

DESIGN A QUAKE-RESISTANT BUILDING

→ INTRODUCTION

An earthquake is a natural phenomenon that occurs in many parts of the world. The magnitude, or size, of an earthquake can be measured using the Richter scale, where 1 is a tiny quake and 10 is the biggest quake possible. The magnitude of an earthquake does not necessarily predict the loss of life and destruction. For example, in 1999, an earthquake measuring 7.6 on the Richter scale killed just over 2000 people in Taiwan, but in 2005, an earthquake of the same magnitude killed more than 86 000 people in Pakistan. According to experts, many of the deaths in Pakistan could have been prevented if the buildings had been better designed and constructed.

In this STEM investigation, students are asked to consider the types of buildings that are more likely to resist an earthquake. They need to demonstrate their understandings of how an earthquake occurs, and why some buildings stay standing and others collapse. Students can make a shake table to test their designs, and other ways to test them can be developed.

This STEM challenge is easily differentiated for students by encouraging different groups to use different degrees of complexity when creating their buildings. Students could test different materials as well as designs.

THE CHALLENGE



The main risk to life during an earthquake is the collapse of poorly built buildings. After a devastating earthquake, volunteer organisations often work with local

communities, helping them to rebuild. You want to join a junior volunteer team, but first you must impress the selection panel.

Your challenge is to design and build a model of an earthquake-resistant building. You may choose the type of building: a house, a public building such as a school or perhaps an apartment block. As part of your STEM investigation, you will find out about the structure of the Earth, the cause of earthquakes, flexible building, and important features to think about when designing earthquake-resistant buildings.

KEY UNDERSTANDINGS

- The Earth has five layers: inner core, outer core, lower mantle, upper mantle and crust.
- The Earth's crust is made up of many pieces, called tectonic plates.
- Tectonic plates move against each other.
- The surface where one plate slips past another is called the fault or fault plate.
- When plates slide against each other, this creates earthquakes.
- The hypocentre is the location below the Earth's crust where an earthquake starts.
- The epicentre is on the Earth's surface, directly above the hypocentre.
- Buildings that are flexible are more likely to withstand an earthquake.

KEY VOCABULARY

- earthquake-resistant
- epicentre
- fault
- hypocentre
- magnitude
- tectonic plate



KEY SKILLS

- Make careful observations.
- Consider different points of view.
- Develop research skills.
- Transform an idea into something that can be seen.



