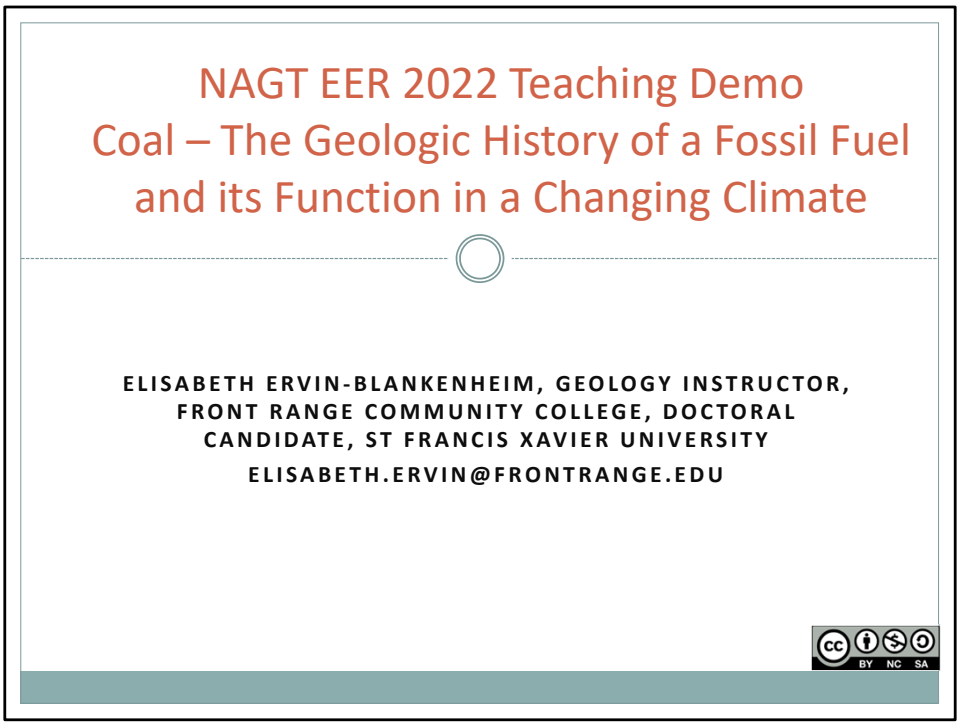
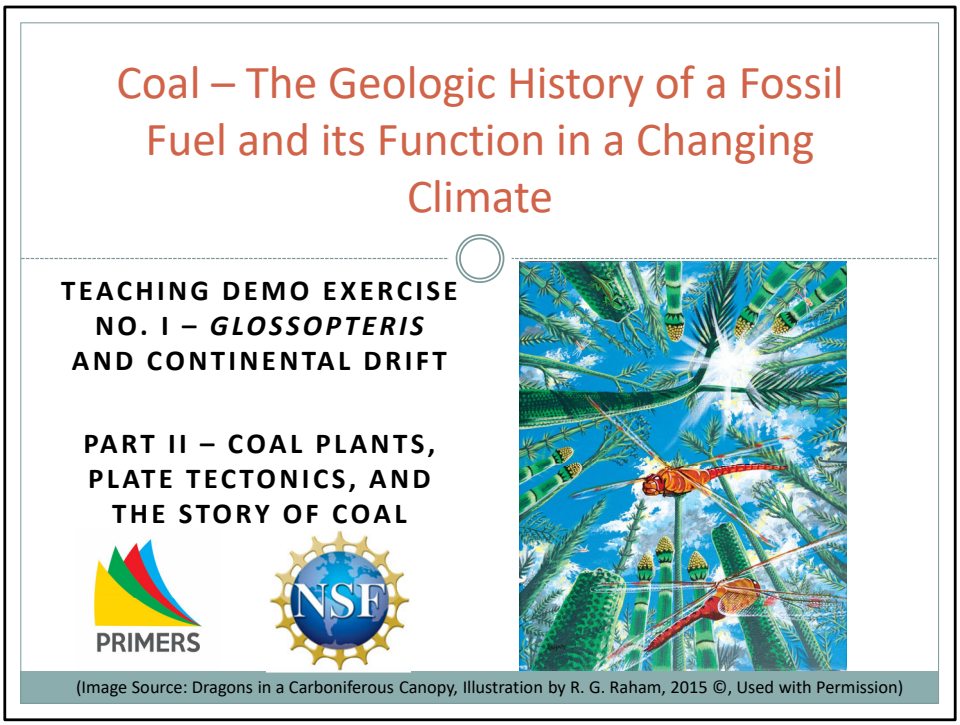


