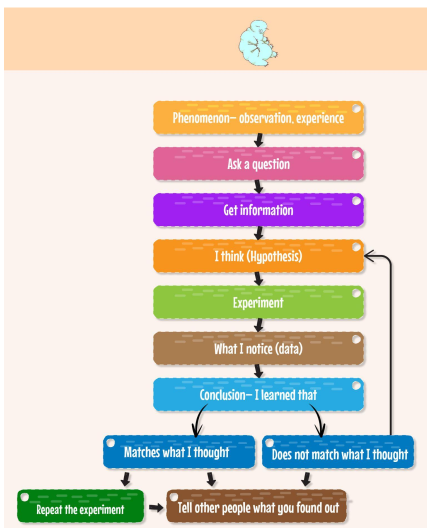
<table>
<tr><td colspan="3">Dr. Rosie Helps the Animals
The effect of “cold” (low thermal energy) phenomenon
Guided Inquiry Lesson
Teacher Lesson Plan</td></tr>
<tr><td>Lesson Summary</td><td colspan="2">This is a 2-day lesson based on the book: Dr. Rosie Helps the Animals. The first day consists of reading and processing the story with a focus on the various remedies Rosie uses. The second day is a guided inquiry lesson based on a fundamental scientific concept alluded to in the story Dr. Rosie Helps the Animals. It employs the phenomenon-based learning approach and gives students a foundational understanding of the particle motion theory.</td></tr>
<tr><td>Phenomenon-based learning is included in the Next Generation Science Standards (NGSS)</td><td colspan="2">
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<tr><td>Phenomenon-based learning using Dr. Rosie Helps the Animals</td><td>Day 1: Read and Process</td><td>Day 2: The effect of “cold” (low thermal energy) phenomenon-based guided-inquiry science lesson</td></tr>
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Day 1: Read and Process

Grade Levels: K-2	Topic: *Dr. Rosie Helps the Animals* (Read and process)	Materials • *Dr. Rosie Helps the Animals* Book or Reading by Rozillia • Remedies Phenomena Pupil Page- cold

Cultural and Linguistic Sustaining Practices

Note: The *Dr. Rosie* story provides several examples of natural remedies. This provides an authentic opportunity for students to share remedies they have learned about or experienced from their culture. From: Cultural and Linguistic Practices

- ☐ Connect the content of the book to your students' cultural and linguistic backgrounds.
- ☐ Ask students to make connections to the remedies in the story by relating them to their own cultural experiences
- ☐ Ask relevant and inclusive questions that connect to all students from various backgrounds

Lesson Objectives/Learning Goals:

- ★ Students will be introduced to veterinary medicine as a STEM profession through an engaging informational fiction story
- ★ Students will be able to identify the remedies Rosie used for each affliction.
- ★ Students will be able to compare and contrast Rosie's remedies with their own experiences.

Time	Activity	Teacher Actions	Student Actions
________ minutes	Introduction to the Dr. Rosie story	**Questions**: *Have you ever been sick? What helped you get better?* Today, you're going to meet a young person who helps animals get better! Listen to find out who Dr. Rosie meets and how she helps each animal.	Reply to the questions

________ minutes	Story Reading and Scaffolded note taking	Give each student a copy of Remedies Phenomena Pupil Page. As you read the story, pause with each remedy. Ask kids if they have had that affliction and what remedies have they used at home. Ask students to match the affliction and remedy on the pupil page.	Listen to the story and match the animal with the remedy

