022

Download citation https://doi.org/10.1080/10899995.2022.2065826 Check for updates

Research

Predict-observe-explain activities preserve introductory geology students' self-efficacy

Nicole M. James, Bailey Zo Kreager & Nicole D. LaDue

Pages 238-249 | Received 01 Jul 2020, Accepted 17 Mar 2021, Published online: 07 Apr 2021

Download citation https://doi.org/10.1080/10899995.2021.1906593 Check for updates

Using the Understanding Science Flowchart to Illustrate and Bring Students' Science Stories to Life

Susan Marie Arlidge,[1] Anastasia Thanukos,[2] and Jessica R. Bean[2]
[1]University of Calgary, c/o BI-186, 2500 University Drive NW, Calgary, Alberta T2N 1N4 Canada
[2]University of California, Berkeley, Museum of Paleontology, 1101 Valley Life Sciences Bldg., Berkeley, California 94720 USA

"The Understanding Science flowchart provides an intuitive way to visualize and explore the nature of science for students at all levels. The nonlinear format provides a fresh approach for many students who may have only experienced "cookie- cutter" laboratories or a linear model of the scientific method. In using the flowchart to draw insights into their research process, students may discover that documenting the process as a lived experience, or telling it as a story, provides a different format for exploring nuances and aspects of science not necessarily captured in the tradition "laboratory report" format"

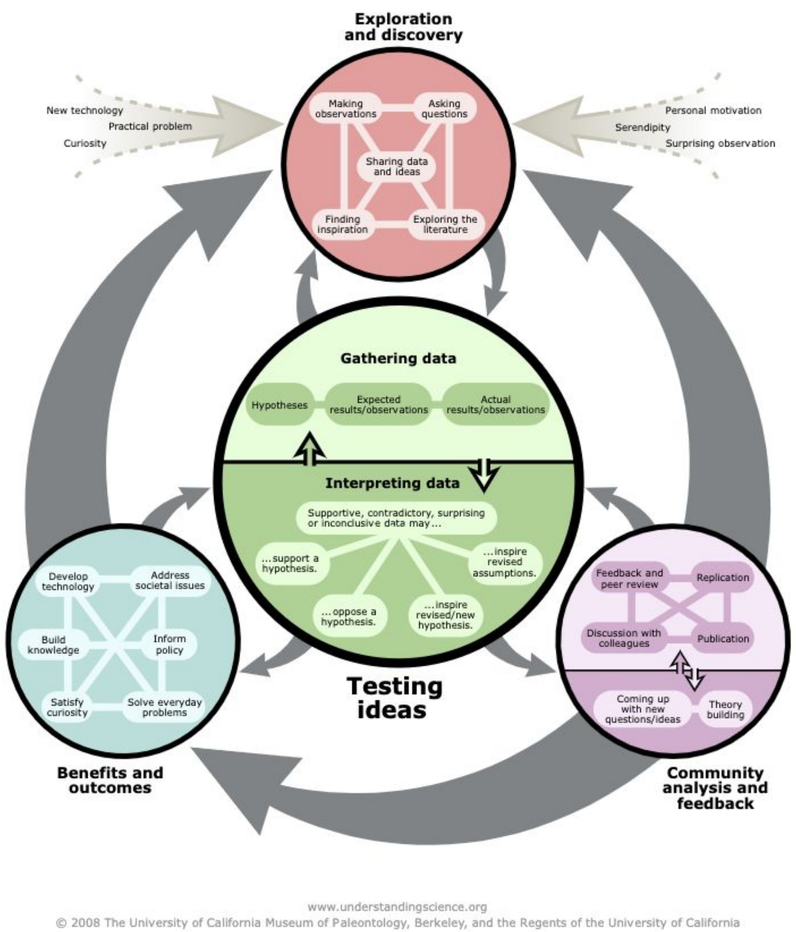


Fig. 1. The detailed version of Understanding Science flowchart.

