Tragedy in Haiti

A lesson to accompany your Earth's Systems Unit *[NGSS MS-ESS2]*

Story

This "Tragedy in Haiti" lesson reinforces the **Define phase** of the **engineering design cycle** through the story of the 2010 Haiti earthquake. The lesson begins with a video account from 17-year-old Rachel Lunique, a real-life survivor of the quake. After hearing her story, students dig deeper into what happened on the day of the earthquake and its disastrous consequences: 300,000 people lost their lives and over a million were left homeless. Through the work of two real-life engineers, students discover how engineers provide help before and after earthquakes strike – by identifying people's true wants and needs.

This lesson is designed to take place after you cover plate tectonics in your Earth's Systems unit. The lesson does not teach plate tectonics but does provide a quick recap of the topic in the context of the story.

Students take on the role of engineers to identify the needs of residents and researchers of earthquake-prone areas **(criteria)**, as well as what stands in the way of getting information and aid to them **(constraints)**.

Why is this important? In the engineering design process, according to the NGSS: "The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful."

About 1-2 class periods

Relevant Engineering Standard:
NGSS MS-ETS1

Printed Documents

You will need printed copies of the following documents, which can be found online at *teemsproject.com.* Navigate to the unit "Tragedy in Haiti," and scroll down to the Quick Links to Resources section.

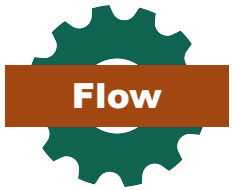
Note: You'll be breaking students into groups of 2-3.

Section	Document Name	Number of Copies
Earthquake Engineering	The Satellite Picture Problem	1 per group
	The Satellite Picture Problem - For Teachers	1 for yourself
	Springville Maps - For Teachers	1 for yourself
	Springville Map (Blank)	6-8 per group
	Level 1 Earthquake Map	1 per group
	Anne the Earthquake Engineer	1 per group

Teacher Tips

- When you access *Tragedy in Haiti* online, for the best experience, view your browser "full screen."
- For any resource document that you open, you can click on it to zoom in for a closer look. Then use your mouse or touchpad to drag the document up or down.
- Close any resource by clicking on the X in the upper right corner.

Flow of the Lesson



Rachel's Story: Steps

Rachel's Story

1.

At goteems.com, scroll down to find the lesson called Tragedy in Haiti-- and then click GO!

2.

Then, project this screen for the class

3. Click the **Start Here** button to open the 1-minute video. The video will start automatically. Watch and listen to the story as a class.

4. When the video ends, close the viewer and engage students in a discussion using the questions below.

Talk About This

- **What happened to Rachel's house?**
  - It was destroyed in an earthquake.
- **What happened to Rachel during the earthquake?**
  - She was in her house when a wall fell on her. Her hand was injured and she was trapped for two days.
- **How did Rachel get out?**
  - A neighbor found her and dug her out.
- **How do you think Rachel felt after she was rescued from the earthquake?**
  - Responses may vary. For example: happy to be alive, worried about her family, hungry and thirsty, etc.
- **What do you think changed in Rachel's life after the earthquake?**
  - Responses may vary. This question can start students thinking about the impact of earthquakes and natural disasters. For example:
    - Did Rachel have any place to live?
    - Did Rachel have food to eat or water to drink?
    - Were there things Rachel couldn't do because her hand was hurt?

5. Tell students: *The earthquake in Rachel's story really happened, about 10 years ago, in a country called Haiti. Let's find out more about the earthquake.*

Killer Quake

1.

At goteems.com/lessons/tragedy-in-haiti, scroll down to Resource Block One. Project this screen for the class.

2. Click on the resource **The Quake** to open the 2-minute video. (AUDIO should be ON.) The video will start automatically.

Killer Quake

3. Watch and listen to the story as a class. When the video ends, close the viewer. To check understanding, you can ask students the questions below.

Talk About This

- **Did any of the people in Haiti know the earthquake was coming?**
  - No. It seemed like a regular day and there was no warning.
- **What things happened to people because of the earthquake?**
  - Their houses fell down.
  - Families couldn't find each other.
  - People got hurt – and some died.
- **The place where this earthquake started (the focus) wasn't very far underground. Why was that bad?**
  - It meant the shaking was very strong.
- **The point where the earthquake hit was near many big cities. Why was that bad?**
  - The earthquake hit where lots of people lived close together.
- **Was there just one quake?**
  - No – there were more quakes (aftershocks) minutes and days after the first one.

