Lesson 3.4 - Earthquakes

Overview

During this lesson, students will gain understanding of what an earthquake is and how they are caused; looking at how they are measured and where they occur in the world. This will lead to looking at how buildings are constructed to be resistant to an earthquake. Students will build their own straw structures to test on their SAM system which simulates an earthquake.

Key Information

Level 3: (Ages 10-11) US Grades 4 or 5

Time: 45/90 minutes

Warm-Up	5 minutes
Mini-lesson	10 minutes
Worked Example	7 minutes
Challenge 1	7 minutes
Challenge 1 - Debug	5 minutes
Challenge 2	7 minutes
Tidy Up / Exit Ticket	4 minutes

Lesson Topics

- **Earth and Space Science**
  - Earthquakes and plates
- **Scientific Thinking**
  - Asking relevant questions and using different types of scientific enquiries to answer them
- **Art and Design**
  - Explore and use mechanisms, devices and materials for imaginative activity that leads to original and creative outcomes
- **Design and Technology**
  - Generate, develop, model and communicate ideas through talking, drawing and mock-ups
- **Computing**
  - Inputs, outputs, abstraction, debugging

Learning Objectives

- ***As a result of this lesson, students will be able to***
  - To identify what an earthquake is and how they occur
  - Understand that different materials and objects can shake when they come into contact with a force like an earthquake
  - To understand that a buildings design needs to be considered in earthquake prone areas
  - Build a structure to represent a strong building
  - Create a SAM system to test the strength of a structure

Materials

- Pre-made Jello
- Straws
- Blu-Tack

Materials continue on Page 2

- Cardboard
- Coffee / sugar
- Lego

Warm Up – Which Will Shake? 5 minutes

Can we tell if something will shake?

Objective: Understand that different materials and objects can shake when they come into contact with a force like an earthquake

Procedures: Teachers look at the images of different objects and ask the students to think about the construction of each and whether they will wobble when they are shaken. The most relevant teaching point iis to consider that all objects will be affected by differing strengths of shaking but some a lot more than others.





Sample photo ideas: Jello, eiffel tower, jellyfish, golden gate bridge, tower

Link forward: Students explore how objects move when an earthquake occurs

Mini-lesson 10 minutes

What is an earthquake and how can we make a sound structure?

Objective: To identify what an earthquake is and how they occur. To understand that a building's design needs to be considered in earthquake prone areas

Procedures: The teacher explains what an earthquake is and how they are caused. The class explores how base isolation has been developed to help a building withstand the effects of an earthquake. Students learn how an earthquake is measured on the Richter Scale and how this information is used when constructing new buildings.

You can use this video to facilitate the mini-lesson or for your own background knowledge: https://youtu.be/II1M8o0BHPc

Key Words

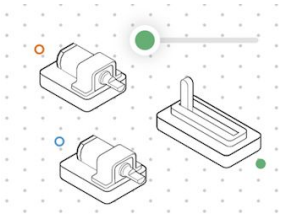
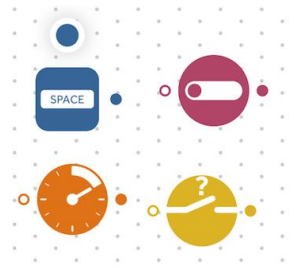
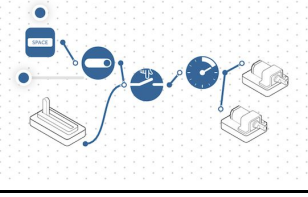
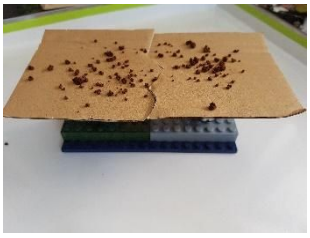
- Tectonic Plates
- Structure
- Earthquake
- Base Isolation
- Crust
- Richter Scale

Let's Discuss: *What is base isolation? In your workbook or with a partner, record, discuss, or share the measured earthquakes in order with strongest first.*

