

## Photo Topics

These are general, cross-disciplinary questions that are not intended to be studied in any order if, indeed, they are studied at all. They are offered as stimuli to encourage students to see their Chemistry studies in the wider Scientific, International and Theory of Knowledge contexts. They may also be helpful in other subjects and other ways.

*You will need to use a viewer program to open the photographs in the folders.*

1. **Scientific Theory.** In everyday conversation, the word 'theory' has a rather loose meaning. "Wind is caused by the trees flapping their leaves" is the sort of theory you might hear in the latter stages of a party. Scientists mean something much more precise when they use the word 'theory'. Photos T1P1 & T1P2 show the garden of Down House, Sussex, UK. One of the most influential theories in the history of science was conceived in this house and whilst walking in this garden. What was this theory and who was the scientist? What are the main differences between a 'scientific theory' and a 'party theory'?
2. **Roman Glass.** Photos T2P1 & T2P2 show a piece of glass from the Roman Era. You can see it has a slightly crystalline structure. What is glass – a liquid or a solid?
3. **Crystals and the 2<sup>nd</sup> Law of Thermodynamics.** Photo T3P1 shows a mineral crystal (quartz). It is quite evidently 'ordered'. The 2<sup>nd</sup> Law of Thermodynamics (Law of Increasing Entropy – increasing disorder) appears to preclude the existence of such naturally occurring structures. Is there a conflict here? Does the conflict extend to the complex molecules you may study in Biochemistry?
4. **Antarctica, greenhouses and ozone.** Photos T4P1-5 show Antarctica. What role have scientific research stations in Antarctica played in detecting and monitoring the 'Greenhouse Effect' and the 'Ozone Hole'. Photo T4P1 is the Polish research station Henryk Arctowski, T4P2 is the Argentine station Almirante Brown and T4P3 is the historic British station Port Lockroy. Note the actual greenhouse at Henryk Arctowski. Antarctic research stations have played a major role in uncovering the facts about atmospheric carbon dioxide and the ozone layer. Why?

5. **Pyrotechnics.** Fireworks are thought to have been invented by the Chinese in the 9<sup>th</sup> century. News of the discovery probably spread to the West along the overland trade route known as the 'Silk Road'. Whilst explosives have had many negative impacts, they also have many positive uses (mining, construction etc.). Pyrotechnics (T5P1), common as a centrepiece of many major celebrations, are the closest most people ever get to an explosion. What are the chemistries of the most common pyrotechnics and how do their designers achieve such vivid colours?
6. **Spa Chemistry.** A modern spa (T6P1) or swimming pool will generally be 'salt chlorinated' to prevent the growth of pathogens and algae. At the heart of such systems is an electrolytic cell (T6P2). What chemical processes are behind such systems?
7. **Nitrogen, the Whale, the Diver and DCI.** Human sub-aqua divers must be careful to calculate the amount of nitrogen that is dissolving in their tissues. If they ascend from depth too rapidly, the extra dissolved nitrogen can form bubbles in the blood, joints etc. This condition is known colloquially as 'the bends' because victims can be bent double from the pain. The correct name for the condition is 'decompression illness' – DCI. Why does extra nitrogen dissolve in the tissues of divers? T7P1 shows a dive computer that monitors the divers nitrogen uptake. T7P2 shows a dive profile downloaded from such a computer. Why is it safer to descend rapidly and ascend slowly? T7P3 shows a Minke Whale. Why do whales not need to worry about DCI?
8. **Cola Fountain.** T8P1 shows the result of adding several Mentos (a common mint flavoured 'sweet') to a bottle of 'cola'. As you can see, the result is surprising (and potentially dangerous as well as being messy – CARE!). What is happening here?
9. **Food Additives.** T9P1, T9P2 & T9P3 show some food labels. Look at these and some others. What, if any, additives have been used, what are they and how do we know that they are safe?
10. **Cavendish.** T10P1 & T10P2 show the country home of the Cavendish family, Chatsworth House in Derbyshire, England. Various members of this aristocratic family made distinguished contributions to science. They also endowed one of the most famous of all research laboratories. What were these contributions?