5E Integrated STEM Lesson Plan – Template

Lesson Title: *Quakes*

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Topic:

The topic of this lesson is Earthquakes, New Technologies, and Engineering Design.

Targeted Grade Level:

Middle School *6-8*

Time Needed:

Time needed is 10- 1 Hour Class Periods

Subject Integration:

Science, Technology, Engineering, and Math

Justification:

The students will be taking their science content of natural hazards and focussing on earthquakes. As stated in the performance expectations the students will look at the technologies used to mitigate the effects of earthquakes on building structures. Students will be looking at new technologies when it comes to the design of structures. The students will research these technologies that engineers use in their designs to mitigate the effects of earthquakes. The students will be using geometry and equations to scale their designs into structural diagrams to build from.

Standards:

NGSS Performance Expectations

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. [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ● Analyze and interpret data to determine similarities and differences in findings.	**ESS3.B: Natural Hazards** ● Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.	**Patterns** ● Graphs, charts, and images can be used to identify patterns in data. - ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** ● The uses of technologies and any limitations on their use are driven by individual or societal needs,

		desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.

Common Core State Standards:

Math:

MP.2	Reason abstractly and quantitatively. (MS-ESS3-2)
7.EE.B.4	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-ESS3-2)*

ELA:

ELA/Literacy -

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. *(MS-ESS3-2)*
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS3-2)

ITEEA Standards

Standard 9 Engineering Design: Students will develop an understanding of engineering design. (Modeling, testing,

evaluating, and modifying.) Standard 20 Construction Technologies: Students will develop an understanding of and be able to select and use construction technologies.
Other Standards

Measurable Student Learning Objectives:

Students will be able to describe how humans are affected by earthquakes.

Students will be able to understand why engineers need to learn about earthquakes.\

Students will be able to identify cause-effect relationships involved in earthquakes and structural designs.

Students will be able to explain how new technologies are used in engineering new structures to mitigate the effects of an earthquake.

Students will be able to model new technologies used by engineers to mitigate the effects of an earthquake.

Nature of STEM:

The students take the science of earthquakes, and pair it with engineering and math and create a structure that incorporates the new technologies that engineers use in their designs to mitigate the effects of earthquakes. The students will learn about the design and engineering process and be able to APPLY what they have learned. The Nature of STEM is about application of prior knowledge to new concepts and solving problems. This lesson plan covers the application of what they have learned about earthquakes, even though their main misconception is that there are no earthquakes in Kentucky. The students will also discuss the future colonization of Mars. I want them to predict if the same engineering concepts will work on that landscape as well, or if they believe that new concepts will have to emerge to withstand a mars quake.

Engaging Context/Phenomena:

Mars quake video: https://www.nasa.gov/feature/jpl/what-does-a-marsquake-look-like (Part of the video shows simulation of earthquake, moonquake, and mars quake.)

World's Largest Earthquake Test

Earthquake drill

Data Integration:

The students will be collecting data on the different types of technologies used in buildings to mitigate the effects of earthquakes. The students will research 5 different technologies and compare them. (The students will cite where they collected their information.) The students will pick at least one technology into the design of their structure.

Differentiation of Instruction:

Modifications in my classroom include readers, scribes, and extended time.

The great thing about this lesson is that most students will be able to build on their own. I will assist students who need readers or scribes with their research and drawing of their designs where necessary.

Real-life Connection:

The New Madrid Fault Line runs zigzag along the borders of Arkansas, Missouri, Tennessee, and Kentucky. Kentucky students conduct earthquake drills in school but the majority of them have never experienced an earthquake of any magnitude. The majority of my students believe that places like California and other countries only experience earthquakes and do not understand why we conduct the drills. I have designed the engineering activity so that students will understand that there are places not on plate tectonic lines that do experience earthquakes. Once the students

understand that we can experience earthquakes and there is a fault line at the edge of Kentucky, then they are eager to find out if the structures in Kentucky have to follow the same guidelines as those in California.

Possible Misconceptions:

The biggest misconception is that earthquakes do not happen in Kentucky.

Another misconception is that all building requirements are the same no matter where you go.

