

SHAKE IT UP (LEVEL 3)

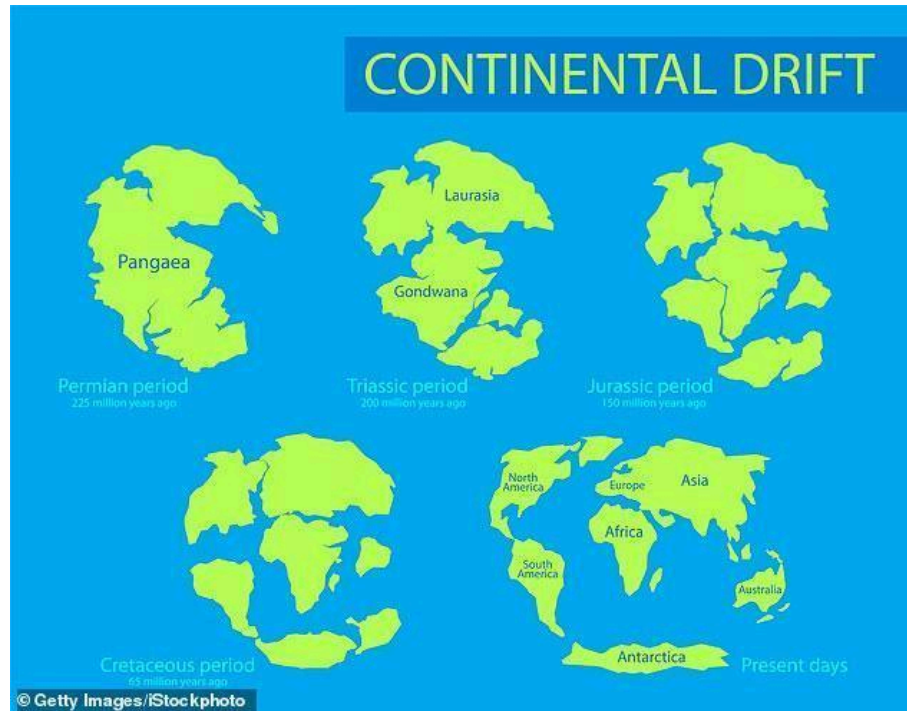
Description	Learners will begin to understand the way the Earth is designed as tectonic plates, how mountains form, what earthquakes are and how we respond to them!
Leading Question	How would you keep your community safe if there was an Earthquake?
Total Time Required	6 hours total over 5 days
Resources Required	Pens – Paper, Boiled Egg, Biscuits / Clay, Tub, Desks / Tables, Cardboard, Scissors, Styrofoam, Glue, 2 desks or tables, 1 coin, Pencil or Marker, A stack of heavy books, A ruler, A piece of cardboard, 3 rubber bands and paper Extension Materials: Vinegar, Baking Soda, Empty Plastic Bottle and a World Map
Subjects	Science, Art and Design, Literacy
Learning Outcomes	By the end of this project, learners will be able to: <ol style="list-style-type: none"> 1. Discuss how the earth was formed and explore tectonic plates and the various layers of the Earth 2. Discuss how the movement of the tectonic plates leads to the formation of geographical features 3. Explore ways in which they can develop earthquake-resistant structures 4. Identify any risks or dangerous areas and items within their homes and come up with earthquake preparedness protocols for their homes
Previous Learning	Basic knowledge on the world map
Self-guided/ Supervised activity	High

DAY 1

Today you will learn about the earth!

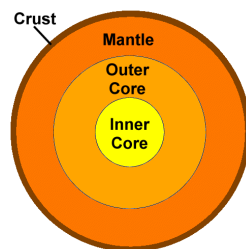
Time	Activity and Description
15 minutes	<ul style="list-style-type: none"> ● Reflect on how you think the Earth's surface and continents formed. ● Take pieces of biscuit, clay or any object that floats and create minor cracks on the surface without breaking them into pieces.