Examples from Phoebe's classroom

- Classroom norms
- Policies and procedures
  - Grading example
- Scaffolding
- Incorporating texts that discuss complex issues
- Formative and Summative reflections

Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom

Louis Deslauriers[a,1], Logan S. McCarty[a,b], Kelly Miller[c], Kristina Callaghan[a], and Greg Kestin[a]

[a]Department of Physics, Harvard University, Cambridge, MA 02138; [b]Department of Chemistry and Chemical Biology, Harvard University, Cambridge, MA 02138; and [c]School of Engineering and Applied Sciences, Harvard University, Cambridge, MA 02138

Edited by Kenneth W. Wachter, University of California, Berkeley, CA, and approved August 13, 2019 (received for review December 24, 2018)

Frame your own narrative and cite research - both in the classroom and in T& P narratives

"The crucial difference between the 2 groups was whether students were told directly how to solve each problem or were asked to try to solve the problems themselves in small groups before being given the solution….Students in active classrooms learned more (as would be expected based on prior research), but their perception of learning, while positive, was lower than that of their peers in passive environments…."

Classroom Community Agreement

“What rules, qualities, and behaviors do we want to have in our class this semester?”

We…

- are supportive of each other’s learning
- listen to each other
- try to leave our egos behind
- encourage questions, discussion, and collaboration
- acknowledge that we are coming from different backgrounds and experiences
- show an interest in learning
- hold people accountable, but with grace
- make space for others and let people finish talking before responding
- respond to the point, not the person
- don’t play devil’s advocate
- respect confidentiality
- love fossils

Policies & Procedures

- Meet each student where they **are** and expect growth and learning **from there**.
- No excuse needed extensions
- **Re-grades** on some assignments (**growth mindset**)
- 0-3 point grading system - **de-emphasize grades** and lower student stress and anxiety
- No timed exams
- No exams at all! Multiple low-stakes untimed quizzes
- Everything open note (when was the last time you googled something?)

Labs (due a week after your lab day) **and Weekly wrap-up quizzes** (posted at the end of each week on GLOW) are both graded on a 0-3 scale based on your mastery of the content.

- 3 = mastered (learning displayed with no errors)
- 2 = moving towards mastery (learning displayed with minor errors)
- 1 = developing (learning displayed with areas for substantive growth)
- 0 = nothing turned in

You have **3 days (72 hours)** after getting back your lab or quiz to fix any errors and get them re-graded; your final grade will be the higher score.

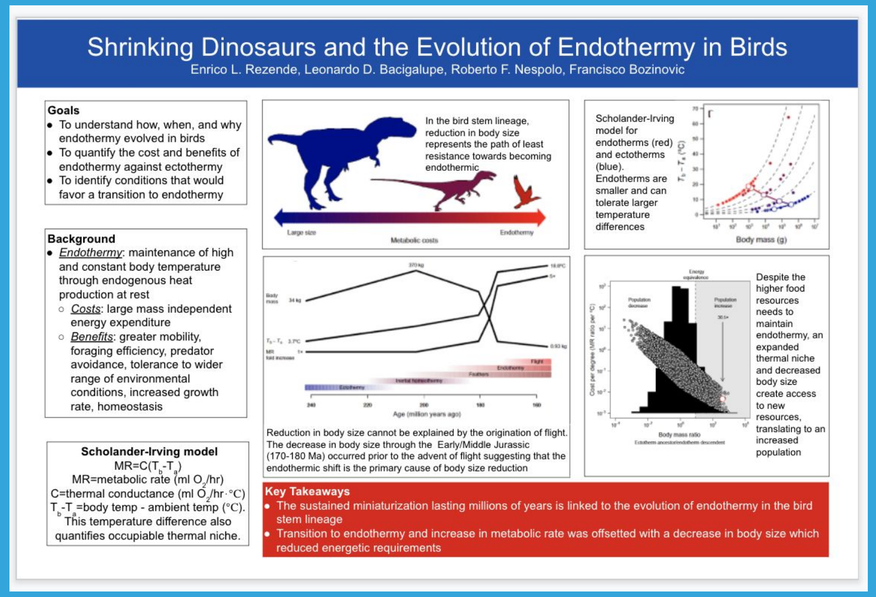
Letter Grades: How does all of this translate into a letter grade? If you get mostly 2's, you'll likely get a B in the class. If you get mostly 3's, you'll likely get an A in the class -- see below for a breakdown. Of course it's possible that you'll mix and match these (i.e. you might get all 3's on labs, but only get 50% on pre-lecture quizzes); this is were +'s and -'s come in, as I see fit. I do not give A+ grades. Remember, assignments with a * are available for re-grades.

