Student Activities

1. Colours in Opals

1 Explain the meaning of the term 'play of colour'.

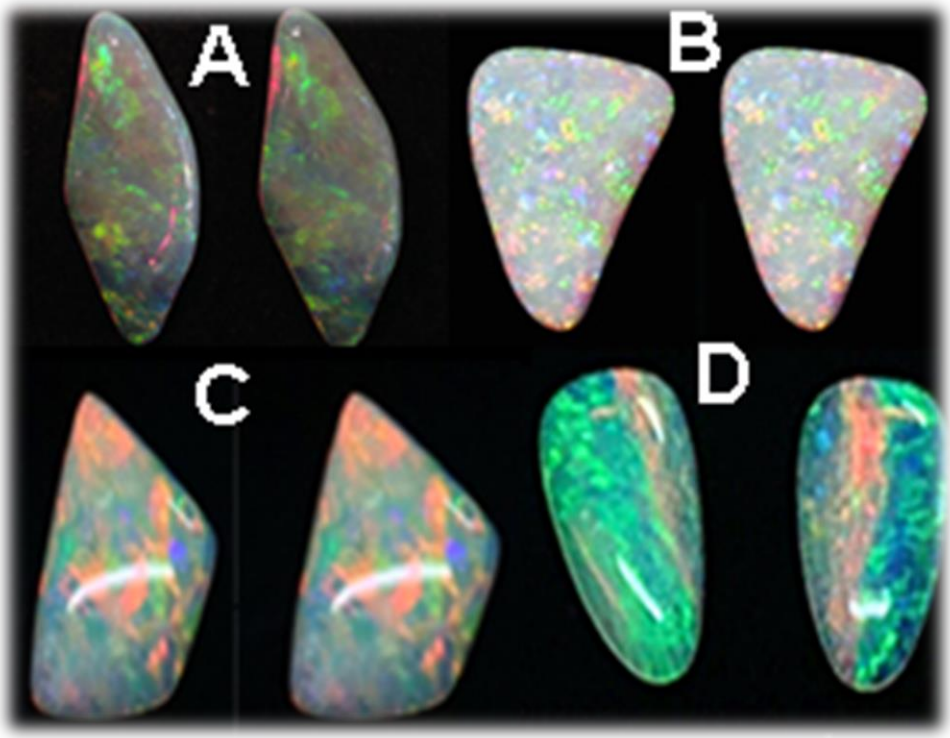
_____

_____

2 The photograph below shows a variety of gemstones.

On the above photograph, circle those gemstones that you would expect to show a play of colour.

3 The illustration below shows two photographs of each four opals labelled A, B, C and D.



a. Which of the opals were photographed from two different positions?

_____

b. Give a reason for your answer to part a. of this question.

_____

_____

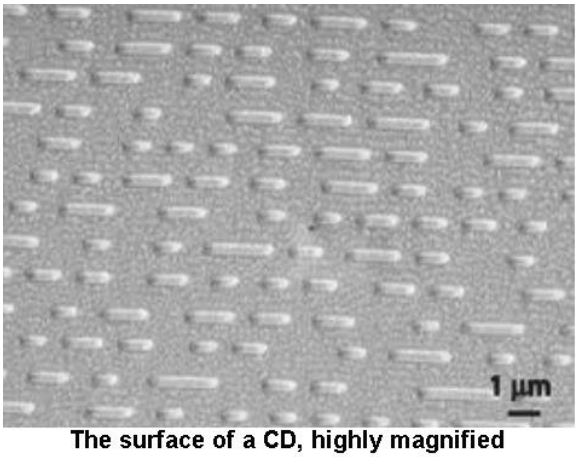
You will need an old CD or DVD for the following activities.

Background information

A CD or a DVD is made of aluminium coated with plastic. The adjacent diagram shows the surface of a laser, highly magnified. It consists of regular arrays of bumps (called pits) and flatter areas (called lands)

When light is reflected from or passes through an object containing a regular pattern of small ridges or scratches, interesting colours and patterns are produced.

Like the raindrops that form a rainbow, the pits and lands on a CD surface separate white light into its different colours.



The surface of a CD, highly magnified (1μm is 1millionth of a metre)

1 You can show that your CD or DVD displays a play of colours.

a. Describe and try out 2 processes by which you can do this.

Process 1 _____

_____

_____

Process 2 _____

_____

2 a. Use your tablet (iPad or similar) or your mobile 'phone to obtain some photographs that illustrate the play of colour you have been looking at.

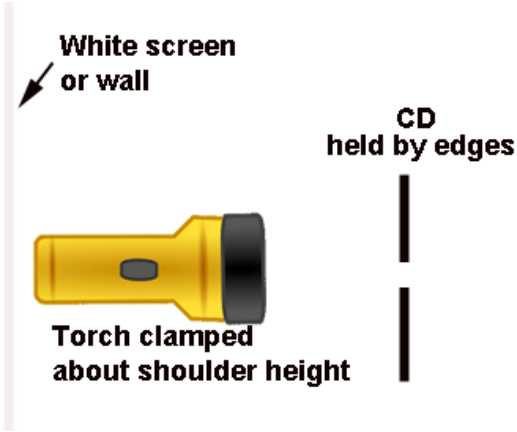
b. If you have the facilities, print two of your photographs, and glue all or parts of them in the space below. You may also like to use one as wallpaper for your device.

c. Make a short video showing the play of colours actually occurring.