- Take a tub/cup/bowl of water and float the biscuit, clay or other object on a tub of water.
- Observe how the pieces keep splitting into smaller pieces just like the Earth's crust. The way these biscuit or clay pieces split and move is just how the Earth's supercontinent Pangaea split into the current different continents.
- The image below demonstrates how earth was one big continent called Pangaea at the beginning and then it split into different continents.

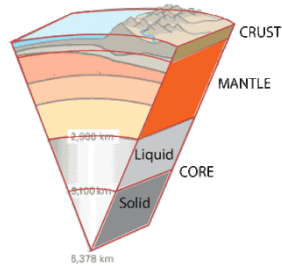


30 minutes

- It may seem like the Earth is made up of one big solid rock, but it's really made up of several parts. Some of them are constantly moving! You can think of the Earth as being made up of several layers, sort of like an onion.
- See the picture below to see the four main layers of the earth: the crust, mantle, outer core, and inner core.



Obtained from: https://www.ducksters.com/science/composition_of_the_earth.php



Obtained from:

https://www.usgs.gov/natural-hazards/earthquake-hazards/science/science-earthquakes?qt-science_center_objects=0#qt-science_center_objects


- **1st layer - Crust:** The crust is the thin outer layer of the Earth where we live. The crust varies from around 5 km thick (in the ocean floor) to around 70 km thick (on land where we live called the continental crust). This is where we live, on pieces called plates.
- **2nd layer - Mantle:** The next layer of the Earth is called the mantle. The mantle is much thicker than the crust at almost 3000 km deep.
- **3rd Layer – Core**
 - **Outer Core:** The Earth's outer core is made up of iron and nickel and is very hot (4400 to 5000+ degrees C). This is so hot that the iron and nickel metals are liquid!
 - **Inner Core:** The Earth's inner core is made up of iron and nickel, just like the outer core, however, the inner core is different. The inner core is so deep within the earth that it's under immense pressure. So much pressure that, even though it is so hot, it is solid.

20 minutes

Layers of the Earth Activity:

- Boil an egg with the help of your parents.
- Step 1: With the boiled egg, begin by peeling the shell of the egg off. Think about the shell like the first layer of the earth. What is the first layer of the earth? (*Answer: The Crust*).

	<div data-bbox="737 264 1042 579" data-label="Image"> </div> <ul data-bbox="425 590 1393 695" style="list-style-type: none"> ● Step 2: The next layer of the egg is the white of the egg. It is the middle layer. Think about the white of the egg as the second layer of the earth. What is the second layer of the earth? (<i>Answer: The mantle</i>) <div data-bbox="732 695 1047 1018" data-label="Image"> </div> <ul data-bbox="425 1031 1382 1136" style="list-style-type: none"> ● Step 3: The only portion of the egg remaining is the layer at the center of the egg. Think of this layer as the last two layers of the earth combined. What is the last (inward) layer of the earth? (<i>Answer: The core</i>) <div data-bbox="732 1136 1050 1459" data-label="Image"> </div>
<p>10 minutes</p>	<ul data-bbox="425 1482 1386 1661" style="list-style-type: none"> ● Think about how the Earth is like a jigsaw puzzle ● Draw and design your own map of the Earth as a jigsaw puzzle with 15 pieces on a piece of paper or Cardboard (representing the 15 plates). ● Draw or trace one below or use your own imagination of the various continents.

