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CRIN E06: Elementary Science C&I

Discovery Circus

Grade: Fifth Grade

Subject: States of Matter

Unit of Study: States of Matter and Forces

October 27, 2008

Lesson Plan Template

Topic: Matter
Date: November 7, 2008
NSES: Physical Science Content Standards (5-8)
Grade level: Fifth
SOL:
Subject: States and Compositions of Matter

USI.5 The student will demonstrate knowledge of the factors that shaped colonial America by
c) describing colonial life in America.
USII.1 The student will demonstrate skills for historical and geographical analysis, including the ability to
b) make connections between past and present;
5.4 The student will investigate and understand that matter is anything that has mass, takes up space, and occurs as a solid, liquid, or gas. Key concepts include:
a) atoms, elements, molecules, and compounds.
b) mixtures including solutions; and
c) the effects of heat on the states of matter.

Daily Question: What are the properties of the states of matter?

Procedures for Learning Experience	Guiding Questions	Materials Needed	**E**valuation (Assessment)	Approximate Time Needed
Engagement: Bring the students around a table to observe. Ask students to make note of what happens to the materials we are about to use. Using a preheated hot plate and metal pan, drop in a small handful of shaved ice. Allow the students to watch the ice change into a liquid and then evaporate into gas. (Note: Make sure students are kept away from steam.)	Think about: What are we seeing here? How many forms of water did we observe? What is happening to the composition of the water as it changes forms?	Hot plate, metal pan, shaved ice, goggles which will be worn through the entire circus	Students will be assessed by the teacher on participation in this observation exercise.	10 minutes

Exploration: Break students into small groups to go from activity station to activity station. Students will answer the corresponding questions in their activities booklet which correspond with the stations. The five stations students will explore are: 1. "Making Goo" –students experiment with a mixture of water and cornstarch 2. "Liquid Layers" –students will observe what occurs when hot water is added to cold water 3. "Icebox" –students will note different ways to keep ice from melting with the use of electricity 4. "Blowing Balloons" –students will observe the chemical reaction that produces carbon dioxide gas to blow up a balloon 5. "Microscopes" –History and impact microscopes have had on science and society.	See questions for each station on the student handouts.	See materials section of each discovery circus card.	Students will be informally evaluated based on observations of participation at each station.	35 minutes
Explanation: Bring group together for a whole-class discussion. Ask students several questions addressed in their activity handouts. As students share responses, point out and elaborate their accurate observations. Discuss the relationships between the five stations (e.g. how heat affects the states of matter, the properties of the states of matter, atoms, elements, and molecules, mixtures, solutions,	What did you learn? What was your favorite station? Why is it important to know the properties of matter? Why is it important that we can see the smallest elements of matter? What did we see when the	Completed student handouts.	Students will be evaluated based on their thoughtful contributions to the class discussion as well as their answers to the questions on their handouts.	15 minutes

and compounds, and the history of examining what makes up matter). Recall the melting of the ice and evaporating water in the engage portion, re-ask the questions.	ice melted and then the water evaporated? What happened to the atoms in the water as it changed from solid to liquid to gas? What compound is water?			
Extension: * During the next day of class, ask the students to gather around to observe a new demonstration. After providing students with safety goggles, tell students to watch what happens as you pour sugar into a hotplate and the sugar melts. Then pour some of the melted sugar into a tall graduated cylinder of cold water. Ask students to use their knowledge gained from the previous day's discovery circus to help them explain what happened to the melted sugar particles when they made contact with the cold water. Working in their small groups, students will form hypotheses supported by their new Discovery Circus knowledge and other previous knowledge. They will then discuss and defend their ideas with the whole group.	What did you observe happen to the sugar when it was added to the cold water? Thinking back to yesterday, what affect does heat have on matter? Conversely, what affect do you think cold will likely have? We also discussed how the particles of matter exist differently among the different states of matter. Thinking about this, what happened to the sugar particles as they hit the cold water?	Hot plate, metal pan, liter of water, 6 cups of sugar, cylinder of cold water (1 liter), goggles for everyone	Students will be assessed by the teacher on their participation in small group work, hypotheses they generate and use of supporting knowledge, and participation in class discussion.	About 20-25 minutes.

