

Is it a Chemical Reaction?		Grade 5 - Properties and Changes in Matter	
<b>Lesson Plan</b>		<b>Safety Notes</b>	70%-90% Isopropyl alcohol is flammable. Keep away from flames. Safety goggles or eye protection recommended Gloves (tumeric can stain)
<b>Description</b> Students will learn that chemical changes result in the formation of a new substance. Students will explore how to identify a chemical reaction through these experiments.			
<b>Materials</b>			
<p><b>Gas Formation:</b></p> <ul style="list-style-type: none"> <li>- Baking Soda</li> <li>- Vinegar</li> <li>- Cup</li> </ul>	<p><b>Turmeric pH Indicator:</b></p> <ul style="list-style-type: none"> <li>- Turmeric Powder</li> <li>- Isopropyl Alcohol</li> <li>- Household solutions (baking soda, vinegar, soap, soda water, lemon juice, milk, etc.)</li> <li>- Jars or cups</li> </ul>	<p><b>Turmeric Reaction:</b></p> <ul style="list-style-type: none"> <li>- Turmeric Powder</li> <li>- Isopropyl Alcohol</li> <li>- Baking soda</li> <li>- Calcium Chloride (hardware store) - or vinegar</li> <li>- Ziplock Bag</li> </ul>	
<b>Science Background</b>			
<p>Anything that takes up space and has mass (weight) is made of matter. The three states of matter are solids, liquids, and gasses. The molecules, or particles, in these three phases behave differently:</p> <ul style="list-style-type: none"> <li>- Gases: particles are well separated and move freely at high speeds</li> <li>- Liquids: particles are close together and move and slide past each other</li> <li>- Solids: particles are tightly packed and generally do not move from place to place</li> </ul>			
<b>Physical Change</b>			
<p>A physical change happens when molecules move from one physical state of matter (solid , liquid, or gas), to another physical state. There is no change in the atomic structure, and a new substance is not created. For example, a water molecule (H<sub>2</sub>O) is always made up of 2 hydrogen atoms, and 1 oxygen atom. If you start with a solid ice cube, and it melts into liquid water, you have changed the physical state of matter, but not the atomic structure of H<sub>2</sub>O. You can also reverse a physical reaction, in this case by freezing your liquid water back into an ice cube.</p>			
<b>Chemical Change</b>			
<p>A chemical change happens when the atomic structure of a substance changes. Unlike physical changes, chemical changes are considered irreversible and a new substance is formed. There are several signs of a chemical change, including:</p> <ul style="list-style-type: none"> <li>● Formation of gas (bubbles)</li> </ul>			

- Change in colour
- Change in pH,
- Change in temperature (increase or decrease),
- Formation of new solid or liquid,
- Appearance of light
- Production of electricity

For example, when you bake a cake, you create a new substance. During the baking process, we usually create a new substance, carbon dioxide gas, which makes our cake light and fluffy!

## pH

pH is something used to help determine whether a substance is acidic or basic. The pH scale goes from 0 to 14, where 0 is a strong acid, 7 is neutral (water), and 14 is a strong base.

## Activity Procedure

### Baking Soda & Vinegar

1. Add a teaspoon of baking soda to a  $\frac{1}{4}$  cup of vinegar.
2. What do you observe? Was there a sign of a chemical reaction?

### Turmeric pH Indicator

1. Mix  $\frac{1}{4}$  teaspoon of turmeric powder with  $\frac{1}{4}$  cup rubbing alcohol in a jar or cup. This is your indicator for acids and bases.
2. Prepare small cups with 2 tablespoons of household solutions (soap water, vinegar, baking soda water, lemon juice, milk, etc.)
3. Add  $\frac{1}{4}$  teaspoon of the turmeric indicator into each household solution and mix. Note the final colour of each solution.
4. Which household chemicals are bases? Which are acids? Was there a sign of a chemical reaction?
5. If any of your solutions changed colours, how can you change it back?