This activity is one of three experiential laboratories developed for my doctoral research. It will be submitted to Teach the Earth in 2023. For questions, please email me at the address above.



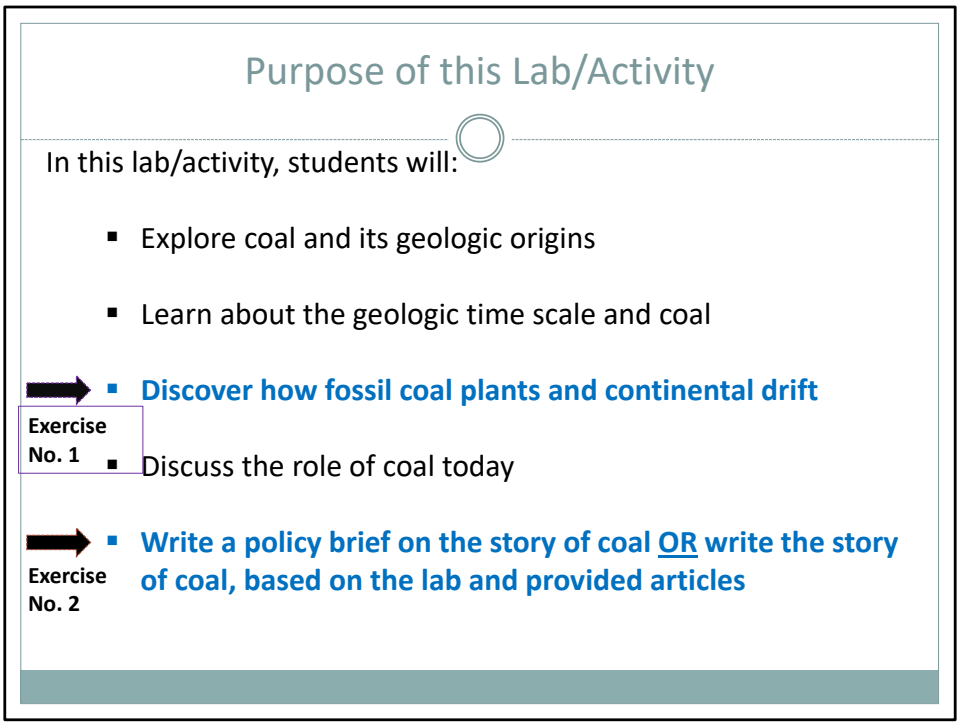
This work is supported by the ALI/PRIMERS Grant through the National Science Foundation, and thank you goes to Patrick Shabram, the co-PI for the grant, and Geography and Geoscience Faulty, Front Rance Community College. Thank you also to my illustrator, R. G. Raham.
Contact Information: Elisabeth Ervin-Blankenheim, Doctoral Candidate, St. Francis Xavier University, N.S., and Geology Instructor, Front Range Community College, Elisabeth.Ervin@frontrange.edu

This presentation is a teaching demo on an experiential lab comprised of an introduction to coal and its story. It includes an overview of just what coal is, a virtual field trip to a Carboniferous coal forest trapped in the rocks, a rare view into how coal is formed, a look at the timescale of the Earth, and how coal fits into geologic time. The virtual field trip to the UNESCO World Heritage site, Joggins Fossil Forest, Nova Scotia, helps provide context for the story of coal and its origins. The lab continues with several activities including working with fossil plant data to reconstruct Pangea, and a discussion on the Nature of Science, followed by one of two writing assignments for the students.

