Rock Detective – Granite Globules
Teacher Information

Aim

These STEM activities encourage students to investigate real-world rock structures using scientific and mathematical skills. Students become rock detectives in the suggested exercises and can extend their new skills to investigations of local geology or their favourite rocks.

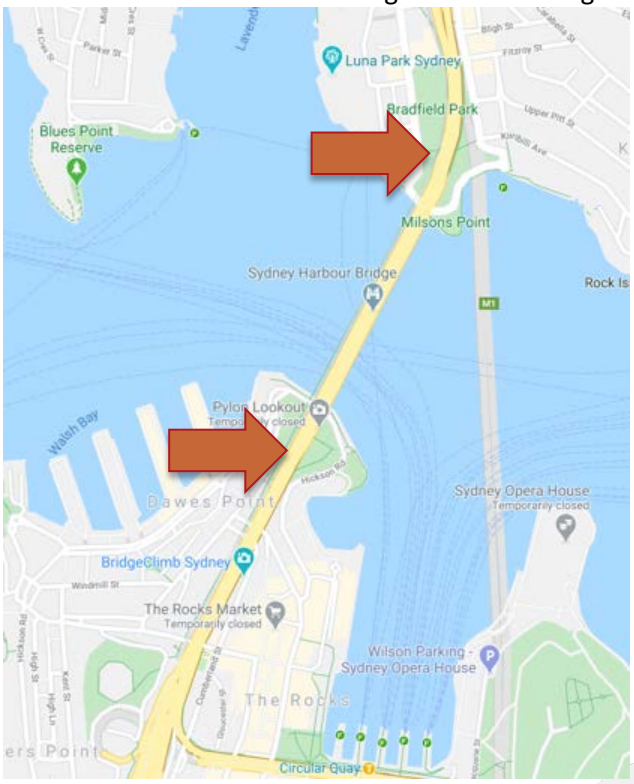
Background

The concrete piers and pylons of the Sydney Harbour Bridge are faced with granite that was quarried at Moruya, 300 km south of Sydney. Granite was chosen because it is attractive, strong and resistant to weathering. Three purpose-built ships carried more than 173,000 granite blocks to Sydney for the construction.

Granite is an igneous rock that forms when molten magma cools slowly underground. Sometimes magma with a different composition is injected into a magma chamber and the two liquids mingle. This process is recorded as different coloured globules in the rock facing the piers and pylons of the Sydney Harbour Bridge. These rocks act as a stimulus for an experiment (magma mingling) and the rock detective activities that build scientific and mathematical skills.

Optional Field Work

Visit the rocks facing the concrete piers and pylons of the Sydney Harbour Bridge at Dawes Point Battery (Park) near Circular Quay or at Bradfield Park, Milsons Point. Dawes Point is a 15-minute walk from Circular Quay train station and Bradfield Park is a 5-minute walk from Milsons Point train station. The granite blocks can also be seen when walking across the bridge.



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ALL YEAR LEVELS

Activity 1 – Class discussion about rocks

Find out what students know about rocks. You may have a junior expert who can share their enthusiasm with classmates. You might like to run a show and tell activity. Suggested questions:

- Do students have a collection of rocks and/or crystals at home?
- What rocks are near school or home?
- Do students know the names of different rock types and/or how they form?
- Has anyone seen interesting rocks on holidays?

Activity 2 – Magma mingling model

Students build a model magma chamber and make observations. See the AusEarthEd Magma Mingling video for instructions.

Materials:

Plastic cup or bottle	Water	Red food colouring
Vegetable oil	AsproClear tablets	

Method

1. Pour approximately 2 cm of water into the cup and add a drop of red food colouring
2. Pour 6 cm of oil into the cup
3. Add half of an AsproClear tablet and observe. Add the other half of the tablet when the reaction slows down. (You might like to video your experiment on a mobile device to review during the discussion.)

Discussion

- What shapes are formed during the 'magma mingling'?
- What direction do the shapes travel?
- How many globules go up versus down? (count and/or keep a class tally)
- This model shows what happens when two types of magma (molten rock) mingle. What shapes would you expect to see in a rock that formed where two magmas had mingled?