Day 2: The effect of "cold" (low heat) phenomenon-based guided-inquiry science lesson		
Grades levels: K-2	**Topic:** Effect of Cold Phenomenon	**Materials:** ● (per group or as a demo) balloon, string, marker, scissors, freezer or ice chest, ruler ● Effect of cold phenomena pupil pages (Level 1, 2, and/or 3 according to student needs)
NGSS Standards (Science Practices) K-2		
● **Asking questions and defining problems**– *How does cold affect the size of something? How can a swollen bump be made to get smaller?* ● **Developing and Using Models**– *A balloon is a model for a swollen bump* ● **Planning and carrying out investigations**–*compare balloon size before and after being in the freezer* ● **Analyzing and Interpreting Data**–*What happens to the size of a balloon when it is cold? What does this mean about how cold (low heat) affects the size of some things?*	● **Constructing Explanations and Designing Solutions**– *The air particles inside the balloon get closer together when they are cold. This makes the overall size of the balloon smaller.* ● **Engaging Argument from Evidence**– *evidence suggests that cold makes substances shrink (get smaller)* ● **Obtaining, Evaluating, and Communicating Information**– *If cold makes things get smaller, a compress with ice inside can help bring down swelling*	

Lesson Objectives/Learning Goals	To the teacher: *This lesson provides a foundational understanding of the particle motion theory, a higher-grade NGSS content standard. Content that is both general and specific to this guided inquiry is provided below.*
• Students will utilize a variety of science practices to investigate the effect of cold on a substance (air) • Students will make connections between how cold affects the size of a balloon and how a compress filled with ice affects a swollen bump	

Science Content Background for this Lesson

(for more on this fascinating physical science phenomenon, read Deeper Dive at the end of this lesson)

The ***particle motion theory*** states that everything is made of tiny particles (atoms and molecules). The particles are attracted to each other. The mutual forces of attraction are different for different substances. The particles are constantly moving with what is called "kinetic energy." Adding energy (heating them up) makes the particles move more and get farther apart from each other which makes the entire substance that they are made of get bigger in size. This is called ***thermal expansion***. A marshmallow heated in a microwave is an example of thermal expansion. Taking heat away ("cooling") makes the particles slow down and get closer together, making the entire substance smaller. This is called ***thermal contraction***. For example, once the microwave is turned off, the marshmallow gets smaller in size.

Thermal Contraction and Expansion
Expansion and Contraction of Matter: Particle Motion Theory

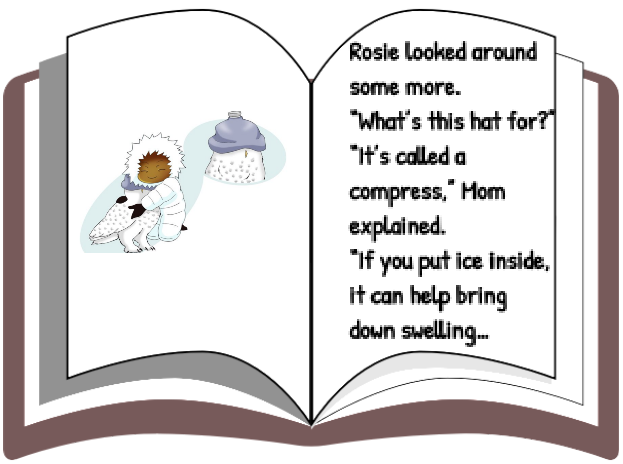
In this investigation, students will test the effect of cold (reduced thermal energy) on the size of a balloon. The balloon is a model of a bump on the head.

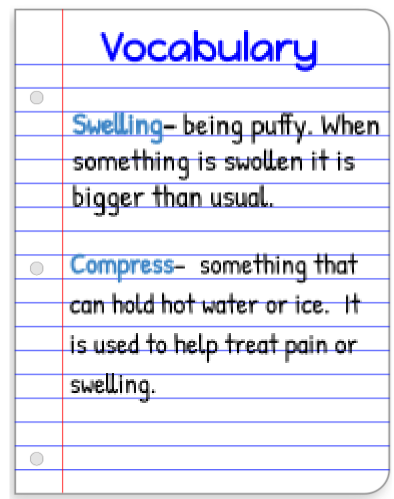
Background Relating to this Investigation

When you blow up a balloon, air particles (even though you cannot see them) from your lungs go into the balloon. The particles have energy and are hitting each other and the inside of the balloon, sort of like bumper cars. If the balloon is heated up, the air particles gain more energy and move faster and farther apart. They put more pressure on the inside of the balloon and the entire balloon gets bigger. Likewise, if the balloon is put in a freezer, the air particles lose energy, move more slowly, and get closer together. They put less pressure on the inside of the balloon, and the entire balloon gets smaller.