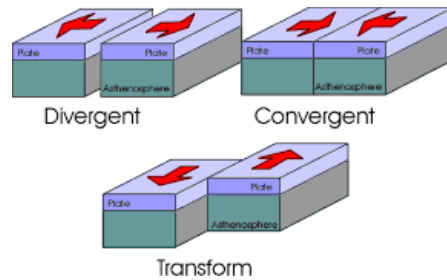
	 <ul style="list-style-type: none"> ● Paint over your world map with blue representing the oceans and label the ones that you know ● Depict the continents and land in green or a chosen color and label the ones that you know ● The jigsaw puzzle pieces drawn above represent the tectonic plates of the earth. A tectonic plate is a massive, irregularly shaped slab of solid rock, generally composed of both continental and oceanic surface. The tectonic plates are a combination of the crust and the outer mantle.
<p>10 minutes</p>	<p>Reflection: Thinking about the activities today, can you tell us:</p> <ul style="list-style-type: none"> ● Two things you have learned from today ● One thing you found interesting ● One thing that you still have a question about <p>Parents/educators will ensure to respond to your questions where possible.</p>

DAY 2

Today you will learn about how the earth can be like a puzzle.

Time	Activity and Description
<p>5 minutes</p>	<ul style="list-style-type: none"> ● Step on the ground. Do you think the ground beneath our feet is moving? Can you feel it move? Let's learn about it!
<p>15 minutes</p>	<ul style="list-style-type: none"> ● Even though we cannot feel it, tectonic plates move less than 3 inches (about 17 cm) per year. These plates slide over each other to cause friction that in most cases creates Earthquakes, mountains and ridges. ● There are three types of plate boundary movements: <ul style="list-style-type: none"> ○ divergent: plates moving apart ○ convergent: plates coming together ○ transform: plates moving past each other

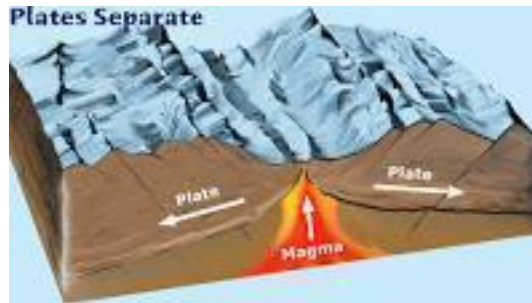
- See the diagram below:




15 minutes

Understanding the three different types of movements:

- Do some experiments to help us understand the different types of movement of the plates and the geographical features such as mountains, earthquakes and ridges.
- Ridges are formed by divergent boundary movements.

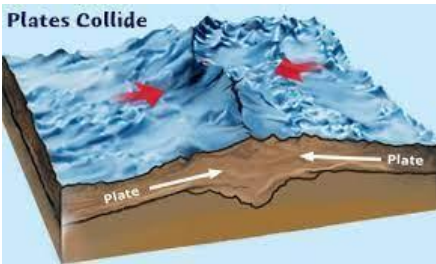





- We will first learn about ridges that are caused by divergent plates (plates that move away from each other).
- Place two desks or tables with their ends touching each other - these represent two tectonic plates that are moving away from each other and the papers represent the magma underneath that will form new crust in the gap that is made by the separation of the plates
- Place two pieces of paper vertically into the gap between the desks. Leave just enough of the papers sticking out so that there is something to pull out
- Slowly pull the papers out from the gap, spreading the papers apart onto the desks as you go. Make sure that both papers are pulled at the same speed
- Use a pen to draw a stripe of color on both pieces of paper at the ridge. This stripe of color represents the new rock that is formed at the ridge.
- Continue to pull the papers and draw more stripes in alternating colors to represent subsequent time periods. Make sure each new stripe extends on both pieces of paper.
- The result should be a mirror-image set of colored stripes, representing how the new crust forms as an ocean floor as two plates move away from one another.

