1 CURIOUS MINDS:
EXPLORING PHYSICAL SCIENCE

This year, we're diving into the exciting world of physical science! You'll learn to ask questions like a detective, explore experiments, and uncover the secrets of how everything around us works. Get ready for a year full of fun discoveries!

Recommended Reading

- *Cece Loves Science*, by Kimberly Derting & Shelli R. Johannes
- *Charlotte the Scientist Is Squished*, by Camille Andros
- *Mad Margaret Experiments With the Scientific Method*, by Eric Braun
- *Mesmerized*, by Mara Rockliff
- *My Dog Is Not a Scientist*, by Betsy Ellor
- *The Princess & the Petri Dish*, by Sue Fliess

ACTIVITY Penny Detective: Uncovering the Best Cleaner

Many of us have dull, dirty pennies lying around, lacking their former shine. In this lab, you'll play the role of a scientific detective to discover which cleaning method works best for pennies. You'll explore a variety of cleaning solutions, from classic soap and water to a wacky option like ketchup! Can you uncover which cleaner works the best?

SUPPLIES

- 25 dull, dirty pennies
- 5 glass bowls or beakers
- Water
- Dish soap
- Vinegar
- Salt
- Ketchup
- Paper towel

INSTRUCTIONS

1. Before you start, read through these instructions carefully and form a hypothesis by noting your best guesses in the table below. Which cleaning method do you think will be most effective? Which do you think will be the least effective?
2. Search through your coins to find 25 dull, dirty pennies. Look for those that are dark or have a greenish tint.
3. Set out five bowls and prepare them for cleaning your pennies.
    a. Bowl 1: Add 1/2 cup of warm water.
    b. Bowl 2: Combine 1/2 cup of warm water and several drops of dish soap. Stir gently to mix.
    c. Bowl 3: Pour in 1/2 cup of white vinegar.
    d. Bowl 4: Mix 1/2 cup of white vinegar plus a teaspoon of salt. Stir gently until the salt dissolves.
    e. Bowl 5: Pour in 1/2 cup ketchup.

4. Place five pennies into each bowl, ensuring they are fully submerged. You may need to press the pennies into the ketchup with your fingers. Don't worry about getting messy; just be sure to wash your hands afterward!
5. Allow the pennies to soak in their cleaning solutions for about 15 minutes.
6. After 15 minutes, use a paper towel to dry off the pennies. Set the pennies together in a pile in front of each of their bowls of cleaning solution.
7. Examine the pennies closely and answer the questions below.

HYPOTHESIS

1. Draw a circle around the cleaning method you think will be most effective.
2. Place an X through the cleaning method you think will be least effective.

Cleaning method
Water
Water + soap
Vinegar
Vinegar + salt
Ketchup

RESULTS

1. Draw a circle around the cleaning method that was most effective.
2. Place an X through the cleaning method that was least effective.

Cleaning method
Water
Water + soap
Vinegar
Vinegar + salt
Ketchup

QUESTIONS

Was your hypothesis about which cleaning method would be most effective correct?

❍ **Yes** ❍ **No**

Was your hypothesis about which cleaning method would be least effective correct?

❍ **Yes** ❍ **No**

Why do you think some solutions were better at cleaning than others?

_____

_____

If you could try cleaning pennies with another substance, what would you try?

_____

LESSON 1: RICHARD FEYNMAN

Science is a process of continual learning, of continual approximation, of getting closer and closer to the truth.

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COLOSSIANS 1:15-19

15 He is the image of the invisible God, the firstborn of all creation.

16 For by him all things were created, in heaven and on earth, visible and invisible, whether thrones or dominions or rulers or authorities—all things were created through him and for him.

17 And he is before all things, and in him all things hold together.

18 And he is the head of the body, the church. He is the beginning, the firstborn from the dead, that in everything he might be preeminent.

19 For in him all the fullness of God was pleased to dwell,

COLOSSIANS 1:20-23

20 and through him to reconcile to himself all things, whether on earth or in heaven, making peace by the blood of his cross.

21 And you, who once were alienated and hostile in mind, doing evil deeds,

22 he has now reconciled in his body of flesh by his death, in order to present you holy and blameless and above reproach before him,

23 if indeed you continue in the faith, stable and steadfast, not shifting from the hope of the gospel that you heard, which has been proclaimed in all creation under heaven, and of which I, Paul, became a minister.

QUESTION:

What is chemistry?

