SUPER COOL

TEACHER GUIDE

PLANNING

Here's a suggested schedule for this kit! The activities should be completed in order, but you can choose when the lessons take place over time.

ACTIVITY INFORMATION	SECTION (S)	TIME REQUIRED	DAY/ LESSON
ACTIVITY 1: SPIKY SCIENCE Watch something unusual happen with ice. **Total time: 45 min**	☐ The Freeze	45 minutes	Day 1
ACTIVITY 2: GETTING TO THE POINT Grow your own crystals. **Total time: 3 h 30 min**	☐ Crystal Spikes (Set Up)	30 minutes	Day 2
	☐ Crystal Spikes (Observations – Day 1)	30 minutes	Day 3
	☐ Crystal Spikes (Observations – Day 2)	30 minutes	Day 4
	☐ Crystal Spikes (Observations – Day 3)	30 minutes	Day 5
	☐ The Science Behind Spikes	60 minutes	Day 6
	☐ S		
ACTIVITY 3: YUMMY PHASES Discover more about uses for crystal stru phase changes with a tasty sna			

Full schedule available with purchase

Question 2: Although the freezer in Activity 1 was not a completely isolated system, we are going to assume that it is for the purpose this question. If the freezer is the boundary of the isolated system, what are the two components of the experiment that began at different temperatures? Explain.
Answer: The water and air would be the two components that began at different temperatures. Water was a higher temperature (warmer) and the air was a lower temperature (cooler).
How to Help: *If there were other frozen items in the freezer you used for this experiment that your student is using as a replacement for the air, encourage them to think about the experiment as if the only thing in the freezer was the well plate with water. This will help them to recognize that the air is the lower temperature component regardless of what was put into it to freeze.*

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SPIKES AND SOCIETY

CONTENT

• In this section, your student will learn about the uses of nanotechnology and the relationship to crystalline structures.
• Student will learn the following vocabulary terms: nanoparticles, nanostructure, and nanotechnology.

activity 3 YUMMY PHASES

Crystalline structure is useful in society and technology, as well as for the formation of many of the foods your student enjoys. In this activity, students will make a food that has a crystalline structure and design their own related experiment.

LEARNING GOALS:

- **I can use visual, graphical, and mathematical representations to explain the relationship between state of matter and temperature for various substances.**
- **I can investigate to show that combining two components with different temperatures in a closed system result in thermal energy becoming more evenly distributed.**

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TASTY TREAT

PREPARATION AND SUPERVISION

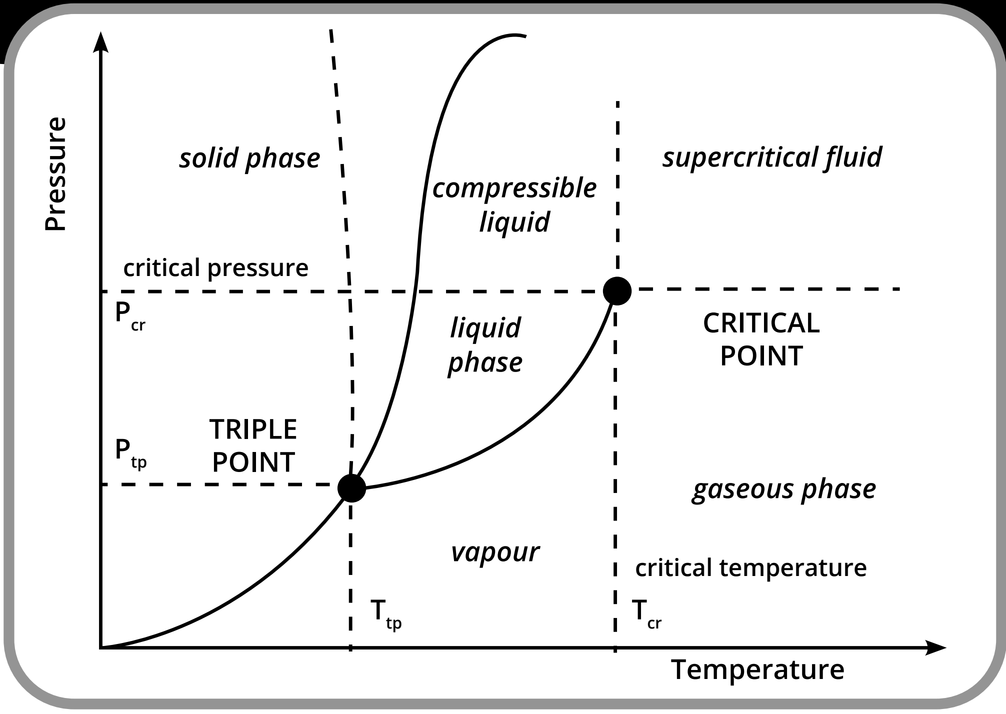
- Make sure the smaller bag is completely sealed before your student begins to flip their ice cream. If it's not completely sealed, it may open during the flipping process and some salt may have contaminated the ice cream.
- If the ice cream isn't freezing well in the bag, you can also pull the 5X7 zip bag out of the 9X12 bag and set it in the freezer to finish freezing it.
- An alternative to the bags is coffee cans with lids and sealing those lids with tape.
- Dairy-free milks are an option for students who do not consume dairy products. However, the ice cream will be more icy and less creamy than if you used a dairy based product.