KEY ACTIONS

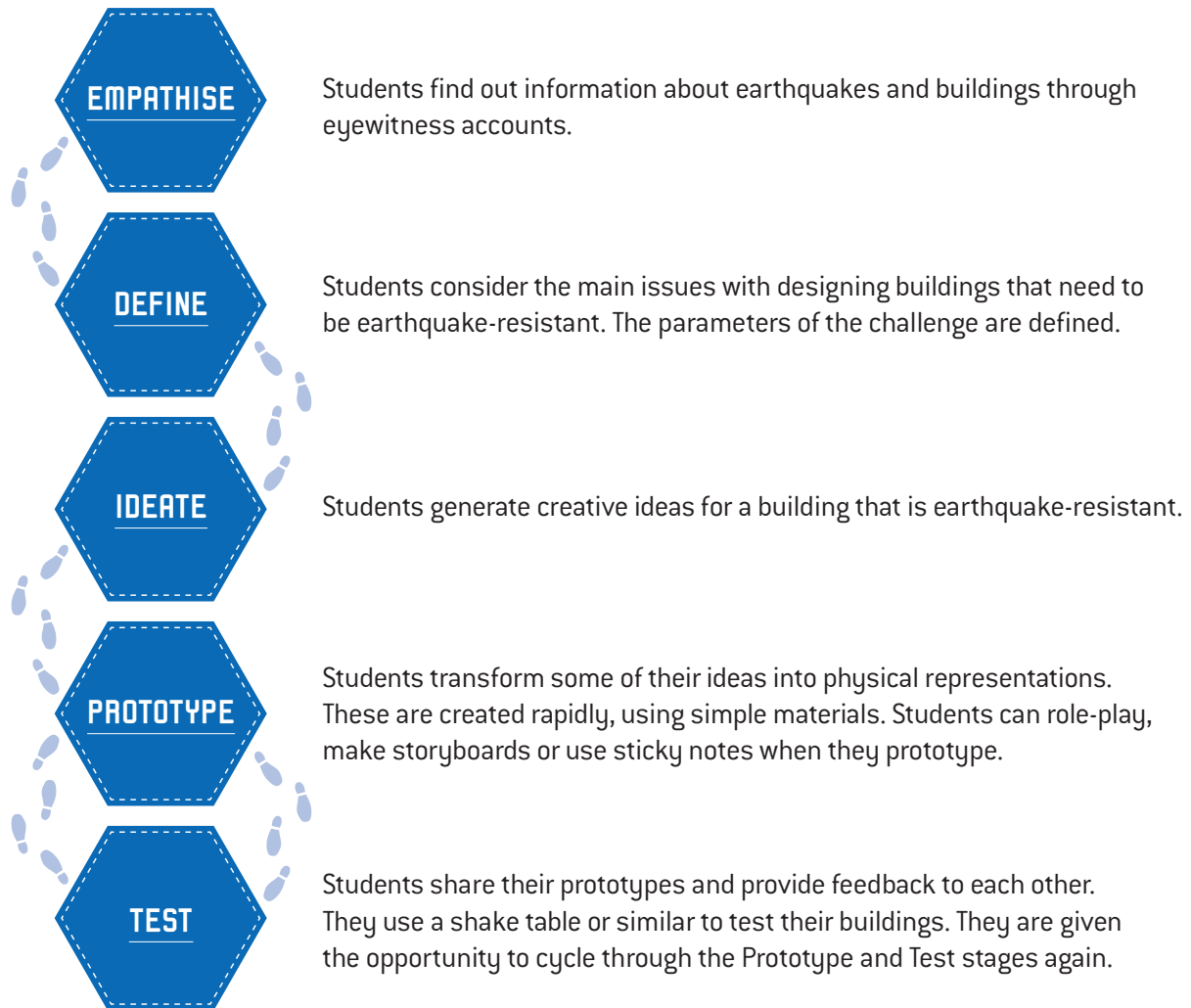
- Find out information from eyewitnesses of earthquakes.
- Experiment with different shapes and materials.
- Explore ways of making a structure strong and flexible.
- Design a way to create a building that can stay standing when the ground vibrates.



→ OVERVIEW OF STAGES

TUNE IN:

- Share an introductory video about earthquakes.
- Discuss students' understandings of what an earthquake is, how it occurs and the impact it can have, and establish prior knowledge.
- Explore the structure of the Earth, how earthquakes occur, the types of structures that can survive earthquakes and the science behind this.
- Provide students with the STEM Investigation challenge card.



SHARE AND EVALUATE:

Final prototypes are shared and evaluated, with opportunities for expert feedback.

→ SUGGESTED SCHEDULE

LESSON	STAGE
1–3	Tune in: share information about earthquakes; explore the structure of the Earth, how earthquakes occur and the features of buildings that survive earthquakes; introduce the student challenge
4–5	Empathise: learn about earthquakes through different eyewitness accounts over time; empathise and write/record in journal
6	Define: define the main issues and write/record in journal
7	Ideate: develop ideas and write/record in journal
8–10	Prototype and Test: conduct prototyping and testing cycles, and write/record in journal
11–13	Share and evaluate: share and evaluate designs and prototypes

DESIGN A QUAKE-RESISTANT BUILDING

→ CURRICULUM LINKS

The following tables show the key Science, Technologies and Mathematics curricula with which this STEM investigation is aligned.

SCIENCE

YEAR	STRAND	SUB-STRANDS AND CONTENT
6	Science Understanding	Earth and space sciences: <ul style="list-style-type: none"> Sudden geological changes and extreme weather events can affect Earth's surface
6	Science as a Human Endeavour	Use and influence of science: <ul style="list-style-type: none"> Scientific knowledge is used to solve problems and inform personal and community decisions
5 & 6	Science Inquiry Skills	Questioning and predicting Planning and conducting Processing and analysing data and information Evaluating Communicating

TECHNOLOGIES

YEAR	STRAND	CONTENT
5 & 6	Design and Technologies Knowledge and Understanding	<ul style="list-style-type: none"> Investigate characteristics and properties of a range of materials, systems, components, tools and equipment, and evaluate the impact of their use
	Design and Technologies Processes and Production Skills	<ul style="list-style-type: none"> Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions Generate, develop and communicate design ideas and processes for audiences using appropriate technical terms and graphical representation techniques Select appropriate materials, components, tools, equipment and techniques, and apply safe procedures to make designed solutions Negotiate criteria for success that include sustainability to evaluate design ideas, processes and solutions Develop project plans that include consideration of resources when making designed solutions individually and collaboratively

