

# Changing States of Matter

| FRAMEWORK |                                                                                                                                   |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------|
| I.        | Scientific and Engineering Practices<br>1. Asking questions<br>4. Analyzing and interpreting data<br>6. Constructing Explanations |
| II.       | Cross-Cutting Concepts<br>7. Stability and Change                                                                                 |
| III.      | Physical Sciences<br>PS 1. Matter and its interactions<br>PS 3. Energy                                                            |

| SKILLS/OBJECTIVES                                                                                             |
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| <ul style="list-style-type: none"><li>o Introduce the three states of matter</li></ul>                        |
| <ul style="list-style-type: none"><li>o Develop an understanding of how states of matter can change</li></ul> |
| <ul style="list-style-type: none"><li>o Understand that two states of matter can exist together</li></ul>     |

| MATERIALS                                                                                                                                                                                                                                                                                                                                                                                                                             |
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| <ul style="list-style-type: none"><li>o 6 top halves of bottles</li><li>o 10 ziplock bags</li><li>o 10 pairs of adult gloves</li><li>o dry ice (about one hand full)</li><li>o 20 Rubber bands</li><li>o 40 packets of poprocks</li><li>o 5 bottles of diet coke (20 oz)</li><li>o 1 mortar and pestle</li><li>o 20 Petri Dishes</li><li>o 8 balloons</li><li>o Warm water (less than a cup full)</li><li>o 1 pair of tongs</li></ul> |
| NOTES                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Ensure that only the volunteers are involved in touching the dry ice. Tongs or a cup should be used to move the dry ice, it should not be touched directly.                                                                                                                                                                                                                                                                           |

## BACKGROUND

- Who knows what the 3 states of matter are?
- What makes these three states of matter different? (Different molecular interactions)
- How can we turn one state of matter into another? (Changing temperature! This can change how the molecules act with each other) Which state of matter has the fastest moving particles (gas)
- What are some of the words that describe changes in states of matter? Changes between gas and liquid can be described as vaporization and condensation. Changes between liquids and solids can be described as melting and freezing. Are there other changes that could happen?
- Can 2 states of matter exist together in the same entity? YES! One example is a can of soda, it is a liquid with Carbon Dioxide pumped into it (that's where the bubbles come from)

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|--------------|------------------------------------------|
| Activity # 1 | <b>Arm Dance of the States of Matter</b> |
| Materials    | o None                                   |
| Worksheet    | No                                       |

- Lets have a quick review of the states of matter!
- Imagine your arms are two molecules that could interact with each other; lets start of as a gas, you molecule-arms have a **lot of energy and want to move around to fill the space!**
- Now, imagine your arms are getting colder and **condensing** into a **liquid, the movement of your arms should slow down but still be fluid.**
- Now pretend it is getting really cold, what will happen? Your arms are going to **freeze and become solid, hold them close together and they should vibrate a little.**
- So now that we have the basics down, lets think about some interesting ways that different states of matter can interact or change
- **Have the children pair up; one will have arms imitating gas molecules and the other will have arms imitating a liquid-** collectively the arm movements are kind of like the molecular interactions of soda
- **Now have the pairs be a gas and a solid-** what could this be imitating? Poprocks!

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| Activity # 2 | <b>Gas Hidden in Candy</b> |
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| Materials | <ul style="list-style-type: none"> <li>o 8 packets of Poprocks</li> <li>o 4 petri-dishes</li> <li>o 1 mortar and pestle</li> <li>o 2 balloons</li> <li>o 3 bottles of diet coke</li> </ul> |
| Worksheet | No                                                                                                                                                                                         |

- What makes poprocks interesting? They pop! But why? They are actually a solid candy with pockets of Carbon Dioxide pumped in them. So its kind of like soda, EXCEPT it is a gas in a solid not a liquid!
- Lets test it! As a demo, **rip open 1 packets of poprocks and pour half of them into a mortar and pestle and begin to crush them.**
- What do we hear? We hear pops, because the mortar and pestle are breaking into the air pockets with carbon dioxide, so the gas is being released and making a noise. What do we see? We can see some of the candy jumping when the pressure from the gas is released!
- Now that we have see that gas is in the candy, but what is going on when we eat poprocks?
- Lets find out! **Distribute petri dishes to groups of 2 or 3 children that are filled about half-way with water. The have the children add a packet of poprocks** (if you need to use half of a packet because you are running low on candy that's fine)
- What do we hear? We hear the popping again! This is because the water is dissolving the candy and unleashing the gas trapped in the candy. The water is like our saliva, so this is like the process that occurs when we eat poprocks.
- So we have heard the gas but is there a way that we could see the gas from the poprocks; what sorts of things can we use to capture gas? Balloons!
- Show the kids the bottle of soda; there is already some gas in the soda, but what will happen when we put the candy in there? The liquid soda will dissolve some of the candy and release more gas
- Lets check! Have a club member conduct the demo. First **stretch out the balloon by blowing it up a few times and then letting it deflate.**
- **Do this next part quickly to minimize gas escaping. Open the soda pour in 2 packets of poprocks using the funnel and then wrap the end of the balloon around the mouth of the bottle.**
- The balloon should inflate a little. What is the gas inside? It is carbon dioxide from the soda and the poprocks!

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| Activity # 3 | <b>A New Change of Matter</b>                                               |
| Materials    | <ul style="list-style-type: none"> <li>o 6 top halves of bottles</li> </ul> |

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|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | <ul style="list-style-type: none"> <li>o 10 ziplock bags</li> <li>o 1 pair of tongs</li> <li>o rubber gloves</li> <li>o dry ice (about one hand full)</li> <li>o 20 Rubber bands</li> <li>o funnel</li> </ul> |
| Worksheet | No                                                                                                                                                                                                            |

- We have talked a little about melting (solid to liquid) and evaporation (liquid to gas) BUT what would happen if we had a substance that could just skip the liquid phase? What if something could go straight from solid to gas? What would it look like? Has anyone heard of a substance that can do this? Dry ice can!
- Show the kids dry ice, but do NOT let them touch it! Notice that lack of a liquid stage. Going from solid straight to gas is called **sublimation**.
- Lets make something fun with dry ice! We are going to make a **dry ice smoke ring launcher**.
- **Secure the unopened ziplock bag around wider open end of the half bottle of with a rubber band** (make sure it is REALLY secure, or this will be a mess)
- **Pour some WARM tap water into the cup through the hole in the top** (where the cap would be screwed on) you **only need a few tables spoons of water** (0.5 inches full)
- **Use gloves to add a 1 piece of dry ice through the hole**
- **Now holding the half bottle with the hole facing up and slightly tilted away from your body you can apply pressure to the plastic bag part bottom and little rings of CO2 will be pumped out**
- **Kids can volunteer to poke the end with the ziplock bag while a volunteer is holding it.**

See youtube if you are interested:

<http://www.youtube.com/watch?v=nQHjExZvuy4>

## CONCLUSION

- Can different states of matter exist together? Can you think of any examples?
- What is it called when a solid transforms into a gas?
- What makes poprocks pop?
- (Based on how short on supplies we are for poprocks the kids can eat some)