Chemical & Physical Changes

Teacher guide • Two classroom demonstrations

Learning goals

Students will distinguish chemical changes from physical changes, identify evidence of a chemical reaction, and use particle theory to explain changes in state and gas pressure.

Demonstration 1: Elephant toothpaste

Concept: Chemical change. Hydrogen peroxide decomposes into water and oxygen gas. A catalyst speeds up the reaction, and soap traps the oxygen in bubbles to make foam. The reaction releases heat (it is exothermic).

Reaction: $2\ H_2O_2 \rightarrow 2\ H_2O + O_2$

Ask students to observe: rapid foam formation, gas production, and any temperature change demonstrated by the instructor. Explain that foam is soap bubbles containing oxygen; the foam itself is not a new substance.

Safety note: Do not use 30% hydrogen peroxide as a classroom recipe. It is highly corrosive and can cause serious skin and eye injuries; the reaction can also become hot and vigorous. Use only a school-approved, appropriately diluted demonstration prepared and conducted by a trained adult under the school's chemical-safety procedures, with the required PPE and controls. If those controls are not available, use a video or an approved alternative. Do not let students handle the concentrated chemical.

Demonstration 2: Collapsing can

Concept: Physical change and particle theory. Heating a small amount of water in a can creates water vapour that displaces much of the air. Rapid cooling condenses the vapour back into liquid water, greatly lowering the pressure inside the can. Atmospheric pressure outside is then greater and crushes the can.

Important clarification: The can does not collapse simply because particles move closer together. Condensation reduces the amount of gas inside the can, lowering its internal pressure. The greater outside air pressure causes the collapse.

Safety note: This demonstration involves hot metal, hot water/steam, and a sudden collapse. It should be performed only by a trained adult using the school's approved risk assessment, equipment, PPE, and procedure. Students should observe from a safe distance and must not handle the heated can.

Teaching sequence & discussion

1. Before each demonstration, have students make a prediction and identify what evidence they will watch for.
2. During each demonstration, ask students to record observations separately from explanations.
3. After elephant toothpaste, connect gas production and the formation of new substances to chemical change.
4. After the can demonstration, trace the sequence: heating → water vapour → cooling → condensation → lower internal pressure → greater external pressure → can collapses.
5. Compare the two: both involve gas, but elephant toothpaste forms new substances (chemical change), while the can demonstration involves a change of state and pressure (physical change).

Quick answer key

Student question	Expected response
Elephant toothpaste: what gas is produced?	Oxygen gas.
Why is it a chemical change?	Hydrogen peroxide decomposes into different substances: water and oxygen.

Student question	Expected response
Can: what happens to water vapour as it cools?	It condenses into liquid water.
Why does the can collapse?	The internal pressure drops; greater atmospheric pressure outside crushes the can.
Is the can demonstration chemical or physical?	Physical change: a change of state and pressure occurs; no new substance is formed.
Why do the demonstrations differ?	One produces new substances; the other changes state/pressure without producing a new substance.

Chemical & Physical Changes

Observation & analysis worksheet

Name: _____ **Date:** _____

Investigation 1: Elephant toothpaste

Before the demonstration — predict: What do you think will happen when the materials are combined?

_____

_____

Do you predict a chemical change or a physical change? Explain.

_____

_____

Observations

What am I observing?	My observations
What happened when the materials were combined?	
Was gas produced? What evidence did you see?	
Did the temperature change?	
What happened to the volume/amount of foam?	

Think like a scientist

1. What gas was produced during the reaction? _____

2. Why is elephant toothpaste considered a chemical change?

_____

_____

3. Identify two pieces of evidence that a chemical reaction occurred.

• _____ • _____

Investigation 2: The collapsing pop can

Before the demonstration — predict: What do you think will happen to the can when it is rapidly cooled?

_____

_____

What do you think happens to the particles inside the can as the temperature changes?

_____

_____

Observations

What am I observing?	My observations
What happened when the can was heated?	
What happened when the can was cooled?	
What happened to the shape of the can?	
What happened to the water vapour?	

Understanding the particles

4. What happens to the movement of gas particles when they are heated?

_____

5. What happens to water vapour when it cools?

_____

6. Why did the can collapse? Include the words *pressure* and *particles* in your answer.

_____
_____

7. Was the can demonstration a chemical change or a physical change? Explain.

_____
_____

Compare the two demonstrations

Question	Elephant toothpaste	Collapsing can
Chemical or physical change?		
Was gas involved?		
Was there a temperature change?		
Was a new substance produced?		

Final thinking questions

1. What is one major difference between a chemical change and a physical change?

_____
_____

2. Can gas production be evidence of a chemical change? Explain using elephant toothpaste.

_____
_____

3. How does particle theory help explain what happened in the collapsing can?

_____
_____

4. Challenge: Both demonstrations involve gas. Why does one demonstrate a chemical change while the other demonstrates a physical change?

_____
_____
_____

My biggest takeaway from today's demonstrations:

_____
_____