How does this relate to a compress with ice in it? Icing a swollen bump is effective because the cold constricts blood vessels and decreases circulation to the area so there is less buildup of fluid at the site.

Excerpt from Dr. Rosie Helps the Animals





To the teacher: This lesson provides a foundational understanding of the particle motion theory, a higher-grade NGSS content standard

Rosie's mom claims that ice can bring down swelling. This is a guided inquiry lesson to test the effect of cold on the size of an object (a balloon)

Before Starting

1. What did Rosie's mom say that ice would do to swelling? If you pretend that a balloon is like a head bump, what do you think will happen to the size of a balloon if it is put in a freezer? Will it stay the same? Will it get larger? Will it get smaller?
2. How can you figure out if the size of a balloon changes when it gets cold?

Experiment:

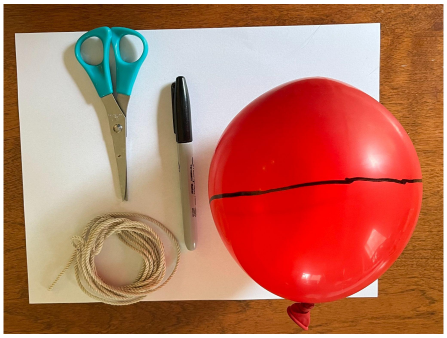
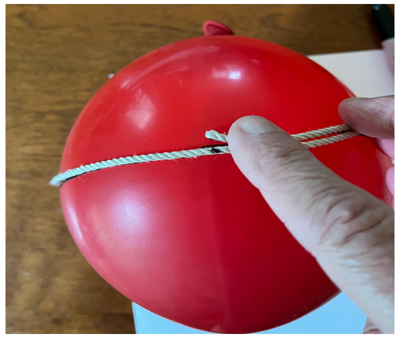
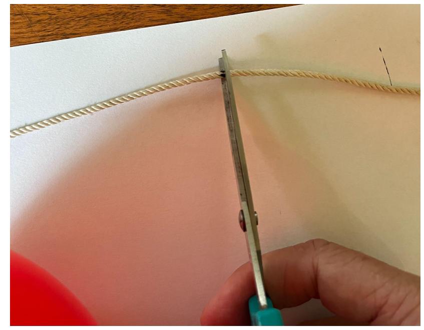
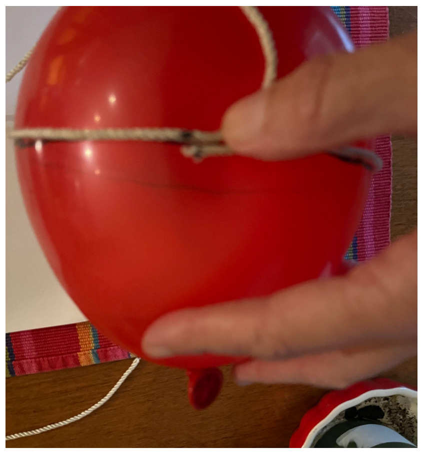
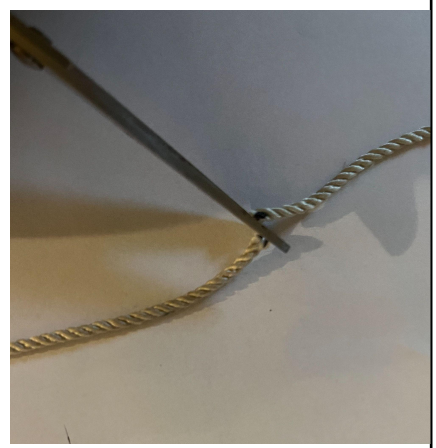
The effect of "cold" on the size of a balloon

