Physical and Chemical Changes

Educator Notes

Learning Objectives

- Demonstrate how physical and chemical changes occur in nature.
- Use observational evidence to distinguish between physical and chemical changes.

Safety

- Before using sharp instruments, discuss safety procedures surrounding proper use.
- The teacher should review all demonstrations prior to being performed and set safety procedures as needed.

Challenge/Investigation Preparation

- Be sure to read through the background material to understand the different types of physical and chemical changes, or physical and chemical weathering.
- Supply each group with:
  - Shallow dish
  - Enough vinegar to cover the items listed below when they are in the shallow dish
  - Shiny penny, nickel, safety pin, paperclip, steel nail or screw
  - One to two tablespoons of salt
  - Hydrogen peroxide (equal to the amount of vinegar used)
  - Sand or soil, approximately three to four cups per group
- Option: Feel free to ask students to bring in items to accessorize the small town they will build. Items the size of the toy green soldiers or smaller would be appropriate.

Introduce the Challenge

Watch the Physical and Chemical Changes STEMonstration video with the students.

Ask

- After viewing the STEMonstration, ask students to describe “physical change.” Discuss how students know, based on their observations, if a physical change has occurred.
  - Be sure students understand a physical change may change the size or shape but not the composition of a substance.
- Ask students to describe “chemical change.” Discuss how students know, based on their observations, if a chemical change has occurred.
  - Be sure students understand in a chemical change the substance changes composition and a new substance that has been made.

Grades 6 to 8

Suggested Pacing

60 minutes

Materials

- ☐ Student Worksheet
- ☐ Writing utensil
- ☐ Clock, watch, or stopwatch
- ☐ Computer with internet
- ☐ Measuring cups and spoons
- ☐ Nickel
- ☐ Safety pin
- ☐ Paperclip
- ☐ Steel nail or screw
- ☐ 3% Hydrogen peroxide
- ☐ Table salt
- ☐ White vinegar
- ☐ Petri or shallow dish
- ☐ Shiny penny
- ☐ Soil/sand (3-4 cups per group)
- ☐ Water
- ☐ Watering can
- ☐ Tray or baking pan
- ☐ Gardening gloves (optional)
- ☐ Small plastic trees, people, or animals
- ☐ Building blocks (to represent buildings)

National STEM Standards

- MS-PS1-2
- MS-PS1-4 (thermal energy)
- PS3.D (photosynthesis)
- MS-ESS2-1 (weathering)

Facilitate the Challenge

Plan (Experiment Setup)

Students will set up their own chemical and physical change demonstrations.

- Put students into groups of two or three and provide each group with a penny, nickel, pin, paperclip, and screw. Have students make initial observations of the items and write their observations in the Chemical Change Observation table on the Student Worksheet. While recording observations, students may draw, explain, insert a picture, etc. It is at the teacher's discretion how the observations will be recorded on the worksheet.
- Students will try to demonstrate a chemical change on the penny, nickel, pin, paperclip, and screw by preparing a combination of vinegar, hydrogen peroxide, and salt in their dish. Allow students to determine the amount of each substance they will use to initiate a chemical change on these materials over time.
- Students should record how much of each reactant was used to make the fastest chemical change in the "Amount of Reactants" section on the Student Worksheet.
- Inform students of the least amount of vinegar that should be used. Remember, there needs to be enough vinegar to cover the objects once they are in the shallow dish.
- Tell students how much of each reactant they'll be provided but let them know they do not need to use the entire amount given. Have them record the amount of each reactant provided they plan to use in their demonstration at the top of their student sheet.

Once everyone has their initial observations completed, their reactant measurements recorded, and the solution combined, have teams place all the objects into the solution at the same time. Be sure the teams understand the objects should not be touching each other. Timekeeper starts the time.

- Students will predict overall results, the order in which the objects will change from fastest to slowest, the approximate time change will begin to occur, and record observations for the first eight minutes. Following the eight-minute period, have students set their observations aside. Be sure to assign one student on the team to be the timekeeper.

