

Student Sheet

In this practical I will be:

- Learning about the general make up of paints and using key terms such as **pigment**, **binder**, **extender**, **tempera**, **lake pigment** and **precipitation**.
- Preparing egg tempera paint and a lake pigment egg tempera paint.
- Observing, and comparing and contrasting various aspects of the two paints, including, how easy are the paints to use, how do they look, and how have the paints changed over time?

Introduction:

As a prehistoric science-artist, it's your job to create and use paint for cave paintings. Like all science-artists you want your paints to be interesting and allow you to express your art.

You have recently heard that you can use different types of **pigments** in your paint, including **lake pigments**. However, your tribe has never used these before. In order to see how good these different pigments, and the paints they make, are you decide to carry out an experiment...

Equipment:

- 1 egg (or substitute provided)
- 1 pot of calcium carbonate (low hazard)
- Metal ruler or spatula
- Plastic disposable cups
- Coloured chalks
- Saucer or tile
- 2 teabags
- 2 spoons
- 2 eye droppers or dropping pipettes
- 2 paintbrushes
- Safety spectacles

Method:

Preparing the pigment

1. Select a coloured chalk. A red, blue or green chalk will often give a good colour but it depends on the depth of colour in the coloured chalks.
2. Using the metal ruler or metal spatula scrape the side of the coloured chalk so the chalk powder falls into a pile into a plastic cup.
 - What colour did you choose?
 - Why do you think you need to make a fine powder of the chalk?



Preparing the lake pigment

3. Use the second cup to crack the egg into and save the egg shell.
4. Carefully wash out the membrane material inside the egg shell.
5. Dry the egg shell with a paper towel.
6. Put the dry egg shell onto the saucer or tile.
7. Using a metal spoon try to crush the egg shell until you have a fine powder. You may find this difficult but it illustrates the degree of difficulty early artists experienced in making their paints. Your teacher will give you some egg yolk ground in a mortar with a pestle.
8. Transfer the egg shell powder into a clean plastic cup.
9. Take the tea bags, place it them into warm water and stir taking care to not break the bag. This will probably take 5–8 minutes.
10. Use the eye dropper or dropping pipette to transfer a small amount of the tea solution into the cup with powdered egg shell or calcium carbonate until the egg shell powder (calcium carbonate) is just covered.
11. Stir the mixture with a spoon and leave to stand for 6–8 minutes.
12. Now carefully pour off the tea liquid into another cup leaving the egg shell in the cup.
13. Using a clean spoon carefully remove the wet egg shell powder.
14. Smooth the wet egg shell powder on a paper towel. Leave to dry while you prepare your binder (step 15) for 20–30 minutes.
 - Why do you think you need to make a fine powder of the egg shell?
 - Why do you think the tea bags had to be put in hot water and left for a long time?
 - What colour is the tea solution in the cup?
 - Why do you think the coloured egg shell powder is spread out onto a paper towel?

Preparing the binder and making egg tempera paint

If your egg yolk has already been provided for you start from step 17 instead.

15. Using an egg separator separate the yolk from the white.
16. Keep the separated yolk and white in separate cups.
17. Using a clean eye dropper transfer some of the egg yolk (or egg yolk substitute a craft glue will do) the powdered chalk.



18. Use a cotton bud or spoon to stir the mixture until you have a coloured paste. If it's too liquid-like scrape some more chalk powder into the mixture. If too thick add some egg yolk (or substitute) or a small amount of water.
19. When you have a paint paste that you think is right use a paint brush to paint a square or small picture on one half of a piece of white paper. Label it 'egg tempura paint'.
20. Leave to dry overnight.
 - Describe the appearance of the egg yolk and the egg white. This can still be observed by the students using an egg yolk substitute if the teacher shows them with the real egg in the demo.
 - Was making the paint paste easy?
 - Describe the appearance of the paint before painting.
 - Describe the appearance of the dry paint on your painting.
 - Was it glossy, dull, bright, smooth, or rough?

Preparing the lake pigment egg tempera paint

21. Now take the dried egg shell or calcium carbonate you put into tea and smoothed out on to a paper towel.
22. Scrape some of this coloured egg shell powder into a clean cup.
23. Now using the eyedropper or plastic pipette again transfer some of the egg yolk (or substitute) to the coloured egg shell (calcium carbonate).
24. Stir with a clean cotton bud or spoon until you have a paint paste. Again if it's too liquid-like scrape some more egg shell powder into the mixture. If too thick add some egg yolk or a small amount of water.
25. When you have a paint paste you think is right, use a clean paint brush to paint another square or small picture on the same piece of white paper as before. Label it 'lake pigment tempura paint'.
26. Leave to dry overnight.
 - Describe the dried egg shell and its colour.
 - Do you think the dried egg shell should have been crushed to make a fine powder?
 - Was making the paint paste easy?
 - Describe the appearance of the paint before painting.
 - Describe the appearance of the dry paint on your painting.
 - Was it glossy, dull, bright, smooth, or rough?



- What for you are the differences between the two paints?

Going further:

Make more colours of the two paints by repeating the method with a different chalk. Alternatively each pupil or group could be given a different colour so as a whole class there would be a selection of different coloured paints.

If you have saved the egg white, you could try using the egg white instead of the yolk and evaluate that against the **tempera** and **lake** paint. Students will not be able to carry out this part if they have used the egg substitute.

Evaluate the different types of paint by answering the following questions

- Are they both the same colour and **hue**?
- Do they both spread evenly?
- Is the colour a strong or weak one?
- Do they have to be the same thickness of paste to work?
- Are the surfaces smooth or rough?
- Do they each dry in the same time?
- Do they both work on the different surfaces such as paper, wood, plaster or cloth?

Theory:

The paint you make is egg **tempera paint**. It is composed of egg yolk, powdered pigment that is insoluble, and water. It is a mixture of fine solid particles suspended in a liquid.

The mixture would be called **homogenous** because the pigment particles remain evenly suspended and so the colour is even throughout.

The egg yolk acts as the binder or glue to stick the pigment onto the paper or other surface.

The addition of water as an extender makes the paint a usable paste that will flow and spread easily over a surface. When you buy manufactured tempera paint it is likely to contain a gum like gum Arabic rather than egg yolk.

Homemade egg tempera can only be used for a single painting session. Over time the tempera paint changes. The water evaporates, and the chemical composition of the yolk changes. The yolk protein cures, becoming thicker.

In the lake paint the dye is **soluble** in water and so to make this paint the brown dye from the tea is absorbed onto the calcium carbonate of the egg shell. This lake pigment is then mixed with egg yolk and water to make the paint.

