

# What's the MATTER with chemical reactions?

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## Synopsis of the Activity:

This workshop is to demonstrate chemical and phase changes. The audience should learn that there is a difference between a chemical and phase changes, but both involve matter. Visitors should leave with an understanding that matter is all around us, all the time and cannot be destroyed or created.

## Audience:

This can be for all ages but is mostly for 4<sup>th</sup> and above. The best setting for this activity is a classroom, its nice with a small group because it can become a lot more hands one for the students but also works in large groups as well.

## Activity (Learning) Goals OR Learning Objectives:

Students and participants should be able to tell the difference between chemical reactions and phase changes. Students should also learn what characteristics we can observe that help us tell if a chemical reaction is taking place.

Learning goals should include:

1. Engagement in science; this is a huge call and response type of activity. The kids (no matter what the group size) should be asked thought provoking questions that encourage self-investigation.
2. Understanding and feeling comfortable using the scientific vocabulary that is laid out in this course should also be a learning goal.
3. The biggest learning goal of the activity is for the kids to have fun and want to explore science past the activity.

## Materials:

**\*Try All Demos Before Hand, Its important to know how an experiment will go and what materials you may have forgotten otherwise.**

-Table

Elephant toothpaste: This is a chemical reaction and exothermic. The two substances change into a different substance

1. Gloves
2. Goggles
3. 1 L graduated cylinder
4. 25 mL 30% hydrogen peroxide
5. 4 g Potassium Iodine (KI)
6. Clear plastic tub
7. Neutralizing solution

THIS IS AN EXOTHERMIC REACTION AND FLAMIBLE! Make sure that there is at least 5 ft. between your audience and the experiment. Wear gloves and safety goggles when doing this experiment. SPRAY WITH NUTRILIZTING SOLUTION IMMEDIATELY after the experiment is over.

**Dry Ice Bubbles:** This is a phase change, sublimation.

1. Dry ice
2. Water
3. Bowl
4. Soapy water
5. 1 inch cloth
6. Towel

**\*DRY ICE MUST BE HANDLED WITH GLOVES**

**Non-Newtonian liquid:** This is a physical change; it may look like a chemical reaction but once the water evaporates the cornstarch will be left.

1. Cornstarch
2. Water
3. Food Coloring
4. Large bowl

**Baking soda balloon:** Chemical reaction and endothermic. Creates a gas, which is one of the characteristics of a chemical reaction

1. Baking soda
2. Vinegar
3. Plastic bottle
4. Balloon
5. Funnel

### **Preparation and Set-up:**

**Elephant toothpaste:** 3 minutes prep time before hand to mix solution together.

Preparing water, potassium iodine and soap. Also preparing the neutralizing solution before hand is vital, since the experiment is flammable.

**Baking soda:** (5 minutes)

Place baking soda in balloons before hand is helpful and attaching the balloons to the top of the bottle with vinegar makes it simple for kids to come up and pour in baking soda straight in

**Non-Newtonian liquid:** (30 seconds to mix)

Preparing the cornstarch and water before hand may be helpful, it is very simple to mix together on the spot. As long as you have extra water to add in if you are going to be doing this for more then a few minutes.

### **Guiding Questions:**

What are three phases of matter? What's an example of a liquid? What's an example of a gas? What's an example of a solid? What is matter? What does that mean? What is a chemical reaction? What's the difference between a chemical reaction and matter changing phases? What's an exothermic reaction? What's an endothermic reaction?

### Baking soda:

What do you think will happen when we mix vinegar and baking soda? What do you think will happen to the balloon? Why? Why does the balloon stop blowing up? What did you guys observe? Is gas a matter? Is this matter changing phases?

### Dry Ice:

What do you guys think will happen when we add dry ice to water? What is dry ice? What will happen when the bubble pops? Why? We see the gas inside the bubble, once it rolls off the table and onto the floor is it gone? Is this an example of a chemical reaction? Or A phase change?

### Elephant toothpaste:

What did you guys observe? What happened? Is this a chemical reaction or a phase change? How can we tell this is a chemical reaction?

### Non-Newtonian liquid:

What is a non-Newtonian liquid? What do you notice about this substance? What makes this different than liquid or a solid? What similarities does it have to a liquid? Or a solid?

### **Activity Description:**

This activity can be formed into a tabletop activity but is made for a classroom or group activity. If you wanted to do a tabletop activity this is easy to manipulate, using any two of the activities except elephant toothpaste (this is expensive to do, so doing it more than once would not be cost or clean up affective). This activity has a small amount of vocabulary that is supposed to be used over and over again throughout the presentation. The presentation starts with asking, what are three states of matter that we see everyday? Liquid, solid and gas are the three that will be discussed; students may know the other two states so be prepared to discuss them as well. Ask for examples of each one and ask why are they different? Then repeat or explain in simple terms how a solid is different then liquid. Talking to kids about liquid being made up of really small particles that are close together and a gas is made up of really small particles that we can't even see and these are so far apart that they make a gas. With older kids you can use the word molecules/atoms to describe this.

