The Great Shake

4th Grade

Unit 2 – *Weather or Not*

Text Connections: *Earthquakes* by Seymour Simon

Magic Tree House: Earthquake in the Early Morning by Mary Pope Osbourne

(Magic Tree House book is not a unit text – see additional information section)

Design Challenge Summary

Challenge: What will the students be required to do?

One of the worst earthquake events that ever happened in the United States did not take place in Alaska or California. It actually happened in Arkansas along the New Madrid Fault Line in 1811. Today, you are acting as if you are engineers. You will make models of buildings and test how well your structures stand up under the stress of an earthquake.

Students learn how engineers construct buildings to withstand damage from earthquakes by building their own structures with toothpicks and marshmallows. Students test how earthquake-proof their buildings are by testing them on an earthquake simulated in a pan of Jell-O®.

Standards: What standards are addressed?

Science:

NS.1.4.1 Communicate observations orally, in writing, and in graphic organizers
NS.1.4.2 Refine questions that guide scientific inquiry
NS.1.4.3 Conduct scientific investigations individually and in teams
NS.1.4.5 Communicate the designs, procedures, and results of scientific investigations
NS.1.4.6 Estimate and measure length, mass, temperature, capacity/volume, and elapsed time…
NS.1.4.7 Collect and interpret measurable empirical evidence in teams and as individuals
NS.1.4.8 Develop a hypothesis based on prior knowledge and observations
NS.1.4.9 Identify variables that affect investigations
NS.1.4.10 Identify patterns and trends in data
NS.1.4.11 Generate conclusions based on evidence
NS.1.4.12 Evaluate the quality and feasibility of an idea or project
NS.1.4.13 Use simple equipment, age appropriate tools, technology, and mathematics in scientific investigations

Math:

Mathematical Practice Standards
4.MD.1. Know relative sizes of measurement units within one system of units
4.MD.2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
4.MD.3. Apply the area and perimeter formulas for rectangles in real world and mathematical problems.
4.MD.4. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots.

ELA:

W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
W.4.3 Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
W.4.4 Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.
W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.
W.4.10 Write routinely over extended time frames and shorter time frames for a range of discipline-specific tasks, purposes, and audiences.
SL.4.1 Engage effectively in a range of collaborative discussions with diverse partners on grade 4 topics and texts, building on other's ideas and expressing their own clearly.
SL.4.3 Identify the reasons and evidence a speaker provides to support particular points.
SL.4.4 Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

Result: What will students know, value, and be able to do as a result of the lesson? What's the big idea?

Identify some of the factors that make buildings earthquake-proof.
Model an earthquake-proof structure using simple materials.
Compare a model structure with what it represents.
Understand why engineers need to learn about earthquakes.
Know and apply the engineering design loop.
Value collaboration and discussion.

Assessment: What evidence will be used to determine student learning?

Activity Embedded Assessment

Journal: Have students record their own observations in the section titled, "What I've observed."
Measurement: Have students measure the length and width of their structures and calculate the perimeter and area.
Measurement: Have students measure the elapsed time their structures withstood the earthquake forces.

Post-Activity Assessment

Journal: Have students fill in the final sections of the journal labeled, "Facts I've Learned," and "Questions I Have." Solicit questions from the students and let other students answer.
Display Data: Have students create a graph, table, or plot to represent and interpret classroom data.

Did they create a structure that withstood an earthquake?
Did they follow the design loop process?
Did groups work collaboratively together?

Prior Knowledge/Experiences: What prior content knowledge and skills will the students need?

Experience with the Engineering Design Loop process
Connections to the Mathematical Practices
Investigations/Inquiry in Science
Engineering Connection
Experiences with structural elements (ie. cross bracing, large "footprints," and tapered geometry)
Introduction/Motivation
Research Journal: Use the attached Earthquake Journal page. Have students enter the new vocabulary words for the lesson (such as: tectonic plates, Ring of Fire, focus, epicenter, surface waves, body waves, P waves, S waves, aftershocks, seismograph, Richter scale, Mercalli scale) in the Vocabulary section.

Summary/Connections: How will this design challenge connect with new/future learning, other content areas, real world experiences, etc.?

This lesson will help students develop problem solving skills and collaboration skills that are essential in succeeding in the 21st century. It will allow students the opportunity to transfer and apply skills from various content areas within one task.

Math: Generate graph, table, or line plot with the data from their measurements. 4.MD.4

Writing: Write a summary of the design process used to create student structures. W.4.3; W.4.4

Speaking/Listening: Discuss issues and challenges the students encountered during the design task.
Some examples:

- Do any two structures look exactly alike? What are some of the differences in design?
- What makes one design better than the other? (ie. base, strength, height, cross bracing, large "footprints," and tapered geometry)
- Did the final design end up anything like what you planned?

