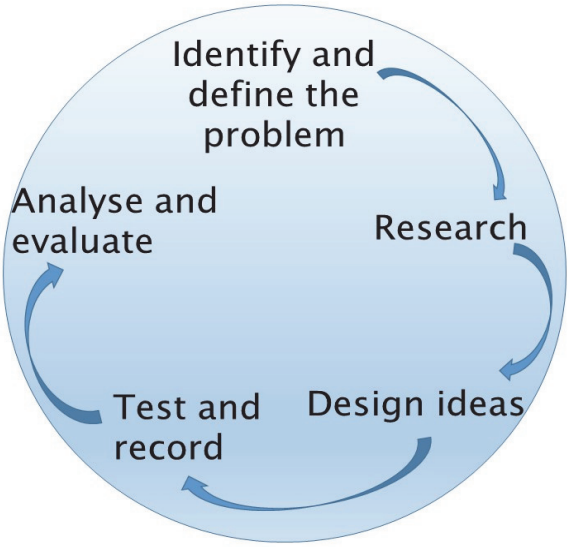
The Challenge

Have you ever wondered why the Moon is covered in craters, but the Earth's surface is relatively crater free? What leads to these two neighbours being so different? Your challenge is to investigate how natural activity changes the Earth's surface over time.



Background Information

You may have heard the phrase 'Dynamic Earth', but what does that mean? Dynamic means constantly changing. There are many natural systems and processes on Earth that lead to it being a planet of change.

Water is a major instrument for change on the Earth's surface. Seas can erode cliffs and shorelines; they can move sand and change where beaches are. Rivers can cut down hillsides and create gullies. Glaciers can creep over the land, scouring out chunks and creating wide U-shaped valleys. Rain and snow can enter cracks in rocks and slowly break them apart.

Even the wind is powerful enough to cause changes to the Earth's surface. The wind can carry sand and sediment particles which can erode rocks and landscapes. Wind can move sand dunes and change deserts.

Plants and animals can also change landscapes. Tree roots help to hold soil in place. When trees are removed from an area then we can get landslides, or removal of topsoil by wind and water. Animals can burrow into the ground or produce tracks on the surface.

Furthermore, what is going on inside the Earth can also affect how it looks on the outside. The Earth is made up of layers and the deeper you go in the Earth, the hotter it gets. Sometimes hot material is brought up from below the Earth's surface and can erupt out at volcanoes. The lava can spread over the Earth and create new land. Volcanoes can get very big and form mountains.

Background Research

1. What is the definition of erosion?

Suggested website: https://www.nationalgeographic.org/encyclopedia/erosion/

2. What are some natural causes of erosion?

3. How does the atmosphere of the Moon compare to Earth's atmosphere?

Suggested website: https://spaceplace.nasa.gov/all-about-the-moon/en/

4. Why does the Moon have lots of craters on its surface when the Earth doesn't?

Suggested website: https://astronomy.swin.edu.au/~smaddiso/astro/moon/craters.html

5. How does the surface of Mars and Mercury compare to the surface of Earth? Add photos below to show the difference.

Earth	Mars	Mercury

Deep Valley

Objective

To investigate how the distance from the source of a river affects the depth and width of a valley.

Equipment

- Large tray or roasting tin
- Sand and gravel mix
- Jug with water in it
- Ruler

Method

Improve the method below adding extra detail to make it a fair test. Draw a diagram to show the set up.

1. Pile up the sand and gravel on one side of the tray to make a large hill.
2. Slowly pour the water onto the top of the 'hill' so that it creates a river (flowing down into the rest of the tray).
3. Once a riverbed has been created, stop pouring the water.
4. Measure the depth and width of the riverbed at the top, middle and bottom of the hill and record this into the table below.

Improvements

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Diagram

Prediction

What do you think will happen to the depth and the width of the valley?