4. Explain to students: *The country of Haiti, and people like Rachel, had a very hard time in this big earthquake. Let's look at some maps to learn more about where Haiti is.*

5. Click on the resource **Haiti Map** to open the document. This resource is intended to help students identify where Haiti is in relation to the United States. Point out to students the outline of the United States and the area where your school is located. Then point out the location of Haiti (in blue) and note that it's part of an island.

6. Click on the resource **Epicenter Map** to open the document. Explain to students: *This map gives us a closer look at the country of Haiti. The red circles show where the earthquake hit. It was near a big city (point to Port-Au-Prince). That's where Rachel lived. At the time, nearly one million people lived in that city. And there were millions more people all around it. So you can see that this was a very bad place for the earthquake to happen.*

7. Explain to students: *Before we find out more about the Haiti earthquake, let's go back and think about how earthquakes happen. Remember what we learned about tectonic plates? We're going to watch a short video that reminds us what we know.*

8. Click on the resource **Plate Tectonics** to open the 1-minute video. (AUDIO should be ON.) The video will start automatically. Watch and listen to the video as a class. When the video ends, close the viewer.

9. Click on the resource **Plate Map** to open the document. Explain to students: *Here's another map of the United States and Haiti. (Point to the green circle to identify Haiti.) But this map also shows the tectonic plates that are underneath the land and oceans.*

10. To check understanding, you can ask students the questions below.

Talk About This

- **What do you think these red lines show?**
  - The lines show the edges of tectonic plates.
- **What do you notice about where Haiti is?**
  - It lies on the edge of two tectonic plates.

11. Click on the resource **Faultline** to open the 45-second video. (AUDIO should be ON.) The video will start automatically. Watch and listen to the video as a class. When the video ends, close the viewer.

12. Explain to students: *Haiti was right on the edge of two plates that slipped and caused this gigantic earthquake. And Rachel lived in a city, Port-au-Prince, that was close to the center of where the earthquake hit.*

13. Tell students: *Let's find out what happened to Rachel – and the other people of Haiti – after the earthquake was over.*

Earthquake Engineering: Steps

Earthquake Engineering

1.

At goteems.com/lessons/tragedy-in-haiti, scroll down to Resource Block Two. Project this screen for the class.

2. Click on the resource **Rachel's Story** to open the 1-minute video. (AUDIO should be ON.) The video will start automatically. Watch and listen to the story as a class. When the video ends, close the viewer.

3. To check understanding, you ask students the questions below.

Talk About This

- **After the earthquake, Rachel and her family had no home. Where did they live?**
  - They all had to live in a tent.
- **What was Rachel's life like after the earthquake? What are some things she worried about?**
  - She didn't have protection from the weather – like rain and hot sun.
  - It was hard for her to get food and water.
  - Her hand was hurt, so she couldn't do some things that she used to be able to do.

4. Explain to students: *After the earthquake, things were very hard for Rachel and all of Haiti. Haitian engineers knew there was a lot of hard work ahead to rebuild their country. The earthquake affected so many people that they couldn't fix all the problems on their own. Many people around the world wanted to help.*

Thinking like an engineer, how would you start deciding what to do?

5. Bring your students' attention to the engineering design cycle, and start a discussion about the **Define** phase using the questions below.

Talk About This

- **Remember the engineering design cycle? Where does this process usually start?**
  - Answers will vary, but may include ideas like: finding out what the problem is, the "define" phase, discovering people's needs
- **What is the Define part of the design cycle? What happens?**
  - Answers will vary, but may include ideas like: talking to and/or observing people to figure out their needs, engineers carefully figuring out exactly what problem they want to solve

6. Explain to students: *Now we're going to see what one engineer named Gitanjali (Gih-taan-juh-lee), along with her team, decided to do to help Haiti.*

7. Divide the class into groups of two or three students each. Give each group a copy of the resource "The Satellite Picture Problem."

8. As a class, read through the first page of The Satellite Picture Problem. Then discuss the question at the bottom of the first page. (As Gitanjali talked to the different groups, what phase of the engineering design phase do you think they were doing? Why?) Throughout this activity, you can refer to the resource The Satellite Picture Problem – for Teachers to help guide the discussions.