MATHEMATICS

YEAR	STRAND	SUB-STRANDS
5 & 6	Measurement and Geometry	Using units of measurement Geometric reasoning

→ OTHER CURRICULUM LINKS

AC

GENERAL CAPABILITIES

- Literacy
- Numeracy
- Information and Communication Technology (ICT) Capability
- Critical and Creative Thinking

→ ASSESSMENT

The following resources are provided for assessing students at different stages of the STEM investigations:

- Generic reproducible 1 (Key vocabulary table), for assessing understanding of vocabulary
- Generic reproducible 2 (Self-evaluation), for student self-evaluation of the learning process
- Generic reproducible 3 (Responding to the investigation), for assessing student engagement in the challenge, and the collaboration and skills involved in the design thinking stages
- Generic reproducible 5 (Design thinking assessment rubric), for evaluating student engagement in the design thinking stages
- Learning journal templates 1, 2, 3 and 4, for incorporating student reflection and evaluation

→ GETTING READY FOR THE INVESTIGATION

You can prepare yourself and students for this STEM investigation in the following ways:

- Identify groups of students who will work well together.
- Investigate the **Useful apps**.
- If possible, open a class account for an app that creates multimedia presentations, such as Adobe Spark Video. (Students are not old enough to use an individual account so a class account should be used.)
- Review the **Key science knowledge** that supports this investigation, and look at the **Useful links**.
- Gather materials for the shake table, if building one.
- Start collecting materials for prototyping (as shown on the **Materials needed** list).
- Determine where prototypes will be kept between lessons.
- Create a wall space where students can share their ideas during the Ideate stage.
- Organise the class into pairs.
- Start thinking about:
 - » how the buildings will be evaluated, if not building a shake table
 - » who will view the designs
 - » who will provide expert feedback about the designs, and whether it will be provided in person or in digital form
 - » who could assist with building a shake table.

USEFUL APPS

- App for creating semantic maps (links between different words and/or concepts), such as Popplet
- App for creating multimedia presentations, such as Adobe Spark Video and iMovie
- App for creating interactive links (for example, between descriptions, videos, images and websites and a main image), such as ThingLink
- App for creating infographics, such as Canva

MATERIALS NEEDED

- Sticky notes (half a pad per pair)
- Paper
- Coloured card
- Pens and markers
- Sticky tape
- Pipe-cleaners
- Cardboard
- Paperclips
- Other building materials, such as recyclable packaging, boxes, tubes
- For the shake table (link to instructions at **Useful links**):
 - » Cardboard box
 - » Strong card
 - » Rubber bands
 - » Zip tags (cable ties)
 - » Scissors
 - » Double-sided foam tape
 - » Battery pack with batteries
 - » Motor
 - » Gear
 - » Sticky foam circles
 - » Foam circle with the middle cut out
 - » Washer
 - » Craft sticks/icypole sticks

USEFUL LINKS

- Information about where earthquakes happen, such as information about the US Geological Survey at <http://mea.digital/su43>
- An introduction to earthquakes, such as at <http://mea.digital/su44>
- Information about the San Francisco earthquake of 1906, such as at <http://mea.digital/su45>
- Information about earthquake-safe buildings and structures, such as at <http://mea.digital/su46>
- Discussions about whether you can earthquake-proof a city, such as at <http://mea.digital/su47>
- Earthquake shake table instructions, such as at <http://mea.digital/su48>
- Information about how earthquakes are measured, such as at <http://mea.digital/su49>
- Japanese pagodas during earthquakes, such as at <http://mea.digital/su50>
- Information about the structure of the Earth, such as at <http://mea.digital/su51>

RESOURCES PROVIDED

- Generic reproducibles 1, 2, 3, 4, 5
- Reproducibles 3.1, 3.2, 3.3
- Learning journal templates 1, 2, 3, 4 (on disc)

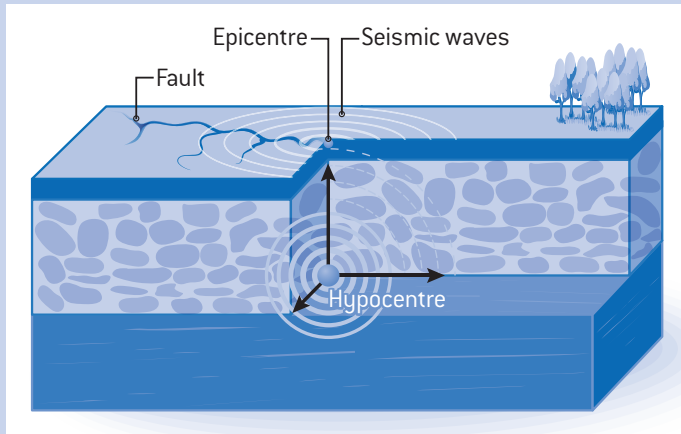
KEY SCIENCE KNOWLEDGE

This section provides an overview of the key science concepts and vocabulary needed for this unit.