Results and Analysis

	Top	Middle	Bottom
Depth (mm)			
Width (mm)			

1. Where was the river channel the deepest?

2. Where was the river channel the widest?

3. Draw a picture to show how the river channel changed at the different stages

Top	Middle	Bottom

Evaluation

1. Was your prediction supported?

2. How could you improve this experiment?

3. What does this investigation tell you about how rivers can change the Earth's surface?

Size of Sediment

Objective

To investigate how the distance from the source affects the size of the sediment a river can transport.

Equipment

- Large tray or roasting tin
- Sand and gravel mix
- Jug of water
- Large piece of gutter (~ 2 m long)
- Measuring tape

Method

Improve the method below adding extra detail to make it a fair test. Draw a diagram to show the set up.

1. Place one end of the gutter in the tray on the ground, and raise the other end up at an angle (someone can hold the gutter or you can prop it up)
2. Add some sand and gravel to the raised end of the gutter
3. Slowly add water to the pile until the sediment (sand and gravel) begins to slide down the slope.
4. Record how far each different size of sediment got from the top of the slope

Improvements

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Diagram

Prediction

Results and Analysis

	Gravel	Coarse sand	Fine sand
Distance from top (cm)			

1. Which type of sediment moved the furthest from the source?

2. Which type of sediment moved the smallest distance from the source?

Evaluation

1. Was your prediction supported?

2. How could you improve this experiment?

3. What does this investigation tell you about how rivers can change the Earth's surface?

4. Do you think you would get the same results if there was a large rain event and more water was added to the river?

Gravity Movement

When you drop something, it will fall to the ground. This is because of the force of gravity, attracting objects towards the centre of the Earth. This gravitational pull often causes landslides and avalanches to occur, as rocks and soil on less stable hillsides are pulled downwards.

Objective

To investigate how the steepness of a hillside affects how fast a boulder will roll down it.

Prediction

Do you think there will be a relationship between the steepness of a slope and the time it takes for a ball to roll down it?

Equipment

- Long piece of gutter or drainpipe (~ 2m long)
- Ball (that will fit in the gutter/pipe)
- Stopwatch
- Some books or blocks (of the same size)
- Metre rule

Method

Improve the method below adding extra detail to make it a fair test. Draw a diagram to show the set up.

1. Place one end of the guttering on a book or block.
2. Measure the height of the raised end using the meter rule and record this in the table.
3. Release the ball at the raised end of the gutter and start the stopwatch. Stop timing when the ball reaches the bottom. Record the time it took for the ball to roll down the gutter in the results table.
4. Repeat another two times, recording your results in the table.
5. Add another book or block on top of the first (to raise the end of the gutter) and repeat the investigation three times for the new height. Continue to do this until you have a stack of books or blocks five high.

Improvements

Diagram

Results and Analysis

Height of raised end (cm)	Time taken for ball to roll down the guttering (s)		
	Trial 1	Trial 2	Trial 3

1. What was the fastest time for the ball to run down the guttering?

2. What was the slowest time for the ball to run down the guttering?

3. Draw a graph, with the height of the raised end of the gutter along the bottom axis and the time for the ball to roll down the guttering on the side axis. Graph the *fastest* time for each.

4. Is there a relationship between the height of the raised end and the time taken for the ball to roll down the slope?

Evaluation

1. Was your prediction supported?

2. What variable(s) did you keep the same in this investigation?

3. What variable did you change in this investigation?

4. Was this a fair test?

5. How could you improve this experiment?

6. What does this investigation tell you about how the steepness of a hillside might affect the speed at which boulders and sediments could move down it?

7. Do you think a landslide would be more likely to happen on a steep hill or one with a gentle slope?

8. How could you extend this experiment to investigate other factors which could affect the rate at which a boulder or other material might fall down a hill (e.g. if the hill side was wet or covered with trees).

Soils on Slopes

Objective

To investigate if the type of soil on a hillside will affect how quickly it creeps downwards.