Notes: This lesson is being used as a transition back into science from social studies in a fifth grade classroom. However, it could be used as a form or review of states of matter knowledge and an introduction to the concepts of matter covered by the fifth grade SOLs.
Safety Notes: All students must wear goggles at all times during the Engagement, Exploration, and Extension. Some centers do not have safety risks inherent in them, but since other projects are going on around students, it is best that they wear protection as a

precaution. Also, teachers must be careful to be aware of hot elements around the room such as hot plates and water. These items must be kept in secure places that will not be easily knocked into or bumped over. Also, whenever possible, try to use plastic materials instead of glass.

Differentiation Strategies: Students will be working in small groups through the activities, so the teacher should place struggling students with better-abled students. If desired, specific tasks can be assigned such as recorder, group speaker for class discussion, or materials manager who makes sure the activity is ready for the next group. Students with physical limitations can participate in most of the activities or can have another person demonstrate while they observe. Students with visual limitations can be guided through feeling most of the activities, such as feeling where the layer of hot water is compared to cold water, squeezing the goo, feeling the amount of water in the bags of ice, and feeling the balloon inflate. The microscope activity could be simulated with textured paper representations.

Rubric

	3 points	2 points	1 point
Following directions and participation in activity	Follows all of the directions the first time; participates in all aspects of the activity.	Does not follow all of the teacher's directions the first time they are given; limited participation.	Does not follow the teacher's directions for the activity: does not participate in the activity.
Cooperating and contributing to the group	Cooperates with other group members and fulfills role as a partner and group member; is an active contributor.	Has some difficulty cooperating with others and/or fulfilling role as a group member.	Does not cooperate with others or fulfill role as a partner/group member. Must be removed from group.
Discussing observations and answering thoughtfully	Actively contributes to discussion of observations; thoughtfully answers questions.	Contributes only partially to the class discussion and answers with little thought or consideration.	Does not discuss any observations; does not answer any questions.
Critical thinking and making predictions	Applies observations and explanation to make connections to states of matter; correctly explains/predicts what is happening in the extension.	Does not correctly or completely use information to explain/predict what they are observing.	Does not attempt to use prior or new knowledge to make explanations/predictions.

The Matter Discovery Circus, Teacher Information Card

Activity # 1

Title: Liquid Layers

Topic: States of Matter and Forces

Grade Level: Fifth Grade

Standards: 5.4 The student will investigate and understand that matter is anything that has mass, takes up space, and occurs as a solid, liquid, or gas. Key concepts include:
c) the effects of heat on the states of matter.

Materials: Four clear glasses; spoon; hot salt water; cold salt water; hot plate; pot for hot plate; container with ice; large freezer bag for holding water in ice; two different colors of food coloring (e.g. green, red); crayons of matching color to food coloring; and receptacle for discarded water.

Discussion Questions:

What did you observe when hot was added to cold as compared to cold added to hot?
What differences between the water samples could have produced your observations?
How would the differences in the water affect the floating of objects on the water surface?
If the experiment did not work, what might have been the cause?

Source:

Adapted from: Bosak, S. (2000). *Science Is…(Second Edition)*. Canada: Scholastic Canada Ltd.

Notes: Students are **not** to perform this experiment alone since the hot water poses a danger to students. It is important that the water is poured from the most dense to the least dense: cold salt water on the bottom then hot salt water. Be careful to not mix the layers as you pour into the glass. Tilt the glass slightly and run a new liquid along the side of the glass as you add a layer.

The Matter Discovery Circus, Student Card

Activity #1

Title: Liquid Layers

Directions:

Note: A teacher will pour the liquids involved in this activity for safety reasons.

1) On your activity sheet, make predictions about what will happen before the different waters are added. Take note of the order in which the different waters will be added. First: cold salt water on the bottom then hot salt water and make your predictions.
2) Write your observations as the different waters are added.
3) Once both waters are in the cup, use the crayons to color the observation cup on your activity sheet.
4) Note the second order: hot salt water on the bottom then cold salt water and make your predictions.
5) Repeat your observations for the second procedure adding hot water to cold water.
6) Answer associated questions.

Activity # 1 - Liquid Layers

1. Your predictions:
when cold water is added to hot water. Why?

when hot water is added to cold water. Why?

2. Color your final observations:

Cold added to Hot

Hot added to Cold

3. Think of your best answer to these questions:
What differences between the water samples might explain your observations?

What happened when the hot water was poured on top of the cold?

How might this affect the ability of objects to float on the water surface?

The Matter Discovery Circus, Teacher Information Card

Activity # 2

Title: Ice boxes

Topic: States of Matter and Forces

Grade Level: Fifth Grade

Standards: USI.5 The student will demonstrate knowledge of the factors that shaped colonial America by c) describing colonial life in America.