After students have completed their chemical change demonstration using simple metal objects, the students will demonstrate physical changes by simulating precipitation on a model city.

- Provide students with a tray, sand or soil, building blocks, and other student picked accessories to build a small city in the center of the tray. The sand or soil is the ground the city will be built on.
- Students will design how they want their city to look and draw it in the "City Planning" section on the Student Worksheet.
- Using the items the teacher has provided and the plan they have developed, allow the students some time to construct their city.
- After the city is built, students will simulate rain by sprinkling water from the watering can over the city. Students will observe the physical change of the sand and city, record it, and answer discussion questions.

Test

- Students will now return to the chemical change experiment and make some additional observations, starting at the 16-minute mark.
- Follow the "Chemical Change Observations" chart and make observations according to time increments.

Extensions

- For the chemical change demonstration, have students adjust the amount of reactants used to see if a new set of the same items will change faster or slower.

Additional Resources

eClips Interactive Lesson Physical Change: https://nasaeclips.arc.nasa.gov/resources/download/85

NASA Spotlite Interactive Lesson Evidence of Chemical Change: https://nasaeclips.arc.nasa.gov/resources/download/113

Physical and Chemical Changes Student Worksheet

Chemical Change
Amount of Reactants

Decide how much of each reactant you are going to use to cause the greatest chemical change in the shortest amount of time.

_____ White vinegar

_____ Hydrogen peroxide

_____ Salt

Predict the order the items will begin to chemically change from first to last. (nail/screw, nickel, paperclip, safety pin, penny)

1 _____ 2 _____ 3 _____ 4 _____ 5 _____

Chemical Change Observations

Record the changes in the items as time progresses. Observations may be drawn, explained, inserted as photos, etc. to compare the changes over time.

Time in minutes ↓ from entering the solution	Nail/Screw	Nickel	Paperclip	Safety Pin	Penny
0 Initial observation					
2					

4					
8					
16					
32					
60					

Post-Lab Questions: Respond to these items based on your observations and the data collected.

1. If you could do this demonstration again, what changes would you make to the amount of each reactant used?

2. Explain what happened to the item that took the longest to change and why you think the chemical change occurred the way it did.

3. Brainstorm at least two ways a chemical reaction could be slowed down.

4. Think about the experiments highlighted in the STEMonstration video you viewed. What evidence of chemical changes were observed on the Solid Fuel Ignition and Extinction – Growth and Extinction Limit (SoFIE-GEL) that were **not** present in the demonstration you just conducted?

5. In the second part of this exercise, you will be demonstrating evidence of physical change by simulating precipitation on a model city. How might information from the SoFIE-GEL experiment help a city planner inform their design?

Physical Change

Several physical changes were presented in the STEMonstration video by crew members on board the International Space Station. Evidence of physical changes are apparent in day-to-day life on Earth as well. In this section, your group will be documenting evidence of physical change resulting from precipitation on a model city. The rectangle represents the tray or object your instructor gave you to build your city. Looking at the items you have to create your city, design how you want it to look and where items will be placed. It may be helpful to make a key instead of drawing out each item in your city.

City Planning Key (create a legend to identify the structures on your model city):

Predict what will happen to your city during a rainstorm.

Use the sprinkler to simulate precipitation falling over your model city and record your observations of any changes caused by the 'rain' in the space below.

Post-Lab Questions: Respond to these items based on your observations and the data collected.

Describe the evidence of a physical change you observed in your model city. How do you know those changes were not chemical?

If you had the opportunity to redesign your city, do you think you could prevent those physical changes from occurring? Provide an example.

Think back to the demonstration you conducted on chemical changes with simple metal household objects and your discussion of SoFIE-GEL. Have you seen other evidence of chemical change in your own environment? (i.e., a rusted bicycle, burning exhaust). How might a city planner use evidence of chemical change to inform future planning?