

*9th/10th Grade  
Earth and Space Science*



**Teaching the Science and Engineering Education (SEEd) Standards**

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# Earthquake Construction Investigation

Grade: 9th/ 10th

## Effects of Earthquake Waves on Humans

Time: 60-90 minutes



### Utah SEEd Standard

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#### Standard ESS.2.6

Evaluate **design solutions** that reduce the effects of natural disasters on humans.

Define the problem, identify criteria and constraints, analyze available data on proposed solutions, and determine an optimal solution. Examples of natural disasters could include earthquakes, tsunamis, hurricanes, drought, landslides, floods, or wildfires.



### Materials

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- Teacher PowerPoint [Earthquake Lesson PowerPoint](#)
- 8 plastic boxes (Step 1): about 117 red bricks, 100 cement cinder blocks, 75 Keva wooden blocks
- 8 ziplock bags (Step 2): 10 small and 4 long stainless steel straws, about 7 long stem pieces, 30 short pieces, about 76 stem connectors, 10 clay sticks, rubber bands.
- 8 Wobble earthquake tables
- [Earthquake notes worksheet](#)
- Extra resources: [Seismic waves - P & S waves](#)



### Vocabulary

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- Primary waves (P waves) - the fastest and the first waves to arrive, they have a high frequency.
- Secondary waves (S waves) - The slower and the second waves, they arrive after the P waves, they have low frequency.
- Constraint - a limitation or restriction.
- Architectural foundation - A subterranean structure designed to transmit the structural loading of a building to the underlying ground.
- Foundation- the lowest load-bearing part of a building, typically below ground level.
- Structural supports - Structural support is the term for the columns and/or framework that hold up a structure.



## Directions

Directions are also embedded in the teacher PowerPoint

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### Engage (5 mins)

- Tell students they have been hired by a construction company to design buildings in Utah County to withstand earthquakes. Explain that they will work in table groups and be given supplies to build whatever structure they want.
- Lead a discussion about structure and function. Remind students that structure is how something is built and function is what that structure does. Structure determines function. Explain that students will need to consider the structure and function of their buildings during this activity. Show students the two PowerPoint slides of various buildings and ask them questions about what they can infer about the buildings' structure and function.
- To review P and S waves, show students the P and S wave video found in the PowerPoint.
- Model for the class how to shake the wobble table. P waves come first during a real earthquake. Demonstrate how to simulate P waves for the students by shaking the table back and forth quickly so that the wobble table produces a quick vibration. S waves come second during a real earthquake. Demonstrate for the students by shaking the wobble table using a slow rocking motion. Later in the lesson, students will test their structures by shaking their wobble tables using the P and S wave rocking motions.
- Before students start building, give them some time to brainstorm and draw a prototype on their worksheets first.

### Explore (25-30 mins)

- First, hand out a wobble table to each group. Then give each group the Step 1 materials. These include wooden blocks, red bricks, and cement blocks (Step 1 supplies are found in 8 plastic containers). Students will build a structure directly on the wobble table for 5 minutes using only these items. This is to represent structures that were built in earlier times with limited technology. After building for about 5 minutes, tell them that the earthquake is coming in one minute.
- After a minute, have everyone wobble P waves (fast, rocking waves) for 15 seconds (this is how long an earthquake usually lasts). **Ask:** What do you wish you had to make these structures more stable? What supplies would you need so it does not fall over?
- Next, distribute the Step 2 supplies to each group. These supplies will allow students to provide support and a foundation to their structures. Supplies include stainless steel straws, clay, plastic STEM connectors, and rubber bands. Students are given freedom to create whatever structure they want. They have about 10 mins to build. Make it a class competition!

- Once their structure is complete, each student needs to draw a simple model of their structure on their worksheet.
- Tell students that an earthquake is coming in one minute and to finish their drawings. Hand each group an iPad so they can film the earthquake in slo-mo. The student who does the filming should hit the record button and then count to five before another student shakes the wobble table. It takes the iPad a few seconds to start recording in slo-mo which is why it's important to count to five before shaking the table.
- Now the earthquake is here, every group needs to shake their wobble tables. Make P waves first and then S waves. The earthquake should last for about 15 seconds. One person will film it in slo-mo to see the impact. This video will be presented to the class and will be automatically uploaded to the cloud.
- If there is enough time, students can adjust their structure after watching the video and test/film their adjusted structures using the iPads.
- Make sure all supplies get cleaned up and put nicely back into the plastic containers and zip lock bags. Tell students that each piece is counted and that these supplies will be used in other classrooms so treat them gently.

### Explain (25-30 mins)

- Students will discuss together briefly what happened to their structure, what they would change and what they learned. They can add these notes to their worksheet.
- Each group of students will then present their videos to the whole class. Students need to refer to P and S waves in their video as they present to the class. Students will explain to the class what went well and what did not. They should also explain what they learned and what they noticed as they did the experiment.
- Video upload instructions:
  - Once students have finished filming, they need to choose the best video (if they have multiple) to show to the class and **delete** everything else.
  - iPads need to be connected to the cloud before teaching.
  - Open up icloud.com
  - Sign in with Username: [Keggington@uvu.edu](mailto:Keggington@uvu.edu) Password: SeedPods123
  - An authentication code will be sent to one of the iPads, type in the code on the computer.
  - Go to the photo album on the computer. This is where the videos will be uploaded automatically. Each group will come up and show the teacher which video is theirs to present it to the class.
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### Elaborate (25-30 mins)

- After each group presents, ask: What would you change, adjust, or improve about your group's structure based on what you have learned from all the videos?
- Have students draw a new design on their worksheet considering this information.

