



# national science week 2021

## DIY Science – Mineral Art

*Humans have left their mark on the world through art since ancient times. Make your own mineral-based writing tools to create unique works of art.*

### Safety

To avoid breathing in dust, wear a dust mask when handling powders such as plaster of Paris, graphite, and clay. Handle powdered materials slowly and carefully to avoid generating dust. Wear rubber gloves or food-handling gloves to avoid the raw materials coming in direct contact with skin. Steps that require the use of a hot oven should be carried out by an adult.

### What you need

Used plastic cups (e.g. clean, dry yoghurt tubs), teaspoon for measuring, and old spoons or ice-cream sticks for mixing ingredients.

*Chalk:* plaster of Paris, food colouring, plastic film

*Pencil lead:* oven, graphite powder<sup>†</sup>, kaolin clay powder\*, Fuller's earth clay powder\*, baking tray lined with aluminium foil

<sup>†</sup>From automotive parts or hardware stores

\*Available from cosmetics or soap-making suppliers



### What to do

*Chalk:* To a plastic cup, add 2 teaspoons of plaster of Paris, 1 ½ teaspoons of water, and a few drops of food colouring. Stir to form a thick paste, adding a little more plaster if the mixture is too wet, or a few drops of water if the mixture is too dry. Spread the mixture onto a piece of plastic film and use the film to roll the plaster mixture into a stick shape. Leave to harden for about 1 hour. Remove the plastic film and leave the chalk to dry before using it to draw on a chalkboard, paper, or concrete.

*Pencil lead:* Preheat the oven to 230°C. To a plastic cup, add 2 teaspoons of graphite powder, ⅓ teaspoon of kaolin clay, and ⅓ teaspoon of Fuller's earth. Add 1 teaspoon of cold water and mix thoroughly. Add another ½ teaspoon of water and mix to form a thick paste. Roll the mixture into two rod shapes (approximately 6 cm x 0.8 cm), place them on the baking tray, and bake in the hot oven for 20 minutes. Leave the pencil leads to cool completely.

The pencil leads will be fragile, so handle with care, and use them to draw on a piece of paper. Try using different ratios of graphite and clay to make different pencil leads. For example, 1 ½ teaspoons of graphite and ½ teaspoon of each type of clay for a harder pencil lead, or 2 ½ teaspoons of graphite and ¼ teaspoon of each type of clay for a softer and darker pencil lead. Record the results in the table on the next page.

### What's happening?

When a mineral-based writing tool, such as chalk or a pencil, is rubbed on a surface, some of the mineral sticks to the surface and leaves a mark. Plaster of Paris is the chemical 'calcium sulfate hemihydrate' (CaSO<sub>4</sub>·½H<sub>2</sub>O), which is made by heating the mineral 'gypsum' (calcium sulfate dihydrate CaSO<sub>4</sub>·2H<sub>2</sub>O). 'Lead' pencils have never been made from lead, however, the mineral



graphite was originally thought to be a type of lead (Pb). Graphite is a form, or allotrope, of the element carbon (C). Other allotropes of carbon include diamond and buckminsterfullerene (which has carbon atoms arranged in the shape of a soccer ball).

## Results

Pencil leads are graded uses the letters H for hard, B for black, and F for fine. Adding more clay increases the hardness (H) of a pencil lead. Decreasing the amount of clay gives a softer lead that leaves a darker, black (B), mark. The most common type of pencil lead is HB, which is in the middle of the range of hardness and blackness. Different pencil manufacturers have their own recipes to give the desired pencil properties.

| Graphite (teaspoons) | Clay (teaspoons) | Pencil lead mark |
|----------------------|------------------|------------------|
|                      |                  |                  |
|                      |                  |                  |
|                      |                  |                  |

## Did you know?

Very high-quality graphite was discovered in England in the 1500s and it was used for making marks on wool, moulding cannonballs, and as a writing tool. In 1794, Nicolas-Jacques Conté invented the modern pencil lead by combining clay with the lower-quality graphite found in France. People have used mineral-based pigments to create artworks since ancient times. Aboriginal people traditionally use ochre in body paintings and rock wall paintings, with rock paintings dating back at least 65 000 years. Ochre is a mixture of clay and the mineral iron oxide and it can be found in a range of colours.

## Find out more

- Discover how ochre is used in Indigenous art: <https://www.indigenous.gov.au/news-and-media/stories/making-ochre-luyini-mungalina-place>; <https://theconversation.com/pigments-and-palettes-from-the-past-science-of-indigenous-art-35604>
- Learn how bacteria are used to date ochre found on ancient Aboriginal artefacts: <https://theconversation.com/when-bacteria-tell-a-story-tracing-indigenous-australian-ochre-sources-via-microbial-fingerprinting-85455>
- See how pencils are manufactured on an industrial scale: <https://www.dailymotion.com/video/x7yw49s>