

5.3 Chemical Properties, Chemical & Physical Change

Learning Goals/Success Criteria: *At the end of this lesson, I will be able to:*

- Describe evidence for a chemical change and classify change as physical or chemical

Chemical Properties are characteristics that describe a substance's ability to undergo changes to its composition to produce one or more new substances. Some examples of chemical properties are listed below:


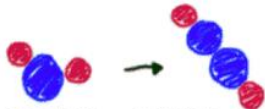
Chemical Property	Description	Examples of real substances with property:
Reactivity with Acids	Ability to react with acids non-reactive = inert	Baking soda reacts with vinegar (acetic acid) to produce CO ₂
Reactivity with Water	Ability to react with water non-reactive = inert	Alkali metals react with water
Reactivity with Oxygen (Corrosion/Oxidation)	Destruction of a substance	Rusting on cars
Bleaching Ability	Removal of a pigment	Chlorine bleach Hydrogen Peroxide (H ₂ O ₂) breaks down the pigment/color in hair
Flammability/Combustibility	Flammable, combustible, nonflammable	Paper Gasoline burns easily if ignited

The main difference between physical and chemical properties is whether or not a NEW product is formed.

Physical Property	Chemical Property
<ul style="list-style-type: none"> Observed without changing the composition of the substance 	<ul style="list-style-type: none"> Observed when the chemical identity of a substance is changed. Indicates how a substance reacts with something else

Chemical & Physical Change

When we are observing chemical properties, we must observe a chemical change:

Physical Change	Chemical Change
<ul style="list-style-type: none"> Composition of the substance remains exactly the same No new substances are made May be able to return to their original state 	<ul style="list-style-type: none"> Change in the starting substance (reactants) and the production of one or more new substances (products) Change in the chemical or physical properties Cannot get the original substances back easily
<p>Examples:</p> <ul style="list-style-type: none"> Changes in shape, size or form Changes of state Change involving melting, boiling, evaporation/condensation, crystallization, dissolving 	<p>Examples:</p> <ul style="list-style-type: none"> Burning a candle Mixing vinegar and baking soda Iron rusting
 <p>PHYSICAL CHANGE OF WATER INTO ICE</p>	 <p>CHEMICAL CHANGE OF WATER INTO HYDROGEN PEROXIDE</p>

Evidence of a Chemical Change

We might not always be able to observe a chemical change and rely on five main pieces of evidence that a chemical change has occurred. Your teacher will demonstrate these 5 different pieces of evidence. Make notes in the table below.

<i>Evidence:</i>	<i>Observations:</i>
<p><i>An unexpected change in colour</i> A new substance has formed that has a different colour than the original substance.</p>	<p>pH Rainbow Tube [Universal Indicator + NaOH (Sodium Hydroxide + HCl (Hydrochloric Acid))]</p> <ul style="list-style-type: none"> • Change in rainbow color
<p><i>A change in odour</i> A new substance has formed that has a detectable odour.</p>	<p>Oil of Wintergreen</p> <ul style="list-style-type: none"> • minty smell <p>Fireworks</p> <ul style="list-style-type: none"> • smells like rotten eggs
<p><i>Appearance of bubbles (not caused by heating).</i> A new substance is produced in the form of a gas.</p>	<p>HCl (Hydrochloric Acid) + Mg (Magnesium Metal)</p> <ul style="list-style-type: none"> • Bubbles formed, fizzing action, forming H₂ gas <p>NaHCO₃ (Baking soda) + CH₃COOH (Vinegar/Acetic Acid)</p> <ul style="list-style-type: none"> • Bubbles formed, fizzing action, forming CO₂ gas
<p><i>A new solid is formed.</i> A new substance is produced that does not dissolve in the mixture and shows up as a solid. The solids that are formed from two solutions are called precipitates (insoluble solid).</p>	<p>KI (Potassium Iodide) + Pb(NO₃)₂ (Lead (II) Nitrate)</p> <ul style="list-style-type: none"> • Yellow color formed + precipitate formed (insoluble solid)
<p><i>A change in temperature, light or sound.</i> Energy is released or absorbed during the chemical change and is detected as a change in temperature, light or sound.</p>	<p>Refer to demo for the gas produced in demo 3 (Hydrogen gas)</p> <ul style="list-style-type: none"> • Highly flammable, ignites, change in temperature, light, and a pop sound • Same as fireworks

TWO WAYS TO CHANGE

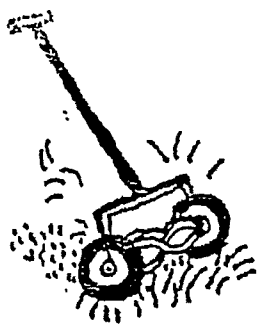
A melting ice sculpture ... a spectacular bonfire ... a cake baking in the oven ... a milkshake in the making ... an explosion ... all of these involve changes in matter. Some are physical changes (changes in shape, colour, or state) and others are chemical changes (changes involving chemical reactions). Which are which? For each change described below, write P for physical change or C for chemical change. Be ready to explain your choices.