ANSWER:

The study of what the world is made of and how that stuff interacts and changes

LESSON 1

QUESTION:

What is physics?

ANSWER:

The study of how things move and work and how energy is used

LESSON 1

QUESTION:

What is the scientific method?

ANSWER:

A step-by-step process to help scientists investigate and solve problems

LESSON 1

CURIOUS MINDS: EXPLORING PHYSICAL SCIENCE

Lesson 1 Quiz

1. What is physical science?

A) The study of living organisms
B) The study of outer space
C) The study of historical events
D) The study of how the world works, including physics and chemistry

2. Which branch of physical science focuses on motion and energy?

A) Biology
B) Chemistry
C) Physics
D) Geology

3. Which branch of physical science focuses on what the world is made up of and how it interacts and changes?

A) Biology
B) Chemistry
C) Physics
D) Geology

4. What does scientific inquiry involve?

A) Memorizing facts
B) Asking questions and exploring ideas
C) Following strict rules
D) Completing worksheets

5. What is the first step of the scientific method?

A) Analyzing data
B) Conducting an experiment
C) Asking a question
D) Drawing a conclusion

6. Why is sharing your scientific findings important?

A) To win awards
B) To help others learn and inspire new questions
C) To keep information secret
D) To compete with friends for who is best

7. What is a hypothesis?

A) The final result of an experiment
B) Conducting an experiment
C) Data collected during an experiment
D) A testable prediction about what will happen

9 CHEMICAL REACTIONS IN ACTION

Have you ever wondered why certain things bubble, change color, or even produce heat when mixed together? These are all signs that a chemical reaction is happening! In this lesson, we'll explore what happens at the molecular level when bonds break and new ones form. Plus, you'll learn to spot the telltale signs of a chemical reaction, like color changes, fizzing bubbles, temperature shifts, and even light!

Recommended Reading

- *Chemical Reactions: It Matters,* by Rachael Morlock
- *Fizz, Gurgle, Pop! Chemical Reactions in the Lab,* by Daniel R. Faust
- *Building Blocks of Chemistry: Chemical Compounds & Reactions,* by William D. Adams, pp. 4-16
- *Chemical Reactions,* by Jenna Winterberg
- *Chemistry for Curious Kids,* by Lynn Huggins-Cooper, pp. 100-101
- *Every Day, Chemistry,* by Julia Sooy

ACTIVITY Chemical Detectives: Uncovering Reaction Clues

This week you'll become a science detective and investigate a mysterious chemical reaction right in your own kitchen! In this lab, you'll mix two common household substances—calcium chloride (often found in de-icing products) and baking soda—to uncover what happens when they react together. Will you witness gas bubbles fizzing up? Will the temperature change as the reaction takes place? Could there possibly be a solid precipitate or a color change? Let's see what you uncover!

SUPPLIES

- Calcium chloride ($CaCl_2$) (available in de-icing products)
- Baking soda
- Water
- 2 clear plastic or glass containers
- 1 Tablespoon measuring spoon
- 1 cup measuring cup
- Stirring stick or spoon
- Safety goggles and gloves (recommended)

INSTRUCTIONS

1. You'll be watching a chemical reaction take place, so be sure to complete this lab with a parent or another adult present. It's also recommended that you wear safety goggles and gloves.
2. Prepare your calcium chloride solution.
   a. In your first container, mix 2 tablespoons of calcium chloride with 1 cup of water. Stir gently with a stirring stick or spoon until the calcium chloride is dissolved.
   b. What do you notice happening as you stir the substances together? Be sure to feel the side of your container to see if there is any change in temperature. Watch to see if there are any other indications that a chemical reaction has occurred.
   c. Record your observations in the table below.

3. Prepare your baking soda solution.

   a. In your second container, mix 2 tablespoons of baking soda with 1 cup of water. Stir gently with a stirring stick or spoon until the baking soda is dissolved.

   b. What do you notice happening as you stir the substances together? Be sure to feel the side of your container to see if there is any change in temperature. Watch to see if there are any other indications that a chemical reaction has occurred.