Materials: Three wooden boxes of equal size; soil; straw; and three plastic sandwich bags containing four ice cubes each.

Discussion Questions:

Which of the boxes had the least melted ice inside of it?

Why do you think this box's ice was the least melted?

What was the straw used for? What was the soil used for?

Why would it be important to early settlers to keep ice from melting?

Can you think of other ways to slow the ice from melting without the use of electricity?

Source:

Bellis, M. (2008). *The History of Refrigerators and Freezers*. Retrieved October 19, 2008 from http://inventors.about.com/library/inventors/blrefrigerator.htm

Notes: Before the electric refrigerator, people used to keep their food cool by using the snow and ice found locally or on a nearby mountain. Some would use wooden boxes lined with straw and ice to keep their food cold or dig a hole in the ground and line that with straw and ice or snow. In order to keep the food cool, you had to find ways to slow down the ice from melting. Lining a hole or wooden box with straw would aid in the insulation and slow the ice or snow from melting. The first artificial refrigerator was not demonstrated until 1748.

Assemble the boxes for student observations. Make sure to label (A, B, C) the bags and the boxes so the same bags remain with the same boxes. In the first box, place a bag of ice inside. In the second box, line the bottom of the box with straw, place a bag of ice inside, and then cover the bag of ice with more straw. In the last box, line the bottom of the box with soil, place the bag of ice inside, and then cover the bag of ice with more soil. Make sure that the bags of ice are reburied after each group.

The Matter Discovery Circus, Student Card

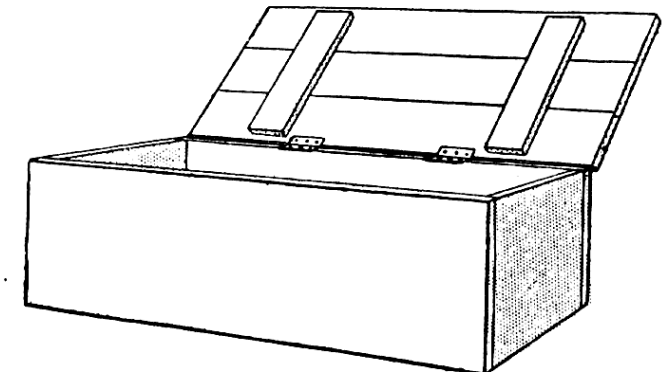
Activity #2

Title: Ice boxes

Directions:

You are a pioneer in the days before electricity. As you travel, you need a way to store your food without it spoiling, but you do not have a freezer to do it! Check out these methods of keeping ice from melting and decide which way is going to keep your food fresh the longest!

1. Each box contains the same amount of ice in a bag.
2. One by one, take out and examine the amount of melted ice water in each bag. **Do not open the bags or remove the water.** Make notes comparing the amount of melted ice among the boxes.
3. Make sure to put the bags of ice back into the boxes as you found them. This means putting the A bag of ice back into the A box, reburying the B bag of ice in straw in the B box, and reburying the C bag of ice in soil in the C box.
4. Answer the questions on your activity sheet.



Activity #2

Observation Notes:
Box & Ice A:

Box & Ice B:

Box & Ice C:

Think of the best answer to these questions…

1. Which of the boxes had the least melted bag of ice inside of it?

2. Why do you think this box's ice was the least melted?

3. What was the straw used for? What was the soil used for?

4. Why would it be important to early settlers to keep ice from melting?

The Matter Discovery Circus, Teacher Information Card

Activity # 3

Title: Making Goo

Topic: States of Matter and Forces

Grade Level: Fifth Grade

Standards: 5.4 The student will investigate and understand that matter is anything that has mass, takes up space, and occurs as a solid, liquid, or gas. Key concepts include:
a) atoms, elements, molecules, and compounds.

Materials: 2 cups of cornstarch; 1 cup of water; pie tin; measuring cup; spoon

Discussion Questions:

Can you shape it into a ball?

Does it dribble between your fingers?

Is this a solid or a liquid?

When does it feel like a solid and when does it feel like a liquid?

Source: Bosak, S. (2000). *Science Is…(Second Edition)*. Canada: Scholastic Canada Ltd.

