STEM4CLIM8 LESSON PLAN - EARTHQUAKE

Deliverable: IO2.A3 Lesson Plans

STEM4CLIM8

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NUCLIO

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REVISION HISTORY

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REFERENCED DOCUMENTS

ID	Reference		Title
1	2020-1-UK01-KA201-079141		STEM4CLIM8 Proposal
2			

APPLICABLE DOCUMENTS

ID	Reference		Title
1			
2			

1. General Information

1.1 Lesson Title

Climate Change and Natural Disasters

1.2 Topic(s)

Earthquake

1.3 Brief Description

This lesson aims to support and enhance classroom lectures on topic of earthquake as a natural disaster. The goal is to raise awareness and educate on preparedness for earthquake, which can reduce its disruptive impacts on communities.

2. Lesson Information

2.1 Main Subject Domain:

Environmental Education, Earth Sciences, Geology

2.2 Connection to the science curriculum:

Country	Grade(s)	Unit(s)	Main Objectives
Portugal	7	Earth in Transformation	Consequences of Earth's internal dynamics
Turkey	5	Unit 6: "Human and Environment Relationship"	- Explains destructive natural events caused by natural processes. - Represents the means of protection from destructive natural events.

2.3 Connection to other subject domains:

Engineering, Technology, Mathematics

2.4 Keywords

Earthquakes, Natural Disasters

2.5 Age Range / Grade Level

Grade 5-6

2.6 Didactical Hours:

120 minutes (3 40-minute lessons)

2.7 Learning Objectives and Expected Outcomes

Students will learn about:

- how earthquakes occur
- relationship of earthquakes with climate change and other natural disasters
- understand why engineers need to learn about earthquakes.
- what causes earthquakes and how engineers use this knowledge to design more 'earthquake-proof' structures.

2.8 Main Skills involved / acquired competences:

Students during this lesson will demonstrate the following 21st Century Skills:

- Information Literacy: Students will be using informational books to gather further information on tectonic plates.

- Media Literacy: Students will use console and Minecraft explaining tectonic plates in an effective and easy way to understand.

- Communication and Collaboration: students will work in groups to do activity.

- Creativity and Innovation will also be key in creating high quality buildings in Minecraft.

3. Lesson Contents

3.1 Lesson Procedure

This lesson introduces concept about the Earth's structure. and how the movement of the Earth's layers results in changes in the Earth's surface. It is expected that, after this lesson, students will understand how the movement of two tectonic plates past one another on their fault lines causes the ground to shake.

Before, during, and after this lesson, students will develop questions regarding tectonic plates and earthquakes, and how they affect the Earth's crust. It is important that students

develop a full understanding of how the Earth works so they can work together to ensure it lasts for years to come.

After learning about tectonic plates and how they are related to earthquakes, students will better understand how the Earth works.

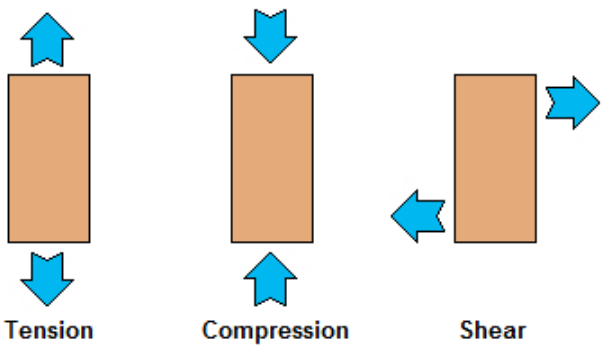
At the beginning, show students pictures or videos about earthquakes to get their attention. Ask students if they ever had any earthquake-related experiences before, and how they felt about it.

The following questions can be asked in order to measure students' prior knowledge and to reveal their alternative conceptions, if any:

- What is an earthquake?
- Where do earthquakes happen?
- What is the role of plate tectonics in the formation of earthquakes?
- Do you know how many fault lines in your country?
- What are the potential dangers of these fault lines in the future?
- After that, discuss the word "stress" as a class. In what other context have you heard of this word?