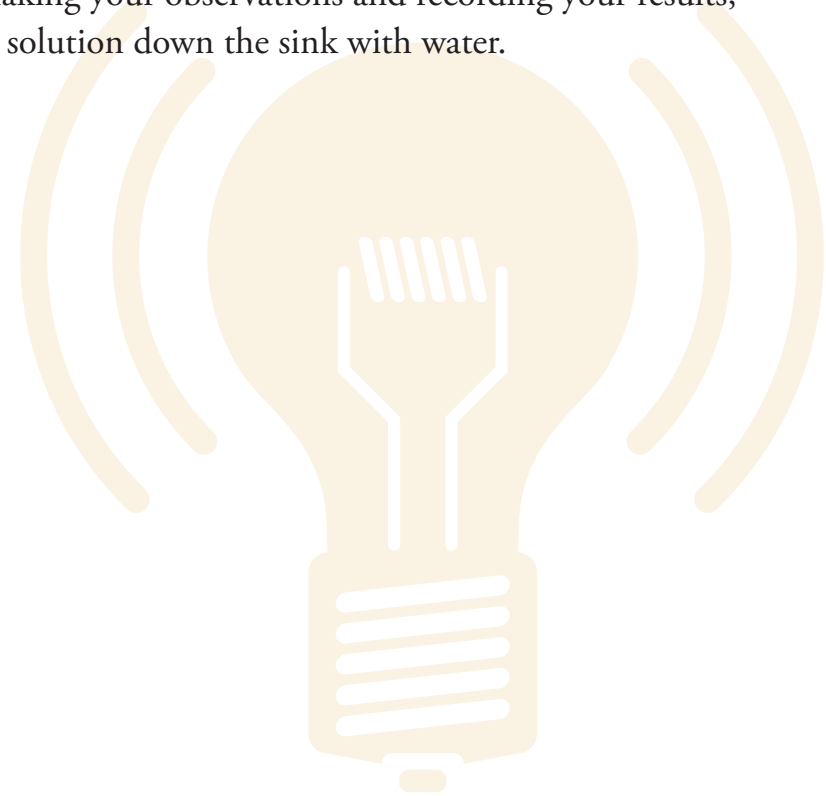
   c. Record your observations in the table below.

4. Mix the two solutions.

   a. Slowly pour the calcium chloride solution into the baking soda solution. Stir gently with a stirring stick or spoon.

   b. What do you notice happening as you stir the substances together? Be sure to feel the side of your container to see if there is any change in temperature. Watch to see if there are any other indications that a chemical reaction has occurred.

5. After you've spent time making your observations and recording your results, clean up by washing your solution down the sink with water.



	Calcium chloride + water	Baking soda + water	Calcium chloride solution + ~~sodium carbonate~~ solution
Temperature			
Light emission			
Color change			
Gas formation			
Formation of a precipitate			
Do you think a reaction occurred?			

QUESTION:

What is a chemical reaction?

ANSWER:

A chemical reaction occurs when bonds between molecules break and atoms combine to form new molecules

LESSON 9

QUESTION:

What are the signs you can look for to determine whether a chemical reaction has occurred?

ANSWER:

1) Color change
2) Gas formation
3) Temperature change
4) Light emission
5) Formation of a precipitate

LESSON 9

LESSON 9: GILBERT LEWIS

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Lesson 9 Quiz

1. What happens during a chemical reaction?

A) Atoms stay the same and only change position.
B) Atoms never change, only molecules do.
C) New atoms are created.
D) Molecules break apart and atoms form new molecules.

2. What are the substances that you start with in a chemical reaction?

A) Products
B) Catalysts
C) Reactants
D) Elements

3. When you mix iodine and starch, the color changes to blue-black. What sign of a chemical reaction is this?

A) Gas production
B) Color change
C) Temperature change
D) Formation of a precipitate

4. What type of reaction feels hot to the touch?

A) Endothermic
B) Exothermic
C) Precipitation
D) Bioluminescent

5. What is it called when a solid forms in a liquid solution after mixing two liquids together?

A) Precipitate
B) Gas
C) Light emission
D) Evaporation

6. What do we call the substances formed after a chemical reaction?

A) Products
B) Reactants
C) Atoms
D) Bonds

7. What is most likely happening if you notice bubbles and fizzing when mixing two substances?

A) A color change is occurring.
B) A temperature change is happening.
C) A gas is being produced.
D) A precipitate is forming.

8. Which of these is NOT a sign of a chemical reaction?

A) Gas bubbles are formed.
B) A color change happens.
C) A solid forms in a liquid.
D) The substance freezes.

9. What holds atoms together to form molecules?

A) Physical forces
B) Gravity
C) Chemical bonds
D) Heat