WINTER BREAK LEARNING PACKET

STEM

6TH GRADE STUDENT

DEC 22ND – JAN 5TH

DEPARTMENT OF CURRICULUM & INSTRUCTION

Week One: December 22-26, 2025

Welcome to Your Winter Break STEM Challenge Packet!
Have fun exploring these activities and remember, always get your parents' permission and have adult supervision for every experiment. Stay curious and enjoy your break!

Standard: 6.PS3.1

Analyze the sources of energy in a system to gather evidence supporting that energy is conserved during transfers of kinetic, potential (elastic, gravitational, and chemical), and/or thermal energy.

Overview: In this activity, students will design, build, and test straw rockets to explore how energy transfers while remaining conserved. By launching rockets and recording data, students will use a simple model to understand energy transformations and apply scientific reasoning to explain their observations.

Objective(s):

Students will:

1. Construct straw rockets and record data from multiple rocket launches to analyze patterns.
2. Modify their rocket design to improve performance and explain how changes affect energy transfer.
3. Reflect on how energy transformations occur in everyday systems.

Materials:

- Pencil
- Scissors
- Tape
- Soda Straw
- Meter Stick or Measuring Tape
- 2 Copies of Rocket Template, Data Log, and Data Analysis Graph

Day 1: Build Your Rocket

Student Instructions:

1. Read the instructions on the page labeled **"Make a Straw Rocket."**
2. Construct your rocket as specified by the instructions and test it to make sure it works.
3. Challenge a family member to make one as well.

Energy Connection:
Before launching, think:

- Where is the energy coming from to make the rocket move?
- How is energy transferred when you blow air into the straw?

K-12 Students

Make a Straw Rocket

Create a paper rocket that can be launched from a soda straw – then, modify the design to make the rocket fly farther!

Materials

- Pencil
- Scissors
- Tape
- Soda straw (plastic or reusable)
- Meter stick or measuring tape
- Rocket template and data log

1. Cut out and shape the rocket body

Cut out the rectangle. This will be the body tube of the rocket. Wrap the rectangle around a pencil length-wise and tape the rectangle so that it forms a tube.

2. Cut out and attach the fins

Cut out the two fin units. Align the bottom of the rectangle that extends between the fins with the end of the rocket body, and tape the fin to the body tube. Do the same thing for the other fin on the opposite side, making a "fin sandwich."

3. Bend the fins

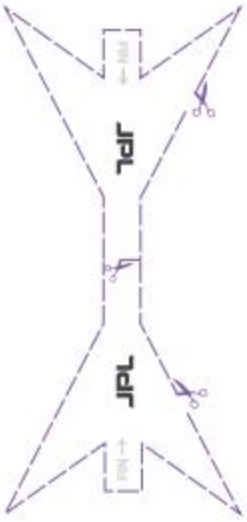
Bend the fins on each fin unit 90 degrees so that they are each at a right angle to each other. When you look along the back of the rocket, the fins should form a "+" mark.

4. Make and measure the nose cone

Twist the top of the body tube into a nose cone around the sharpened end of your pencil. Measure your nose cone from its base to its tip and record the length on the data log and on the rocket itself.

5. Prepare to launch!

Remove the pencil and replace it with a soda straw. Be sure your launch area is clear of people and hazards. Then, blow into the straw to launch your rocket! Record the distance the rocket travels on your data log.



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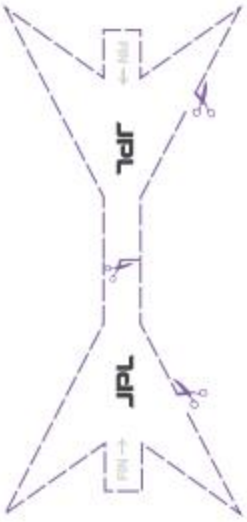

Day 2: Launch & Record Data

Student Instructions

1. Find a safe open space indoors or outdoors.
2. Place the straw in your mouth, aim upward at a safe angle, and blow to launch your rocket.
3. Create several different nose cone lengths for your rocket and test your rocket with each nose cone, **five trials per rocket**.
4. Measure the **length of each nose cone and distance traveled** for each rocket.
5. Record your data in the **"Straw Rocket Data Log"** for **five trials per rocket**.
6. Calculate the **average distance for each rocket** and save the data for the next part of the activity.

Energy Connection:

- What energy transfer happens when you blow air into the straw?
- Where does the energy go after launch?
- What happens each time you modify the length of the nose cone?