Extensions:

***Re-Engineering*:** After students have tested their structures, they should redesign and rebuild them, then test again. What can they do to make it stronger? Did it topple? Should they make a bigger base? Make it taller or shorter? Let students design and rebuild as often as time allows.

Drawing the Geometry: Have students make drawings and label the shapes in their designs (cube, pyramid, triangle, etc.).

***Make a Pitch!**:* Have students pretend to be engineers and make flyers to convince a company to let them design a better building or structure.

***News Broadcast**:* Have student teams write news broadcasts about an earthquake that has hit their hometowns. Have the broadcast begin with something exciting to catch the listener's attention. Then tell the facts of the event. Have the teams share their news broadcasts with the class.

Materials/Equipment/Preparation: What materials and equipment will students need to successfully complete this design challenge?

Each student/group needs:

- toothpicks
- miniature marshmallows
- Earthquake Journal

For the entire class to share:

- eight 8½-inch square disposable baking dishes, or one 8½ x 11-inch disposable roasting or baking pan
- 8 boxes Jell-O® (plus a stove, water and pan to make the Jell-O® in advance)

ADDITIONAL INFORMATION

The idea from this lesson came from Teach Engineering: Earthquake in the Classroom.

Magic Tree House: Earthquake in the Early Morning – This is not part of our Common Core unit texts; however, this book can be useful in comparing/contrasting fiction/non-fiction information.

ONLINE RESOURCES

Photos:

Google Image search results:

http://www.legoengineering.com/wp-content/uploads/2013/06/earthquake.jpg
http://www.urbansurvivalnetwork.com/wp-content/uploads/2013/03/Survival-Guide-How-to-Survive-an-Earthquake.jpg
http://images.brisbanetimes.com.au/file/2011/02/23/2199285/large2.jpg
http://blog.thomsonreuters.com/wp-content/uploads/2012/04/earthquakes.jpg
http://www.uwgb.edu/dutchs/Graphics-Geol/Animations/SeisWaveAnim.gif

Videos:

Preview videos prior to showing to ensure they are appropriate for your students.

http://video.nationalgeographic.com/video/101-videos/earthquake-101
http://video.nationalgeographic.com/video/earthquake-montage
http://whnt.com/2012/11/13/special-report-could-new-madrid-big-one-shake-alabama/

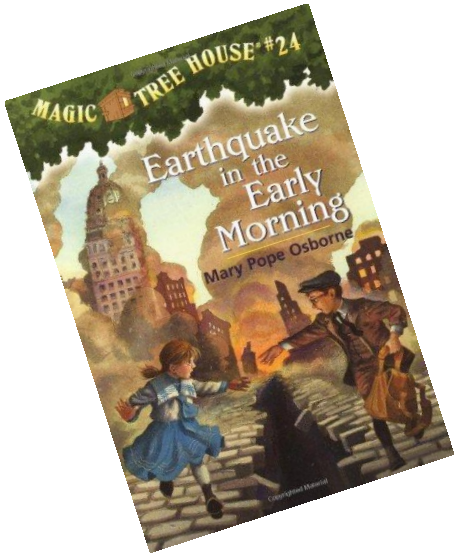
Research sites:

http://earthquake.usgs.gov/learn/kids/
http://shakeout.org/centralus/

Name _____ Date _____

The Great Shake Research Journal

Vocabulary	**Facts I've learned**
Observations	**Questions I have**



The Great Shake

One of the worst earthquake events that ever happened in the United States did not take place in Alaska or California. It actually happened in Arkansas along the New Madrid Fault Line in 1811.

Today, you are acting as if you are engineers. You will make models of buildings and test how well your structures stand up under the stress of an earthquake.

Group Supplies:
toothpicks
marshmallows
teacher will provide pan of Jell-O®

Today, you are acting as if you are engineers. You will make models of buildings and test how well your structures stand up under the stress of an earthquake.

Generate Ideas:

The Great Shake

Original Design – Plan Your Budget:

Allotted Budget: $ _____

Materials	Unit Price	Quantity	Cost
Toothpicks			
Marshmallows			

Redesign – Plan Your Budget:

Allotted Budget: $ _____

Materials	Unit Price	Quantity	Cost
Toothpicks			
Marshmallows			

The Great Shake

Build the Item - create and test your structure:

Record observations from the building process, testing, evaluation, and redesign of the structure.

	Test your design. Be sure to measure and record how long the structure stands. Create a table or chart to display your data.

The Great Shake

Evaluate:

1. As you were building and testing the structure, what were some changes your group made to improve your design? Explain your reasoning for these changes.

_____
_____
_____
_____
_____
_____
_____

2. If you were to do this process again, what would you do differently? Why?

_____
_____
_____
_____
_____
_____
_____