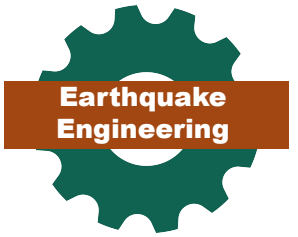
9. Move on to the second page of The Satellite Picture Problem. Explain to students: *Here are the three different groups that Gitanjali talked to. Match each group (on the left) with the most likely reason they didn't use the satellite data (on the right).*

10. Discuss with students about how – and why – they matched the groups to the different responses.

11. Direct students to complete the third page of the activity. After students have been given enough time to finish, ask them to share and build on each other's responses.

12. Tell students: *Gitanjali's work shows how important is in to figure out what people really need when you're in the Define phase of the design cycle. Now let's take a look at how engineers are trying to figure out how to help people before an earthquake hits.*

As we've seen, when there's an earthquake, buildings can break and fall apart. When a building has to be fixed, sometimes other buildings around it have to be closed too. That's because the damaged building might fall down – and it could fall right on top of a next-door house, store or hospital and all the people inside those places. It's safer to move nearby people out to keep them safe and to give construction workers lots of space. Sometimes it takes months to fix a building – which means people may have to move away for a long time, or go farther away for healthcare or food.



13. Explain to students: *No one can prevent earthquakes from happening, but engineers can help us be more ready for them and make sure the results aren't as bad. Here's how:*

- *Remember the different ways people use damage information after an earthquake? Engineers can use damage information to predict the future damage that earthquakes could cause to buildings! That often depends on the strength of an earthquake.*
- *Engineers figure out whether one damaged building would force other nearby buildings to close.*
- *Then, they decide which buildings they should make stronger now so they won't get damaged if there's an earthquake. (Usually they can't fix EVERY building because there isn't enough money).*

Today, you're going to be an engineer figuring out how to help a city BEFORE an earthquake hits. We saw in a video that the Richter scale is one way to measure how strong an earthquake is. Another measure engineers use is Moment Magnitude. Today, in our scale, we'll use the numbers 1 to 5 - where 1 is the weakest earthquake, and 5 is the biggest, strongest earthquake.

14. With the class still in groups, give each group one copy of the "Level 1 Earthquake Map" resource, and 6 to 8 copies of the blank map.

Earthquake Engineering

15. Ask students: *In front of you, you have a map of a city called "Springville." The map is labeled with the names of different buildings. What types of buildings do you see?*

- Possible responses: house, school, bank, hospital, offices, apartments, grocery store, theme park

16. Explain to students: *The number in each square tells you how big an earthquake would have to be in order to damage the building. For example, the apartments in Square A are damaged in a Level 1 or bigger earthquake, and the hospital in Square O is damaged in a Level 3 or bigger earthquake.*

Below the number, some squares say "Close Buildings Around Me!" For example, your first map shows what would happen if there was a Level 1 earthquake.

17. Ask students: *In a Level 1 earthquake, which buildings are damaged?*

- Response: Only the apartments in Square A are damaged.

18. Ask students: *If the apartments in Square A are damaged, what other buildings would have to close?*

- Response: Response: Square A says "Close Buildings Around Me!" so you'd have to close the two homes in Squares B and G, and the bank in Square F.

19. Ask students: *Do you have to close the buildings around the bank in Square F?*

- Response: No, because the bank itself wasn't damaged. It was closed only because the apartments were damaged.

20. Explain to students: *Now it's your turn. On a blank map, draw what happens if there is a Level 2 earthquake. First, use a red pen/crayon to cross out or color all the buildings that would be damaged in a Level 2 earthquake. That's all the buildings labeled 1 or 2. Next, figure out what nearby buildings would need to close.*

21. Give students three to five minutes; then check in with them to see how they did—either individually or as a class. Again, you can ask them which buildings were damaged, and which other buildings had to close. In a Level 2 earthquake, the apartments in Square A and the theme park in Square S would be damaged. That means the bank in Square F and the homes in Squares B and G, would need to close.

22. Tell students: *Great! Now use two more blank maps to show what would happen in a Level 3 and a Level 4 earthquake. (We don't need to do a Level 5, because every building would be damaged if there were an earthquake that big).*

23. When students are finished (probably in about 10-15 minutes), ask them: *What do you notice about your maps?*

- Possible Responses: As earthquakes get bigger, more buildings close. Sometimes, when one building is damaged, a lot of other buildings have to close.

24.