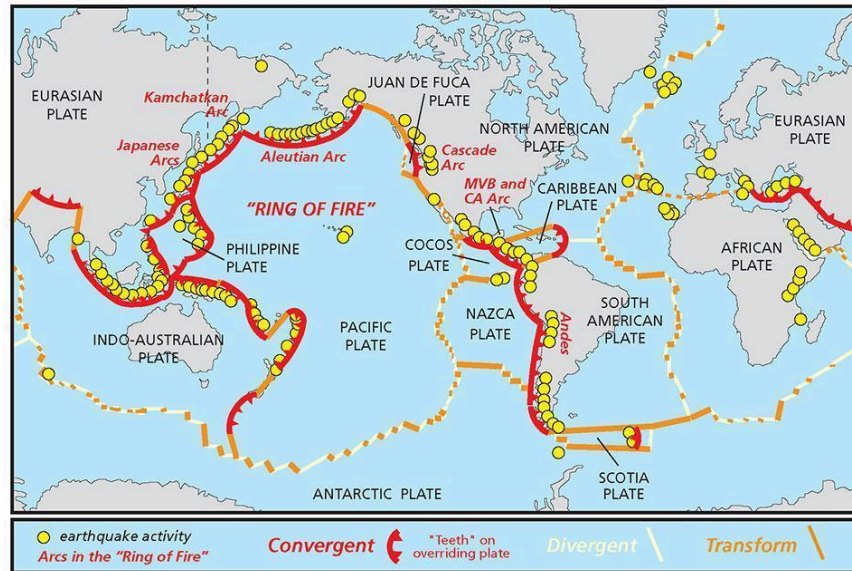
<p>15 minutes</p>	<p><u>Understand how earthquakes are formed by transformative boundary movements:</u></p>  <p>The diagram shows two brown rectangular blocks representing tectonic plates. They are positioned horizontally and are sliding past each other in opposite directions, as indicated by red arrows on their top surfaces. The word 'plate' is written on the side of each block. The background is a light blue sky.</p> <ul style="list-style-type: none"> ● Transformative plates that slide over each other and cause friction creates Earthquakes in most cases. <ul style="list-style-type: none"> - Place your hands-on top of each other's palms facing downwards. The palm of your upper hand should be touching the back of your other hand. - Now rub your hands in this position and notice how your left hand moves to the right and right hand moves to the left. The heat created when the hands rub represents the friction created when the transformative plates slide over each other. In most cases, this creates an earthquake as the crust shakes.
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DAY 3

Today you will understand how earthquakes and mountains are formed and earthquakes happen.

Time	Activity and Description
<p>15 minutes</p>	<ul style="list-style-type: none"> ● You will also understand convergent plates movements when the plates collide with each other and form mountains.  <p>The diagram is titled 'Plates Collide'. It shows two brown rectangular blocks representing tectonic plates moving towards each other, as indicated by white arrows on their bottom surfaces. The word 'plate' is written on the side of each block. As they collide, a mountain range is formed between them, with red arrows pointing towards the peaks. The background is a light blue sky.</p> <ul style="list-style-type: none"> ● Hold up both your hands touching at the fingertips as shown in step 1.

	<ul style="list-style-type: none"> ● Each of your hands represents a different tectonic plate. Push your hands together from your wrists as shown in step 2 and observe how your fingers move upward to form a mountain as shown in step 3 (see images below for clarification). ● This is a representative of two plates colliding with each other – this is how the Himalayas and other mountains were formed when plates crashed against each other <p>Step 1:</p>  <p>Step 2:</p>  <p>Step 3:</p> 
<p>10 minutes</p>	<ul style="list-style-type: none"> ● Look at the map below. What do you see? - at the descriptive level, without any interpretation (e.g. “I see some yellow dots along some lines”, “I see some pieces of the image that are colored in blue”), think (e.g. “I think the yellow dots might be indicating something about the plates”), and wonder (e.g. “Why are the no dots in the east coast of North America?”) in relation to the map.

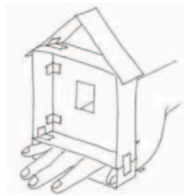


- The map shows the earthquake (yellow dots) and the different boundary plate movements that have occurred around the world.
- Answer the following questions:
 - What do you notice about the distribution of earthquakes?
 - What do you notice about the distribution of convergent, divergent and transform plate boundary movements?
 - Do you see any correlations or patterns?
 - Can you think of a possible explanation for the patterns you see?

