

Chemical changes or chemical reactions are a main part of the study of chemistry. The first question that needs to be asked is, what is a chemical reaction? What makes these changes different from physical changes?

### History

Explore the discoverer's biography, including general facts about his life and anecdotes regarding how he made this particular discovery. Also see other significant scientific discoveries built largely on this concept and other real-world applications in history that may not still be relevant.

### Use/Application through History

Chemistry is a well developed but very ancient science, and chemical changes have been handled by human beings since 4,000 years ago. The Egyptians [URL: <http://www.sas.upenn.edu/~nader/egyptplant.gif>] pioneered the "art" of chemistry, and since then, people have explored and continue to explore the many different aspects of chemistry. Around 1000 BCE, ancient societies discovered and mastered many chemical techniques such as how to extract metal from alloy, to make wine out of grapes or rice, to make pottery or china, and to make pigment for drawing. Throughout the rest of human history, chemistry has been used in the invention of paper, gun powder, ink, and more recently, gasoline, plastic, soap etc. Today, chemistry is used in a variety of ways across the globe.

### Concept Definition

Study the primary definition of this concept, broken into general, basic, and advanced English definitions. Also see the mathematical definition and any requisite background information, such as conditions or previous definitions.

#### General Science

In a chemical change, the substances are altered chemically and display different physical and chemical properties after the change.

#### Basic

Chemical changes are often accompanied by color change, precipitation, generation of a gas, or a combination of the three.

#### Advanced

Substances react chemically in characteristic ways with other substances to form new substances with different characteristic properties. Chemical equations describe the overall outcomes of chemical reactions by identifying the beginning substances (reactants) and ending substances (products).

### **Mathematical Definition**

### **Real World Application**

Discover processes or disciplines in the natural or man-made worlds that employ the concept.

The oil industry uses chemical reactions such as cracking of petroleum.

The military uses chemical reactions in the gas bomb.

Plastic making involves chemical changes with the composition of polymers.

Turning fat or oil and alkaline solution into a bar of soap, widely used in soap industry, is a chemical change.

Reactions in the human body such as digestion, turning food into glucose, ATP, ADP formation, etc., are chemical changes.

Chemical changes even occur in art. For example the obscure oxidation drawing by Andy

Warhol [URL: [http://www.christies.com/LotFinder/lot\\_details.aspx?intObjectID=5074062](http://www.christies.com/LotFinder/lot_details.aspx?intObjectID=5074062)] , was completed by using the chemical reaction of copper metallic paint oxidized by urine.

Chemical changes are everywhere!

## Vocabulary

Learn important vocabulary for this concept, including words that might appear in assessments (tests, quizzes, homework, etc.) that indicate the use of this concept.

Important Vocabulary

**Term**

**Context**

and, +

- Oxygen and hydrogen react to yield water.

balanced chemical equation

- The chemical change is described by the balanced chemical equation.

catalyst

- Manganese is a catalyst in the decomposition of  $\text{H}_2\text{O}_2$ .

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equilibrium

- The equilibrium in chemical reactions within the body is very delicate.

product

- The products of any combustion reaction (burning) are  $\text{H}_2\text{O}$  and  $\text{CO}_2$ .

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react

- Noble gases do not react with anything; they remain unchanged.

reactant

- The reactants in a chemical reaction must be mixed in order to react.

yield

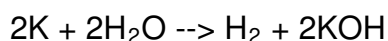
- Many substances, when mixed with oxygen, will yield new products.

## Videos

Browse relevant videos from the Journal of Chemical Education's (JCE) Chemistry Comes Alive! library and other video sources.

### Potassium with Water

Potassium reacts vigorously with water, producing a flame in this exothermic reaction.



### Cold Enough to Freeze Water

Here, the freezing of water is caused by the temperature change in a chemical reaction.

### Iodine Clock

Observe color-change in a chemical reaction between two colorless solutions.

### Genie in a Bottle

The classic demo: Genie in a Bottle . It demonstrates the generating of gas in some chemical changes.

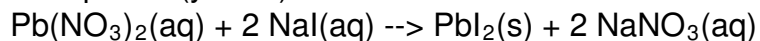
### Sodium Iodide and Lead(II) Nitrate

Adding very pale yellow sodium iodide to colorless lead(II) nitrate produces a yellow precipitate.

Solution A: 0.5 M sodium iodide (very pale yellow)

Solution B: 0.2 M lead(II) nitrate (colorless)

Precipitate: (yellow)



## Classroom Demonstrations

Investigate lab procedures suitable for live classroom demonstrations or guided student exploration.

Demos

**Burning Iron**

**Iodine Clock**

**Chemical Genie in the Bottle**

**Precipitation in Chemical Changes**

## Summary

Read a summary of the concept, indicating the enduring understanding students should retain after class.

Summary

The key to a chemical change is that a new substance with different chemical properties than the starting material(s) must be generated after the change. Chemical changes are most commonly indicated by changing color, the formation of a new state of matter (i.e. solid or gas in a reaction with only liquids), or flame.

## Works Cited

Review the works cited to write the researched parts of this page, such as the discoverer's biographical information and other areas.

Works Cited

Defination, General:

[LINK URL: <http://www.teacherbridge.org/public/bhs/teachers/Dana/chemphys.html>]

Defination, Advanced:

[LINK URL: <http://prisms.mmsa.org/review.php?rid=116>]

The picture in "Application Throughout History":

[LINK URL: <http://www.sas.upenn.edu/~nader/>]

The picture in classroom demonstrations:

[LINK URL:  
<http://www.corrosionist.com/rusted%20nail%20no%20cathodic%20protection%20after%20%20days.jpg>]

The picture of oxidation painting done by Andy Warhol

[LINK URL: [http://www.christies.com/LotFinder/lot\\_details.aspx?intObjectID=5074062](http://www.christies.com/LotFinder/lot_details.aspx?intObjectID=5074062)]

Defination, Basic:

[LINK URL: <http://prisms.mmsa.org/review.php?rid=116>]