Materials for the Experiment:

- Balloon (1 for a demo or more if kids are testing)
- Sharpie(s)
- String
- Ruler
- Freezer or cooler with ice
- Effect of cold pupil page

Directions:

1. Distribute Effect of Cold Pupil Page- have students complete steps up to and including the hypothesis
2. Blow up and tie off a balloon.
3. Use a Sharpie to draw a line around the circumference of the balloon. It does not have to be the exact circumference.
4. Lie a piece of string along the line to determine the circumference. Record.
5. Put the balloon in a very cold area (freezer, cooler with ice) for 15-30 minutes.
6. Remove from the cold area and quickly measure the circumference using another piece of string. Record. Compare or measure the lengths of the two strings.
7. Have students complete the rest of the Effect of Cold Pupil page.

		
		
		The length of the string before it was in the freezer: 17 6/8 inches The length of the string after the balloon was in the freezer: 16 ⅞ inches

Note to Teacher: *Kids can act out this phenomenon. Make a big circle using chalk or a string. Have kids spread out inside the circle. Tell kids they are going to pretend that they turn into "cold" particles. Cold particles have less energy and they get closer together. Ask the kids to huddle together. Draw another circle around the kids in a huddle. Ask kids to compare.*

Making Connections:

1. What happened to the size of the balloon when it was cold?
2. If the balloon is like a swollen bump, what does ice do to the size of the bump?

Extension

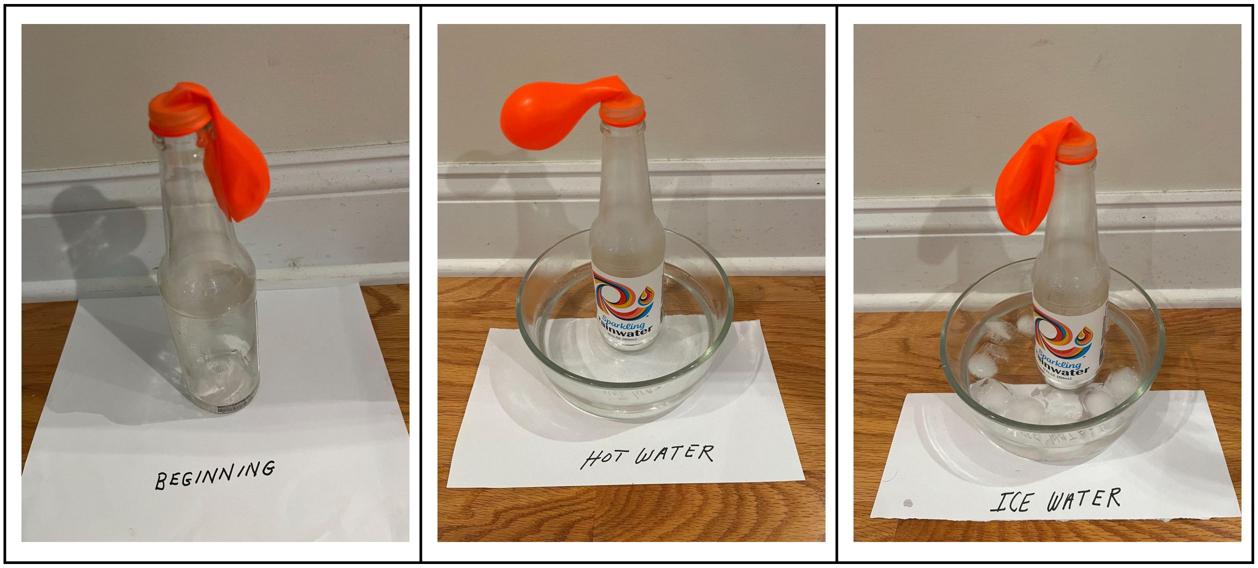
To the teacher: You can do the following as a demo or, depending on the age of your students, they can set the experiment up themselves or in groups.

