

# **Community in the Classroom Presentation Plan**

**Lesson Name** States of Matter: from sublime suds to ice cream science!

**Presenter(s)** Francis group – Kristen, Allie, Amy, Mike, Troy, Praveena and Leah

**Grade Level** 3 **Standards Connection(s)** Matter has 3 states that change when energy is added or removed

## **Abstract:**

Today we are going to be discussing solids, liquids and gases and how they can all be turned into each different state under special conditions. Under extreme temperatures, almost any solid, liquid or gas can be turned into something else. We are going to be exploring what happens when you take some gases and turn them into either a solid or a liquid. Then we will see how you can use these two special substances to rapidly change the properties of almost anything else! We will have three different stations to explore these different properties, one station will look at what happens when a solid turns directly to a gas, another station will look into the different properties of solids and how rapidly freezing objects effects their physical properties and the final station will look at a substance that is not entirely a solid or a liquid, but somewhere in between and how we can make this special substance.

## **Vocabulary/Definitions:**

Review words: solid, liquid, gas. Ask: Can anyone name something that is a solid/liquid/gas? (many possibilities). Explain: A solid is something that does not change it's shape or size no matter where you put it, an example is a rock. A liquid is something can freely move and change shape to be in the shape of whatever container it is put in, an example is orange juice. A gas is something that never has a defined shape or size, an example is perfume, if you spray the liquid it becomes a gas and then the smell will fill this entire room and maybe even spread out into the hallway.

*freezing*: freezing is the process where a liquid turns into a solid. Ask: Has anybody frozen something? (ice, popsicles, etc.)

*condensing*: condensing is the process where a gas changes to a liquid. Ask: Has anybody seen something condense? (foggy mirror after shower, cold drink, etc.)

*melting*: melting is the process where a solid turns into a liquid. Ask: What have you seen melt? (ice cream, ice, snow, etc.)

*boiling (or evaporation)*: boiling is the process where a liquid changes to a gas. Ask: Has anyone ever boiled something? (any sort of food...)

*sublimation*: the process where a solid turns to a gas without ever being a liquid in between. Ask: can anyone figure out which of these processes are opposites of each other? (freezing and melting or boiling and condensing)

## **Materials:**

We'll bring:

Bowl

Ice cream mix

Liquid nitrogen

Paper cups and plastic spoons

Ice cubes

Carton of ice cream with ice crystals in it and cooler to keep it cold



**CRS**

1375 Ada Street, Berkeley CA 94702  
(510)527-5212 • www.crscience.org

Dry ice  
Soap solution  
Leaky Faucet setup  
duct tape  
cryo gloves  
100 mL and 400 mL beaker  
Smaller dewar for demonstration  
Tongs  
Cold gloves  
Rubber bands  
Carrot or Onion or Orange  
Marshmallows  
Flowers  
Balloons

### **Classroom Set-up:**

Set-up prior to our arrival. If it is possible we would greatly appreciate it if the students' desks could be arranged to form three stations. Thanks! If not we will make time to include set up and clean up time.

After the introductions students will be divided into three groups and will then rotate through three different phase transition stations. If possible, it would be best to have the three stations set up with a table (or several desks pushed together) as far away as possible from each other so that the students can really only focus on the station at which they are learning. It should probably take about 5-10 minutes to both move the desks or tables to and from the three stations. The only other set up request we have is that either the door to the classroom or some windows be open for the duration of the demonstration so that the room does not fill up with too much nitrogen.

## **Classroom Visit**

### **1. Personal Introduction: \_\_\_\_\_ 5 \_\_\_\_\_ Minutes**

We are a group of college graduates that are now in graduate school and have gone on to study chemistry and biology in more detail. All of us are working to make new materials that can help people around the world. Some of the things we are working to make are ways to purify water, deliver medicine exactly to your sicknesses, and take the light from the sun and turn it into energy. Here today we have (introduce ourselves by first name).