Explain to students: *The good news for Springville is that they have enough money to make some buildings stronger - that is, better at standing up against earthquakes. So, for example, look at the apartments in Square A. Right now they can be knocked down pretty easily - by just a Level 1 earthquake. If the town put some of their money toward making the apartment building stronger, they could make it stand up to a Level 2 earthquake. If they put even more of their money toward making the apartment building stronger, they could make it stand up to a Level 3 earthquake. And if they put all of their money into this building, they could make it stand up to a Level 4 earthquake! That's really good news for the buildings around the apartments (in Squares B, F and G), because it would take a Level 4 earthquake before the apartment building is damaged enough that these three buildings have to be closed down.*

So, one choice the town has is to use all their money to strengthen one building - so it can stand up to an earthquake three levels higher. Or they could spread out their money on three different buildings, and make each one strong enough to stand up to an earthquake one level higher. An example of that is: You could spread the money out to spend on the buildings in Squares A, F and K. Now the apartments in A can stand up to a Level 2 earthquake, the bank in F can stand up to Level 5 earthquake, and the home in K can stand up to a Level 4 earthquake. Each goes up one level in standing up to earthquakes.

Work with your group to decide which building or buildings you want to make stronger. You have some extra blank maps – so try drawing how things would look different if a specific building or buildings were stronger.

25. Give students time to choose what buildings to strengthen and redraw their maps. Then, ask students to share: *Which buildings did they decide to strengthen? How did they decide? How did it make their maps look different?*

- Possible responses: encourage students to note similarities and differences between their group and other groups; you could even hang groups' maps on the wall so students can see them. Encourage students to give reasons for their choices--why was one building more important than another to strengthen? In particular, if some groups strengthened the theme park, ask them why they chose that over other buildings. It's not a wrong answer as long as students have a reason! The goal is just to get students thinking about the tough decisions real engineers have to face.

26. Ask students: *In real life, tall buildings sometimes force even more buildings to close than what we saw on our map. For example, if the apartment building in Square A was damaged, it might force the buildings in Squares B, C, F, G, H, K, L AND M to close! Can you imagine why that might be?*

- Possible responses: A building can collapse in any direction, or just pancake with each floor falling directly on top of the next. If a tall building toppled over sideways, it would affect more neighbors than a short building.

27. Ask students: *How do you think that might affect a city?*

- Possible responses: It might be even more important for cities to strengthen tall buildings – or to build more earthquake-proof tall buildings in the first place. Also, because a tall building usually holds more people (either for apartments or offices), fixing one might affect more people than a short building. BUT that also means it could be more expensive!

28. Tell students: [NOTE: If students have already completed the Design Challenge in the Engineering Design unit, you can reference this as a reminder]. *You might remember two other words we've talked about that are part of the Define phase of the design cycle: criteria and constraints. Criteria are the things a design needs to do. Constraints are the limits on a design.*

29. Ask students: *Many earthquake engineers work with local governments to make a plan about which buildings to improve. What criteria would you have to think about as you made a plan?*

- Possible responses: It might be even more important for cities to strengthen tall buildings – or to build more earthquake-proof tall buildings in the first place. Also, because a tall building usually holds more people (either for apartments or offices), fixing one might affect more people than a short building. BUT that also means it could be more expensive! Also, as we've learned, engineers and governments would have to think about whether their are buildings with certain purposes - like hospitals and grocery stores - that are especially important to keep open.

30. Ask students: *What constraints would you face in making a plan?*

- Possible responses: Possible responses: You would have to think about the cost of improving different buildings. And you would have to think about time, so that people aren't without some services for too long.

Take Note!

Some problems don't always fall neatly into categories of criteria or constraints. For example, being able to keep costs low is important (criterion), but the amount of money you have could also be considered a constraint.

We suggest talking to students about how this can be tricky. **What's most important is careful thinking about people's needs to help improve their lives.**

31. Tell students: *Now let's meet a real engineer who has worked on plans for improving buildings!*

32. Give each group a copy of the resource "Anne the Earthquake Engineer." Read the profile together as a class, or have groups read the profile independently.

33. Ask students to share:

- What did you learn about Anne that surprised you?
- Anne said there was a huge earthquake the country where she was living when she was 11, and that's why she wanted to make buildings safer for people. What are some things that you would design to make the world a better place for people?

34. Explain to students: *Being an engineer means you have a chance to help people and make their lives better in many different ways. That starts with the Define phase of the engineering design cycle, when you talk to people about what they want and need.*