DAY 4

Today you will create structures that are Earthquake resistant.

Time	Activity and Description
10 minutes	<ul style="list-style-type: none"> ● Have you ever experienced an earthquake? If yes, what did it feel like? If not, then you can interview your parents or an adult at home if they have ever experienced an earthquake and explain to you what it feels like. ● Some earthquakes are small, while others could be big and could destroy a house or an entire village. Today you will try to create structures that are Earthquake resistant.

	<ul style="list-style-type: none"> ● Check online or ask your parents/an adult at home on the danger and destruction a big earthquake can cause to a building or a place with weak structures.
40 minutes	<ul style="list-style-type: none"> ● Write a hypothesis on whether shorter or taller buildings are more Earthquake resistant. Prompt: Have you ever climbed a tree? Or observed a tree shaking? When it is windy, what part of the tree shakes more? <i>Hint: All buildings shake at the same frequency as the shaking of the Earth, but the movement is magnified as the building gets taller.</i> ● Make your own shake-tables to learn about strong and weak buildings through experimentation. Build a paper house from 3-cm wide strips of paper, scissors, and tape, as shown in the figure. 
10 minutes	<ul style="list-style-type: none"> ● Insert your hands into the base of the building and slide the building back and forth to see how the paper house sways and even collapses. ● Using extra sheets or paper, experiment with methods of strengthening your building by cutting out and taping paper walls, paper X shaped braces, or interior columns to your building. ● Older students can try building houses of two or three stories to determine how height affects a building in an earthquake or cyclone
40 minutes	<ul style="list-style-type: none"> ● Use Styrofoam (thermocool) as a base and construct a tower of any materials available at home such as paper or plastic cups. ● Design two towers: <ul style="list-style-type: none"> - The first tower will be deeply embedded into the base and have a broader base. Learners can use toothpicks, pins etc. to secure the tower into the base. - The second tower will not be as embedded into the base and has a narrower base
10 minutes	<ul style="list-style-type: none"> ● Try and shake the Styrofoam base to test which of the towers will not fall during an Earthquake. ● Shake the base with different levels of intensity to represent different magnitude or strength of Earthquake
10 minutes	<u>Critique and revision:</u>

	<p>Present and test the various structures developed to your parents or family members for feedback and suggestions for improvement. The parents or family members provide feedback using the following format:</p> <ul style="list-style-type: none"> ● Praise: What did you like about the learner’s work done? ● Question: Any questions or clarifications you have about the work? ● Suggestions: In what areas does the learner need to improve their work?
10 minutes	<ul style="list-style-type: none"> ● Reflect on what makes towers more resistant and write this down ● Consult the internet or your parents or an adult in your family if you are not sure of the responses. <ul style="list-style-type: none"> ○ Some of the answers may include: <ul style="list-style-type: none"> ▪ Reinforced walls ▪ Stronger and deeper building foundation ▪ Light roof

DAY 5

Today you will design your community/home emergency plan in the case of an Earthquake.

Time	Activity and Description
20 minutes	<ul style="list-style-type: none"> ● Imagine a violent shaking of the ground for a prolonged period of time; what do you need to do to make your house safe? Either check on the internet or ask your parent/adult in case they are not sure what to do in case of an earthquake. ● Possible responses: <ul style="list-style-type: none"> - Secure or reorganize the different household items to ensure safety - Create a family communication plan - Create an evacuation plan - Know the safe spots within each room - Hold family drills ● Identify the potential dangers around you in times of an Earthquake. Imagine a violent shaking of the ground for a prolonged period of time, what would be a hazard in your home? ● Prompts: What are the household items that are loosely attached and can fall easily? E.g. loose furniture etc. What are the items that can cause injury? E.g. hanging lights, windows etc.? What items have wheels and might move and hurt individuals?
20 minutes	<ul style="list-style-type: none"> ● Make a list of the items in your home and decide how to make your home safer. Draw three columns: 1) Household item, 2) Danger posed, 3) If an earthquake occurs: move, relocate, attach, anchor, replace, remove, fasten, secure, tie down, eliminate and change.