Alternative activity – watch a YouTube video of a commercial lava lamp. Discuss as for the experiment.

Activity 3 – The rock mystery: granite with globules under the Sydney Harbour Bridge

1. Watch videos about the sites under the Sydney Harbour Bridge:
    a. Where are we?
    b. Why is the rock here?
    c. What is special about this rock?
    d. *For the keen geologists* – Minerals in igneous rocks. (optional)

2. Examine the high-resolution photo* of the rocks of the Sydney Harbour Bridge pylons.

ACTIVITIES BY STAGE

Early Stage 1 (Kindergarten)

Observing:

- As a class, view the high-resolution photo of the granite blocks. Ask students what they notice – different textures, colours, types and shapes of materials. Zoom in and out for different observations.*

Counting:

- The granite blocks have smaller darker globules or 'blobs' in them. How many globules are in the high-resolution photo (or a part of the photo that you zoom into)?

Geometry:

- What shapes can they see? What shape are the quarried blocks of granite? Are the globules the same shape? Do the globules differ from each other? How big are the globules compared to the granite blocks?
- On Worksheet 1
    - Trace the shapes
    - Find the biggest and smallest globules
    - Draw a line from the globule to the item closest in size
    - Compare two globules close to each other – which is larger/smaller? Which is longer/shorter? Use comparative language to describe

Rock detective questions:

- How did the globules get into the rock? Show the magma mingling experiment. In the experiment, the water and oil are like two different types of magma. The globules we see in the rock moved through the main magma chamber and mingled with it. The magma cooled down and became solid rock, freezing the globules like a snapshot.
- Was there a lot of magma mingling? Lots of globules indicate lots of mingling.

Stage 1 (Year 1 & 2)

Observing:

- As a class, view the high-resolution photo of the granite blocks. Ask students what they notice – different textures, colours, types and shapes of materials. Zoom in and out for different observations.*

Numbers and measurement:

- The granite blocks have smaller darker globules or 'blobs' in them. How many globules are in the high-resolution photo (or a part of the photo that you zoom into)?
- Record the number of globules and the number of quarried blocks of granite.

Geometry:

- What shapes can they see? What shape are the quarried granite blocks? Are the globules the same shape? Do the globules differ from each other? How big are the globules compared to the granite blocks?
- On Worksheet 2
    - Measure the length and width of the marked globules using formal or informal (matchstick, paddle pop stick or finger width) measurements. Record these measurements in the provided table.
    - Use measurements to determine which is the longest globule
    - Compare globules to common objects in a photograph

Rock detective questions:

- How did the globules get into the rock? Show magma mingling experiment. In the experiment, the water and oil are like two different types of magma. The globules we see in the rock moved through the main magma chamber and mingled with it. The magma cooled down and became solid rock, freezing the globules like a snapshot.
- Was there a lot of magma mingling? Lots of globules indicate lots of mingling.
- Were the two types of magma similar? Do the globules and main rock have similar minerals (similar colours)? What differs?

Stage 2 (Year 3 & 4)

Observing and questioning:

- As a class, view the high-resolution photo of the granite blocks. Ask students what they notice – different textures, colours, types and shapes of materials. Zoom in and out for different observations.*
- What questions could you investigate using a photo like this one?

Numbers and measurement:

- Design a table or bar graph to display measurements of the globules in the granite blocks. Use a magnification that makes it easy to show the class how to measure. We are working on measurement skills, so the actual size does not matter.
- What difficulties are there when measuring irregular shapes?

Geometry:

- What shapes can they see? What shape are the quarried granite block? Are the globules the same shape? Do the globules differ from each other? How big are the globules compared to the granite blocks?
- On Worksheet 3
    - Measure eight different globules and write down the longest (length) and shortest (width) measurement for each in the table. Write down the units you used.
    - Which is the biggest globule based on measurements?

Rock detective questions:

- How did the globules get into the rock? Show magma mingling experiment. In the experiment, the water and oil are like two different types of magma. The globules we see in the rock moved through the main magma chamber and mingled with it. The magma cooled down and became solid rock, freezing the globules like a snapshot.
- Was there a lot of magma mingling? Lots of globules indicate lots of mingling.
- In what ways are the natural globule shapes similar to the globules in the experiment? How are they different? Why would this be the case?
- Were the two types of magma similar? Do the globules and main rock have similar minerals (different colours)? What differs?