WHAT CAUSES EARTHQUAKES?

The Earth is made up of several layers. One of these is the core, which is at the centre of the Earth and consists of molten lava. The crust is the surface layer of the Earth and consists of many pieces, called plates or **tectonic plates**.

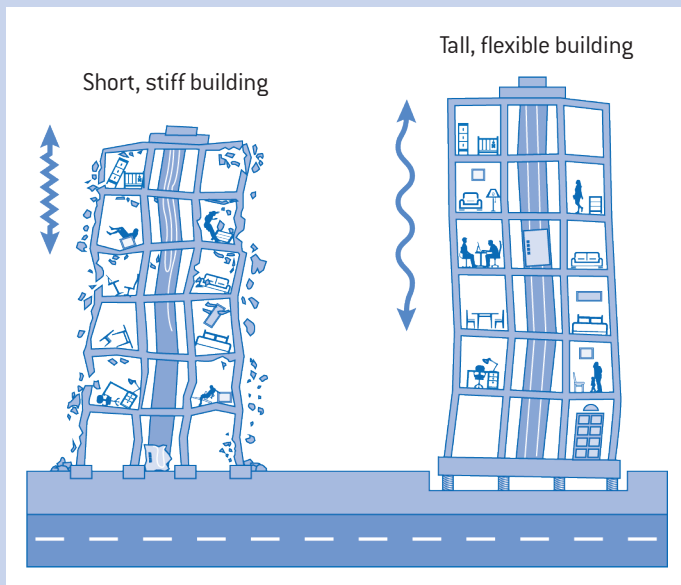
An earthquake occurs when plates slide past each other along a break in the crust called a **fault**. Energy is transferred from one plate to another, causing the plates to vibrate. The **hypocentre** is the location beneath the Earth's crust where the earthquake started. The **epicentre** is the location on the Earth's surface (crust) directly above the hypocentre. The most common way to measure earthquakes is the Richter scale. This scale measures their size, or **magnitude**.



An earthquake starts at a hypocentre beneath the Earth. The epicentre is on the surface of the Earth.

HOW DO EARTHQUAKES CAUSE DAMAGE?

Many buildings collapse during an earthquake due to the way they were constructed and how tall they are. Some buildings are more **earthquake-resistant** than others. When the Earth vibrates, a structure made of rigid materials will vibrate quickly, like the earthquake vibrations, and it can snap. Tall buildings and those made with less rigid materials are more flexible. They sway more slowly than an earthquake's movement, so they are more likely to remain standing. Very tall buildings contain dampers, which help to control the shock of the vibrations. A damper reduces vibration, which occurs when there is an earthquake. There are different types of dampers. Some might be a large mass at the top of a building (a tuned mass damper). Others could be a series of plastic rings at the base of a building that absorb shock waves.



Taller buildings made with flexible materials and rubber springs sway slowly and are better at withstanding earthquakes. Short buildings made with stiff materials and concrete foundations vibrate quickly.

KEY VOCABULARY

- earthquake-resistant** – more likely to survive an earthquake than standard structures
- epicentre** – the point on the Earth's surface directly above the underground focus of an earthquake
- fault** – a break in the rocks that make up the Earth's crust (outer layer)
- hypocentre** – the point underground where an earthquake begins
- magnitude** – the size of an earthquake
- tectonic plate** – a massive slab of solid rock (part of the Earth's crust) that moves and sometimes fractures



→ TUNE IN

1. Ask students to complete **Generic reproducible 1 (Key vocabulary table)** using the key vocabulary for this unit: epicentre, fault, hypocentre, magnitude, earthquake-resistant, tectonic plate. This reproducible will also be used at the end of the unit to demonstrate changes in understanding.
2. Watch the National Geographic online video 'Earthquakes 101' (see **Useful apps/links**), or a similar introduction to earthquakes.
3. Discuss what students observed and learned.
4. Before engaging in the challenge, students need to have an understanding of the Earth's structure, how an earthquake occurs and some of the scientific concepts behind earthquake-resistant buildings. Set up the following three activities (or similar) for students.