	C grade	B grade	A grade
Pre-lecture quizzes	50-70%	70-90%	>90%
Reading feedback	50-70% (completed)	70-90% (completed)	>90% (completed)
Labs*	1-1.9	2.0-2.8	>2.8
Weekly quizzes*	1-1.9	2.0-2.8	>2.8
Participation	1-1.9	2.0-2.5	>2.5
Final project	1-1.9	2.0-2.5	>2.5

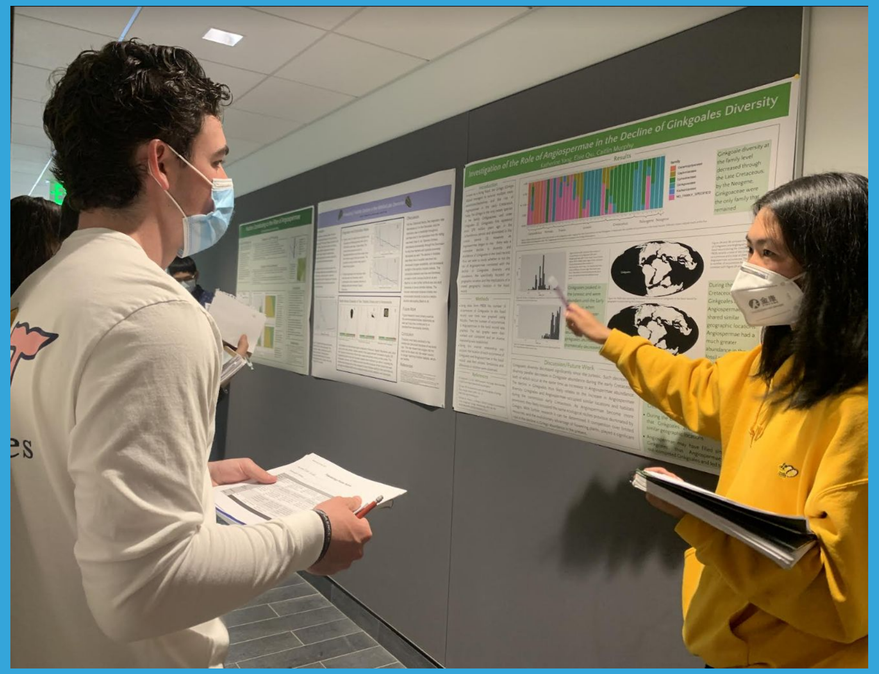
Scaffolding assignments to promote growth mindset

Step 1: What makes a good poster?