Ask what is matter? Where is matter? Are we made up of matter? What about this table?

### Demo 1: Baking soda

I'm going to take some baking soda and add it to the vinegar and let's observe what happens to the balloon.

- What do you think will happen when the baking soda and vinegar come in contact?
  - Create a gas
- What do you think will happen to the balloon?
  - Expand
- Why?

- Why does the balloon stop blowing up?
- What did you guys observe?

When the baking soda and vinegar mix they create a gas (carbon dioxide), gases need more room to spread out, so the carbon dioxide fills the bottle and moves into the balloon to inflate it.

- Is gas matter?
- Does this balloon have mass and takes up space?

We can see matter is really small particles that we can't see with our eyes but when we made carbon dioxide with baking soda and vinegar it fills up the balloon, which is space and mass!!

This is known as an endothermic reaction, that's a fancy word that basically means this reaction absorbs heat.

Later we will see an exothermic reaction, which means that the reaction releases heat

- Is this matter changing phases?
  - No because we are actually making a chemical reaction
  - We started with vinegar and baking soda and now we have water and carbon dioxide

So what is the difference between a chemical reaction and a matter changing phases?

But first we need to ask what is a chemical reaction is?

Let's talk about an example, what makes up water? H<sub>2</sub>O! Well a chemical reaction is when we change the formula, so if we add another Oxygen we have H<sub>2</sub>O<sub>2</sub>, which is hydrogen peroxide. So in our experiment with baking soda and vinegar we had a chemical reaction because now we have carbon dioxide and water.

When matter changes phases, we have ice and melt that ice, what happens to it? Yeah it changes to liquid, water but we still have water!

Does anyone have questions about matter, chemical reactions or phase changes?

### Demo 2: Dry Ice

I want you guys to observe this next experiment and try to figure if it's a chemical reaction or a phase change. This one is going to be tricky!

- Has anyone here heard of dry ice?
- Raise your hand if you've seen an experiment with dry ice?

Dry ice is the solid form of Carbon dioxide!

- What do you guys think will happen when we add dry ice to water?

-Add dry ice to water

- What is going to happen when the bubble pops?

We see the gas forming inside the bubble, once it rolls off the table and on to the floor is it gone?

No, it's still there because matter cannot be created or destroyed. We just can't see it anymore because the particles are so small and far apart

When we added the dry ice to the water sublimation is accelerated

- What the heck is sublimation?
  - Sublimation is the transition of a substance directly from a solid to the gas phase without a liquid phase in the middle.

The gas we see is carbon dioxide gas, dry ice changes directly from solid to gas without being a liquid

- Do you guys think this is a chemical reaction? A phase change?
  - Phase change

This is a phase change! We have carbon dioxide as a solid and when added to water it becomes carbon dioxide gas.

Does anyone have any questions about dry ice or why this is a phase change?

### Demo 3: Elephant Toothpaste

Do you guys remember what an exothermic reaction is?

It's a reaction that releases heat. This experiment is an exothermic reaction.

This next experiment is going to be really cool if it works but I need you guys to stay in your seats and make good observations.

If you guys see a chemical reaction hold up a C with your hand, if you see a phase change hold up a peace sign.

First we are going to mix the hydrogen peroxide with some liquid soap, I'm now adding potassium iodine, which is a catalyst. A catalyst is a fancy word for speeds up a reaction. The hydrogen peroxide breaks down into oxygen and water. This causes oxygen to push out and quickly move out of the container. The soap combines with our new water and turns into foam!

- What did you guys observe?
- What happened?
- Is this a chemical reaction or a phase change?
- How can we tell this is a chemical reaction?

Sometimes it is hard to tell the difference between a chemical change and a phase change. A chemical change usually includes

1. Light being seen, or given off (glowing or a flash of light)
2. Heat; released or absorbed
3. Odor change
4. Change in color

These are a few examples that can help us tell if a chemical reaction is taking place.

Can anyone think of a chemical reaction or a phase change example?

#### Demo 4: Non-Newtonian liquid

Now we are going to look at a substance and I want you guys to make observations of what happens when I add these two substances together. Most people call this experiment Oobleck but we are going to call it by its scientific name, we are making a Non-Newtonian liquid.

Our cornstarch is a solid and when we add in our water (a liquid) we create a non-Newtonian liquid.