Background for Lab/Activity

- **Audience**: This lab activity is designed for introductory geoscience students
- **Setting**: Face-to-face classes or remote learning; Can be modified, e.g., for asynchronous teaching
- **Prerequisite Skills**: An understanding of Latitude and Longitude, and Basic Mapping Skills (Plotting a location based on Lat/Lon)
- **Time Needed**: Approximately 2 to 3 hours
- **Where to Find the Lab**: Part of my doctoral research; email Elisabeth.Ervin@frontrange.edu; Materials to be submitted to the SERC – Teach the Earth site in 2023

Lab weaves together topics of coal, continental drift, plate tectonics, the Nature of Science, and implications of coal as a carbon sink and fossil fuel on the CO2 content in the atmosphere and climate change.



The lab begins with a purpose statement, tasks and how it is assessed, based on Transparency in Learning and Teaching (TILT) from the work of Mary-Ann Winkelmes, 2013. https://tilthighered.com/

Winkelmes, M.A., 2013. Transparency in Teaching: Faculty Share Data and Improve Students' Learning. *Liberal Education*, *99*(2), p.n2.

The coal lab contains the following resources:

- Instructor files – PowerPoint with the virtual field trip and activities, Instructor Notes and Suggestions, MP4 file of author (EEB) narrated field trip, Student Worksheet
- Answer Keys and Rubric for Writing Assignment

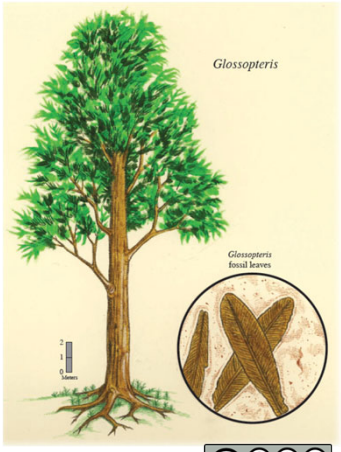
Exercise No. 1 (Students) – *Glossopteris* Fossil Finds

- Plot the location of the *Glossopteris* Fossil Finds (next slide)

- Data Set of Fossil *Glossopteris* Finds (Plot an X at the following generalized latitudes and longitudes

  (Hints a) measure from the zero lines, b) the X should be on a modern-day continent, not out in the ocean)

  - 30 S; 60 W
  - 20 S; 20 E
  - 15 N; 78 E
  - 30 S; 140 E
  - 65 S; 30 E

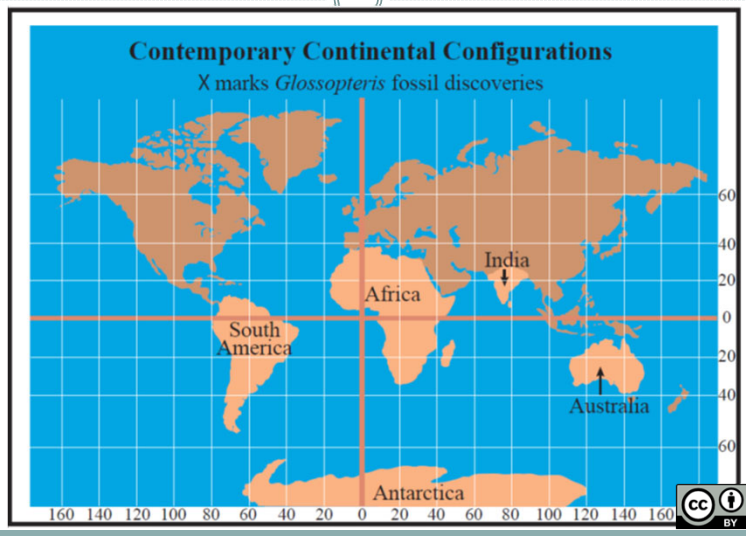


(Source: Illustration by G. Raham, 2020, with input from E. Ervin-Blankenheim. Created for this experiential laboratory, 2021)

Information for the first activity of this lab; plotting *Glossopteris* fossil finds on the following map, also located in the student worksheet.