Straw Rocket Data Log

Length of Nose Cone (in cm)	Distance Traveled (in cm)					Notes
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	

Straw Rocket Data Log

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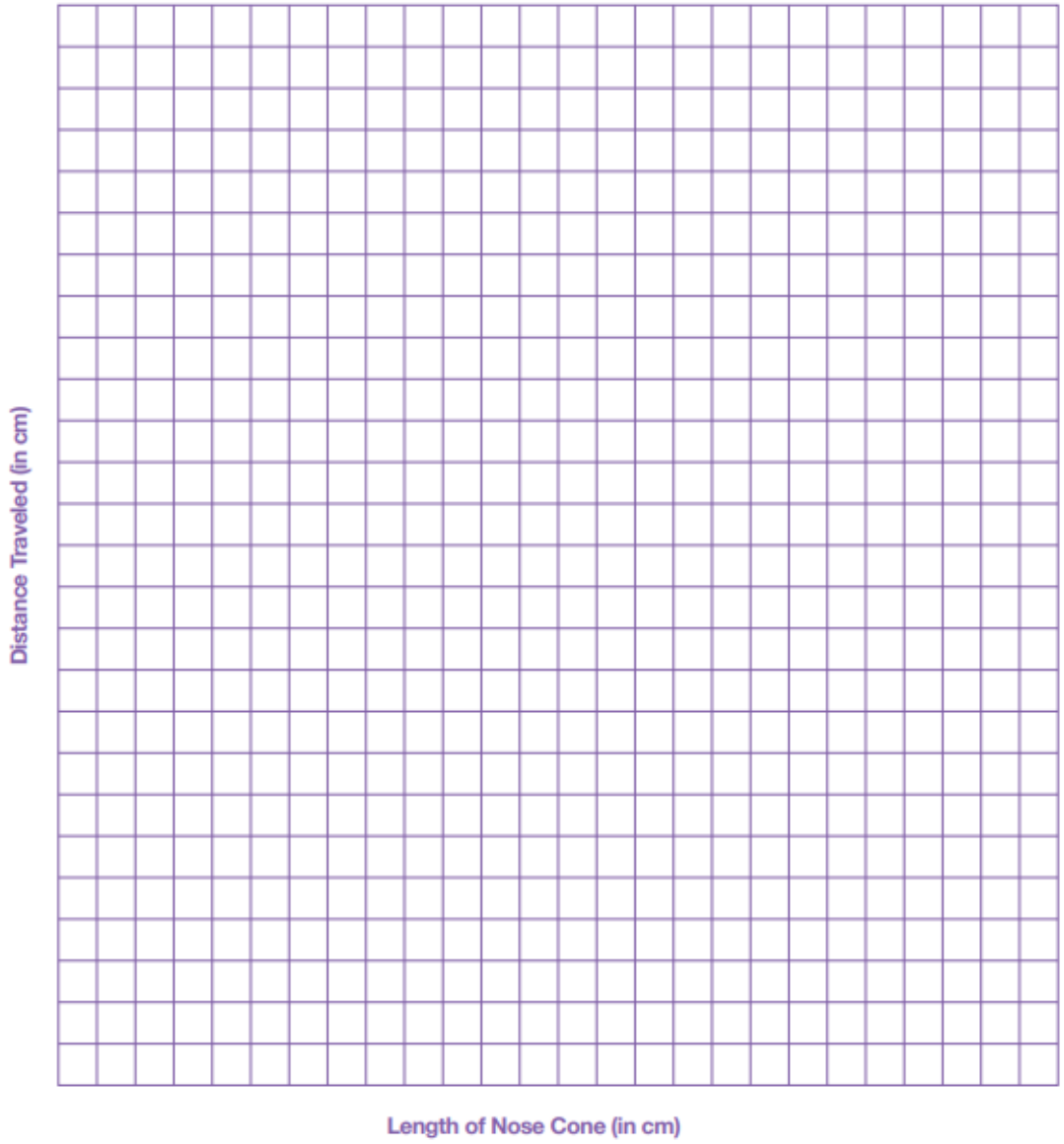
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	

