

“As a matter of heat “
Teacher’s Guide
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1) Chemical concepts.

Substances behave in a variety of ways when heated, depending on their molecular structure.

When heating substances at school, students are able to explain changes of state as changes in the order and kinetic energy of simple particles. This is not so with the changes which take place on heating various materials at home; here the students are not aware of the changes at the molecular level.

Many of the substances they heat at home are polymers. These can be thermoplastic or thermosetting materials.

A **thermoplastic** is a material that is plastic or deformable, elastic, melts when heated and freezes to a brittle, glassy state when cooled sufficiently

Thermosetting plastics (thermosets) refer to a variety of polymer materials that cure, through the addition of energy, to a stronger, crosslinked, form.

2) Brief description of how the demonstration addresses these concepts

Margarine, a *colloid* composed mainly of tryglycerides (relatively small molecules), melts when heated. The process of heating increases the kinetic energy of the molecules which begin to move from place to place as it melts.

Egg white, mozzarella cheese and bread are mixtures which contain polymers (proteins, starch). Upon heating, these will show different transitions.

Frying an egg, with melted cheese and braided bread, demonstrates the different kinds of substances. Eggwhites will form a thermoset the increase of kinetic energy causes globular proteins to unfold and entangle each other while water molecules evaporate. Intermolecular bonds form which prevent conformation changes or translation of the protein molecules. Melted cheese shows thermoplastic properties when heated. In this case, energy absorbed allows the protein molecules to change conformation; when the hot cheese is pulled and form threads, the molecules unfold, arrange themselves in the direction of the thread. This process is similar to the one done while kneading, rolling and pulling the dough. Even after baking, the direction of the polymer chains is more or less conserved. That is why you can tear apart braided bread (a Halla), and it will always separate in the same direction, because while tearing the bread you will be separating polymer chains from each other (starch or protein molecules).

During the demonstration I decide with the students which kind of utensil is better suited to turn the egg - a metal (stainless steel), plastic (nylon, PE) or wooden spatula ? This task is done daily without even knowing that it is being done and deals with the “bond” between the property of a material and its use.

3) A guide to preparing and performing the demonstration, including safety and disposal issues.

Materials:

Two eggs, 1oz margarine, salt, two slices of cheese, one halla (braided bread

Equipment:

A frying pan, nylon, stainless steel and wooden spatulas and a plastic spoon, matches, a heating device (a heating plate or Bunsen burner),

A video camera connected to a projector to show the audience the process (I used my desk top camera).

Safety precautions should be taken as you do while cooking.

4) Description of how the demonstration is used in the classroom to foster learning and understanding of the concepts.

This demonstration is simple, known to the students, but everybody enjoys watching cooking demonstrations. That is why this demonstration is so surprising and special. The students see how much chemistry there is in such a common daily task. I hope that some of them will think “Chemistry” while frying an egg, cooking and doing other daily, mundane tasks.