Prediction

Do you think that different soil types will creep downhill at different speeds? If yes, which soil type do you think will creep the fastest?

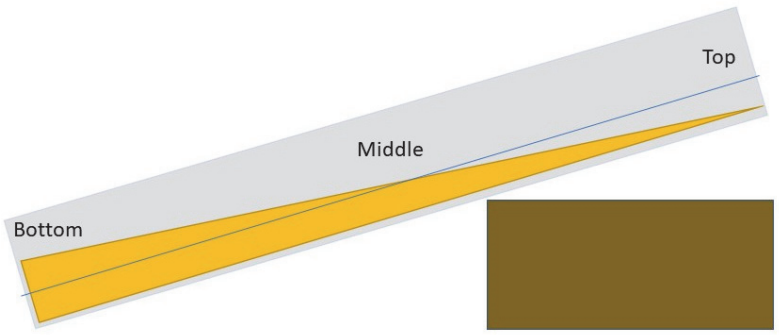
Equipment

- Three or more different types of soil (or sand)
- A tray or roasting pan
- A ruler
- A thick book (or block)
- A stopwatch
- Marker pen
- Spray bottle filled with water

Method

Improve the method below adding extra detail to make it a fair test. Draw an adjusted diagram to show any changes to the set up.

1. Fill the tray with a layer of one type of soil, 1 cm thick. Lightly mist the soil with water from the spray bottle.
2. Raise one end of the tray so it is resting on the book and then tap it gently on the sides for a while.
3. Measure the thickness of the soil at the top, middle and bottom of the tray and record this in the results table.



4. Carefully pour the soil back into the original container.
5. Repeat the experiment using the other types of soil, one at a time.

Improvements

Diagram

Results and Analysis

Type of soil/sand	Original thickness (mm)			Final thickness (mm)		
	Top	Middle	Bottom	Top	Middle	Bottom

1. Which type of soil was thickest at the bottom after tapping?

2. Which type of soil was thinnest at the top after tapping?

3. Complete the table below:

Type of soil	Original thickness at bottom (mm)	Final thickness at bottom (mm)	Change in thickness at bottom (mm)

4. Draw a graph, with type of soil on the bottom axis and change of thickness on the side axis.
5. Which type of soil had the largest change in thickness?

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Evaluation

1. Was your prediction supported?

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2. What variable(s) did you keep the same in this investigation?

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3. What variable did you change in this investigation?

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4. Was this a fair test?

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5. How could you improve this experiment?

6. What does this investigation tell you about how the type of soil might affect the amount of downward creep?

7. Which type of soil do you think would be more likely to be part of a landslide?

Acid Rain

Rainwater is usually slightly acidic. Increased carbon dioxide and sulphur in the atmosphere makes it more acidic than normal, this can be caused by volcanic eruptions. When acid rain lands on certain rocks it can cause a chemical reaction, which makes them dissolve over time.

Objective

To investigate which rock types will be most affected by acid rain.

Prediction

Which rock type do you think will be most affected by acid?

Equipment

- 4 x small samples of different rock types (e.g. limestone, sandstone, granite and basalt).
- An ice cream container with water in it
- 4 x cups (or beakers)
- Measuring jug
- Vinegar (a weak acid)
- Tweezers or tongs
- Weighing scales
- Sticky labels and marker pen

Method

Improve the method below adding extra detail to make it a fair test. Draw a diagram to show the set up.

1. Put the rock samples in the ice cream container with water in it, so that they are completely covered and allow them to soak for at least 10 minutes.
2. Weigh the rocks one by one and record their weight in the results table.
3. Put a rock in each cup and label them with the rock type in it.
4. Pour vinegar into each cup, making sure the rocks are completely covered.
5. For five continuous days, remove the rocks from the vinegar (using the tweezers) and weigh them on the scales, recording their weight in the table. Ensure that you wipe all surfaces and wash your hands after doing this.