One of the purposes to ask these questions is to reveal their alternative conceptions about earthquakes. One of the most common is that earthquakes are likely to happen anywhere on Earth.

Then, show to the students the following figure that illustrates the three types of stress that cause rocks to shift, which sometimes leads to an earthquake.



Ask the students to match the three stress words: **compression, tension, and shearing,** to the correct diagram, based on their previous knowledge.

At this step, different activities can be undertaken with the students so they can begin to explore earthquakes and apply what they have learned. These activities are differentiated to challenge students using a different learning style.

First, students can do the "Mountain Formation" activity to better understand how stress can cause plates to move. For this activity, students work in groups of 4 people.

Activity 1: Mountain Formation

Materials Needed: playdough in different colors, two wooden blocks

1. Create rectangular structures from playdough.
2. Stack different colored rectangles made of playdough
3. The wooden blocks represent the continental plates, while the playdough represent the buildup of sediment on the sea floor.
4. Push the wooden blocks (continental plates) towards each other and observe the "mountains" being formed.
5. Students draw their observations about the folds and the resulting shape.

After discussing the results of Activity 1, they will watch the video https://www.youtube.com/watch?v=yBr-D1cFmEs

Show students some pictures of buildings damaged in an earthquake. Ask students to think and share their hypothesis why some buildings collapse during earthquakes, while other buildings stay standing or have little damage.


Ask students how engineers design buildings. Tell them that they will design an earthquake resistant building as an engineer during Activity 2.

The "Build an Earthquake-Resistant House" activity allows students to better understand that engineers use the engineering design process to come up with an idea, test it, and then redesign the structure based on its performance.

Activity 2: Build an Earthquake-Resistant House

Materials Needed (for each group):

- 30 toothpicks
- 30 miniature marshmallows
- square baking dishes, 21.5 cm x 21.5 cm or 1 oval/retangular baking dish, 21.5 cm x 28 cm (It will be prepared as much as the number of groups.)
- Jell-O, prepared according to package directions

Before the Activity

- Prepare the Jell-O the night before the activity so that it is fully set when students begin the activity. Pour the Jell-O into eight 21.5 cm (8½-inch) square pans to be shared by four students, or in one large pan for the entire class to share.
- Gather materials.

With the Students

Explain to students that they will play the role of civil engineers and take on an engineering design challenge. Their challenge is to design and build models of earthquake-proof buildings, and then test their models to assess how well their structures stand up to ground motion during a simulated earthquake.

1. Explain that engineers creatively work within constraints, such as limited resources, materials. For this engineering design challenge, students are limited to using only mini marshmallows and toothpicks to build their model structures. In addition to the material constraints, students must also meet each of the following design constraints:

   • Buildings must be at least 2 toothpick levels high

   • Buildings must contain at least 1 triangle

   • Buildings must contain at least 1 square

3. Before starting to build their models, have students brainstorm and draw sketches of their building designs in their notebooks. For background knowledge, explain that cubes and triangles are like building blocks that may be stacked in different ways to make towers, and that buildings can have small or large "footprints" (bases). Have students draw and label the shapes in their designs (cube, triangle, etc.).

4. Once students have drawn and labelled their sketches, distribute 30 toothpicks and 30 marshmallows to each student or team, and have them build their first model prototype.

5. Before testing their models, show students the pan of Jell-O (without a structure on top) and tell them this represents the ground. Shake the pan back and forth in a shearing motion to simulate an earthquake. For fair testing, place two marks on the table indicating the distance the pans can be shaken with an even force and speed over a set a time for the duration of the "earthquake".

6. Next, have students test their structures one at a time on the Jell-O pan earthquake simulator. Shake the pan for the set time, force and distance.

7. After the earthquake is over, have students make a quick sketch of their model building before removing it from the pan of Jell-O.