What are latitude and longitude? (follow link and also watch short video)
https://maptools.com/tutorials/lat_lon/definitions
https://www.youtube.com/watch?v=-8gg98ws2Eo

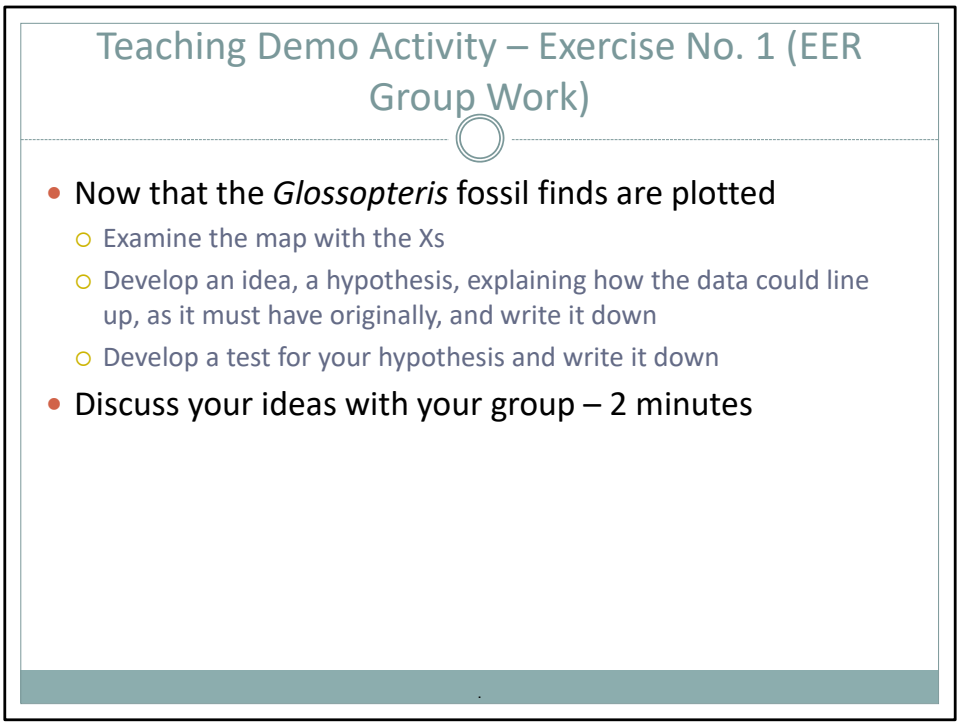
Exercise No. 1 (Students) – Plot the Following Locations of *Glossopteris* Fossil Finds



(Source: Illustration by G. Raham with input from E. Ervin-Blankenheim, 2020, Created for this experiential laboratory, 2021)

Note – the southern continents are labeled and shown in a different shade to help the students begin to identify which locations should be included in the mapping for this exercise (During the wrap-up discussion for Exercise No. 1, the point can be made that these continents represent Gondwana, the southern part of Pangea).