Materials

- Balloon
- empty glass bottle
- hot water
- ice water

Procedure

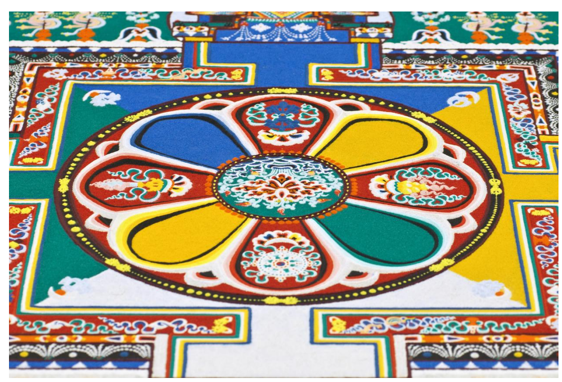
1. Put a balloon over the top of an empty glass bottle. Ask students to predict what will happen to the size of the balloon if the bottle is put in hot water.
2. Put the bottom of the bottle in hot water. Observe.
3. Have students discuss what they observed and why they think it happened.
4. Have students predict what will happen to the size of the balloon if the bottle is put in ice water.
5. Put the bottom of the bottle in ice water. Observe.
6. Have students discuss what they observed and why they think it happened.



Safety Concerns: There are no particular safety concerns with this activity other than precautions one would use with a balloon or a string.

Safety Concerns for the Extension Activity-The hot water does not have to be any hotter than a hot shower. It should not be hot enough to cause any injury.

Deeper Dive Science Content:
https://www.youtube.com/watch_popup?v=-zfV0tQl9MI



A sand mandala is made of individual grains of sand.

Similarly, the **particle motion theory** of matter states that everything (even a grain of sand) is made of tiny particles that you cannot see (atoms, molecules, etc.). These particles are constantly moving (they have kinetic energy) and have forces of attraction between them. For every particular kind of material, the particles in a solid form of that material have low energy (relative to the liquid or gas form of that same substance) and are vibrating in place. The particles do not have enough energy to overcome

the forces of attraction between them so they are locked in a rigid shape. We call this state a **solid**. If you add energy to the particles (heat them up), they vibrate more and begin to get farther apart from each other. We call this the ***thermal expansion of a solid.*** If you continue to give the particles energy (heat them up), they eventually have enough energy and move far enough apart that they are able to partially overcome the forces of attraction holding them in place. When this happens, the particles are no longer held in a rigid shape and they begin to flow around each other. We call this state a **liquid**. If you continue to add energy, the particles in a liquid move more and get farther apart from each other. We call this the ***thermal expansion of a liquid.*** (The "old-fashioned" mercury or alcohol thermometers work because of thermal expansion.) If you continue to add energy to the particles of a liquid they will have enough energy and move far enough apart to completely overcome their forces of attraction. The particles freely move around. We call this state a **gas**. Adding more energy makes the particles in a gas state move faster and get farther apart. We call this the ***thermal expansion of a gas***. If you continue to add energy to a gas, it will become a state called **plasma**.
If you remove energy (the particles get "colder") from a gas, the particles lose energy and get closer together. This is the ***thermal contraction of a gas.*** Eventually, the particles will come close enough to each other that the forces of attraction will begin to hold them loosely in place and they flow around each other. We call this the liquid state. An example of this is condensation on the mirror in a bathroom. If you continue to remove energy from the liquid particles, they move more slowly and get closer together. We call this the ***thermal contraction of a liquid.*** Eventually, when enough energy is removed, the liquid particles get so close together that they are not able to overcome their mutual forces of attraction and they are then held in a rigid structure. We call this the solid state. Removing more energy creates the ***thermal contraction of a solid***. Thermal expansion joints are important in bridge construction. They allow the concrete to expand and contract without cracking. Each kind of material has its own thermal contraction and expansion rates. These are important in everyday life and in building and design. One can remove a metal lid from a glass jar after running it under hot water because the metal and glass have different rates of thermal expansion.

Source: https://siamagazin.com

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