Improvements

Diagram

Results and Analysis

Create a table to present your results in.

1. Which type of rock had the biggest change in mass?

2. Were there any rock types that didn't change their mass?

3. Were there any signs other than change in weight of a chemical reaction taking place?

4. Draw a graph showing the type of rock (bottom axis) against the change in mass (side axis).

Evaluation

1. Was your prediction supported?

2. What variable(s) did you keep the same in this investigation?

3. What variable did you change in this investigation?

4. Why do you think it was important to soak the rock samples in water first?

5. Was this a fair test?

6. How could you improve this experiment?

7. Which type of rocks would be most affected by acid rain?

Land Rebound

Changes on the inside of the Earth can affect what happens on the outside of the Earth. The Earth is made of different layers. The crust is the outer layer of the Earth, it is quite brittle and very thin (if the Earth was shrunk to the size of an apple, the crust would be about the same thickness as the skin). Below the crust there is a layer called the mantle. The mantle is semi-solid – this means it is a solid that flows very, very slowly. A bit like toothpaste, but much more solid. If there is movement in the mantle, it can affect the crust as well.
During the last ice age, a lot of the Earth was covered by ice, including some of Australia. When the ice started to melt, water poured off the land and into the oceans which took weight off the Earth's crust.

Objective

To investigate what happens to the Earth's crust as weight is removed.

Equipment

- Large plastic container or fish tank
- Block of wood (about 20 cm x 15 cm x 15 cm)
- Ruler
- Masses (5 x 50 g)

Method

Improve the method below adding extra detail to make it a fair test. Draw a diagram to show the set up.

1. Fill the container about half full of water
2. Put the wooden block in the water and put all the masses on top of it.
3. Measure the amount (height) of the block of wood that is standing above the water and record this in the results table.
4. Take off one of the masses and record the new height of the block above the water in the results table.
5. Repeat step 4 until all the masses have been lifted off.

Prediction

What do you think will happen to the block of wood as mass is removed?

Improvements

Diagram

Results and Analysis

1. Create a table to present and record your results in.

2. Draw a bar graph to show the mass on the wood (bottom axis) against the height of wood above the water (side axis).

3. What happened to the block of wood as the weights were taken off?

Evaluation

1. Was your prediction supported?

2. How could you improve this experiment?

3. What does this investigation show you about what happened to the Earth's crust as weight (ice) was removed?

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4. In places where this is happening, what do you think is occurring at the shoreline? Would sea level appear to be rising or falling?

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Mapping Change

Objective

To create a field trip guide showing where surface changes can be observed in a local area which other students could use to find these features.

Equipment

- Camera
- Digital map of area (can be downloaded from Google maps)
- Computer with Microsoft Publisher or other design software
- Appropriate permissions to go on an excursion with your classmates
- Notebook

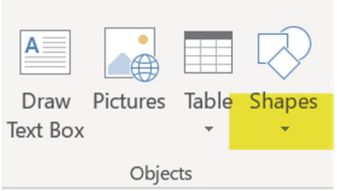
Method

1. Complete the table below adding pictures from the internet

Surface change	What it might look like
Erosion	
Weathering of rocks	
Landslide	
River channel	
Valley	

Plant growth	
Other	

2. Open Publisher and insert the map of your area
3. Decide on a route that you will take to look for evidence of natural surface changes and mark this on your map using the drawing tool from shapes.



4. With permission from your teacher or supervising adult, walk along the route that you marked on your map and take photos of any evidence of surface changes, marking on your map where you took the photo. Make sure you record the photo number, so you know which photo you took where.
5. In your notebook, give each picture a short description explaining what they show.
6. Create a legend for your map with symbols that represent the type of surface change and add the symbols to the map in the places that these surface changes could be observed.
7. Create a Word document describing the route, using directional language such as North and South as well as distances. Explain how to find the features on the way. Then add the photos for each stop and your notes that you took on the way to create a smart field guide.