Solution to exercise No. 1

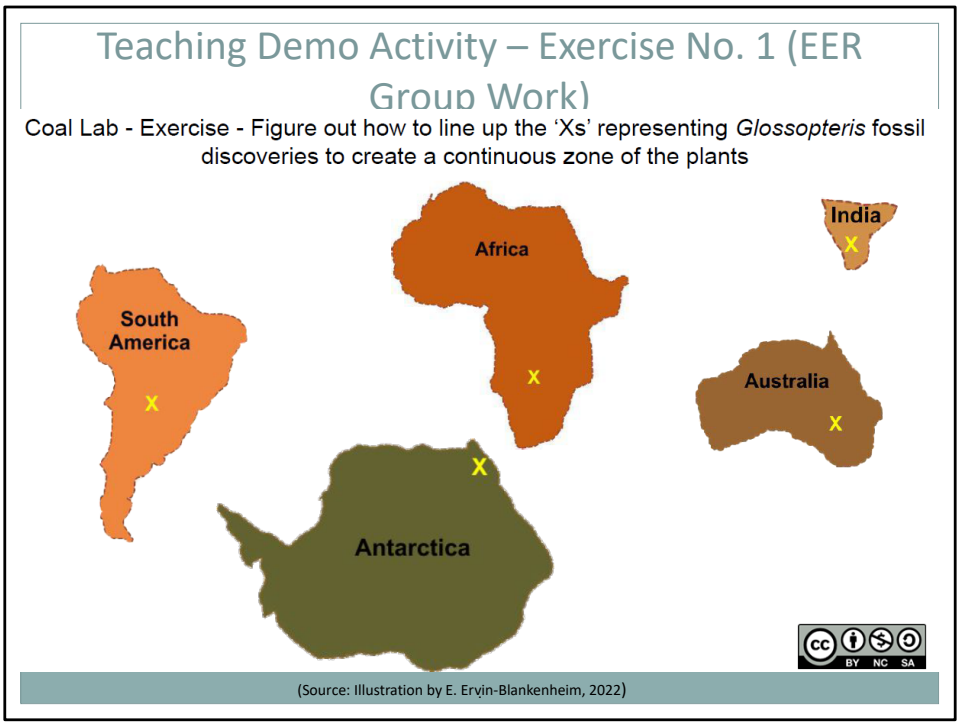


One aim of plotting the Glossopteris data is to encourage students to "think like a scientist," and promote ideas surrounding the Nature of Science (NOS). NOS concepts can be further explored in the wrap-up discussion at the end of the exercise.

Teaching Demo Activity – Exercise No. 1 (EER Group Work)

- To complete the exercise, please go to this Google Slides Link (link sent by email) and follow the steps – 3 minutes
  - Hints: You can drag and drop and rotate the land masses; the zone of Glossopteris may not be a straight line)

https://docs.google.com/presentation/d/1Vetb5Nf7BB3p9TbdGwInfxQcqmZca7aiweQd29f7shA/edit?usp=sharing



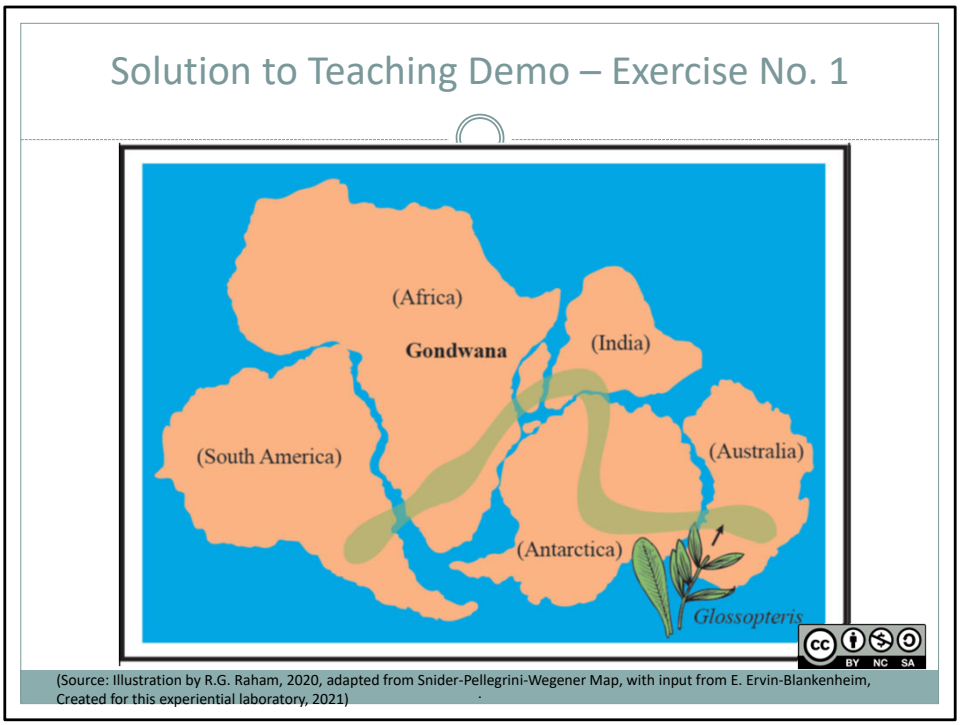
This slide is an image of the online group activity on Google docs (link in the prior slide). The continents are shown in different colors to make them easier to distinguish. The exercise could be done manually in a face-to-face class by having the students carefully cut out a paper copy of the *Glossopteris* fossil locations plotted on the world map, slide no. 7, and work with them manually.