Stage 3 (Year 5 & 6)

Observing and questioning:

- As a class, view the high-resolution photo of the granite blocks. Ask students what they notice – different textures, colours, types and shapes of materials. Zoom in and out for different observations.*
- What questions could you investigate using a photo like this one?

Student investigations:

- Plan an investigation of the globules within the granite.
    - Decide what to measure
    - Plan how many measurements to make (more is better!)
    - Create a table to record data
    - Present a summary of the data in an appropriate graph
- Possible investigations include: Is there a typical length/width ratio of globules? Are globules all approximately the same size? Are black minerals in the rock the same size in globules compared to in the surrounding rock?
  Note: Worksheet 4 contains photos for use in the investigation. Students can also use the high-resolution photo.*

Rock detective questions:

- How did the globules get into the rock? Show magma mingling experiment. In the experiment, the water and oil are like two different types of magma. The globules we see in the rock moved through the main magma chamber and mingled with it. The magma cooled down and became solid rock, freezing the globules like a snapshot.
- Was there a lot of magma mingling? Lots of globules indicate lots of mingling.
- In what ways are the globule shapes similar to the bubbles in the experiment? How are they different? Why would this be the case?
- Were the two types of magma similar? Do the globules and main rock have similar minerals (similar colours)? What differs?
- Does the magma from the globules have a minimum and maximum grain size? Why might this happen?
- In what ways does the magma model (water and oil) differ from a real magma chamber? How are these differences reflected in the rocks?

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Outcomes

Working Scientifically

Early Stage 1	Stage 1	Stage 2	Stage 3
• Pose questions about familiar objects	• Pose questions about familiar objects	• Identify and pose questions that can be investigated scientifically	• Pose testable questions
• Make observations using senses • Record observations using drawings and simple visual representations	• Explore and answer questions in guided scientific investigations • Record observations using informal measurements	• Conduct scientific investigations to find answers • Collect and record observations using basic formal measurements	• Plan and apply the elements of scientific investigations to answer problems • Select appropriate measurement methods

Working Mathematically

Early Stage 1	Stage 1	Stage 2	Stage 3
• Uses objects, actions, technology and/or trial and error to explore mathematical problems	• Uses objects, diagrams and technology to explore mathematical problems	• Selects and uses appropriate mental or written strategies, or technology, to solve problems	• Selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations
• Describes and compares areas using everyday language	• Measures, records, compares and estimates areas using uniform informal units	• Measures, records, compares and estimates areas using square centimetres	• Selects and uses the appropriate unit to calculate areas
• Represents data and interprets data displays made from objects	• Gathers and organises data, displays data in lists, tables and picture graphs	• Selects appropriate methods to collect data, and constructs, compares, interprets and evaluates data displays	• Uses appropriate methods to collect data and constructs, interprets and evaluates data displays

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References:

NSW Education Standards Authority (2017). Science and Technology K-6 Syllabus. NESA, Sydney.

NSW Education Standards Authority (2019). Mathematics K-10 Syllabus. NESA, Sydney.

***Instructions for viewing the high-resolution images**

The high-resolution images are hosted by ImageMatrix at Macquarie University. Each image opens with an overview image created with a GigaPan camera system. You can zoom into the image in ImageMatrix using the scroll function on a mouse or using pinch actions on a touch screen. You can pan around the image using a click-hold and drag motion on a mouse or touch and drag on a touch screen.

Options:

1) *Measuring*: The tools menu allows you to toggle on and off a scale bar and/or a grid overlay. You can use these to measure items in the images or you can press the 'Start measuring' button and double click two locations to measure the size of things very accurately. You can also measure angles by double clicking three locations on the image. Be sure to press 'Stop measuring' after you finish.

2) *Extra-high resolution photos*: For some sites the Layers menu area has additional 'Close-up photos' that are invisible by default. You can turn these visible by clicking the 'a' button at the top right of the close-up photos layer menu area. The Canon lens cap is 60mm and is shown in each close-up photo for scale.

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