ENTROPY

MATERIALS NEEDED:

Iodine (use tincture of iodine, available at a pharmacy)
Starch solution, 3%. To make 100 mL of starch solution: Heat 75 mL of water to boiling. Mix 3 grams of soluble starch with 25 mL room temperature water. Slowly, with stirring, add the starch mixture to the boiling water. Bring to a brief boil, then allow the solution to cool to room temperature.
Test tube, 25 x 200 mm or similar
Bunsen burner
Test tube holder
Beaker, 250-mL or 400-mL
Dropper
Water

SAFETY PRECAUTIONS:

Wear safety goggles while performing this experiment.

Iodine is toxic. Use only small quantities. Keep containers sealed to minimize fumes.

DISPOSAL:

Dispose of all iodine wastes in the proper receptacles for halogen wastes.

PROCEDURE:

Half-fill the large test tube with water. Add one or two drops of tincture of iodine, or a crystal of iodine, so as to form a light brown mixture. Add a few drops of starch solution. The mixture should be dark blue.

Gently heat the mixture in the test tube. At a temperature above 60ºC, the mixture will change color from blue to brown. Remove the test tube from the heat.

Place the bottom quarter of the test tube into a beaker of room temperature water to cool the mixture. What happens as the mixture cools?

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EXPLANATION:

The starch molecules are coiled in a helix-like arrangement. Iodine molecules will fit into the coils resulting in the complex that is formed becoming blue in color. This is an ordered arrangement.

When the mixture is heated, the starch molecules uncoil (become denatured) breaking up the starch-iodine complex. The color of the mixture will become brown. This is a disordered arrangement.

When the mixture is cooled, the starch molecules will reform their coils, incorporating the iodine in the complex and the blue color will return.

Careful cooling of part of the solution will allow you to show both the blue and brown colors in the same test tube.