ACTIVITY 1: THE EARTH'S STRUCTURE

- 1 Provide students with a link to information about the structure of the Earth (see **Useful apps/links**).
- 2 Ask students to create an infographic explaining the key features of the Earth's structure. They could draw the structure on paper, create their own diagrams on the computer, or use an app such as ThingLink to annotate an image found online and share their understandings.
- 3 Ask pairs of students to take turns explaining different features of the Earth's structure (for example, the core, the crust).

ACTIVITY 2: A PAGODA'S EARTHQUAKE-RESISTANT FEATURES

- 1 Watch an online video about what happens to Japanese pagodas during earthquakes (see **Useful apps/links**).
- 2 Discuss the key information presented in the video, focusing on the flexibility of the pagoda.
- 3 Provide students with paper, scissors and tape to experiment with simple, flexible designs.

ACTIVITY 3: SHAKE TABLE

- 1 Provide students with a link to an online video explaining how to make an earthquake shake table (see **Useful apps/links**). Give them the materials required to create the shake table (as shown in the online video). Decide how many shake tables to create and group students accordingly.
- 2 Ask students to follow the instructions in the video. Remind them to pause the video at the end of each instruction, and replay to check they understand the instruction.
- 3 If students are not able to complete this activity, brainstorm some ways that the class could create a machine to test the earthquake resistance of the buildings they are going to design.

5. Introduce the STEM investigation and challenge to the students. Provide them with the student card and read the information together.
6. Introduce the design thinking process by reviewing the stages on the student card.
7. Explain that students will keep a journal about their learning at the different stages of the design.

TOP TIP!

During the Tune-in sessions, conduct vocabulary activities to highlight and develop key vocabulary knowledge. Activities could include drawing semantic webs, creating a word wall or paired discussions. Check **Key vocabulary** definitions or read the **Key science knowledge** if you need a refresher on the key terms and concepts.

USEFUL APPS/LINKS

- Japanese pagodas during earthquakes, such as at <http://mea.digital/su52>
- Information about the structure of the Earth, such as at <http://mea.digital/su53>
- Instructions to make an earthquake shake table, such as at <http://mea.digital/su54>

DESIGN A QUAKE-RESISTANT BUILDING

→ EMPATHISE

During the Empathise stage of the design thinking process, students focus on considering different points of view. To empathise with others, they need to research some of the experiences that people have had. Students will take notes, ask questions, draw diagrams and take photos where relevant.

ACTIVITY 1: SAN FRANCISCO EARTHQUAKE EYEWITNESS, 1906

- 1 Provide students with the link to a boy's written observations and reflections on a large-magnitude earthquake in San Francisco in 1906 (see **Useful apps/links**). Read this together or in small groups.
- 2 Provide students with **Reproducible 3.1 (San Francisco eyewitness)** to record the key information and responses of Lloyd Head, the boy who wrote of his experiences.

ACTIVITY 2: NEPAL EARTHQUAKE EYEWITNESSES, 2015

- 1 Organise students into pairs and provide them with **Reproducible 3.2 (Nepal eyewitness)**.
- 2 Provide students with a link to the BBC News article 'Nepal Quake: Eyewitness Accounts' (see **Useful apps/links**). This article contains three eyewitness accounts of a 7.8 magnitude quake in Nepal in 2015. A second BBC News article (see **Useful apps/links**) gives seven eyewitness accounts of another quake in Nepal a few weeks later. Allocate each student pair a different eyewitness and ask them to record the key information on **Reproducible 3.2**.
- 3 Ask students to share different accounts between pairs.
- 4 Ask students, as a class, if they have experienced an earthquake or if they know of anyone who has. Organise time for people to speak with the class about their experiences.

Sensitivity is required here. Some students might not be prepared to discuss their personal experiences around earthquakes, or those of family members or friends.

ACTIVITY 3: EMPATHISE

- 1 Provide students with **Reproducible 3.3 (Eyewitness comparison)**. Ask them to consider the information provided by eyewitnesses from activities 1 and 2.
- 2 Students should record the similarities and differences of the eyewitnesses' experiences.
- 3 Ask students to generate words that describe how people felt. They can create a semantic map on paper or by using an app such as Popplet.

PROMPTS

- What feature of the earthquake made the most impact on your eyewitness? Why do you think this?
- What are some of the words people used to describe the earthquake?
- What were people concerned about?
- How did people react?