One Solution

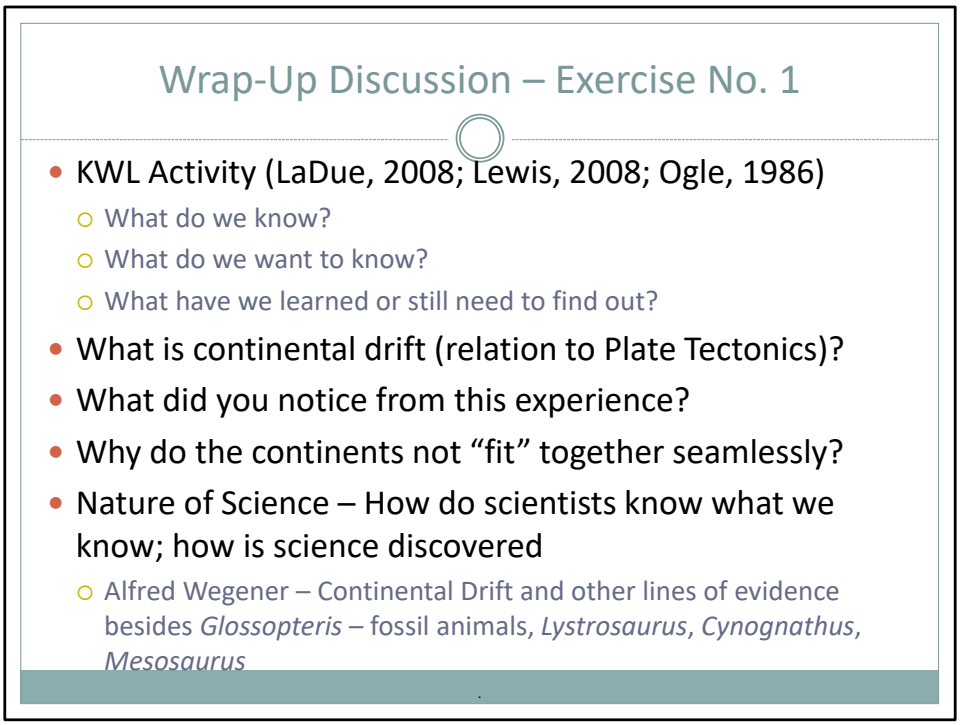
Coal Lab - Exercise - Figure out how to line up the 'Xs' representing *Glossopteris* fossil discoveries and the edges of the continents to create a continuous zone of the plants

(Source: Illustration by E. Ervin-Blankenheim, 2022)

For Teaching Demo only; not for student slides



Solution to exercise No. 1, This map does not contain the other fossil information used to confirm continental drift, such as the distribution of Lystrosaurus, Cynognathus and Mesosaurus folls data.



K-W-L was originally envisioned as a graphic organizer to help students understand and analyze texts (Ogen, 1986). Its use has been expanded to inquiry-based activities (Lewis, 2008). Other meta-cognitive activities could be substituted, such as a jigsaw activity. Other items to consider:

Continents and ocean basins move over time through plate tectonics
Land masses in the equatorial regions have changed over geologic time
Glossopteris grew in the equatorial regions

References

Bazerman, C. Little, J., Bethel, L., Chavkin, T., Fouquette, D., & Garufis, J. (2005). *Reference guide to writing across the curriculum*. Parlor Press LLC.

LaDue, N. (2008). Encouraging metacognition in the K-12 environment. SERC. https://serc.carleton.edu/NAGTWorkshops/metacognition/workshop08/participants/ladue.html

Lewis, E. B. (2008). Content is not enough: A history of secondary earth science teacher preparation with recommendations for today. *Journal of Geoscience Education, 56*(5), 445-455.

Ogle, D.M. (1986). K-W-L: A teaching model that develops active reading of expository text. *The Reading Teacher, 39*(6), 564–570. https://doi.org/10.1598/RT.39.6.11