Lesson Procedure:

5E Model	5E Objectives
Engage 1 Class Period	**Procedure:** The students have already studied earthquakes and waves. They should have an understanding of why and where earthquakes happen. Now I want to take that information and connect it to real life using the New Madrid fault line that runs the edge of Western Kentucky. 1. **Ask the students "where do earthquakes happen". (They should connect to past knowledge.** 2. **Conduct an earthquake drill.** 3. **Ask the students why they think we have earthquake drills in Kentucky.** 4. **Have students do a 10 minute search for earthquakes in Kentucky.** 5. **Ask the students, "where do you think earthquakes can happen".** 6. **Show the Nasa video of earthquake, moonquake, and marsquake.** 7. **Ask students to fill out a KWL chart.** **Modifications:**

	No modifications are needed on this day except for students who need scribes. **Standards Addressed** **ESS3.B: Natural Hazards** Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. **Formative/Summative Assessments** KWL chart **Resources** KWL Chart Mars quake video: https://www.nasa.gov/feature/jpl/what-does-a-marsquake-look-like (Part of the video shows simulation of earthquake, moonquake, and mars quake.)
Explore **2 Class Periods**	**Procedure:** 1. Ask the students to draw a diagram of a two story building. 2. Show World's Largest Earthquake Test 3. Ask the students why the building did not collapse. 4. Have the students research and explore new technologies that mitigate the effects of earthquakes. 5. The students will pick 5 technologies that they find and write a short explanation of how each one is used in construction. The students will create Google slides of each technology. The students must cite their findings in their explanation.

	Modifications Students needing readers or scribes will work in a group with me to create one collaborative google slide presentation. **Standards Addressed** **ITEEA** Standard 9 Engineering Design: Students will develop an understanding of engineering design. (Modeling, testing, evaluating, and modifying.) **ITEEA** Standard 20 Construction Technologies: Students will develop an understanding of and be able to select and use construction technologies. RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. *(MS-ESS3-2)* **Formative/Summative Assessments** The students will be assessed formatively through the observation of their google slide presentations. **Resources**
Explain **3 Class Periods**	**Procedure:** 1. The students will plan their design and their scale for their blueprints. 2. The students will create a blueprint of their structure and it must be to scale. **Modifications** Scale will be provided to these students along with a basic outline of a structure to choose from. The students will tell their scribe what to draw and where. **Standards Addressed** ITEEA Standard 9 Engineering Design: Students will develop an understanding of engineering

	design. (Modeling, testing, evaluating, and modifying.) **Influence of Science, Engineering, and Technology on Society and the Natural World** ● The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. **Formative/Summative Assessments** Formatively assess by observing each students' blueprints and plan designs. **Resources** Students may use floorplanner.com or any free blueprint site to help them with design.
Elaborate **2 Class Periods**	**Procedure:** 1. Students will turn in requisition forms for materials. 2. Students will gain access to building materials. 3. Students will build their structure based on their blueprints. **Modifications** Here I will modify as I see a need from the students during their construction phase. **Standards Addressed** Standard 9 Engineering Design: Students will develop an understanding of engineering design. (Modeling, testing, evaluating, and modifying.) Standard 20 Construction Technologies: Students will develop an understanding of and be able to

	select and use construction technologies. **Formative/Summative Assessments** Formatively assess as students build, make sure they are following their own designs, no matter the outcome. **Resources** Materials are listed in the On Top of Spaghetti file.
Evaluate **1 Class Period**	**Procedure:** Students will bring their structures to the shake table for an earthquake test. **Modifications** There are no modifications needed at this time. **Standards Addressed** Standard 9 Engineering Design: Students will develop an understanding of engineering design. (Modeling, testing, evaluating, and modifying.) **Formative/Summative Assessments** Summative assessment: Rubric is located in the On Top of Spaghetti file. **Resources** On Top of Spaghetti Next Steps: Take this to the next level and colonize mars and since mars has quakes, do the

	same activity only for mars. Note: Look at the difference of materials available and seismic waves.
Extend	**With an extension, I would work with my Gifted and Talented students to find the epicenters of earthquakes. I would use the activity: https://www.jpl.nasa.gov/edu/teach/activity/quake-quandary-a-pi-in-the-sky-math-challenge/** **Standards Addressed:** 7.EE.B.4 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-ESS3-2)*

Teacher Background:

The teacher should have a basic understanding of the forces of an earthquake, the new technologies used in construction and how to build an earthquake table. (Shake table)