### **Topic Introduction: \_\_\_\_\_ 10 \_\_\_\_\_ Minutes**

As chemists we often take advantage of the different states of matter and how they can change back and forth between all of the different states. Ask: Does anybody know what the three different states/phases of matter are? (solid, liquid gas)

Discuss vocab words now

### **2. Learning Experience(s): \_\_\_\_\_ 35 \_\_\_\_\_ Minutes**

We're going to divide the class into three and have them rotate through three demo stations (10 min each)

## Demo 1: Ice Cream Science

Ask: Is ice cream a solid, liquid or gas? How do you know? What is ice cream made of?

Look: Let's look at frozen water... can you scoop that with a spoon? (look at some ice cubes)

Ask: What do you think might make ice cream softer than frozen water?

Explain: Ice cream, although mostly frozen, also has to include a small amount of unfrozen (liquid) water to make it easy to scoop.

Look: Let's look at an ice cream carton with ice crystals in it.

Ask: Has this ever happened to some ice cream in your freezer? How does it taste when this happens? (not good!)

Explain: To prevent these ice crystals from forming we need to have special chemicals, which is usually fat and sugar from cream. It's a balance because we need water in liquid form to keep ice cream soft enough to scoop but we don't want to let it freeze or else ice crystals will form.

Explain: Some people want to have healthier ice cream without all of the fat that keeps it soft. Recently, certain brands of ice cream have used science to answer this problem – what can we add to ice cream to prevent water from freezing that is not fat or sugar? Scientists found this special ingredient from a fish that lives in the arctic. Let's figure out what the secret ingredient could be!

Ask: What is the temperature like in the arctic? (Cold)

Ask: What would happen if the blood in a fish froze? (they wouldn't survive)

Explain: So, fish have a special protein in their blood that prevents ice crystals from forming. Now to keep your ice cream soft, they just make the same chemical that fish use!

Ask: Now, want to make some ice cream?

Explain: Usually ice is used to cool ice cream so it takes a while to churn slowly but we can use something colder than ice so that it goes quickly, liquid nitrogen! (then we'll make liquid nitrogen ice cream – kids will just watch since liquid nitrogen can be dangerous and we'll pass it out)

## Demo 2: Sublime suds

Show the students dry ice. Prevent them from touching it.

Ask: Do you know what this is? (dry ice) Have you ever seen it before? Where?

Ask: Does anyone know what state of matter carbon dioxide is usually found in? (gas – give examples, e.g., exhaust from your car)

Ask: How do you think you make carbon dioxide solid? (make it really cold)

Explain: Correct. Solid carbon dioxide is VERY cold. That's why we can only touch it with these special gloves.

Ask: So, what do you think will happen if we mixed dry ice with water? (allow them to answer)

Demonstrate and explain: The since the water is warmer than the dry ice it causes the carbon dioxide to change phase from solid directly to gas. This is called "sublimation". It refers to the process of changing from solid directly to gas. (Only if someone asks, note differences between water's 3 phase changes under normal conditions, and carbon dioxide's 2 phase changes. Water can sublime directly from ice to vapor as well, but only under very extreme conditions).

Ask: We can capture gas in bubbles. What do you think would happen to a bubble of carbon dioxide when we make it? (ask around, pretend like we don't know). Using our sophisticated bubble maker, we're going to see whether it sinks or floats in air.

Make bubbles, and we'll know. Let children play with bubbles.

## Demo 3: Liquid Nitrogen

Ask: What is the coldest thing you can think of? (Ice is 32F/ dry ice is -109 F)



**CRS**

1375 Ada Street, Berkeley CA 94702  
(510)527-5212 • [www.crscience.org](http://www.crscience.org)

Explain: Today, we have liquid nitrogen with us and its temperature is really, really cold – 320 F—much colder than ice or the dry ice at the other station.

Ask: First of all, who knows where we can find nitrogen? (Air)

Explain: The air we breathe is about 80% nitrogen gas. So what we have here is Liquid air. It took a really powerful refrigerator to make air so cold that it turns into a liquid.

