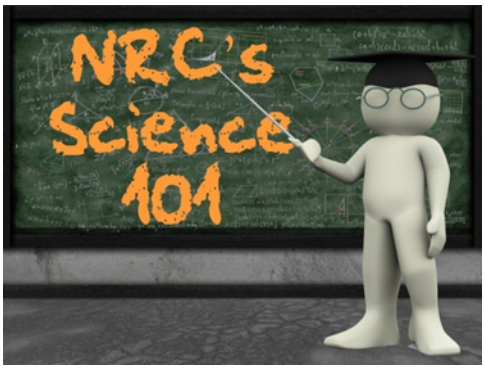
The Nuclear Regulatory Commission's Science 101: What is a Chemical?

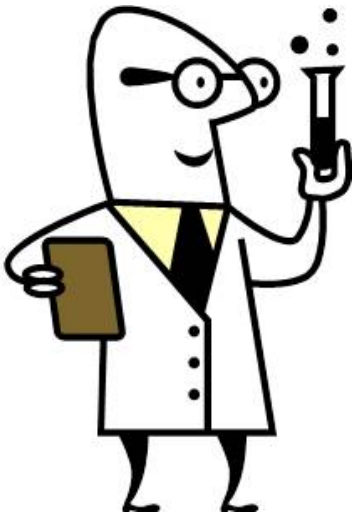


A chemical is any substance that has a defined composition. In other words, a chemical is always made up of the same "stuff." Some chemicals occur in nature, such as water. Other chemicals are manufactured, such as chlorine (used for bleaching fabrics or in swimming pools). Chemicals are all around you: the food you eat, the clothes you wear. You, in fact, are made up of a wide variety of chemicals.

A chemical reaction refers to a change in a chemical. More generally, a chemical reaction can be understood as the process by which one or more substances change to produce one or more different substances. Chemical changes are different from physical changes, which don't result in a change in substances. One example of a physical change is when water freezes into ice. While ice may have different physical properties, it is still just water. Another example is when you dissolve salt into a cup of water. While the salt may appear to disappear into the water, you still have water and salt—no substance changed into a completely new substance.

Here is one example of a chemical reaction: Iron + Oxygen → Iron Oxide

Iron oxide, also known as rust, cannot become iron or oxygen again. It is a completely new substance. In the equation, the substances on the left-hand side of the arrow are considered reactants (the substances that participate in a chemical reaction). The substance on the right-hand side of the arrow is considered a product (a substance that results from a chemical reaction). It's important to note from this example that no material is "lost" in the reaction. On one side of the equation you have iron and oxygen; on the other you still have iron and oxygen (now just combined into one chemical).



In that sense, this example illustrates what is known as the law of conservation of mass. By "law," we mean a general rule of how something works or how something occurs. This description is considered to be extremely reliable due to a large amount of supporting experimental testing and observation. Considering the given example, the law states the products of a chemical reaction have the same mass ("stuff") as the reactants. In other words, while things are rearranged, nothing is created or destroyed.

Here are some ways to tell if a chemical change is occurring:

1. You might notice bubbling or a change in odor, indicating the production of a gas. Such is the case when baking soda is mixed with vinegar.

2. When two clear solutions are mixed together and the resulting mixture is cloudy (due to the presence of some solid substance now in the liquids). This is known as the formation of a precipitate.

3. A change of color (like in our rust example).

4. A change in temperature or if light is produced, such as with fire.

While any of the above may be evidence of a chemical change, physical changes can have some of the same effects. One way to determine the difference between the two is to think about whether the new substance could be physically separated back into its original parts—in other words, if the matter could "go back" to how it originally was. If it cannot, then it's a chemical change.