Day 3: Analyze & Improve

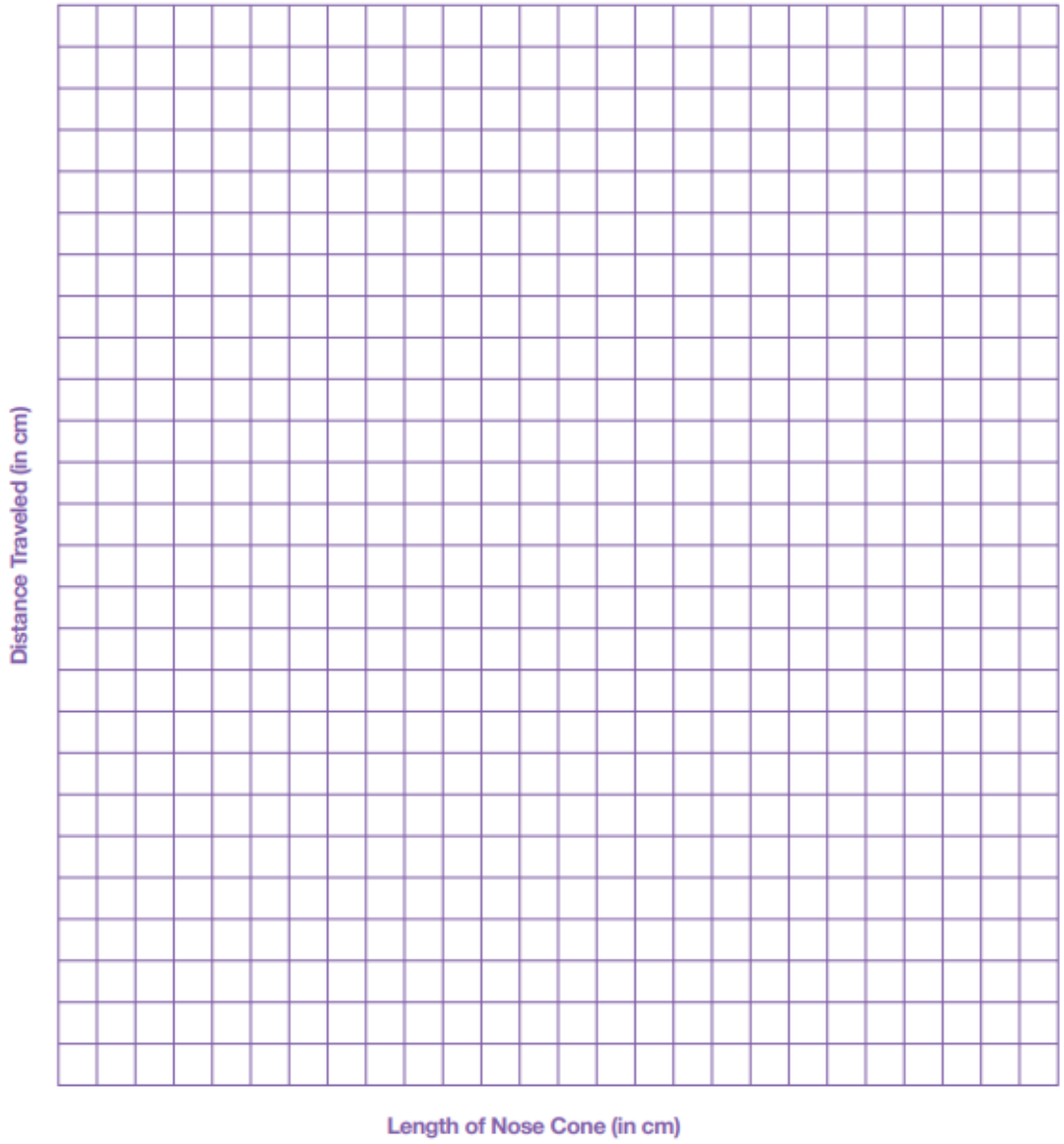
Student Instructions

1. Complete the **"Straw Rocket Data Analysis"** chart below using the results from the activity.
2. Look at your data. Which rocket flew farther? Why do you think that happened?
3. Modify one rocket to improve its flight (add fins, change nose cone, adjust weight).
4. Test again and record results.
5. Write a short reflection:
    a. Which design worked best and why?

Straw Rocket Data Analysis



Straw Rocket Data Analysis



Follow-Up Questions to Discuss with Parents

- How did blowing air into the straw give the rocket energy?
- What types of energy were involved in the rocket launch?
- Why didn’t the rocket keep moving forever?
- Can you think of other examples where energy changes form but isn’t lost?

Explanation of Activity

The Straw Rocket STEM Challenge engaged students in hands-on engineering and scientific reasoning aligned with Standard 6.PS3.1. Students designed and tested straw rockets to explore energy conservation and transformation. By blowing air into the straw, students provided chemical energy (from their bodies) that converted to kinetic energy in the moving air, which then transferred to the rocket. Modifications such as nose cone length and fins affected how efficiently energy was transferred and how aerodynamic forces influenced motion.