Link forward: Link to designing and making a structure to withstand a simulation earthquake

Worked Example — 7 minutes

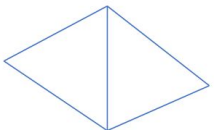
Create a system to observe the effects of an earthquake

Instructions	Workspace	Notes for Teachers
Step 1. Take your sheet of cardboard and cut a zig zag line down the middle.		The idea is to create two tectonic plates out of cardboard, other materials could be used but needs to be sturdy enough to stand alone and not too heavy that the motors can't support the weight.
Step 2. Attach wheels to your Motor blocks. Now turn on and secure two Motor blocks to a Lego base. Fix your cardboard sheets to the top of the wheels.		Lego and blu-tack have been used to hold the motor blocks in place but any other option could be used. The main aim is for the motors to stay stationary with just the wheels moving.
Step 3. Turn on and pair the following blocks and add them to the Workspace: • 2 x Motor Blocks • 1 x Slider Block		Teacher says, *'Remember to check the colour change on the blocks to ensure they are paired with the system*'.
Step 4. Drag the following blocks onto the Workspace: • 1 x Key Press block • 1 x Toggle block • 1 x Switch block • 1 x Interval block		Teacher says, *'Note the colours are all different at this point and that is because they are not connected in a system*'.
Step 5. Connect the blocks together in a sequence shown in the Workspace.		The color of all blocks change to one as the system has been connected. At this time, note the switch has a question mark on it, this is because an input has not yet been determined.
Step 6. Open the Switch block settings and choose 'Slider' from the drop down menu.		Access the settings of the switch and select from the drop down 'Slider'.
Step 7: Place a substance on top of the cardboard 'tectonic plates'.		Coffee has been used in this example here so it can be seen clearly on the cardboard. Any substance that allows it to be seen when it moves is fine like; sugar, soil, glitter etc. This substance may scatter so ensure this task is done in an enclosed area, such as on a tray.

Step 8: Test out your system!		Teacher says, '*Turn the slider on slowly as the motors will move quickly. As the motors start the plates will impact against each other and the substance will scatter. In an earthquake the effects can be quick and devastating*'.

Challenge 1 — 7 minutes

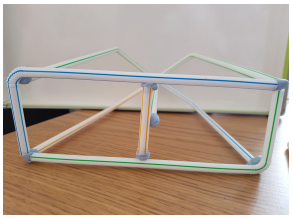
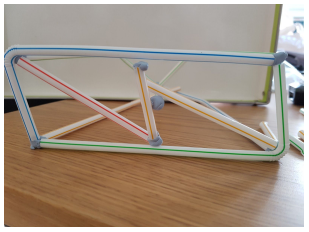
Build a sound structure using straws

Instructions	Workspace	Notes for Teachers
Step 1. Plan your structure out on paper first.		Teacher says, '*Think about your structure and look at the angles. Using triangles and squares and using the student workbook draw out your idea for design'.*
Step 2. Gather materials for your structure. You may want to use straws and blu-tack.		Teacher says, '*Think about what you are going to use, this could be straws and blu-tack or could be cocktail sticks for more complex structures'.*
Step 3. Have a good base to hold your structure in place.		Teacher says, '*A base is essential to hold the structure and allow it to stand alone'.*
Step 4. Using the straws build your structure up and use blu-tack at the joints.		Teacher says, '*The blu-tack will hold the straws together but ensure not too much is used as it will add weight to it'.*
Step 5. Have a look at other people's structures. How do they compare to yours?		By comparing structures with others it will allow the students to see the different concepts and how they impact on design.

