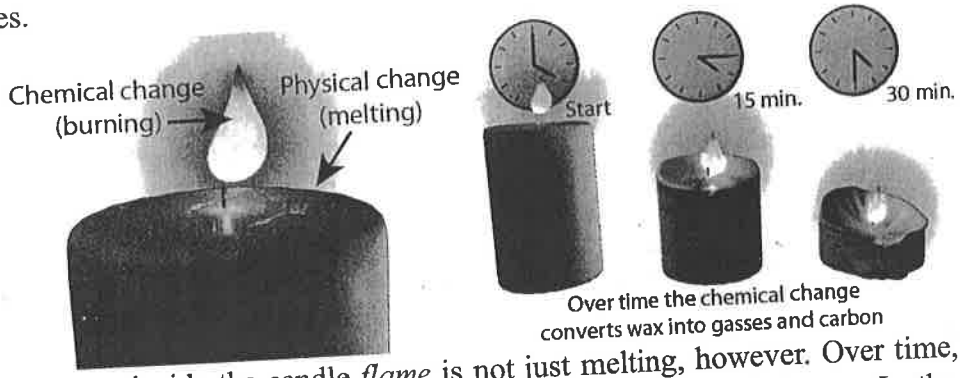
4.1 Understanding Chemical Changes

Reversible changes

Physical and chemical change are fundamentally different. For example, consider a burning candle. Some of the wax in a candle is solid and some is melted. Melting (solid to liquid) and freezing (liquid to solid) are examples of *reversible* changes. If you cool the melted liquid wax down, it becomes solid again. Reversible changes are physical changes.



Over time the chemical change converts wax into gasses and carbon

Irreversible changes

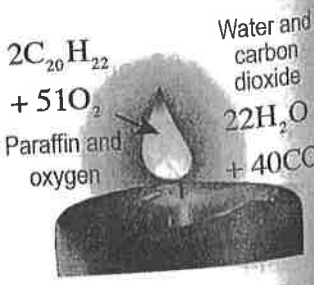
What happens inside the candle *flame* is not just melting, however. Over time, the wax vanishes! Burning wax is a very different, *irreversible* kind of change. In the flame, a chemical reaction changes wax into carbon, water vapor and carbon dioxide, three very different substances. If you cooled down the smoke from a burning candle, it would not become wax again. Wax disappears as a candle burns because water vapor and carbon dioxide are gases that float away into the air.

Physical changes are reversible

$C_{20}H_{42}$, a type of *paraffin* is a major component of candle wax. Each molecule of paraffin contains 20 carbon atoms and 42 hydrogen atoms. If you pour the wax into different shapes, or melt it, or cut it up in tiny pieces, each bit will still be made from molecules with 20 carbon and 42 hydrogen atoms. That's because a physical change leaves the molecules of a substance the same. *Physical changes are reversible*: melting, shaping, cutting, bending and freezing are all physical changes.

Chemical changes are irreversible

Wax burning in a flame is a chemical change. A **chemical change** is a change in the molecules themselves. In the candle flame, the atoms in paraffin molecules are rearranged into molecules of water and carbon dioxide. In burning, wax undergoes an **irreversible change**. Chemical changes are irreversible because they rearrange atoms into different substances.



Chemistry terms

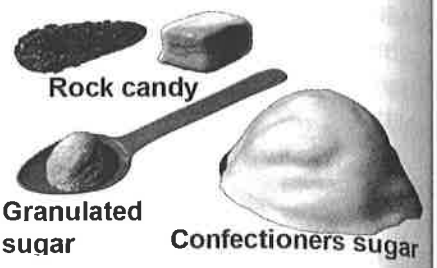
chemical change - a change that affects the structure or composition of the molecules that make up a substance, typically turning one substance into another substance with different physical properties.

irreversible change - is a chemical change that rearranges atoms into different substances

What is NOT a chemical change

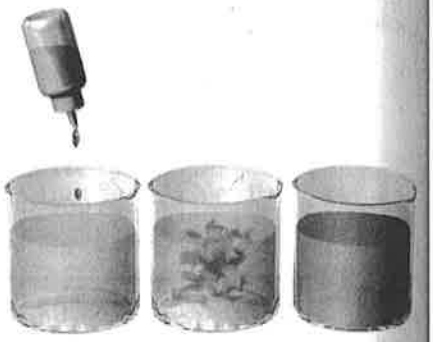
Changes in size or shape are physical changes

Any process that changes the shape of a substance is usually a physical change. That means bending or deforming are physical changes. It also means grinding something up into powder is a physical change. Rock candy, granulated sugar and confectioners sugar are the same substance, but they have been ground into different textures.



Mixing and dissolving are physical changes.

Adding food color to water spreads dissolved dye molecules evenly through the water but does not change the dye molecules into other molecules. This is evidence that dissolving is a physical change. Even vigorous mixing is still a physical change. For example, mix some corn oil in water and it floats. Whip it with a beater and the mixture turns cloudy and white, like milk. Under the microscope however, you still see a mixture of water and oil. The oil droplets have become very small, but each droplet still contains thousands or millions of atoms. Making bigger drops into smaller drops is definitely a physical change. Milk and mayonaisse are mixtures of oils or fats and water.



Mixing is a physical change

"Drying" may be a chemical or physical change

Drying is the opposite of dissolving. In drying, the water is removed from a mixture, leaving any solutes in their dry form. Like dissolving, drying is *usually* a physical change. Drying paint for example is not always just a physical change. Certain molecules in latex or acrylic paint react chemically with oxygen to link together. Dried latex or acrylic paint is a solid that does not become liquid again when you heat it, or add water back to it. In the sense of chemistry, "drying" means the purely physical process of removing liquid without chemical changes.