Sample Student Responses

Day 1 – Energy Connection

- *Where is the energy coming from?*
  "The energy comes from my body when I blow air into the straw. My muscles use chemical energy to push air out."
- *How is energy transferred when you blow air into the straw?*
  "The chemical energy in my body changes to kinetic energy in the moving air, which pushes the rocket forward."

Day 2 – Energy Connection

- *What energy transfer happens when you blow air into the straw?*
  "Chemical energy → kinetic energy of air → kinetic energy of rocket."
- *Where does the energy go after launch?*
  "It becomes kinetic energy as the rocket moves, then changes to potential energy when it goes upward, and some becomes thermal energy due to friction with air."
- *What happens when you modify the nose cone length?*
  "Longer nose cones make the rocket heavier, so it doesn't go as far. Shorter cones make it lighter and more aerodynamic."

Day 3 – Reflection

- *Which design worked best and why?*
  "The rocket with a short nose cone and fins flew the farthest because it was lighter and more stable, reducing energy loss from wobbling."

Key Findings

1. **Energy Conservation Principle**: Energy is not lost; it transforms between forms during the rocket launch.
2. **Design Matters**: Nose cone length and fins significantly influence flight distance due to mass and stability.
3. **Real-World Connection**: Similar principles apply to real rockets and vehicles—energy transfer and aerodynamics are critical.
4. **Scientific Reasoning**: Students use evidence from trials to justify design improvements.

Week Two: December 29, 2025-January 2, 2026

Standard: 6.PS3.2

Use a model to gather evidence to support changes to a system can be caused by transfers of sound or thermal energy (i.e., conduction, convection, or radiation).

Overview:

This lesson engages students with an investigative phenomenon that will help them make sense of the transfer of **thermal energy (heat)** through **conduction and convection**.

Objective(s):

Students will:

1. Use a model to investigate how heating air causes changes in a system.
2. Observe and record evidence of thermal energy transfer and its effects.
3. Explain how conduction and convection transfer energy from the blow dryer to the air inside the bottle.
4. Connect observations to real-world phenomena like hot air balloons.
5. Support claims that energy transfer can cause changes in matter and motion.

Materials:

- Empty plastic water bottle
- Balloon
- Blow dryer
- Tongs
- Safety goggles
- Readworks Article

Pre Lesson-Activity: Read the following passage and respond to the questions.

The Transfer of Heat Energy

This text is from the U.S. National Oceanic and Atmospheric Administration: National Weather Service.

The heat **source** for our planet is the sun. Energy from the sun is transferred through space and through the earth's atmosphere to the earth's surface. Since this energy warms the earth's surface and atmosphere, some of it is or becomes heat energy. There are three ways heat is transferred into and through the atmosphere:

- radiation
- conduction
- convection

Radiation

If you have stood in front of a fireplace or near a campfire, you have felt the heat transfer known as radiation. The side of your body nearest the fire warms, while your other side remains unaffected by the heat. Although you are surrounded by air, the air has nothing to do with this **transfer** of heat. Heat lamps, that keep food warm, work in the same way. Radiation is the **transfer** of heat energy through space by electromagnetic radiation.

Most of the electromagnetic radiation that comes to the earth from the sun is invisible. Only a small portion comes as visible light. Light is made of waves of different frequencies. The frequency is the number of instances that a repeated event occurs, over a set time. In electromagnetic radiation, its frequency is the number of electromagnetic waves moving past a point each second.

Our brains **interpret** these different frequencies into colors, including red, orange, yellow, green, blue, indigo, and violet. When the eye views all these different colors at the same time, it is **interpreted** as white. Waves from the sun which we cannot see are infrared, which have lower frequencies than red, and ultraviolet, which have higher frequencies than violet light. It is infrared radiation that produces the warm feeling on our bodies.

Most of the solar radiation is absorbed by the atmosphere and much of what reaches the earth's

surface is radiated back into the atmosphere to become heat energy. Dark colored objects, such as asphalt, absorb radiant energy faster than light colored objects. However, they also radiate their energy faster than lighter colored objects.

Conduction

Conduction is the **transfer** of heat energy from one substance to another or within a substance. Have you ever left a metal spoon in a pot of soup being heated on a stove? After a short time the handle of the spoon will become hot.