1. glass breaking - P
2. Hammering wood together to build - P
a playhouse



3. a rusting bicycle - C
4. melting butter for popcorn - P
5. glassblower creating sculpture - P
out of glass



6. freezing chocolate-covered bananas - P
7. separating sand from gravel - P
8. spoiling food - C
9. burning toast - C



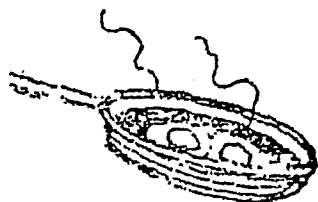
10. making salt water to gargle for a - P
sore throat
11. mixing lemonade powder into water - P



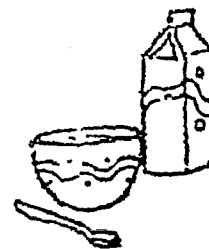
12. cream being whipped - P
13. water evaporating from a pond - P
14. cutting grass - P
15. burning leaves - C



16. humidifier putting moisture - P
into the air



17. corroding metal - C
18. bleaching your hair - C
19. fireworks exploding - C
20. squeezing oranges to get orange juice - P
21. frying an egg - C
22. pouring milk on your oatmeal - P



Physical and Chemical Changes

Part A: Can you recognize the chemical and physical changes that happen all around us? If you change the way something looks, but haven't made a new substance, a **physical change (P)** has occurred. If the substance has been changed into another substance, a **chemical change (C)** has occurred.

1.	p	An ice cube is placed in the sun. Later there is a puddle of water. Later still the puddle is gone.
2.	c	Two chemicals are mixed together and a gas is produced.
3.	c	A bicycle changes color as it rusts.
4.	p	A solid is crushed to a powder.
5.	c	Two substances are mixed and light is produced.
6.	P → c	A piece of ice melts and reacts with sodium.
7.	p	Mixing salt and pepper.
8.	p	Chocolate syrup is dissolved in milk.
9.	c	A marshmallow is toasted over a campfire.
10.	p	A marshmallow is cut in half.

Part B: True (T) or False (F)

1.	F	Changing the size and shapes of pieces of wood would be a chemical change.
2.	F	In a physical change, the makeup of matter is changed.
3.	T	Evaporation occurs when liquid water changes into a gas.
4.	T	Evaporation is a physical change.
5.	F	Burning wood is a physical change.
6.	F	Combining hydrogen and oxygen to make water is a physical change.
7.	T	Breaking up concrete is a physical change.
8.	F	Sand being washed out to sea from the beach is a chemical change.
9.	F	When ice cream melts, a chemical change occurs.
10.	F	Acid rain damaging a marble statue is a physical change.

Part C

Read each scenario. Decide whether a physical or chemical change has occurred and give evidence for your decision. The first one has been done for you to use as an example.

	Scenario	Physical or Chemical Change?	Evidence...
1.	Umm! A student removes a loaf of bread hot from the oven. The student cuts a slice off the loaf and spreads butter on it.	Physical	No change in substances. No unexpected color change, temperature change or gas given off.
2.	Your friend decides to toast a piece of bread, but leaves it in the toaster too long. The bread is black and the kitchen is full of smoke.	Chemical	<ul style="list-style-type: none">• Heat is given off• Color change
3.	You forgot to dry the bread knife when you washed it and reddish brown spots appeared on it.	Chemical	<ul style="list-style-type: none">• Color change (rust)
4.	You blow dry your wet hair.	Physical	<ul style="list-style-type: none">• Water evaporates
5.	In baking biscuits and other quick breads, the baking powder reacts to release carbon dioxide bubbles. The carbon dioxide bubbles cause the dough to rise.	Chemical	<ul style="list-style-type: none">• Formation of gas (bubbles)
6.	You take out your best silver spoons and notice that they are very dull and have some black spots.	Chemical	<ul style="list-style-type: none">• Change of color
7.	A straight piece of wire is coiled to form a spring.	Physical	<ul style="list-style-type: none">• Only change of form
8.	Food color is dropped into water to give it color.	Physical	<ul style="list-style-type: none">• It is still water, but in different colour
9.	Chewing food to break it down into smaller particles represents a physical change, but the changing of starch into sugars by enzymes in the digestive system represents a chemical change.	Physical and chemical	<ul style="list-style-type: none">• Chewing is physical change• Digestion is chemical change
10.	In a fireworks show, the fireworks explode giving off heat and light.	Chemical	<ul style="list-style-type: none">• Heat and light are given off

1. Explain, which of the following changes, is physical and which is chemical?

- a) melting wax, painting it onto cloth and letting it set hard
physical
state change from solid → liquid → solid
- b) heating iron ore and carbon to form iron metal and carbon monoxide gas
chemical, new substances formed
- c) burning toast at breakfast
chemical, new odour (burning) & colour change
- d) carbon dioxide gas bubbles forming in a glass of pop
physical carbon dioxide coming out of solution
- e) tearing a piece of paper into smaller pieces
physical, no new substance formed
- f) modeling clay into a vase
physical, changing shape but no new substance formed
- g) painting a wall
physical, no new substance formed
- h) burning a match
chemical, light emitted + heat
- i) rust forming on a car
chemical, iron + oxygen produces a new substance
- j) digesting a hamburger
chemical, food is broken down into energy

2. Water and gasoline are both clear liquids at room temperature. Describe one physical and one chemical property that might be used to distinguish between them,

physical → odour
water = odourless
gasoline = strong odour associated with it

chemical → flammability
water - not flammable
gasoline - very combustible

3. State two quantitative and qualitative physical properties that change when antifreeze is dissolved in water

quantitative
- volume of the new solution
- density of the new solution

qualitative
- colour of the new solution
- odour of the new solution