Mission: Save Earth

(8-10 class periods of 60 minutes in Length)

Authors

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SUBJECT/GRADE LEVEL

Subject Area: Science

Grade Level: 8th grade (Middle School)

Materials

- AI Access for research (ABE Writing {Writing Feedback & Outline creation}, Magicschool.ai {Rainabot}, ChatGPT, Google Gemini, or CoPilot AI)
- Large poster paper, markers, colored pencils, rulers
- Craft supplies (e.g., modeling clay, cardboard, pipe cleaners, glue, scissors) for physical models (optional)
- Access to presentation tools (Canva, Google Slides, PowerPoint)
- Access to video/audio recording tools (smartphones, tablets, basic video editing apps) for digital projects (optional)

STANDARDS

- MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
- MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

Mathematics Standards | Common Core State Standards

- MP.2: Reason abstractly and quantitatively. (MS-ESS2-2)
- 6.EE.B.6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS2-2)*
- 7.EE.B.7: Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-ESS2-2)*

English Language Arts Standards | Common Core State

- RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2)
- WHST.6-8.2: Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)
- SL.8.5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-2)

LESSON OBJECTIVE(S)

- Students will be able to identify the layers of the Earth.
- Students will be able to explain how convection currents in the asthenosphere affect the movement of tectonic plates in the lithosphere.
- Students will be able to identify different types of plate boundaries.
- Students will be able to explain how various plate boundaries form different land formations (island arcs, mountains, rift valleys, earthquakes, etc.)
- Students will be able to identify and describe multiple natural disasters related to the movement of tectonic plates.
- Students will be able to describe how communities might prepare for and react to various natural disasters resulting from tectonic events.
- Students will be able to share scientific information clearly using a product of their choice.
- Students will be able to apply AGILE Principles in a small group instructional setting to foster creativity and critical thinking skills.
- Students will be able to research and describe the effects of a major tectonic event on local/regional areas and the world.

CAREER CONNECTION(S)

Mentor Background: Dr. Benjamin D. Nye is the Director of Learning Sciences at USC-ICT. Ben's major research interest is to identify best-practices in advanced learning technology, particularly for frontiers such as distributed learning technologies (e.g., cloud-based, device-agnostic) and socially-situated learning (e.g., face-to-face mobile use). His research interests include modular intelligent tutoring system (ITS) designs, modeling social learning and memes, cognitive agents, and educational tools for the developing world and low-resource/low-income contexts. He received his Ph.D. in Systems Engineering from the University of Pennsylvania in 2011. During my summer research, I collaborated with Dr. Nye to assess outputs produced by different AI models to evaluate if they were viable to enable human learning and understanding. I also used my knowledge of NGSS standards to evaluate AI interactions to develop a teacher's useful interaction with the standards.

STEM Careers: Oceanographer, Geohazard Analyst, Planetary Geologist, computational seismologist/geophysicist, Geoinformatics Engineer, AI/Machine Learning Engineer, Data Scientist, GIS Developer/Analyst, Product Manager, Agile Coach, Research Scientist, Professor, Technical Consultant

ENGAGEMENT

Brief Description: Students will read an article about the communities in Tonga that are rebuilding after the 2022 Volcanic eruption and Tsunami.

Procedures:
Using the Mission: Save Earth Slides as a guide, teachers will have students read the article. As they are reading students will take note of what they notice in the article (facts) and also what they are wondering about (questions). Once they have finished reading and reflecting on their own, the teacher will lead the class in making a whole-group notice and wonder chart about what happened in Tonga.

EXPLORATION

Brief Description: Students will complete a webquest to learn more about what happened in Tonga during and after the volcanic eruption and Tsunami. As a class, under the guidance of their teacher, they will create a driving question board to guide student learning as they go through the unit.

Procedures:
Continuing with the Mission: Save Earth Slides as a guide, the teacher will direct students to the Webquest: 2022 Hunga Tonga Volcano and Tsunami. There, students will explore the Earthquake and tsunami as well as their impacts on their own, filling out the Webquest slides as an assignment that can be turned in (click here for teacher answer key to the webquest). Once students complete the webquest, the teacher will bring them back together to discuss questions that students still have about what happened in Tonga, and importantly *why* it might have happened. The teacher will facilitate the creation of a Driving Question Board to house and display student queries so that they might be referred back to as the unit progresses. A Curipod may be used to help with the curation of questions. Click here for a Curipod that we have already made for this unit.

EXPLANATION

Brief Description: This section contains lecture slides over the material in the objectives. Students will learn about layers of the Earth, tectonic plate movement, plate boundaries and interactions, and an overview of natural disasters that are caused by plate movement. We have also included a slide deck about AI prompting here with practice to help assist students in the elaborate portion of the assignment.

Procedures:
Start with the How Plates Move Slides, stepping through Earth layers, plate boundaries, and natural disasters. Feel free to pause at various points throughout the notes for practice. At the end of this

slideshow, there is a page that lets students explore what natural disasters might impact them. Discuss which natural disasters would be relevant to your area. Once you've had this discussion, ask students how they might further explore how they might prepare for/help their communities prepare for natural disasters near them. Look for students to indicate internet research/AI, and use that to segue into AI prompting slides**.** At the end of these slides, there is an activity to have students practice/edit AI prompts.