Step 2: Using Google Slides to make a poster from a scientific article



Step 3: Make original poster for final project using Paleobiology Database



Incorporating texts that explicitly address issues of colonialism, racism, etc

nature ecology & evolution

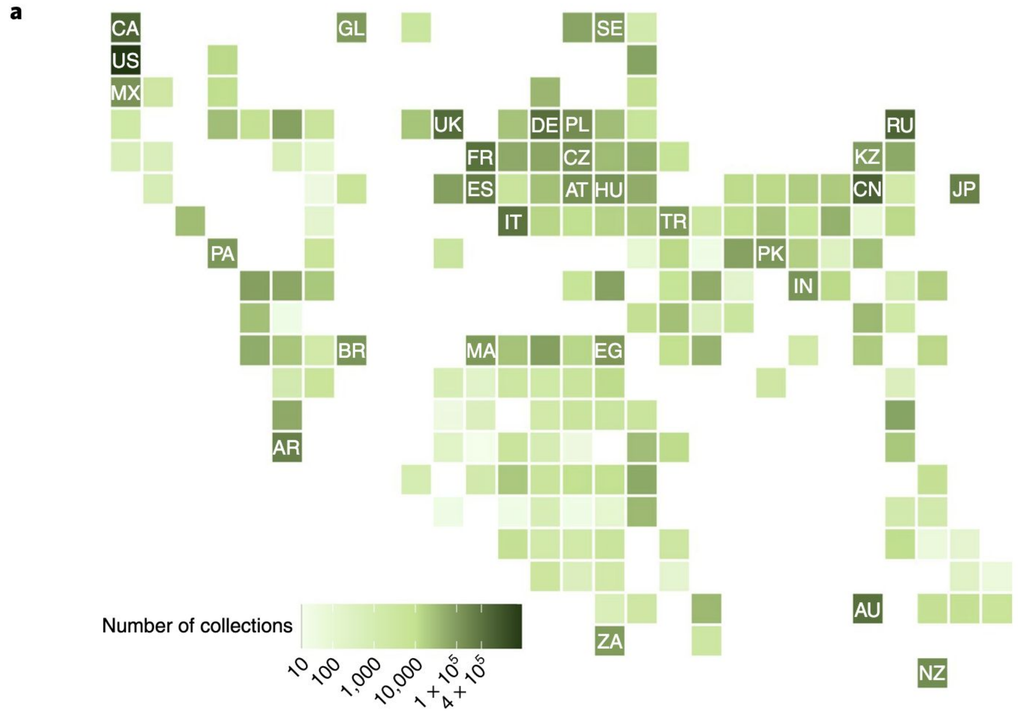
ARTICLES

https://doi.org/10.1038/s41559-021-01608-8

Check for updates

Colonial history and global economics distort our understanding of deep-time biodiversity

Nussaïbah B. Raja[1,8]✉, Emma M. Dunne[2,8], Aviwe Matiwane[3,4], Tasnuva Ming Khan[1,7], Paulina S. Nätscher[1], Aline M. Ghilardi[5] and Devapriya Chattopadhyay[6]



Incorporating texts that explicitly address issues of colonialism, racism, etc

Paleobiology, 2021, pp. 1–13
DOI: 10.1017/pab.2021.28

PALEOBIOLOGY
A PUBLICATION OF THE Paleontological SOCIETY

On The Record

Our past creates our present: a brief overview of racism and colonialism in Western paleontology

Pedro M. Monarrez, Joshua B. Zimmt, Annaka M. Clement, William Gearty, John J. Jacisin, III, Kelsey M. Jenkins, Kristopher M. Kusnerik, Ashley W. Poust, Selina V. Robson, Judith A. Sclafani, Kelsey T. Stilson, Shamindri D. Tennakoon, and Carmi Milagros Thompson*

1. Am I collecting specimens from Indigenous lands?
2. Who truly owns the specimens/data I am using for my research?
3. Who might be affected by my research, and what role do they play in this research?

Self reflection and assessment

Question 1 1 pts

What participation grade would you give yourself in the class? This includes being present in and speaking in class and lab, wether that be in whole-class discussions or small group discussions. This also includes coming to class prepared and ready to engage with your classmates on the material.

- ○ 0
- ○ 1
- ○ 2
- ○ 3

Question 3 1 pts

At the beginning of the semester, I presented the following course goals:

1. Learn about the major features, patterns, and types of fossils and how they come together to build the fossil record.
2. Analyze the possible causes of mass extinctions and evolutionary radiations
3. Gain proficiency using paleobiological methods, including the programming language R
4. Learn how to identify major fossil groups and make inferences about how, where, and when they lived
5. Improve your ability to read and synthesize scientific research article

Pick **two** of the above course goals that you think you made the most progress on / learned the most from and for each, write a short paragraph about why you chose those two goals to highlight and what course activities / actions (readings, lectures, discussions, labs, field trip, etc) facilitated your learning in those areas.

Question 2 1 pts

What worked **well** for you in this course in terms of your learning? What do you think you could have **improved on** in terms of your learning (if anything)?

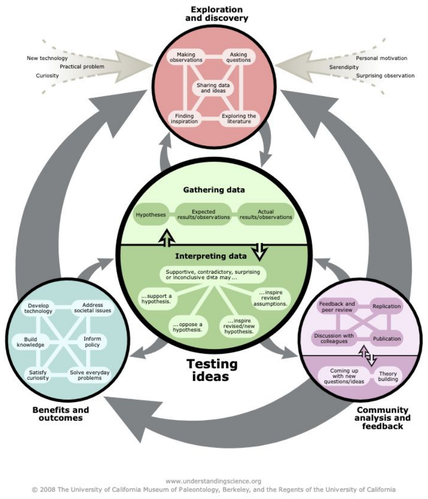


Fig. 1. The detailed version of Understanding Science flowchart.

Breakout room time!

Let’s apply what we’ve learned

1) How can you incorporate understanding science module into an existing lab / activity?
2) How can you re-write your syllabus or a specific assignment to better incorporate one or more of the inclusive teaching practices?