8. As a class, have students compare and contrast their before-and-after sketches. Ask students to share and reflect on what worked and what did not work for their first model prototypes. Explain that engineers learn from "failure" and that this is essential information that helps them to design even better products and solutions. Ask students:

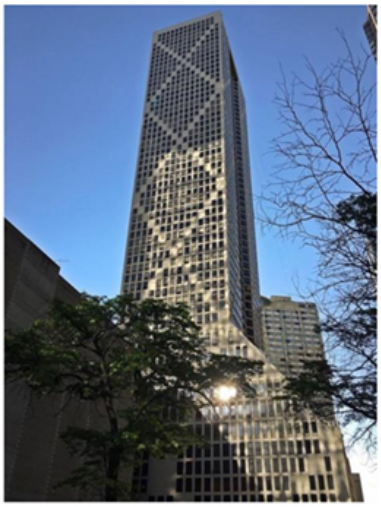
   • Did their model structure stay the same, break, or fall?

   • What ideas do students have to make their structure stronger?

   • Which variable(s) would students change in their building design?

9. Now that students have gone through their first design, build, and test cycle, show






students the following photographs of different earthquake-proof buildings:

Ask students:

- What do you notice about the design of the structures?
- What similarities do you see in building designs?
- What features do you think help make the buildings earthquake-proof?

Have students share their observations. Help students notice that the structures have a large base (smaller at the top) and a cross-bracing design.

Follow-up with asking students:

- What do you think the term "cross-bracing" means?
- How do you think a cross-bracing design helps buildings withstand earthquake damage?

After students share their responses, share the following information with them:

"Earthquake-proof buildings typically have cross-bracing which are made by two diagonals supports placed in an X manner that forms triangles, which are the strongest geometric shape. This design geometry is often seen in bracing on bridges, and it helps keep the building steady by providing lateral stability. Cross-bracing supports and balances tension and compression forces to help prevent the structure from collapsing during an earthquake."

10. Now, based on the results of their first prototype and applying the above structural design tips, have students improve their original structure by redesigning and rebuilding a second prototype that is even more earthquake-proof. If needed, resupply students with replacement materials. For students that had a successful initial design, challenge them to add a third level to their model.
11. Once students have designed and built their second building prototype, repeat steps 6 and 7.
12. Have a class discussion on the results of their second prototypes. Discuss which design elements were most effective at withstanding the earthquake forces, and which parts failed. Reinforce that failing and learning from failure are keys to success in engineering, and that failure is not "bad" or "wrong" but valuable information. Ask students if they had more time and materials how would they improve their next model.

Now, it it time to explore the Minecraft World Earthquake scenario!

Activity 3: Earthquake preparedness

Materials Needed:

- STEM4CLIM8 Console
- Minecraft Education Edition
- STEM4CLIM8 "Shakyna" Minecraft Education World

This world targets to instruct students about earthquakes and how to be prepared for them.

Please follow the instructions described in the "STEM4CLIM8 Minecraft Wolds Scenario and Tips for Educators" document.

3.2 Questions/Assignments

After performing the activities, you may ask some of the following questions:

- What is an earthquake?
- Where do earthquakes happen?
- How do mountains form?
- What kind of designs engineers use to build earthquake-resistant buildings?
- How to prepare for an earthquake?

3.3 Learning Variabilities

Visual impaired students will benefit if they have access to audio descriptions of the images presented during the activities.

Visual impaired students can use a flexible material (such as dish washing sponge) to understand the difference between compression, tension, and shear.

3.4 Assessment and Evaluation

Teachers can assess the student's achievements in multiple ways. In addition to quizzes about the lesson's contents, teachers can also include the participation in the practical activities, and creativity in completing the Minecraft World scenario.

3.5 Links to supportive materials and ICT tools

- Earthquakes and Tectonic Plates

https://www.calacademy.org/educators/lesson-plans/earthquakes-and-tectonic-plates

A lesson plan on how we can use seismic waves to pinpoint the epicenter of an earthquake.

• Plate Tectonics Simulator

A simulator

https://phet.colorado.edu/en/simulations/plate-tectonics

3.6 Credits

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