+ STRETCH THEM FURTHER

+ STUDENTS CAN INVESTIGATE THE CONCEPT OF NANOSIZE FURTHER WITH A COUPLE OF INTERESTING EXPERIMENTS STARTING WITH MAKING DILUTIONS OF 10 DROPS OF FOOD COLOURING [AR 10]. IN THESE EXPERIMENTS STUDENTS MAKE CONSECUTIVE DILUTIONS OF 50% UNTIL THE COLOUR FROM THE FOOD COLOURING IS LOST COMPLETELY. STUDENTS CAN USE THE NUMBER OF TIMES THEY HAVE DILUTED THE SOLUTION TO WORK OUT HOW MANY TIMES MORE DILUTE THE FINAL SOLUTION IS WHEN COMPARED TO THE STARTING SOLUTION. WHILE THE EXPERIMENTAL WORK IS QUITE SIMPLE, THE MATHEMATICAL PROCESSING IS MUCH MORE CHALLENGING AND CAN LEAD TO INTERESTING DISCUSSION BETWEEN STUDENTS IN HIGH ABILITY GROUPS.

impossible to get water to soak into the material. They can also see the shape formed by the surface tension of the water on a hydrophobic surface, which stands up in a rounded way instead of forming a meniscus as with a beaker or measuring cylinder. Students could even synthesise their own hydrophobic materials using a guide produced by the High School Nanoscience Program [AR 7]. If sand is sprayed with outdoor garment spray it can be immersed underwater in a beaker and removed dry. This technology when employed at the nanoscale level can render entire electronic devices waterproof including smartphones and mp3 players. Dramatic video of a phone being immersed underwater had my class captivated [AR 8]. The technology was only unveiled in early February of this year.

SUMMARY

Nanoscience is considered to be a new technology and is at the forefront of modern innovation. However students will find it interesting to discover that gold nanoparticles were being made and used in medieval stained glass windows. The artisans creating the windows trapped gold nanoparticles in the 'glass matrix' in order to generate the ruby red colour in the windows. They also trapped silver nanoparticles, which gave it a deep yellow colour. This example of colour change is testimony to the dramatic change in material properties at the nanoscale. Gold nanoparticles can be made using a relatively straightforward technique in the classroom laboratory where gold (III) is reduced to gold using sodium citrate [AR 9]. The bright red colour can be linked to Home Learning 2, the Lycurgus Cup.

HOME LEARNING

1. Gifted and talented pupils may be able to attempt an interesting calculation using a sugar cube. Explain to students that one sugar molecule is about 1 nanometre in size and that a nanometer is 1 billionth of a meter. Ask students to calculate how many molecules they think could fit along one edge of the sugar cube. When they calculate such a large figure it is a good illustration of how small molecules must be [AR 11].

2. Ask students to investigate the Lycurgus Cup [AR 12]. This ornate Roman Cup displayed at the British Museum was made in the fourth century AD and the colours of the cup can change. When it is looked at in reflected light or daylight, it appears green. However, when light is shone into the cup and transmitted through the glass, it changes colour to red. What gives it these unusual optical properties is due to the glass containing tiny amounts of colloidal gold and silver. Students can present their findings to each other through presentation, a historical 'newspaper' report of the amazing vessel or a short piece of drama based on the presentation of the cup to Roman Emperor Constantine. It could also form the basis of an interesting science school trip if the British Museum is accessible.

+ ABOUT THE EXPERT

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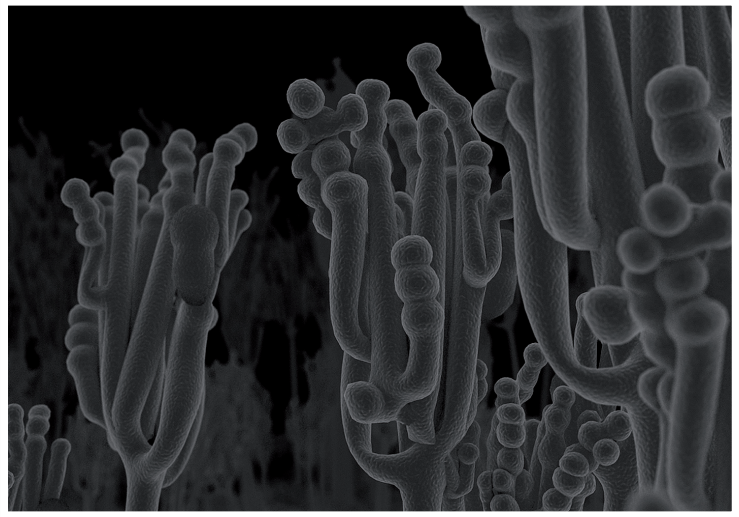
Science Dome is a digital planetarium and film theatre for the exploration of science and mathematics in an interactive way, visiting schools with a giant mobile dome, providing an exciting additional science resource and presenting a different learning experience to students.

The domes can take up to 50 pupils per show with a fully-computerized Digitarium planetarium and specialised projection lenses to provide amazing 360-degree full-dome science shows and films, with a knowledgeable presenter illustrating subjects including: astronomy, the ecosystem, and fractal mathematics.

Example programmes

Fractal Dome (Maths and Natural Symmetry) NanoCam Show: Biodiversity with images of an electron microscope and the latest 3D animation technology showing the five kingdoms of living things. We discover their characteristics, form and their importance for the ecosystems and sustainability.

Also available (can be on the same day):
Solar System Tour and Beyond Dinosaur Show Rocks, Soils and Fossils



The programmes can include films, here are some examples for secondary school ages:
'**Fractals**' from The Fractal Foundation: fabulous mathematical and natural designs

'**Oasis in Space**' from Spitz Inc.: liquid water, key to life on Earth.

'**Astronomyths**' from White Tower Media: a journey from a campfire to the stars

'**Nanocam, a trip into biodiversity**', an incredible journey through the microscopic structures of the five kingdoms.

A full day Science Dome visit costs from £425 (plus travel where applicable), excluding VAT.
A typical day consists of five shows. Science Dome has a special website for schools: **www.sciencediscoverydome.co.uk** This website has resources for primary and secondary teachers,