	<ul style="list-style-type: none"> Design your community emergency plan in the case of an earthquake. 		
No	Household Item	Hazard Posed	If an Earthquake occurs
1	Heavy Books on the Shelf	Heavy items can be displaced and can fall	Move the heavier items to the lower shelf
2	Hanging Glass Chandelier	Glass can be injurious	Secure the light and move bed or table from under this light
3	Lose Chest of Drawers	Not attached to the wall and can fall	Attaching the cabinet to the wall
20 minutes	<ul style="list-style-type: none"> Make a plan for your family with suggested changes to ensure they are aware of the hazards. Create a plan for evacuation or staying safely at home during an earthquake. Given that earthquakes can last as long as 2-3 minutes and be followed by aftershocks or smaller earthquakes, what would you consider the correct safety protocol to be? 		
15 minutes	<ul style="list-style-type: none"> Share your understanding of earthquakes and your emergency preparedness plan with their families and reflect on the changes to be made in your homes. <p>Reflection: Thinking about the activities from the entire week, can you tell us:</p> <ul style="list-style-type: none"> Three things you have learned from this week's activities Two things you found interesting One thing that you still have a question about 		

<p>Additional enrichment activities:</p>	<p>If the resources are available: Learners will now create their own volcanoes that are mountains with open holes on the top. Since under the plates of the Earth there is molten magma, this comes out in the form of lava.</p> <ul style="list-style-type: none"> You will combine 400 ml of vinegar, 100 ml of cold water and 10 ml of dish soap in an empty bottle. In a separate cup they will fill it halfway with baking soda and halfway with water and stir it to a liquid consistency. You will need to be careful of the explosion and now add the baking soda liquid to the bottle. This will cause an explosion This represents the lava that comes out of volcanoes when they erupt <p>EARTHQUAKE MEASUREMENT</p>
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	<ul style="list-style-type: none"> • Learners will reflect on the fact that the land they stand on is moving and how slowly it moves that they cannot feel it. • Learners will measure the impact of earthquakes by designing their own Seismograph instruments. Seismographs are instruments used to record the motion of the ground during an earthquake. • Step 1: Place the tables or desks side by side. Stack the books on top of the piece of cardboard on one desk. • Step 2: Insert the ruler or any long thin stick between two books near the top of the stack. The ruler should stick out over the adjacent desk. • Step 3: Hang the pencil or marker from the end of the ruler using three rubber bands and the coin if needed for extra weight. The marker or pencil should touch a piece of paper placed under it on the adjacent desk when the cardboard is moved. • The first desk represents the place where the earthquake is occurring. • A family member can make the earthquake occur by shaking the cardboard back and forth towards the second desk. The pen will move as this earthquake occurs. The second desk represents the recording station. Learners can record the earthquake by slowly pulling the paper underneath the marker while the cardboard is being shaken. • This record that the seismograph creates is called a seismogram. • Learners should simulate 3 to 5 earthquakes and then make a hypothesis on reading the seismogram. Hint: The tallest wave represents the Earthquake with the maximum intensity (or magnitude)
Modifications for Simplification	<ul style="list-style-type: none"> • Learners can pair up or work in groups. • Reduce the challenges based on the learners' participation and involvement in the process.

ASSESSMENT CRITERIA

By the end of the project, most of the learners were able to:

- Discuss tectonic plates and their movement and how that creates earthquakes.
- Design building structures that are Earthquake resistant.
- Design maps and jigsaw puzzles.
- Identify risks and dangers at home during an earthquake.
- Prepare emergency preparedness plans.