### Turmeric Reaction

1. Add 5 spoonfuls of rubbing alcohol into the Ziplock bag
2. Add 1 spoonful of baking soda into the bag and close it tightly. Mix the solution until the baking soda disappears.
3. Open the bag and add two pinches of turmeric powder. Seal the bag and mix the contents. What does the solution look like?
4. Open the bag and add a large spoonful of calcium chloride (or vinegar if no calcium chloride is available). Close the bag and mix well. What does the solution look like and feel like? Is there any evidence of a chemical change?

## Debrief

### Baking Soda & Vinegar

Mixing baking soda and vinegar together creates a chemical reaction that forms carbon dioxide gas. The sign of a chemical reaction taking place is the bubbling and fizzing, which indicates the formation of a gas.

### Turmeric pH Indicator

Turmeric is an acid base indicator, which changes colour when the solution turns acidic or basic. Turmeric contains a chemical called curcumin, which remains yellow in an acidic or neutral solution, but turns red in a base. When you add turmeric into a basic solution (soap water, baking soda), it changes to a deep red colour (bottom left of photo). This red colour can be changed back to yellow when you add an acid back into the solution (lemon juice, vinegar). A neutralization reaction occurs when you add enough acid so that there is an equal amount of both acid and base - therefore creating a neutral solution.



### Turmeric Reaction

The original solution with alcohol, baking powder, and turmeric was deep red because baking soda caused the solution to be basic. After adding the calcium chloride to the bag and sealing it, you should have seen several indicators of a chemical reaction. First, there was production of a gas, which was seen through the bag filling with air and the bubbling/foaming. Next, the bag gets warm which means this reaction is exothermic, or releases energy in the form of heat. Finally, there was a colour change from red to yellow. When calcium chloride was added to the baking soda solution, carbon dioxide gas was created, and the solution changed back to yellow because carbon dioxide is an acid that mixed with water. If you used vinegar instead of calcium chloride, vinegar is an acid and also creates carbon dioxide when added to baking soda which causes the yellow change in colour.

### Additional experiment to try:

Another natural pH indicator is red cabbage juice! Boil red cabbage pieces in water until it is purple and remove the chunks - and that's it! Add your red cabbage indicator to various household solutions (vinegar, baking soda solution, soap water), and see the different colour changes. The solution will be red in an acid, and blueish-green in basic solutions. The pigment anthocyanin in cabbage allows it to change colour depending on the acidity of a solution.

## Handout

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1. What indicates a physical reaction?
  
  
  
  
  
  
  
  
  
  
2. What indicates a chemical reaction?
  
  
  
  
  
  
  
  
  
  
3. From the list below, identify whether it is a physical or a chemical change.

- Activating a cold pack \_\_\_\_\_
- Burning a log in a campfire \_\_\_\_\_
- Evaporating alcohol \_\_\_\_\_
- Activating a hot pack \_\_\_\_\_
- Ice melting \_\_\_\_\_
- Dissolving sugar in water \_\_\_\_\_
- A rust spot on a car \_\_\_\_\_
- Dropping a Mentos candy into a coke bottle \_\_\_\_\_
- Mixing baking soda and vinegar \_\_\_\_\_

## Handout - Answer Sheet

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1. What indicates a physical reaction?

During a physical change, the substance has changed, such as change in state of matter, but it has not become a new substance.

2. What indicates a chemical reaction?

During a chemical change, a new substance is formed.

Signs of a chemical change (that a new substance was formed) include:

- Formation of a gas - bubbles
- Change in colour
- Change in pH
- Change in temperature - either increase or decrease
- Formation of new solid or liquid
- Appearance of light

3. From the list below, identify whether it is a physical or a chemical change.

Activating a cold pack	<u>Chemical</u>
Burning a log in a camp fire	<u>Chemical</u>
Evaporating alcohol	<u>Physical</u>
Activating a hot pack	<u>Chemical</u>
Ice melting	<u>Physical</u>
Dissolving sugar in water	<u>Physical</u>
A rust spot on a car	<u>Chemical</u>
Dropping a Mentos candy into a coke bottle	<u>Physical</u>
Mixing baking soda and vinegar	<u>Chemical</u>