MORE VOCABULARY

- empathise – understand and consider another person's or group's point of view
- eyewitness – someone who has seen something happen
- point of view – an opinion, attitude or judgement considered in a particular way

JOURNAL TIP

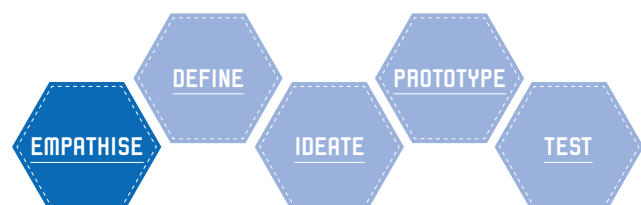
Ask students to complete **Learning journal template 1 (Empathise page)** while they are completing the different tasks. Remind them to date their notes and include photos or illustrations of relevant information.

USEFUL APPS/LINKS

- App to gather information when making observations, such as Popplet
- Eyewitness account of the 1906 San Francisco earthquake, such as 'One Boy's Experience' at <http://mea.digital/su55>
- Eyewitness accounts of the 2015 Nepal earthquake such as at <http://mea.digital/su56> and <http://mea.digital/su298>

ASSESSMENT

This stage of the design thinking process offers opportunities to observe students collecting information, developing questions, and recording their notes and thinking in their journal.



→ DEFINE

The main focus of this stage of the design thinking process is to reframe the challenge. The initial challenge is quite open, so at this stage students learn how to define what needs to be done. This includes noting insights that have been generated.

ACTIVITY 1: CONSIDER OBSERVATIONS

- 1 Students consider the information they gathered in the Empathise stage. They may work in pairs or small groups. Provide them with a whiteboard, large sheet of paper and/or sticky notes to collate some of their key information. They should refer to their information on **Reproducible 3.1 (San Francisco eyewitness graphic organiser)** and **Reproducible 3.2 (Nepal eyewitness graphic organiser)**. Students should then transfer the main findings to **Learning journal template 2 (Define page)**.
- 2 Students should discuss one section of **Learning journal template 2** at a time, write their responses and then continue discussing their ideas for the next section, until the task is complete. This provides students with opportunities to hear others' responses and it provides the teacher with input points.
- 3 Provide students with the opportunity to research further. Ask them to write other information they would like to know. Provide them with **Generic reproducible 4 (Key question table)** to assist them to record their questions, findings and sources.

ACTIVITY 2: CONSIDER INSIGHTS

Students should think of at least one insight they have gained from the process; for example, the shaking of a building is a very frightening experience. Students should add this insight to **Learning journal template 2**. They should then explain how this will affect the design of their model.

When considering insights, students could think about the following:

- What was something unexpected that you saw or found out? How was it unexpected?
- How will you decide on the most important aspect of your model?
- Is there any other information that you need or would like to know? How will you find out?

ACTIVITY 3: CONSIDER CONSTRAINTS

At this stage, let students know the constraints of the challenge by describing the types of materials that will be available and how students will test the building's flexibility when it is vibrated. Students can then update **Learning journal template 2**.

PROMPTS

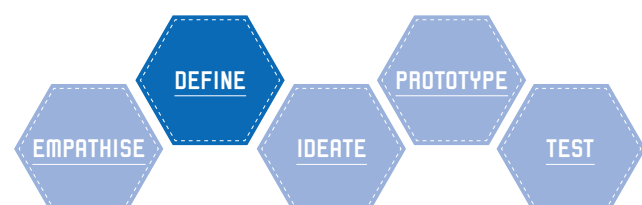
- What did you discover?
- What were the most important pieces of information that you gathered?
- What was something new that you learned?
- What other information do you need?

MORE VOCABULARY

- define – state the meaning of something
- insight – an accurate understanding of someone or something

JOURNAL TIP

Discuss the term 'insight'. Explain that it relates to something students have learned about the people and situations they read about.



DESIGN A QUAKE-RESISTANT BUILDING

→ IDEATE

The Ideate stage of the design thinking process is all about generating lots of ideas. Students need to be flexible in their thinking and be able to move beyond obvious ideas. At this stage, ideas are not judged, just generated and gathered.