- Lastly, students will write a sentence about how their new structures would withstand P waves and S waves.
- Extra if you have time: Explain that there are other natural disasters that affect humans. These include tsunamis, hurricanes, drought, landslides, floods, and wildfires.
- In groups, students can choose one of these natural disasters and discuss possible solutions they could design to reduce the effects on humans.

### Evaluate

- Check the students' [worksheets](#) for understanding. Listen to their responses/video presentation and check their designs for understanding of earthquakes.

## 9th/10th Earth and Space Science Inventory List

### Lesson 3: *ESS.2.6* - Earthquake

#### Tote 1:

- 8 wobble tables

#### Tote 2:

- 6 boxes containing;
  - 75 wooden keva pieces
  - 100 cinder blocks
  - Approx. 117 red bricks

#### Tote 3:

- 2 boxes containing;
  - 75 wooden keva pieces
  - 100 cinder blocks
  - Approx. 117 red bricks
- 8 ziplock bags containing:
  - 10 clay sticks
  - Stem constructors: about 7 long pieces, approx. 30 short pieces, approx. 37 connector pieces
  - 4 long stainless steel straws
  - 10 small stainless steel straws

#### Other Materials Needed:

- 8 iPads
- One extension port
- 8 iPad chargers

# Earthquake Notes Worksheet

Grade: 9th/ 10th

## Effects of Earthquake Waves on Humans



### Define the Problem

Write down the problem:

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### Constraints

Identify your constraints and criteria for success

What are some constraints you faced at the beginning?

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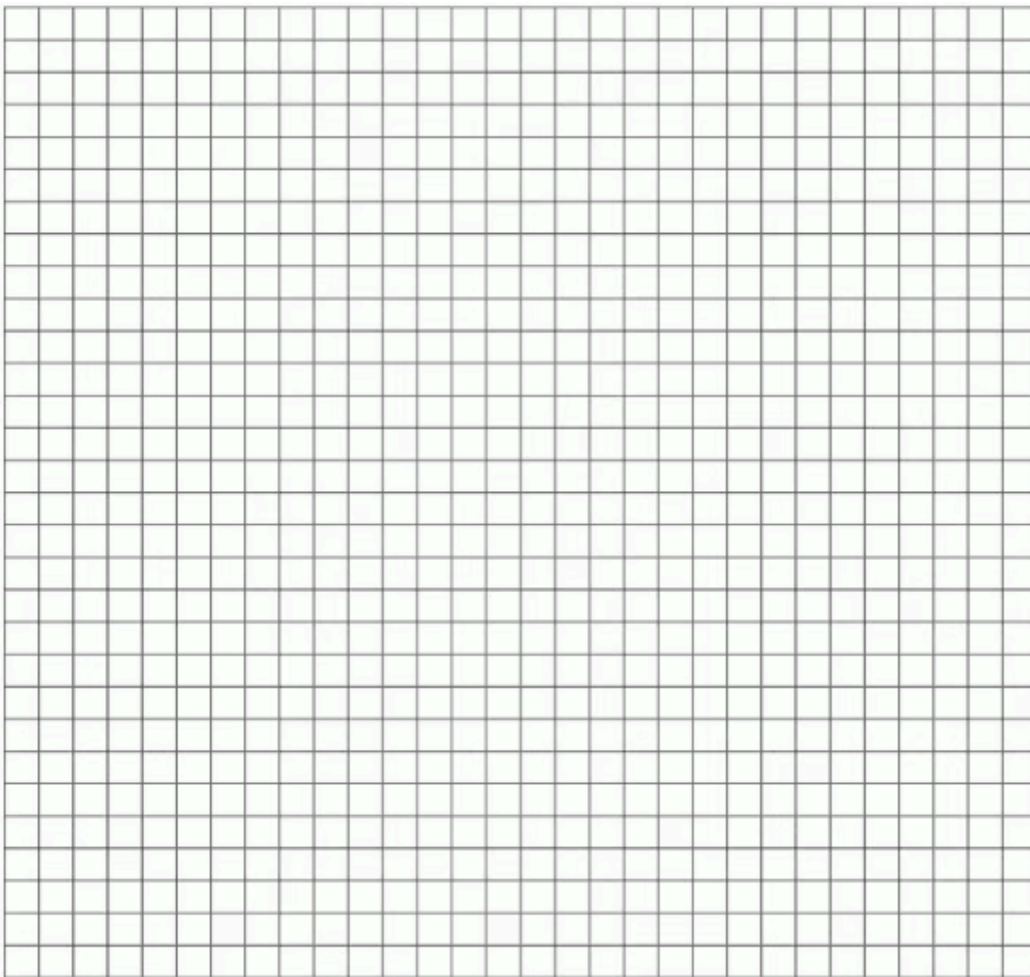




## Step 1

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**Brainstorm:** Draw your simple model(s)



**Select:** If you drew multiple models, pick the one you think will work best.

**Prototype:** Construct your building

**Test:** Shake it!!

 **Analyze**

**Iterate:**

<u>What worked well?</u>	<u>What didn't work?</u>

What would you do differently next time?

**Communicate:**

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