Segue: Now that we know what liquid nitrogen is, we are going to use it to make other things cold.

/\*We'll have some fruits, flowers, rubber bands, and balloons. All nitrogen handling will be done by us exclusively. Frozen materials may be passed around once at room temperature.

Ask: What do you think will happen when we put this into the liquid nitrogen? (Dip balloon- Inflated balloon gets much smaller).

Explain: Gas inside the balloon “shrinks” when you make it cold (avoid confusing pressure explanation).

Look: Let's keep it outside for a while, and see what happens to it

Segue: In the meanwhile, let us look at some flowers and fruits.

Ask: How does a flower (rose) or orange feel when you touch it? (Soft). Pass some around. Now let us see what happens when we dip them in Liquid Nitrogen. Let us find out. (Dip flowers and Fruits)

Look: Now touch the flower and orange and see how it feels

Explain: The flowers and fruits froze.

Ask: What liquid do you think is present in fruits and flowers which make them freeze when they get cold? (Water)

Explain: Fruits and Flowers have a lot of water in them, which freezes into ice when it gets really cold.

That is why they turn so hard—just like ice. Now let us see how hard they get (throw the frozen orange to shatter)

Explain: We can also use a frozen banana (instead of a hammer) to put a nail in the wall.

Ask: What will happen to a rubber band? (No longer stretchy, turns brittle).

Segue: Because liquid nitrogen is so cold, it can be used to make some things in a special way.

Ask: Has anyone heard of Dippin' Dots?

Explain: Dippin' Dots are a type of ice cream that comes in tiny round balls instead of the normal large scoops. Liquid nitrogen is used to freeze the ice cream mixture when it is being made, which means there is less air in it. Because the ice cream mixture has less air, it doesn't puff up like normal ice cream, and can be made into these tiny round “dots.”

/\*Tie in, or allude to ice cream station, depending on whether they've been there already.\*/\*

### 3. Wrap-up: Sharing Experiences and Building Connections 4 Minutes

So today we explored the three states of matter (what are they again?) and the transformations that can occur between them. Let's go back over the worksheet that you all filled out today. What transformations did you observe today? (solid to gas, liquid to solid, liquid to gas, etc). What changed in the objects you saw undergoing these transformations? Why do you think these changes occurred? How did we force the changes in matter? (extreme temperature, etc). Did anything surprise you as you watched and learned about these transformations? Can you think of any other transformations between states of matter that we see or experience every day?

### 4. Close: 1 Minutes

Thanks so much for letting us come and share with you today!

TOTAL 50 – 60 Minutes

## **Follow-up – After Presentation**

Suggest students write a letter explaining “How we learned about \_\_\_\_\_?”

List or attach examples of activities, websites, connections for additional learning.

Attach worksheets, hand-outs, visuals used in classroom presentation.



**CRS**

1375 Ada Street, Berkeley CA 94702  
(510)527-5212 • www.crscience.org

# States of Matter

Fill in the words **solid**, **liquid**, or **gas** to describe these transformations between states of matter.

**Melting** is when a \_\_\_\_\_ turns into a \_\_\_\_\_

**Freezing** is when a \_\_\_\_\_ turns into a \_\_\_\_\_

**Boiling** is when a \_\_\_\_\_ turns into a \_\_\_\_\_

**Condensing** is when a \_\_\_\_\_ turns into a \_\_\_\_\_

**Sublimation** is when a \_\_\_\_\_ turns into a \_\_\_\_\_

During each demo, circle any time you see the following transitions. Remember what you see so we can talk about them together at the end!

## Demo 1: Liquid Nitrogen

Melting

Freezing

Boiling

Condensing

Sublimation

## Demo 2: Sublime Suds

Melting

Freezing

Boiling

Condensing

Sublimation

## Demo 3: Ice Cream Science

Melting

Freezing

Boiling

Condensing

Sublimation