# THE LITHOSPHERE

Wake Forest University

Natural Hazards Engineering Research Infrastructure (NHERI)

Bedoya, L., Clayton, P., & Sopko, J.B.

## Details

*Grades*

These lessons have been designed for a high school level (9 – 12), but they can be adapted to lower grades by simplifying the information provided.

*Standards*

This content is aligned with the following North Carolina Department of Public Instruction (NCDPI) standard.

- *EEn 2.1. Explain how processes and forces affect the lithosphere.*

and the following NGSS standards:

- *HS-ESS2-1 and ESS2-5 Earth's Systems*
- *HS-ESS3-1 Earth and Human Activity*
- *HS-ETS1-1 and ETS1-2 Engineering Design*

## Topic Progression Plan

The suggested progression plan covers content which is crucial for the understanding of the practical lessons provided, although lessons could be developed independently. Highlighted lessons are those provided in this series.

- Brief reminder of the different layers of the earth with its subdivisions (Core: Inner/Outer, Mantle: Lower/Upper with special emphasis on the Asthenosphere, Crust: Bedrock and weathered materials).
- The Rock Cycle (*EEn.2.1.1*)
- Weathering and Erosion: Types, influence of climate, topography, and rock composition. (*EEn.2.1.3*)
- Soil Texture Lesson (*EEn.2.1.3*)
- Geohazards: Landslides, earthquakes, tsunamis, sinkholes, groundwater pollution, and flooding (*EEn.2.1.4*)

- Plate Tectonics: motion, types of plate boundaries, locations, and their corresponding geographical landforms. (*EEn.2.1.1*)
- Volcano hands-on practice (possible experiment with $H_2O_2$ and NaI, Alka seltzer contained plastic wrap, wax volcano) (*EEn.2.1.1*)
- Shake Table Lesson (*EEn.2.1.1/ EEn.2.1.2; HS-ESS2-1; HS-ESS3-1; HS-ETS1-1; HS-ETS1-2*)
- Material Xylophone Lesson (*EEn.2.1.1/EEn.2.1.2/EEn.2.1.4*)
- Liquefaction Lesson (*EEn.2.1.4; HS-ESS2-5; HS-ESS3-1; HS-ETS1-1; HS-ETS1-2*)
- Locating an Earthquake: Plates, Faults, and Maps (*EEn.2.1.1*)

# Resources


- 1906 Historical research on the San Andreas Fault. (n.d.). Earthquake.usgs.gov. https://earthquake.usgs.gov/earthquakes/events/1906calif/18april/historical.php

- Ballegooy, S. van, Roberts, J. N., Stokoe, K. H., Cox, B. R., Wentz, F. J., & Hwang, S. (2015). Large-Scale Testing of Shallow Ground Improvements using Controlled Stage-Loading with T-Rex [Review of Large-Scale Testing of Shallow Ground Improvements using Controlled Stage-Loading with T-Rex]. In 6ICEGE.

- Clayton, P. M. (2021). Natural Hazards Engineering [PPT Natural Hazards Engineering]. {Personal communications}.

- Duman, E., Lozano, J., & Nichols, E. (2023). 2023 Turkey Earthquake Virtual Report on Geotechnical Impacts Report Date: 2/9/2023 Geotechnical Extreme Events Reconnaissance (GEER) Association Turning Disaster into Knowledge. Retrieved August 3, 2023, from https://www.spolmik.org/wp-content/uploads/2023/02/GEER_-2023-Turkey-EQ-Virtual-Report_c.pdf

- Holdsworth, B. (n.d.). Turkey-Syria earthquakes: shallow depth of main shocks is a key reason why they've been so devastating. The Conversation. https://theconversation.com/turkey-syria-earthquakes-shallow-depth-of-main-shocks-is-a-key-reason-why-theyve-been-so-devastating-199540

- July 2010, B. I. 29. (2010). Huge Chilean Earthquake Raised Country's Coast. Livescience.com. https://www.livescience.com/6795-huge-chilean-earthquake-raised-country-coast.html

- M9.0 - Tohoku, Japan - March 11, 2011 | Earthscope. (n.d.). Www.earthscope-Program-2003-2018.org. https://www.earthscope-program-2003-2018.org/about/archived_events/m9.html

- Melnick, D., Cisternas, M., Moreno, M., & Norambuena, R. (2012). Estimating coseismic coastal uplift with an intertidal mussel: calibration for the 2010 Maule Chile earthquake (Mw = 8.8). Quaternary Science Reviews, 42, 29–42. https://doi.org/10.1016/j.quascirev.2012.03.012

- Putzer, M. (2022, September 21). Huge "T-Rex" Truck in Texas Makes Artificial Earthquakes. MotorBiscuit. https://www.motorbiscuit.com/huge-t-rex-truck-texas-make-artificial-earthquakes/

- Quezada, J., Jaque, E., Catalán, N., Belmonte, A., Fernández, A., & Isla, F. (2020). Unexpected coseismic surface uplift at Tirúa-Mocha Island area of south Chile before and during the Mw 8.8 Maule 2010 earthquake: a possible upper plate splay fault [Review of Unexpected coseismic surface uplift at Tirúa-Mocha Island area of south Chile before and during the Mw 8.8 Maule 2010 earthquake: a possible upper plate splay fault]. Andean Geology, 47(2), 295–315. https://doi.org/10.5027/andgeoV47n2-3057

- Ryczkowski, A. (2009, December 11). How to Read a Soil Texture Triangle Chart. EHow.com; eHow.com. https://www.ehow.com/how_5735575_read-soil-texture-triangle-chart.html

- Sahadewa, A., Zekkos, D., Woods, R. D., Stokoe II, K. H., & Matasovic, N. (2014). In-situ assessment of the dynamic properties of municipal solid waste at a landfill in texas [Review of In-situ assessment of the dynamic properties of municipal solid waste at a landfill in texas]. Elsevier. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S0267726114000943

- Seismic Reflection Survey | GeoSiam. (n.d.). https://geosiamservices.com/services/ground-services/seismic-survey/seismic-reflection-survey/

- Serhan, Y. (2023, February 6). The Deadly Earthquakes in Turkey and Syria: What We Know. Time. https://time.com/6253208/turkey-earthquake-syria-updates/

- Soil Jar Science – Ithaca Children's Garden. (2020, July 3). https://www.ithacachildrensgarden.org/soiljarscience/

- Stokoe, K., Cox, B., Clayton, P., & Menq, F. (2017). NHERI@UTEXAS Experimental Facility: Large-Scale Mobile Shakers for Natural Hazards Field Studies (Issue Paper N° 2387) [Review of NHERI@UTEXAS Experimental Facility: Large-Scale Mobile Shakers for Natural Hazards Field Studies].

- Stokoe II, K. H., Cox, B. R., Clayton, P. M., & Menq, F. (2020). NHERI@UTexas Experimental Facility with Large-Scale Mobile Shakers for Field Studies [Review of NHERI@UTexas Experimental Facility with Large-Scale Mobile Shakers for Field Studies]. Frontiers in Built Environment, 6(575973). https://doi.org/10.3389/fbuil.2020.575973

- Taylor, A. (n.d.). Photos: A Month Since the Devastating Earthquake in Turkey - The Atlantic. Www.theatlantic.com. https://www.theatlantic.com/photo/2023/03/photos-month-devastating-earthquake-turkey/673317/