3 The following activity is most effective if carried out in a darkened room.

a. Clamp a torch or ray box above the surface of a bench, at about your shoulder height, so that it is close to a white wall or screen, and facing away from the screen. The light beam must be horizontal.

b. With your fingers around its edge, hold your CD upright so that the light shines on its surface. The adjacent diagram shows one way of arranging the apparatus.



c. Describe the pattern produced on the wall or screen.

_____

_____

d. Make a series of photographs that show how the pattern changes when you alter some of the following:

i. the distance between the CD and the torch.

ii. the angle at which you hold the CD.

iii. the shape of the reflecting surface either by covering half of the CD with dark paper or by breaking it in half.

Assignment

Describe some examples of animals that are able to change their colours.

2. The Nature of Opal

The world around us contains many examples, other than opals or CDs of colour displays produced by materials or objects that do not actually contain any colour pigments.

Like a rainbow and the spheres of which precious opal is formed, apparently colourless materials and objects can split white light into the colours that it contains.

In the activities below you will discover various methods of producing colours in unexpected ways.

You will need some coloured pencils to record what you see.

1 Using a glass prism (best done in a darkened room)

You will need a triangular glass prism, equipment to make a narrow beam of white light (e.g. a ray box or a torch combined with a piece of cardboard containing a hole, and a white screen.

a. Try different ways of arranging your apparatus so that you can see the best possible spectrum (or rainbow) on your screen.

b. Look at your spectrum from different positions of your head.

Do you notice any difference in the spectrum colours you can see? _____

Describe one difference between the colours than a glass prism produces and the colours that an opal produces.

_____

_____

c. In the space below draw and label a diagram showing how you arranged your apparatus to produce a spectrum. Draw and colour your spectrum on the screen

2 Using a Diffraction Grating (best done in a darkened room)

A diffraction grating consists of a clear plastic etched with many lines. You can also buy 'Rainbow Glasses' that are made of diffraction gratings.

Look through the diffraction grating at a bright light.

a. How many spectra can you see? _____

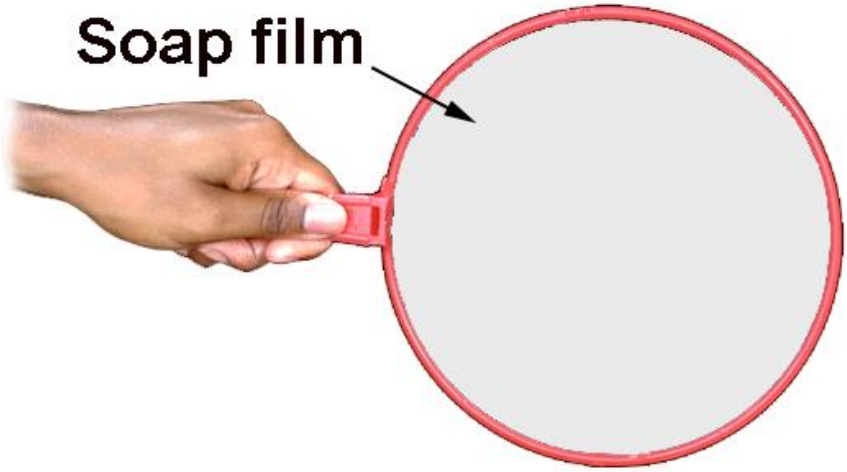
b. Are the colours the same as those you produced using the glass prism? _____

c. Do your spectra show any 'play of colour'? _____

d. In the space below, sketch and colour the image you see through the diffraction grating.

3 Colours in a soap bubble

You will need a circular ring between 5cm and 10cm in diameter with a handle. You can use a plastic one like the ring show in in the diagram below, or make your own wire ring.



You will also need a bowl of water to which a few drops of washing-up detergent have been added.

a. Dip the ring into the bowl of soapy water and then hold it so that it is vertical (upright).

b. Check that you have made a soap film. If you have no film, repeat step a. until a film is formed.

c. Move the film around in the light until you see some colours. If the film breaks, make another one.

d. Describe the pattern made by the colours.

_____

e. Does this pattern show a 'play of colours' when you move your head? _____

_____

f. Are all the colours the same as those you saw using the prism and/or the diffraction grating?