MULTIPLE AGES AND ABILITIES:

If you are working with a more advanced student, you can introduce them to these additional vocabulary terms: critical point, latent heat effusion, and triple point.

Critical point is the point on a phase diagram where both the liquid and gas phases of a type of matter have the same density. This means that at this point you would not be able to tell whether the matter was a liquid or a gas. Latent heat, also known as latent energy or heat of transformation, is the amount of thermal energy required to convert a solid into a liquid or liquid into a gas without a change in temperature.

Triple point is when the temperature and pressure of a type of matter as a solid, liquid, and gas exist in equilibrium.



THINK ABOUT IT!

Question 1: You have a piece of matter at 1 atmosphere (atm), at what temperatures are the melting/freezing boundary and the vaporization/condensation boundary at?
Answer: The melting/freezing boundary is at 0 ºF and the vaporization/condensation boundary is at 100 ºF.

Question 2: Can a piece of matter be 2 atm and 30 ºF? Explain.
Answer: Yes, it can. The piece of matter would be in the liquid state.
How to Help: *Like with a grid, help your student connect the two points to find the state of matter.*

Question 3: Indicate the pressure and temperature for a gaseous piece of matter.
Answer: A gaseous piece of matter is at least 100 ºF and no more than 1.25 atm.

Ideal Gas Law

• In this subsection, your student will learn the vocabulary term Ideal Gas Law and work through examples using the equation and given data sets.

Question 1: A gas in a jar takes up 17 liters, at a pressure of 48atm and temperature of 300K. you raise the temperature to 480K and lower the pressure to 12atm. What is the new volume of the gas?
Answer: 108.8L
How to Help:

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$
$$\frac{(48atm)(17L)}{(300K)} = \frac{(12atm)V_2}{(480K)}$$
$$\frac{(816atm \bullet L)}{(300K)} = \frac{(12atm)V_2}{(480K)}$$
$$2.72\frac{atm \bullet L}{K} = \frac{(12atm)V_2}{(480K)}$$
$$(480K)(2.72\frac{atm \bullet L}{K}) = (12atm)V_2$$
$$(1305.6atm \bullet L) = (12atm)V_2$$
$$\frac{(1305.6atm \bullet L)}{12atm} = V_2$$
$$108.8L = V_2$$

Question 2: You are blowing up a balloon to fill it with 2 liters of 120K air at a pressure of 67.3kPa. How many moles of air are in the balloon?

Answer: $1.35 \times 10^{-1}\ mol$
How to Help:

$$PV = nRT$$
$$(67.3kPa)(2L) = n(8.31\frac{L \bullet kPa}{mol \bullet K})(120K)$$
$$n = \frac{(67.3kPa)(2L)}{(8.31\frac{L \bullet kPa}{mol \bullet K})(120K)}$$
$$n = 0.135mol$$
$$n = 1.35 \times 10^{-1} mol$$

SHOW WHAT YOU KNOW

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Question 1: In a closed system, where pressure is held constant, a gas's temperature went up, what does this tell you about the new volume?
Answer: The volume of the gas would also increase.
How to Help: *This question determines your student's understanding of Charles's Law. If they struggle, refer them to the diagrams and equations in the previous section to find the one that indicates a relationship between temperature and volume, which will be Charles's Law. Then, have them indicate what Charles's Law tells them about the relationship between temperature and volume.*

Question 2: In the following scenarios, indicate which if the following equations you should use and why. Then, use the equation, to calculate the missing variable. Equation options: Gibbs Free Energy, Gay-Lussac's Law, Ideal Gas Law, combined gas law
a. A reaction occurs at 113K where the change in enthalpy is 12kJ and the change in entropy is 72JK^{-1}.

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Kit	SU-SPRCOO
Instructions	IN-SPRCOOT
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