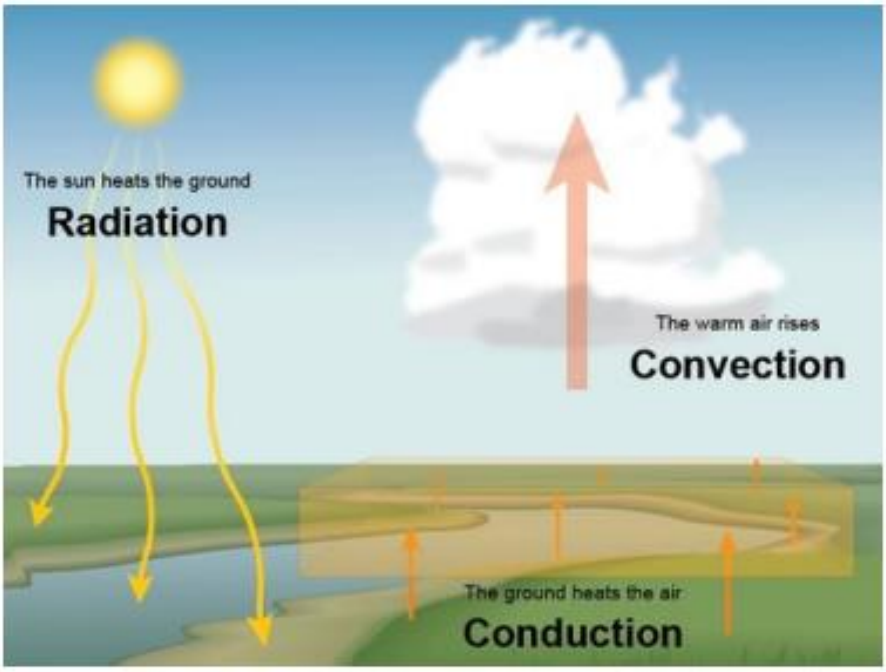
This is due to **transfer** of heat energy from molecule to molecule or from atom to atom. Also, when objects are welded together, the metal becomes hot (the orange-red glow) by the **transfer** of heat from an arc.

This is called conduction and is a very effective method of heat **transfer** in metals. However, air conducts heat poorly.

Convection

Convection is the **transfer** of heat energy in a fluid. This type of heating is most commonly seen in the kitchen when you see liquid boiling.

Air in the atmosphere acts as a fluid. The sun's radiation strikes the ground, thus warming the rocks. As the rock's temperature rises due to conduction, heat energy is released into the atmosphere, forming a bubble of air which is warmer than the surrounding air. This bubble of air rises into the atmosphere. As it rises, the bubble cools with the heat contained in the bubble moving into the atmosphere.



As the hot air mass rises, the air is replaced by the surrounding cooler, more dense air, what we feel as wind. These movements of air masses can be small in a certain region, such as local cumulus clouds, or large cycles in the troposphere, covering large sections of the earth. Convection currents are responsible for many weather patterns in the troposphere.

Vocabulary

interpret

verb

definition: to understand in a particular way.
Dan interpreted his father's frown as a refusal.

Spanish: interpretar

forms: interpreted, interpreting, interprets

source

noun

definition: the start or cause of something.
Not knowing Latin was the source of his trouble with scientific terms.

Spanish: fuente, nacimiento

transfer

noun

definition: the act of moving something from one person or place to another.
The transfer of the star player to another team disappointed fans.

Spanish: traslado, transferencia, paso, traspaso

1. Before you start reading...

Here are the vocabulary words that will be in this reading. Let's see how well you already know them.

Check the box that shows how well you know each word. It's ok if you don't know them yet (this is not graded)!

	Don't know it	Have heard of it but not sure of its meaning	Know something about its meaning	Know it well
interpret				
source				
transfer				

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2. Word Matcher

Every word has other words that have similar meanings or even the exact same meaning (these are called synonyms!). Draw a line from each similar word or synonym to the vocabulary word that it matches!

read see define origin seed

interpret **source** **transfer**

cause shift removal transportation

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3. After reading and exploring the words through some activities...

Do you know these words better? Check the box that shows how well you know each word. It's ok if you don't know them yet (this is not graded)!

	Don't know it	Have heard of it but not sure of its meaning	Know something about its meaning	Know it well
interpret				
source				
transfer				

Name: _____ **Date:** _____

1. What is Earth's heat source?

A. heat lamps

B. dark colored objects

C. the sun

D. metal objects

2. What does the text list and describe?

A. ways hot air is transferred into and through Earth's atmosphere

B. ways heat is transferred into and through Earth's atmosphere

C. ways radiation is transferred into and through Earth's atmosphere

D. ways visible light is transferred into and through Earth's atmosphere

3. Read this sentence from the text.

"Most of the solar radiation is absorbed by the atmosphere and much of what reaches the earth's surface is radiated back into the atmosphere to become heat energy."