_____

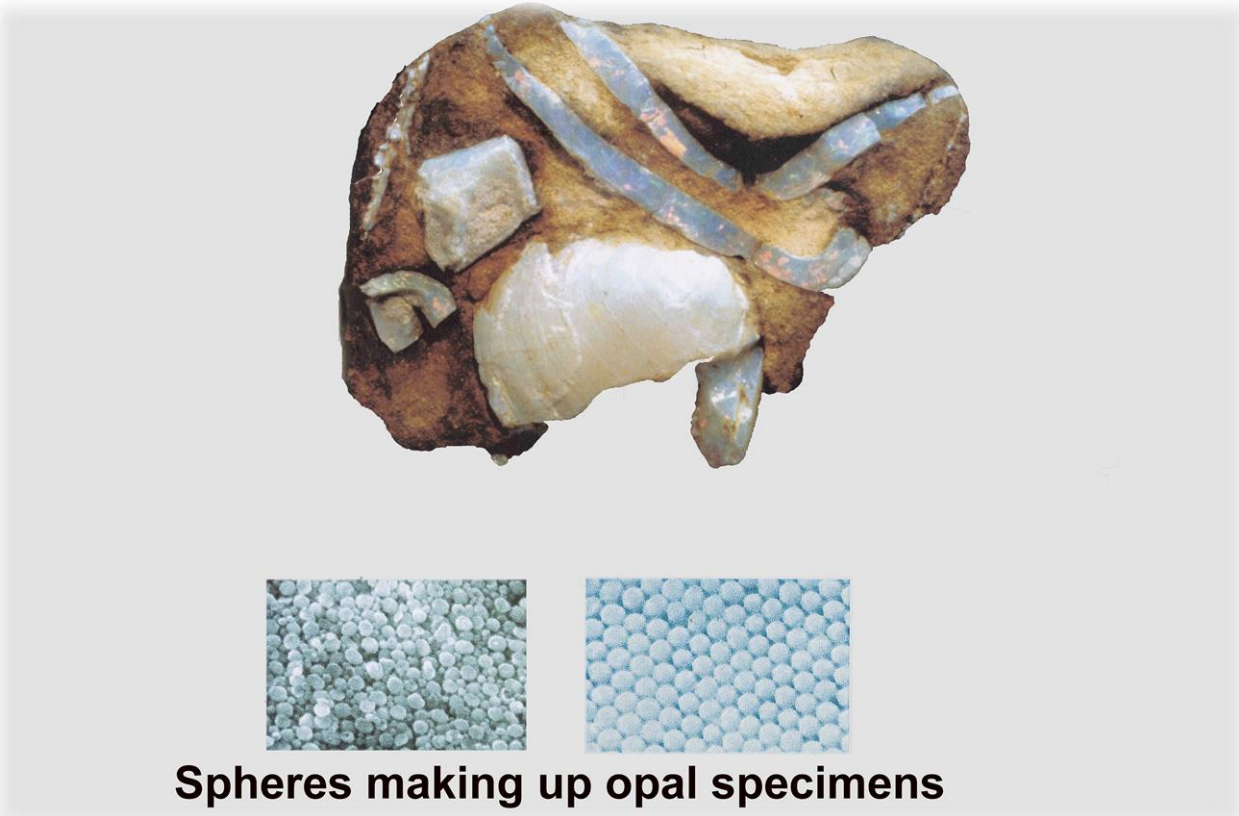
g. Look carefully at the top part of the film. Describe how it is different from the rest of the film

_____

h. Working in pairs, photograph the film using your 'phone or tablet. Glue your photograph into the space provided below.

4 Patterns of Spheres

1 The illustration below shows a photograph of a rock specimen containing some precious opal and some potch, together with diagrams illustrating two different arrangements of the spheres that form the opal specimens.



a. Label the diagram to show the positions **on the specimen** of the precious opal and the potch.

b. Draw arrows on the illustration to show which of the arrangements of spheres probably make up each of the types of opal within the rock specimen.

c. Give reasons for your selections in part b.

_____

_____

2 Use some steel wool to roughen part of the surface of an old CD.

a. Describe changes in the colours and play of colours between the roughened surface and the original surface of the CD.

_____

_____

b. Explain how these changes illustrate the differences between precious opal and potch.

_____

_____

c. Photograph your damaged CD so that you can compare the effects of the roughened CD with the undamaged CD.

Print your photograph and glue it into the space provided below.

Assignment

You have seen several examples of colours and interesting patterns being formed when light is reflected off or passes through an object that contains many small ridges or scratches. There are many other ways you can see such patterns. Some examples are given below:

- Squint at a distant bright light at night. Patterns form when light bends around your eyelashes and imperfections that make up the lens of your eye. Tilt your head to one side while watching the pattern and notice any changes.
- In a dark room, look at a candle flame through a nylon stocking, a silk scarf, a feather or a tea strainer. The pattern you see depends on the material you are looking through and changes when you move your head.
- Buy a set of "rainbow glasses" in a toyshop or on line. Their lenses consist of diffraction gratings similar to the one you looked through in the activities you have been doing.

Your task is to investigate the above methods, and any others, of producing patterns of colours and produce a written and illustrated report or Powerpoint presentation. This presentation should list any materials you used, describe exactly how you used them and the patterns you obtained. You may use photographs or your own coloured diagrams.