Notes: In a liquid, the molecules move around a little. In a solid, the molecules stay in a fixed position. Some substances have the properties of both a liquid and a solid. In the mixture of water and cornstarch, long chains of molecules coil together like a pile of spaghetti. The molecules don't flow easily under high pressure or force. When you squeeze the water and cornstarch mixture, it feels like a solid; when you stop squeezing, it goes back to a liquid. Scientist call this a "polymer." Although there are measurements for the mixture, a little extra water or cornstarch might need to be added. There should be plenty of shallow bowls for each student, so that the bowls can simply be disposed of. And have the water and cornstarch measured out before the students get to the station. Also, be sure to have newspaper or scrap paper on the table to help with fast clean between switching. And most important, DO NOT pour the mixture down the drain; it will clog the pipes. When done, but the mixture into a plastic bag and throw it into the trash.

The Matter Discovery Circus, Student Card

Activity # 3

Title: Making Goo

Directions:

1.) Pour 1 cup of water into a bowl.

2.) Stir in 2 cups of cornstarch (already measured in your bag), a bit at a time. As you stir, occasionally test the mixture's thickness by lightly tapping the surface with a spoon.

3.) The mixture is "just right" when you will be able to stir it but it will be very difficult and the mixture won't splatter when you hit it with the spoon.

4.) Complete the sheet for this activity.

Activity #3 – Making Goo

Think of the best answer to these questions…

1. What do you notice is unique about this mixture?

2. Can you shape it into a ball? What happens if you let go?

3. Can the mixture dribble from you hand?

4. Is the mixture a solid or a liquid?

5. Why do you think the goo can be firm and dribble through your fingers?

6. Molecules in liquids move around a little, while molecules in solids stay in a fixed position. How do you think the molecules are arranged in this goo?

The Matter Discover Circus, Teacher Information Card
Activity # 4
Title: Blowing Balloons
Topic: States of Matter
Grade Level: Fifth Grade
Standards:
5.4 The student will investigate and understand that matter is anything that has mass, takes up space, and occurs as a solid, liquid, or gas. Key concepts include
a) atoms, elements, molecules, and compounds;
c) the effect of heat on the states of matter.

Materials:
Balloons
Small funnel or a small piece of paper rolled up in a funnel shape
Baking soda
Vinegar
Small clean empty bottle

Discussion Questions:
What did you observe?
What evidence do you see that a gas is present?
What are some of the observed properties of gas?
How is the gas carbon dioxide released?
Will other gasses cause the balloon to blow up; have you ever seen any?

Source: http://www.familieswithpurpose.com/funwithgas.html
http://www.light-science.com/gasballoon.html

Notes:
The vinegar mixes with the baking soda to create a chemical reaction that produces carbon dioxide gas. Your balloon begins to inflate due to the pressure (force) of the gas in the bottle; the more gas, the more the balloon inflates. CAUTION: an adult will need to help. There is the possibility that putting too much gas-making mixture in the bottle can cause the balloon to explode! Don't pop the balloon!
The students may relate this to blowing up a balloon with oxygen or helium.
When a volcano erupts, it gives off gases. This experiment shows how the buildup of gas pressure can inflate a balloon. This is what happens inside a volcano: gas pressure builds up causing an enormous explosion to take place. This explosion often releases a deadly, hot gas cloud. Other gasses that cause balloons to inflate are helium balloons and hot-air balloons.

The Matter Discovery Circus, Student Card
Activity #4
Title: Blowing Balloons

Directions:
1) Using the funnel, add 3 teaspoons of baking soda (pre-measured) to each balloon.

2) Fill each bottle 1/3 full with vinegar (pre-measured).

3) Without dropping in the baking soda, fit the balloon over the bottle opening.

4) Hold up the balloon and let the baking soda fall into the vinegar.

5) Watch as the baking soda mixes with the vinegar to make carbon dioxide gas and blow up the balloon.
6) Discuss with your group and answer the associated questions.

Activity #4 -Blowing Balloons

What did you observe when the baking soda mixed with the vinegar?

What are some of the properties of gas?

What evidence do you see that a gas is present?

Why, do you guess, does mixing baking soda and vinegar release a gas?

What other gasses, that you can think of, will inflate the balloon; have you ever seen any? (hint- balloons at a carnival and balloons at an air show)

How do you think this works?

The Matter Discover Circus, Teacher Information Card
Activity #5
Title: Microscopes
Topic: States of Matter
Grade Level: Fifth Grade
Standards: 5.4 The student will investigate and understand that matter is anything that has mass, takes up space, and occurs as a solid, liquid, or gas. Key concepts include a) atoms, elements, molecules, and compounds;

Materials:
Printed out timeline
Spectacles
Magnifying glass
Microscope (compound and digital)

Discussion Questions:
How was the microscope invented?
How has the microscope evolved?
What has the microscope enabled us to do?
Why is the microscope so important?

