Physical and chemical changes

Duration
60 minutes

Lesson overview
Students explore how matter changes both physically and chemically through hands-on learning and scientific demonstrations. They identify different signs to help distinguish between physical and chemical changes, and explore the different ways these changes occur in daily life.

Objectives
Students will be able to:
• differentiate between physical and chemical changes
• identify different signs of physical and chemical changes
• provide examples of physical and chemical changes

Curriculum connections - Science
Big idea
• materials can be changed through physical and chemical processes

Content
• physical ways of changing materials
• chemical ways of changing materials

Curricular competencies
• observe objects and events in familiar contexts
• compare observations with those of others
• sort and classify data and information using drawings, pictographs and provided tables
• communicate observations and ideas using oral or written language, drawing or role-play

What you’ll need
• glass of water and ice cubes in a separate glass
• clear glass, white vinegar, baking soda and food colouring (optional)
• Physical and Chemical Changes Slideshow
• Physical and Chemical Changes Slideshow Notes
• Physical and Chemical Changes Student Handout
• computer, projector and screen
Preparation

- Review the Physical and Chemical Changes Slideshow, Physical and Chemical Changes Slideshow Notes, and Physical and Chemical Changes Student Handout.

- Prepare the materials for Activity 1. Have the ice cubes in one glass and the water in another glass. Set them up in a space where students can easily see them.

- Prepare the materials for Activity 2 so that students can work independently or in small groups.

- Set up the chemical change demonstration in Activity 2 in a space where students can easily see it. Have a clear glass, white vinegar, baking soda and food colouring if you would like to add colour.

- Make copies of the Physical and Chemical Changes Student Handout (one per student).

- Set up the computer, projector and screen to present the slideshow.

- Consider using the Grade 2 Solids, Liquids and Gases lesson from Energy Leaders to pre-teach the three states of matter.

Lesson notes

In this lesson students explore physical and chemical changes of matter and some examples of these changes in everyday life.

A physical change does not alter what the substance is but may alter how it looks; no new substance is formed as a result of the change. For example, when boiling water, the temperature changes and the water may turn to water vapour (steam), but the water molecules are not changed – they're still water. Students may recognize that a physical change has happened when the physical properties of matter have changed (mass, volume, length, state of matter, etc.) but no new materials are present. A physical change of materials occurs when there is a rearrangement of molecules, but the rearrangement does not affect the internal structure of the molecules.

A chemical change results in the formation of new chemical substances. At the molecular level, chemical change involves making or breaking bonds between atoms. Examples of chemical changes include burning natural gas to cook or heat homes and water, a nail rusting, etc. When iron rusts, a new substance – iron oxide – is formed. Students will learn that a chemical change has happened when a new substance has formed with different properties than the original substance, and the change is not reversible. Some signs of a chemical change include heat, light or bubbles being released, which will be observed in the demonstration in Activity 2.

Reactions may involve both physical and chemical changes happening at the same time.

Word list

- chemical change
- natural gas
- energy
- particle
- gas
- physical change
- liquid
- properties
- matter
- solid
Lesson activities

Activity 1: Reviewing matter and properties (10 minutes)
• Review the three states of matter (solid, liquid, gas) with students.

• Show students the glass of water:
  - Is the water a solid, liquid or gas?
  - How do you know?

• Show the students the glass with ice cubes:
  - Is the ice a solid, liquid or gas?
  - How do you know?

• Ask the students if they can think of examples of gases.

• Review the following information with students or use to summarize the discussion:
  - All matter is made up of tiny particles – so tiny that our eyes can’t see them.
  - Particles in solids are packed closely together. The particles do not move around very much.
  - Particles in liquids are a little bit further apart from each other. The particles can slide past one another (easily flow).
  - Particles in gases are held together only by the shape of their container. The particles can move in all different directions to fill that container.
  - All matter can change. There are two types of changes: physical changes and chemical changes.
Activity 2: Physical and chemical changes (20 minutes)
- Hold up a couple of pieces of paper and ask students how the paper can be changed. Have students come up with as many suggestions they can, such as:
  - folding
  - crumpling
  - tearing
  - cutting
  - writing on the paper
  - getting the paper wet
  - burning the paper
- Have students work independently or in small groups and provide them with scrap paper and a variety of tools to make changes to the paper (scissors, pencils, markers, etc.).
- Allow time for students to experiment with making changes and share their ideas with each other. Explain that these are examples of physical changes.
- Tell students that you’re going to show them an example of a chemical change. Ask them to watch carefully and pay attention to the materials at the beginning and at the end.
  - Place the glass in front of you. Add approximately 1/4 to 1/2 a cup of white vinegar to the glass.
  - If you want to use food colouring, add a couple of drops to the vinegar.
  - Add approximately 1/2 tsp of baking soda to the vinegar and have students observe the reaction.
- Discuss the following questions as a class:
  - What were the original materials?
  - What is left at the end?
  - How is this change different than the ones they made to paper?
  - What type of change is this? Physical or chemical?

Activity 3: Physical and chemical changes slideshow (10 minutes)
- Have students brainstorm the difference between physical and chemical changes.
- Present the Physical and Chemical Changes Slideshow, using the slideshow notes as guidance.

Activity 4: What have we learned? (20 minutes)
- Give each student a Physical and Chemical Changes Student Handout and have them review the images.
- Provide students with scissors to cut out the images and glue them in the correct column on page 2 of their handout.
- Have students compare their charts with a partner.

Assessment
- Assess student participation during Activities 2 and 3.
- Collect the Physical and Chemical Changes Student Handout and assess for completion and understanding of the difference between physical and chemical changes.
Extensions

• Provide students with a variety of materials, such as paper, cardboard, glue, crayons, markers, tin foil, string, cotton balls, etc. Have students demonstrate how to physically change materials to create a piece of art using the materials (e.g. animal or robot).

• Explore other chemical changes, such as:
  - Composting: have students explore what happens in a composter, including how heat is produced. Consider starting your own class composter to explore this chemical reaction.
  - Hand warmers: have students explore the science behind these seemingly “magical” devices and the chemical reaction involved when iron is exposed to air.
  - Sugar, water and yeast: mix the ingredients together and have students observe bubbles and any smells coming from the reaction.

Definitions

classical change: a change that results in the formation of new chemical substances; at the molecular level, chemical change involves making or breaking bonds between atoms

energy: the capacity or ability to do work, such as moving an object; energy exists in a variety of forms, such as electrical, mechanical, chemical, thermal or sound, and can be transformed from one form to another

gas: a state of matter; an air-like substance that fills the entire space or container confining it

liquid: a state of matter; a fluid-like substance that takes on the shape of its container

matter: anything that takes up space and has mass

natural gas: composed mostly of methane and other hydrocarbons (hydrogen and carbon); found in sedimentary rock underground; occurs naturally in the ground and is formed from the decomposition of plants and animals that lived millions of years ago; the cleanest burning fossil fuel

particle: matter is made up of tiny particles that move

physical change: a change that results in the rearrangement of molecules, but the rearrangement does not affect the internal structure of the molecules

properties: characteristics, qualities or attributes of a thing

solid: a state of matter; a firm or stable object that maintains its own shape