ACTIVITY: GENERATE IDEAS

- 1 Ask groups of students to draw or write their ideas.
- 2 Each new idea should be written or drawn on a separate piece of paper or sticky note.
- 3 Ask students to group ideas on a wall or board.
- 4 Ask students to look at the different ideas and provide feedback to each other. It is important that students don't defend their ideas at this stage. They should just be listening to the feedback.
- 5 After the initial feedback, ask students to come up with more ideas. Encourage them to be creative and even radical.
- 6 Ask students to choose four of their ideas to write in their journal. Students use **Learning journal template 3 (Ideate page)** to do this. Ask students to choose one idea to explore further and explain the reasoning behind their choice.

At this stage, students may have produced a series of drawings that are annotated. They may have a collection of sticky notes, which they can organise into related ideas.

Encourage students to view and read others' ideas before giving feedback. Feedback could be within small groups or between partners. Considering others' ideas is an important part of this process, so students can build on their own ideas as they continue to ideate.

At each stage of this activity, ask students to discuss their thoughts before writing their responses. This will help them to think through their ideas and select their final ideas to develop.



PROMPTS

- How do your chosen ideas relate to earthquakes?
- How might you test your design?
- How can you make it more flexible?
- How can you make it a different shape?
- What if you had to use different materials?

MORE VOCABULARY

- feedback – information about, for example, a person's performance or the design of a product, which can be used to make improvements
- ideate – generate many ideas without making judgements about the ideas

JOURNAL TIP

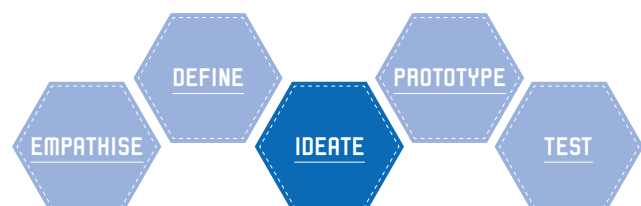
When choosing four ideas to include in the journal, students should try to choose ideas that aren't related.

USEFUL APPS/LINKS

- Tools for creating ideas, such as at <http://mea.digital/su57>
- Tips for creativity and innovation, such as at <http://mea.digital/su58>

ASSESSMENT

At the Ideate stage, assessment could include observations about the number and diversity of students' ideas, and their ability to provide feedback and create additional ideas. Reflection in the journal should provide an insight into some of the reasoning behind students' choices.



→ PROTOTYPE

At this stage of the design thinking process, students are asked to create a physical prototype of a solution. It is the stage where students need to get their ideas out of their head and presented in a way that engages other students and helps them to understand the concept. When students create, it helps them to think and solve problems and disagreements. Students can role-play, make storyboards or use sticky notes when they prototype. The most important feature is that viewers can interact with whatever is produced.

ACTIVITY: TRANSFORM IDEAS INTO PROTOTYPES

- 1 Ask students to choose one idea, and perhaps one aspect of that idea, to prototype.
- 2 Provide students with a range of materials to use to create their prototype. Remind students that a prototype should be created rapidly and is not meant to look 'nice'.
- 3 After a prototype has been created, ask students to see if it works and get feedback from others.
- 4 Students then use the feedback to prototype again.

Ask students to fill in the Prototype part of **Learning journal template 4 (Prototype and test page)**. See the **Journal tip** for further student guidance.

The Prototype stage is often very messy. It is important that students are focusing on their ideas, rather than the end product. Provide them with lots of materials – recycling depots can be a useful source of resources. Students may add labels to prototypes to explain some of the main features. Photographing and annotating pictures of prototypes can be useful.

To gain feedback, students could ask each other some of the following questions:

- What is the main feature of your prototype?
- How does your prototype work?
- Which aspects work best? What will you keep?
- Which aspects need changing? How might you do this?
- What other materials might you need?



PROMPTS

- What worked?
- How could it be improved?
- What else do you need to know, do or have?
- What other suggestions do you have?

MORE VOCABULARY

- feedback – information about, for example, a person's performance or the design of a product, which can be used to make improvements
- prototype – an initial version of a model of a product or process that is used to develop a final model

JOURNAL TIP

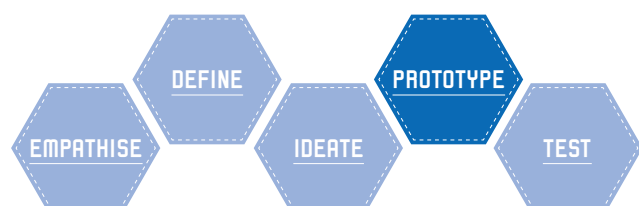
Remind students to highlight the main features of their prototype. If students are creating an electronic journal, they can insert a photo of their prototype and annotate it.