Source:
http://inventors.about.com/od/mstartinventions/a/microscope.htm

Notes: The light microscope was invented in the Renaissance. It was an instrument that enabled the human eye, by means of a lens or combinations of lenses, to observe enlarged images of tiny objects. About 1590, two Dutch spectacle makers, Zaccharias Janssen and his son Hans, while experimenting with several lenses in a tube, discovered that nearby objects appeared greatly enlarged. That was the forerunner of the compound microscope and of the telescope. In 1609, Galileo, father of modern physics and astronomy, heard of these early experiments, worked out the principles of lenses, and made a much better instrument with a focusing device. The father of microscopy, Anton van Leeuwenhoek of Holland, was the first to see and describe bacteria, yeast plants, the teeming life in a drop of water, and the circulation of blood corpuscles in capillaries. The introduction of the electron microscope in the 1930's was co-invented by Germans, Max Knott and Ernst Ruska in 1931, Ernst Ruska. If pushed to the limit, electron microscopes can make it possible to view objects as small as the diameter of an atom.

The Matter Discovery Circus, Student Card
Activity #5
Title: Microscopes

Directions:

1) **Read the timeline of the invention and evolution of the microscope.**

2) **Examine the tools provided.**

3) **Look at objects through each tool.**

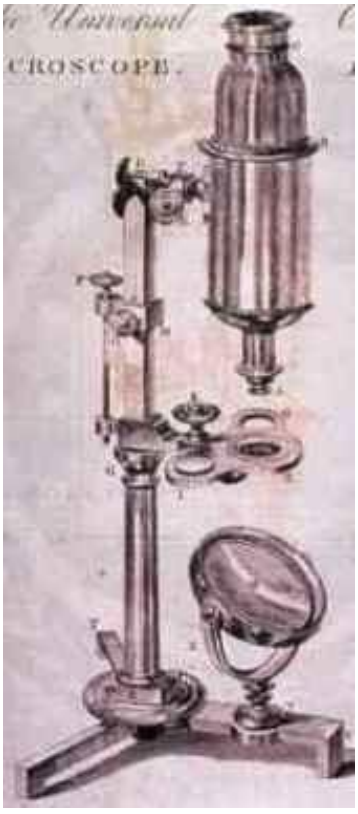
4) **Discuss with your group and answer the associated questions.**

Activity #5

- **Circa 1000AD** – The first vision aid was invented (inventor unknown) called a reading stone. It was a glass sphere that magnified when laid on top of reading materials.

- **Circa 1284** - Italian, Salvino D'Armate is credited with inventing the first wearable eye glasses.

- **1590** – Two Dutch eyeglass makers, Zaccharias Janssen and son Hans Janssen experimented with multiple lenses placed in a tube. The Janssens observed that viewed objects in front of the tube appeared greatly enlarged, creating both the forerunner of the compound microscope and the telescope.



- **1665** – English physicist, Robert Hooke looked at a sliver of cork through a microscope lens and noticed some "pores" or "cells" in it.

- **1674** – Anton van Leeuwenhoek built a simple microscope with only one lens to examine blood, yeast, insects and many other tiny objects. Leeuwenhoek was the first person to describe bacteria, and he invented new methods for grinding and polishing microscope lenses that allowed for curvatures providing magnifications of up to 270 diameters, the best available lenses at that time.

- **18th century** – Technical innovations improved microscopes, leading to microscopy becoming popular among scientists. Lenses combining two types of glass reduced the "chromatic effect" the disturbing halos resulting from differences in refraction of light.

- **1830** – Joseph Jackson Lister reduces spherical aberration or the "chromatic effect" by showing that several weak lenses used together at certain distances gave good magnification without blurring the image. This was the prototype for the compound microscope.

- **1872** – Ernst Abbe, then research director of the Zeiss Optical Works, wrote a mathematical formula called the "Abbe Sine Condition". His formula provided calculations that allowed for the maximum resolution in microscopes possible.

- **1903** – Richard Zsigmondy developed the ultra microscope that could study objects below the wavelength of light. He won the Nobel Prize in Chemistry in 1925.

Activity #5

What do you notice when you look at objects through these tools?

Which tool lets you see the smallest object the clearest?

What can scientists use microscopes for?

Why is it important for scientists to be able to see atoms and molecules?

What have we learned from the use of microscopes?