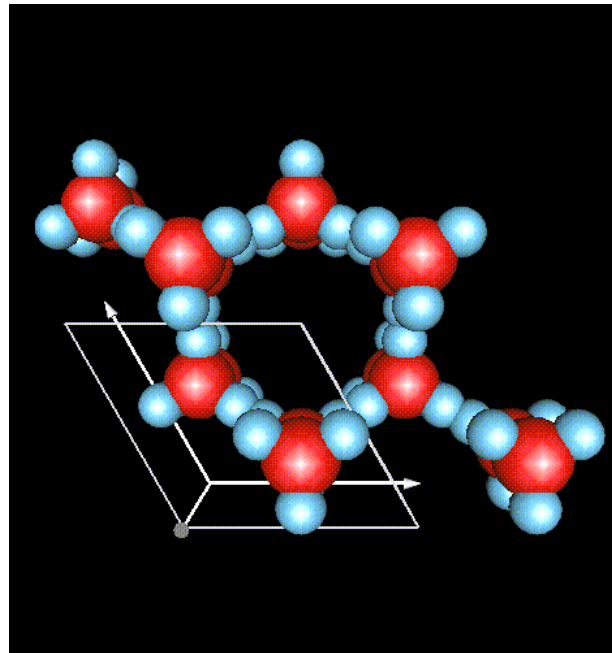




The Chemistry and Thermodynamics of Ice Cream



Created for the Deep Impact Mission, A NASA Discovery Mission
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Educator/Student - Enrichment



"The Reason for the Seasons:" - Snowflake Shapes

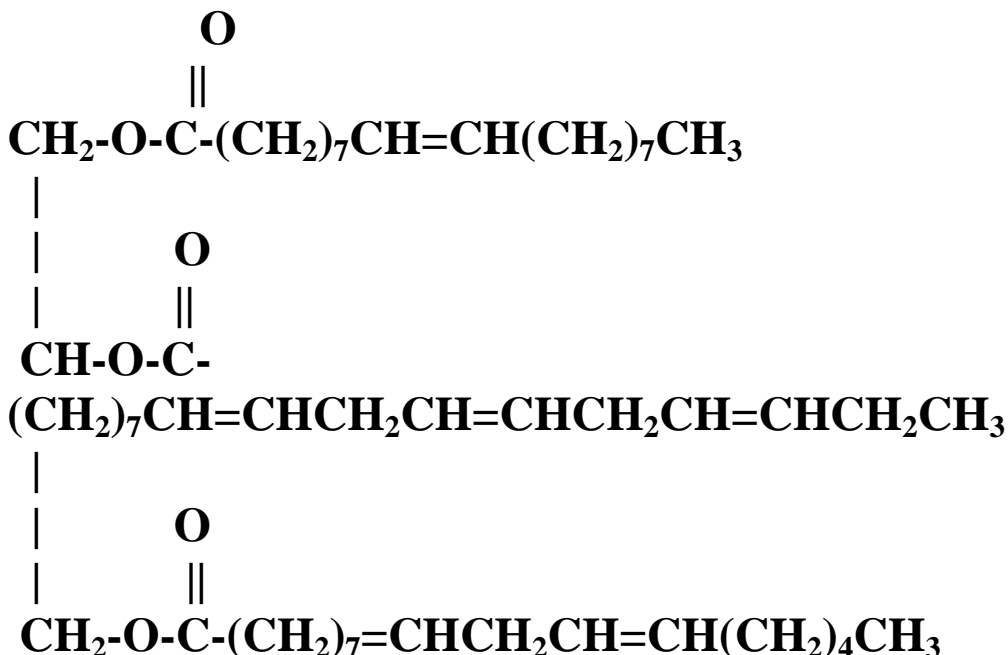
The picture above was created at the Institut Laue-Langevin an international research centre and world leader in neutron science and technology. It is based in Grenoble in the South-East of France. It shows an ice crystal. The crystal is made of many molecules of water (H₂O). The atoms are shown by different colors. The darker atoms are oxygen. The lighter atoms are hydrogen. The hydrogen atoms are attached at an angle near 120 degrees. The hydrogen atoms are attracted to each other and form hexagonal rings in all directions.

As ice crystals or snowflakes grow, they expand by attaching new water molecules to each other. Looking at them with a hand lens or microscope tells us about how they join together. The angles are always the same so the designs always have six sides. Whether ice crystals or snowflakes, observing the shape under "atomic microscopes" reveals a shape that is always hexagonal.

If the angle had been different, the shape would have been different. Salt crystals (NaCl) are made of two elements, sodium (Na) and chlorine (Cl) which join at 90 degree angles. Under a hand lens or microscope, the crystals of salt appear as little dice or cubes. The shape of the crystal is determined by the angle of chemical bonding (joining together).

What does “ice” have to do with “ice cream”?

Below is a typical triglyceride butterfat molecule from which ice cream is made. Ice cream is formed when many tiny ice crystals form between the "arms" of the triglyceride butterfat molecule.



Typical molecule of butterfat, a triglyceride, found in ice cream.

Extensions: Chemistry, Crystals and Calories

- Look at the drawing of the butterfat molecule. The letters stand for chemical elements, joined together in long chains. You can make a “MODEL” of the molecules with gum drops and toothpicks
- You can make up a code...which element (gumdrop) is which color:
The elements are:
Carbon (C) Color _____
Oxygen (O) Color _____
Hydrogen (H) Color _____
- Build the molecule with groups assembling a part of a chain. Connect them with toothpicks (chemical bonds...the glue that holds elements together in molecules). . The symbols "=" or "||" mean use two toothpicks. These are called double bonds in chemistry. Then lay them out and connect the whole butterfat molecule on the floor or table.

D. What is a comet - ice cube or ice cream? Deep Impact will help us find out.
The data from Deep Impact will tell us a little about how the comet
formed...blob of water or snowball of crystals that came together.

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