Checks for understanding: *Why should we not use too much blu-tack to hold the straws together? Why do we add angles to a structure?*

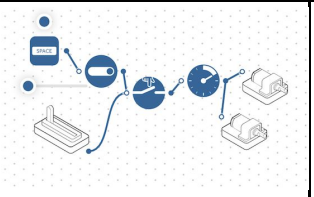
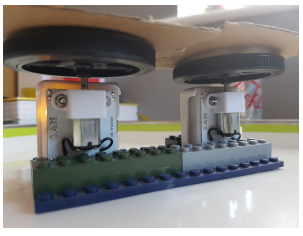
Challenge 1 - Debug it — 5 minutes

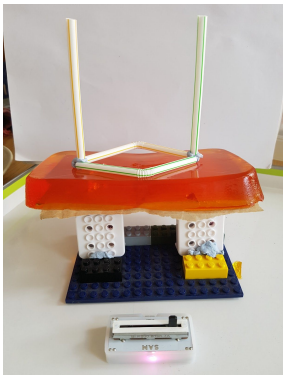
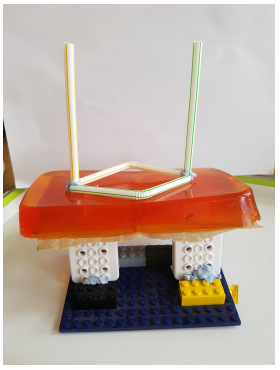
Some of the bases are not strong enough to hold the weight above, can we make it stronger?

Instructions	Workspace	Notes for Teachers
Step 1. Look at your base and think about how to make it stronger.		Teacher says, *'Can a triangle be made anywhere to add strength to the base?'*
Step 2. Add straws and blu-tack to your structure.		Add straws to build the base up – opportunity to discuss the importance of a good foundation on any building to hold all aspects in construction.
Step 3. Could your structure survive an earthquake? Test it!		Teacher says, '*Give the structure a little nudge and see if they are able to withstand it and not fall or demolish'.*

Challenge 2 — 7 minutes

Make a system to test your structure

Instructions	Workspace	Notes for Teachers
Step 1: Open your SAM Workspace from the Worked Example and pair the blocks.		We need to make sure the system is still ready to activate our physical blocks and pair them with the system so we can make our earthquake.
Step 2. Set up the tectonic plates.		Remember to set this up so the two plates are aligned. As a recap this was two pieces of cardboard placed on top with a zigzag join simulating the tectonic plates and fault line.
Step 3. Add the jello to the top of the tectonic plates.		Remember to do this carefully not to destroy the jello or more will be needed. You could use greaseproof paper underneath it to help it from sticking to the tectonic plates. The importance of jello is that you can see the vibrations when it is shaken. This is an excellent representation of an earthquake as depending on the size of the earthquake depends on how much the earth shakes.

Step 4. Add your structure to the top of the jello.		Teacher says, '*The house on the jello doesn't fall because it is *cushioned* by the jello. This is called "base isolation." Engineers constructed these in skyscrapers that float on systems of ball bearings, springs and padded cylinders. Acting like shock absorbers in a car, these systems allow the building to be decoupled from the shaking of the ground'.*
Step 5. Start activating your Slider block!		Teacher says, '*As you increase the slider to the right you will see the motors starting to increase their speed. You will see that the motors are no longer spinning fast and this is because of the weight the jello has placed on the motors. Just like a building on the ground, the weight would make it harder to shake'.*
Step 6. Whose will last the longest?		Teacher says, '*Gather your straw structures and let's see how long they last in an earthquake, whose can last the longest?'* Opportunity to document the position of the slider and associate this with a number based on the Richter scale.

Extension Ideas:

- **Science**
  - Compare the structure and develop a competition for the structure that stands the longest or remains standing
  - Hot and cold – what effect heating up and cooling down has on materials and the stability of a structure
  - Peer evaluations – competition and comparing looking at strengths and weaknesses of designs
- **Geography**
  - Discussion or research - Would you live on a fault line?
- **English**
  - Write a story of an earthquake from a first person's perspective
  - Write a news story about an earthquake and the effects - positive or negative
- **ICT/D&T**
  - Look at Google Sketchup or CAD software to look at structure design of buildings and how theirs could be developed further

Checks for understanding: *What was the purpose of the cardboard and the motors? Why did we use jello?*

Tidy Up / Exit Ticket — 4 minutes

Reinforcing the learning objectives of the lesson, students can reflect on key takeaways by completing and submitting an exit ticket.

