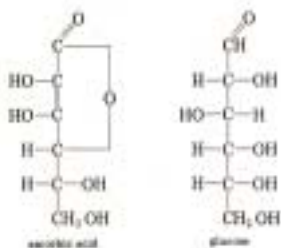


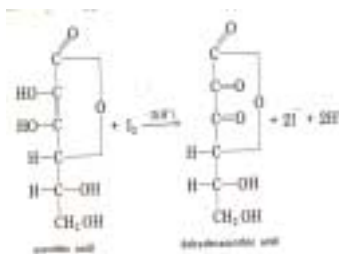
## VITAMIN C

**WHO:** Ascorbic acid,  $C_8H_6O_6$ , is a carboxylic acid. The acid acts as an enzyme to catalyze some oxidation-reduction reactions and it is needed to repair some tissues. Vitamin C is found naturally in many foods, particularly citrus fruits.



Structurally, ascorbic acid is similar to glucose:

**WHAT:** To analyze the vitamin C content of a sample, we will react the vitamin C with  $I_2$ . The reaction splits off two  $H^+$  and two electrons to form dehydroascorbic acid. At this time the  $I_2$  is reduced to  $I^-$ .



To detect this reaction we will use a dilute starch indicator. The  $I_2$  preferentially reacts with ascorbic acid. When there is no longer any ascorbic acid present, any additional, or excess  $I_2$  will react with the starch showing a purple color.

**HOW:** To make a comparison between a variety of samples measure out equal amounts, and add a consistent amount of starch.

1. Measure 10mL of each sample in a clean test tube.
2. Add five drops of a saturated starch solution to each sample.
3. Carefully add (counting each time) drops of an  $I_2$  solution (we used a 2% pharmacy solution) until the solution darkens. Gently stir the solution and continue adding, one drop at a time, until you see a distinct purple color.

This can be made semi-quantitative by determining the moles of  $I_2$  in the 2% iodine solution, and utilizing the 1:1 stoichiometry in the reaction. Other variables to test could include actual fruits subject to different conditions, vitamin C tablets, or other foods besides the citrus family.

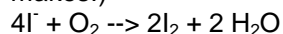
## SALT; NaCl & I<sub>2</sub>

**WHO:** NaCl is found in many foods, but in our diets it is typically an additive. It provides some necessary ions to maintain proper osmotic pressure and is used in setting up potential differences for conducting nerve impulses. However, too much salt can contribute to high blood pressure. The Na<sup>+</sup> ions and Cl<sup>-</sup> ions pack together in a regular array to form a cubic crystal. Since iodine is a critical component to our health, it can be added to commercial salt. Typically, the added amount is quite small, yet can be at a significant level for meeting daily needs. It is important to note the label when purchasing salt.

## PREPARING ICE CREAM

**WHO:** The preparation of the tasty dessert ice cream requires temperatures low enough to freeze a solution of milk fat, sugar and water. Adding solutes to a solvent depresses the freezing point of the resulting solution. For a nonionic solute, one mole of solute dissolved in one kilogram of water will lower the freezing point by 1.86°C. Adding ionic solutes can have an even greater effect. This is due to ionic solutes producing a greater number of ions per mole of solute.

**WHAT:** To detect the presence of iodine in salt, we can cause the iodide to be oxidized with hydrogen peroxide. (H<sub>2</sub>O<sub>2</sub>, yes what a difference an atom makes!)



The iodine produced can then be detected as it reacts with a starch indicator to form a purple color.

**HOW:** The iodide ions must be in solution to participate in the oxidation. Note that the number of electrons lost by the I<sup>-</sup> must equal the electrons gained by the oxygen that is generated from the H<sub>2</sub>O<sub>2</sub>.

1. In separate large test tubes, add the same amount of plain salt, iodidized salt and iodidized sea salt.
2. To all samples add sufficient water to dissolve the sample.
3. To each sample add approximately 5 mL of 3% H<sub>2</sub>O<sub>2</sub> -stir.
4. To each sample add 5 mL of saturated starch solution.
5. Observe the presence of a purple color indicating the presence of I<sub>2</sub>.

How could you make this quantitative?

You can remove the purple color by reacting the I<sub>2</sub> with 0.1 M S<sub>2</sub>O<sub>3</sub><sup>2-</sup> perhaps making another quantitative determination.

**WHAT:** When a solvent freezes the molecules are changing from a disordered state (liquid) to a more ordered state (solid.) This means that the solvent must lose some energy. The same must be true for a solution. However, a solution is even more disordered than the pure solvent. Therefore more energy must be removed before the transition (freezing) can take place. When the solution freezes the solid that forms is the solvent.

**HOW:** First we will prepare an ice cream mixture in a small sealed bag, then we will immerse that in a rock salt solution that will be below 0°C.

1. In the small sealable baggie mix 1 cup of milk, sugar, and a few drops of vanilla, exhaust excess air and seal the baggie.
2. In the larger sealable baggie, add 3-4 cups of crushed ice. Record the temperature of the ice.
3. Place the sealed small baggie inside the large baggie after you have added some rock salt to the ice. Exhaust the air from the large baggie.
4. Place the baggie assembly inside some newspaper for insulation (use duct tape) and shake the entire package for several minutes.
5. Unwrap the newspaper, check the consistency of the "ice cream" to see if it has frozen. Check the temperature of the ice-salt solution.

**JELLO & LIGHT -  
THERE'S ALWAYS  
ROOM**

**WHO:** Jello® is a commercially available gelatin product. When added to water a colloid is produced. This can be used to demonstrate an interesting property of light. When light moves through a medium its velocity depends on the density of the medium. When light moves from one medium to another (such as the jello colloid to air) it will bend. This bending is known as refraction. If the angle of the light from one medium to another is increased eventually the angle of refraction is greater than  $90^\circ$ . At this point light will be reflected back into the medium.

**WHAT:** Fiber optic systems make use of the internal reflectance as light is sent in a glass fiber. The light can continue to “bounce” inside the fiber as the proper angle is maintained. This can be seen using a laser pointer and specially prepared jello. The laser beam moves slower through the jello than it would in air. If light is made to strike the jello – air interface at an angle larger than the “critical angle” you can observe the internal reflection.

**HOW:** Prepare jello according to the following recipe:

1. Boil approximately 3 1/2 cups ( 840 mL) of water.
  2. Add 3 packages of Jello and 4 envelopes of Knox clear gelatin – stir.
  3. Allow the mixture to cool and set.
  4. Slice and remove (carefully) a strip of the solid gelatin.
- Now you can use the gelatin strip as a light guide. Gently curve the strip on a flat surface. Use the laser pointer to aim a beam in one end of the gelatin strip. Move the incident angle until you can observe the beam being internally reflected and emerging out the other end of the strip in a different direction.

Further work.... Look into the nature of colloids and define the “Tyndall Effect.”