ELABORATE

Brief Description: **AGILE Project: Earth Impact Detectives.** Student teams will research a theoretical geological event, then design and present a product based on their findings. The project culminates in an AGILE Showcase* and an Agency Debrief focusing on team collaboration and future improvements.

*The AGILE Principles are concepts utilized across many different companies for their product development. Its roots come from the software industry.

Procedures:

Teacher Preparation:

The teacher needs to set up teams for the projects-based assignment, which they will remain in for their project. I suggest creating diverse homogeneous groups that have a proper balance of skills and abilities. Then, decide which tectonic events each team will use based on the Plausible list of tectonic events. The teacher will prepare for the lesson by preparing the Mission Briefs with the assigned Tectonic Event. Familiarize yourself with the AGILE principle concept in the AGILE Principles

Elaborate Steps:

Introduction to AGILE Principles and Scenario Briefing: The teacher will introduce the AGILE Principles to the class, which will be used to give students the parallels of what the technology workforce does and what they do in small group projects. This will be followed by the "Earth Impact Detectives Briefing," (which is the Project Kickoff Meeting in AGILE). The teacher might want to start with a brief review of the 2022 Hunga Tonga volcano eruption to refresh student perspectives before the briefing. Each small group will then be assigned a hypothetical but geologically realistic major tectonic event, and their mission as "Earth Impact Detectives" (Project requirements and Inquiry list) will be explained: to research and analyze the assigned region and hypothetical event. Their goal is to create a project to inform others about potential impacts and propose solutions for preparation and response.

The 2 Project cycles (AGILE) for the project are Research & Analysis phase (1-2 class periods) and the Product Development phase (1-2 class periods). The research phase the students will be using Magicschool.ai Rainabot (you can set up classes in Magicschool.ai, but not necessary) or other district approved AI (Google Gemini, Copilot AI, ChatGPT, etc) as well as search engines to answer the guiding questions within their Earth Impact Detectives Assignment. Daily routines for the Daily Briefings (AGILE Daily Stand-up) are in the Earth Impact Detectives Briefing. After the Research Phase, start the Product Development phase (AGILE Sprint cycle) over 1-2 class periods, plus potential homework, students will select one of four project options to present their findings and proposed solutions. The product ("Global News Briefing" slides or written report; "Impact Story" video or podcast; "Tectonic Model & Safety plan" physical model and explanation; or "Community Action Plan" poster or brochure) will be presented to the class in an AGILE Project Showcase as part of the evaluation process. Rubrics for the projects are in the EVALUATION section.) After initial project drafts, groups will briefly share their product with another group for constructive feedback using a simple checklist focused on clarity,

scientific correctness, and completeness. Dedicated time will be provided for groups to refine their projects based on this feedback. Students can also use ABE Writing to provide feedback on any written documents. It can give counter-arguments from different roles based on their product. They will then move into the Evaluation Process to do an AGILE Retrospective or Agency Debrief focusing on how their team worked together and how they could improve for the future.

EVALUATION

Brief Description: There are two parts to the evaluation component of this unit. One is a traditional quiz over what students have learned in the earth science content. The other is a conclusion to the project that they are working on in the elaboration phase of the unit after the Project Showcase the teams will get feedback and go through another sprint (Project Cycle) to refine their product.

Procedures:

- Unit quiz
    - Make a copy of the google form!
- Final product (Rubrics) after feedback Project Showcase (Slides 14-15)(Presentation to the United Nations or other global entity) and revisions

REFERENCES

- ABE Writing
- LearnLM Partner Prompt Guide
- Driving Question Board - OpenSciEd
- PAL3 AI Tutoring system
- Life within Naples' volcanic "red zone" - CBS News (Recent News video about citizens living with seismic activity)
- GOSSIP - Eventi sismici It is a database showing the seismic activity in the area over selected years. (It is in italian)
- Driving Question Boards: Open-Sci Ed
- Engage Article: https://www.reuters.com/business/environment/one-year-after-volcanic-blast-many-tongas-reefs-lay-silent-2023-01-15/
- GOES-17 Satellite Video: https://www.youtube.com/watch?v=rVni97WTLIQ
- Tsunami Propagation Video (NOAA): https://www.youtube.com/watch?v=rVni97WTLIQ
- 9 News Australia Video: https://www.youtube.com/watch?v=rVni97WTLIQ
- NOAA Article (Webquest): https://www.ncei.noaa.gov/news/january-15-2022-tonga-volcanic-eruption-and-tsunami
- Natural Disaster Info: https://www.redcross.org/get-help/how-to-prepare-for-emergencies/common-natural-disasters-across-us.html?srsltid=AfmBOoq1wpjWHf3EnPfaQBPdYah9R_Of5h_Gk8OlAcde7qvyuZN7t9BQ#all
- Sinkholes info: https://www.usgs.gov/faqs/what-a-sinkhole