USEFUL APPS/LINKS

- App that can be used for a learning journal, allowing students to draw, link, type and record information, such as Notability
- App that can be used to create an interactive annotation of the prototype, such as ThingLink

ASSESSMENT

Observe students as they make changes to their designs. Are they able to consider feedback, make modifications and move rapidly through this process? Or do they have difficulties with holding on to an idea and accepting feedback?



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→ TEST

At this stage of the design thinking process, students test their prototype to see if it meets the requirements of the audience or user. Students check to see if their prototype meets the criteria set at the start of the design process.

ACTIVITY: TEST FEEDBACK

- 1 Students take their last prototype and consider the original design challenge.
- 2 Ask students to check whether or not their design works. If not, what do they need to do to make it work?
- 3 Provide the opportunity to cycle through the Prototype and Test stages again.

Ask students to fill in the Test part of **Learning journal template 4 (Prototype and test page)**. See the **Journal tip** for further student guidance.

PROMPTS

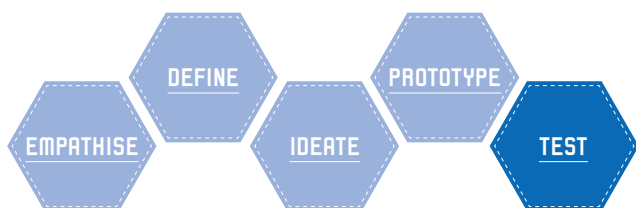
- Does your prototype do what you wanted it to do?
- Does it have additional features that might be useful in an earthquake-prone area?

MORE VOCABULARY

- evaluate – assess something, perhaps considering what worked and what didn't
- feature – a specific aspect of something, such as size, shape, colour, quality
- feedback – information about, for example, a person's performance or the design of a product, which can be used to make improvements
- prototype – an initial version of a model of a product or process that is used to develop a final model
- review – consider an idea, process or product and assess what works and what needs to be changed

JOURNAL TIP

Ask students to think about why it is important to test their ideas before they build their final design.



→ SHARE AND EVALUATE

At this stage of the investigation, students are provided with an opportunity to share their final design, as well as the processes involved in the investigation. Students evaluate their learning journals and their solutions.

ACTIVITY 1: BRING THE DESIGNS TOGETHER

- 1 Provide students with time to create their final designs.
- 2 Encourage them to film the process during prototyping and testing.
- 3 Students can create an iMovie or use Adobe Spark Video (via a teacher-created class account) to demonstrate the process and thinking behind the designs.
- 4 Students should include their learning journals with the display so others can see the different stages of the design process.

ACTIVITY 2: EVALUATE AND GIVE FEEDBACK

- 1 Provide students with **Generic reproducible 2 (Self-evaluation)** to complete.
- 2 Ask students to provide feedback to each other about the most interesting features, the aspects that were most difficult and the changes that they would make if they repeated the task.
- 3 Provide students with opportunities to share their designs with the wider community. This could include inviting someone from Engineers Without Borders, a parent with relevant experience or another external professional. It may be possible to share some of the videos with an expert for feedback about the designs.

ASSESSMENT

Ask students to again complete **Generic reproducible 1 (Key vocabulary table)** using the key vocabulary for this unit: epicentre, fault, hypocentre, magnitude, tectonic plate, earthquake-resistant. Compare their table with the one they completed at the Tune-in session, to demonstrate changes in understanding.

Students complete **Generic reproducible 3 (Responding to the investigation)**. Compare students' responses to those on **Generic reproducible 2**.

Teachers and students each complete **Generic reproducible 5 (Design thinking assessment rubric)**. Students compare the feedback they are given by the teacher with their self-assessment of their design thinking skills.

Name:

Date:

Read about Lloyd Head's account of the earthquake in San Francisco in 1906.

Use the table to write some notes about what he observed and heard.

Also write how he felt at the time.

Description of the earthquake
(sounds, sights)

Words to describe how Lloyd felt
during and after the earthquake

Name:

Date:

Read about one of the eyewitnesses to the earthquake in Nepal.
Think about the following questions and write some notes for each.

What did the person notice?

What did the person do?

What did the person think?

How might you have reacted in this situation?

Name:

Date:

List the main findings from your research and eyewitness accounts.

San Francisco earthquake 1906

Nepal earthquakes 2015

What are some similarities between the earthquakes?
What are some differences?

What do these accounts teach you to think about when designing
an earthquake-resistant building?