What is a Non-Newtonian liquid?

A liquid that doesn't act like a normal liquid at room temperature

At room temperature a normal liquid like water is easy to swim through, you can swim really hard or really fast or really slow but the pool water always acts the same.

If you swam in a pool of honey, it would be harder to swim but if you swam fast or slow it would still be the same difficulty to move.

A Non-Newtonian liquid becomes hard to move in the faster you move and becomes easier to move in if you move slowly.

Some examples of a Non-Newtonian are ketchup, silly putty and quicksand.

- What do you guys notice about this substance?

I can move my hand through slowly through and it moves easily but when I hit the surface hard it's like a solid

- Can I have a few volunteers come up?

This is a physical change, the cornstarch dissolves into the water but once the water evaporates cornstarch is left behind.

Debrief: (This can be done by, asking each student to tell the person next to them the answer, writing it down, having a group response, giant flashcards and the kids raise their hands for the correct answer, or a signal response such as give me a thumbs up if...)

- What is matter?
- What are the three different phases?
- What's an example of a liquid? A solid? A gas?
- What's an exothermic reaction?
- What's an endothermic reaction?
- What is a chemical reaction?
- What is it called when a solid goes directly to a gas/What is sublimation?

- Does anyone have any final questions?

**Teaching Strategies:**Engage:

The activities should require volunteers that will be apart of the demonstrations. The activities should also have a wow factor that keep the kids wanting to see more.

Explore:

Most of the activities are hands on and should involve the kid's touch and making observations. Asking the kids to explore with more questions, getting them to interact more to find the answer.

Explain:

Each step is explained, even when adding chemicals that they have never heard of. Repeating vocabulary also helps understanding. Always explain and ask questions while moving through the workshop to clarify understanding. Have audience members participate by explaining experiments they might have seen using the same materials. Have students relate back to past experiences to help make connections.

Elaborate:

Having examples of each occurrence outside of the demo, ask the visitors for examples as well. Each activity should end with a conclusion or summary of what just happened and why. This will hopefully lead to new questions that students may have, if there is a limited time to discuss this in class then direct them to ask you after the class or places that they can learn this information, the internet, a book, a museum, class mate or teacher.

Evaluate:

At the end of each activity or demo, re-ask the questions you had asked at the beginning of the workshop. This is a way to gage what the visitors need more detail on and how you are doing as an instructor

**Vocabulary:**

Chemical reactions: One or more substances are changed into others

1. Light being seen, or given off (glowing or a flash of light)
2. Heat; released or absorbed
3. Odor change
4. Change in color

Phase change: A change from one state to another without a change in chemical composition

Physical change: changes affecting the form of a chemical substance, but not its chemical composition

Sublimation: state of matter change going from a solid to gas

Endothermic reaction: required the absorption of heat

Exothermic reaction: a reaction accompanied by the release of heat

Catalyst: speeds up a reaction

Non-Newtonian liquid: A liquid that doesn't act like a normal liquid at room temperature

Matter: Anything that has both mass and volume

\*These definitions should be adjusted for each age level

**Science Content Background and Additional Resources:**

<http://www.sciencekids.co.nz/experiments/dryicebubble.html>

<http://looseinthelabscience.com/downloads/ElephantToothpaste2011.pdf>

<http://www.stevespanglerscience.com/lab/experiments/quicksand-goo>

<http://www.momto2poshlildivas.com/2012/01/blow-it-up-exploring-gas-with-balloons.html>

[http://www.chem4kids.com/files/react\\_intro.html](http://www.chem4kids.com/files/react_intro.html)

[http://www.chem4kids.com/files/matter\\_changes.html](http://www.chem4kids.com/files/matter_changes.html)

[http://en.wikipedia.org/wiki/Sublimation\\_\(phase\\_transition\)](http://en.wikipedia.org/wiki/Sublimation_(phase_transition))

[http://www.chem4kids.com/files/matter\\_intro.html](http://www.chem4kids.com/files/matter_intro.html)

[http://chemwiki.ucdavis.edu/Physical\\_Chemistry/Equilibria/Le\\_Chatelier's\\_Principle/Effect\\_Of\\_Temperature\\_On\\_Equilibrium\\_Composition/Exothermic\\_Versus\\_Endothermic\\_Area](http://chemwiki.ucdavis.edu/Physical_Chemistry/Equilibria/Le_Chatelier's_Principle/Effect_Of_Temperature_On_Equilibrium_Composition/Exothermic_Versus_Endothermic_Area)

[http://www.chem4kids.com/files/react\\_catalyst.html](http://www.chem4kids.com/files/react_catalyst.html)