What can you conclude about heat energy?

A. Most of the sun's energy is used to make heat energy.

B. A small amount of the sun's energy is used to make heat energy.

C. All of the sun's energy is used to make heat energy.

D. None of the sun's energy is used to make heat energy.

4. Read these sentences from the text.

> Convection is the transfer of heat energy in a fluid. . . .
>
> Air in the atmosphere acts as a fluid. The sun's radiation strikes the ground, thus warming the rocks. As the rock's temperature rises due to conduction, heat energy is released into the atmosphere, forming a bubble of air which is warmer than the surrounding air. This bubble of air rises into the atmosphere.

What inference can you make about radiation, conduction, and convection?

A. Radiation, conduction, and convection work together to transfer heat energy in Earth's atmosphere.

B. Radiation, conduction, and convection are not important in transferring heat energy in Earth's atmosphere.

C. Radiation, conduction, and convection transfer heat energy from Earth's atmosphere to the sun.

D. Radiation, conduction, and convection work together to transfer heat energy in the sun.

5. What is the main idea of this text?

A. The source of heat for Earth is the sun, and some of the sun's energy is used to make heat energy.

B. White light is when the eye views all the different light frequencies at the same time.

C. The transfer of heat energy from one substance to another or within a substance is called conduction.

D. Heat energy is transferred into and through Earth's atmosphere by radiation, conduction, and convection.

Answer Key For Readworks Article: The Transfer of Heat Energy

1. **C**
2. **B**
3. **B**
4. **A**
5. **D**

Hot Air Balloon Activity:

Activity Description

In this experiment, you will create a simple closed system that models how a hot air balloon works using just a balloon, an empty water bottle, and a blow dryer. When heat is applied to the air inside the bottle, the balloon reacts—demonstrating how thermal energy transfer causes changes within a system. This hands-on activity illustrates how **conduction** and **convection** work together to make air expand and lift objects, just like real hot air balloons.

What happens to air when it's heated, and how can we prove that energy is causing change?

Phenomenon:

Have you ever wondered how something as heavy as a hot air balloon can float into the sky?
Today, we're going to explore how **heat energy** can cause **air to change**—and even lift things up! You'll see this in action with your own mini "hot air balloon" experiment.

Materials

Empty water bottle
Balloon
Blow dryer
Tongs
Safety goggles

What do you think will happen to a balloon when we attach it to an empty bottle and heat the air inside the bottle? Write your prediction below:

Procedure

1. Put on your safety goggles.
2. Secure the balloon over the mouth of the bottle.
3. Hold the bottle with tongs, away from your face.
4. Use the blow dryer to heat the bottle for 45 seconds.

Post-Activity Questions

1. What did you observe during the experiment? Was your prediction correct?
2. How did the balloon respond to the heated air?
3. What evidence do you have that energy was present in the system?
4. How does this experiment relate to the hot air balloon video?
5. Using information from the article and your prior knowledge, explain how conduction and convection caused changes in the mini hot air balloon.

Explanation of Activity and Outcome

This activity addressed **TN Standard 6.PS3.2**, which required students to use a model to gather evidence that changes to a system can be caused by transfers of thermal energy (i.e., conduction, convection, or radiation). Students conducted an investigation using an empty water bottle, a balloon, and a blow dryer to model how thermal energy transfer affects air. They attached the balloon to the bottle and heated the air inside with the blow dryer. As the air warmed, it expanded and inflated the balloon, demonstrating that thermal energy caused a change in the system. Heat transferred from the blow dryer to the bottle (conduction) and then to the air inside, which circulated (convection), making the air molecules move faster and spread out. This expansion exerted pressure on the balloon, causing it to rise and providing clear evidence that energy transfer leads to observable changes.

Key Findings

- **Energy Transfer:** Heat energy moved from the blow dryer to the bottle (conduction) and then to the air inside, which circulated (convection).
- **System Change:** The air expanded as its temperature increased, inflating the balloon.
- **Evidence of Energy:** The balloon's inflation provided clear evidence that thermal energy caused a change in the system.
- **Real-World Connection:** The same principle explains how hot air balloons rise—heated air inside becomes less dense than cooler surrounding air.