Second Grade: Physical Science

HEATING, COOLING, AND REVERSIBILITY: Changes

Background Information

Heating or cooling an object will always change its temperature and may alter other properties as well. The temperature change is reversible, but changes to other properties might be irreversible. Heating, in particular, often causes chemical changes in which atoms alter their bonding to form new substances. Cooking an egg changes the egg in ways that cannot be undone. It cannot be "uncooked" into a raw egg.

Phase changes are generally reversible. Water can be frozen, melted back into liquid, boiled into vapor, and then condensed back into its original liquid form. When considering a manufactured object, however, phase changes often alter the shape of the object in irreversible ways that leave it unsuitable for its intended purpose. Many materials may be cooled without permanent impact. If they contain water, however, freezing will cause the water to expand, possibly rupturing solid structures in irreversible ways.

Performance Expectation

2-PS1-4 Physical Science

Construct an argument from evidence that some changes caused by heating and cooling can be reversed and some cannot.

https://www.nextgenscience.org/pe/2-ps1-4-matter-and-its-interactions

Disciplinary Core Ideas

PS1.B: Chemical Reactions - Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not.

Science and Engineering Practices

Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).

Construct an argument with evidence to support a claim.

Crosscutting Concepts

Cause and Effect - Events have causes that generate observable patterns.

Objectives

- Students will consider how the characteristics of an object change as it is heated or cooled.
- Students will recognize that changes may be reversible or irreversible.
- Students will construct and defend an argument regarding reversibility.

Advanced Preparation

- Pre-cutting cards for students will save time.

Materials

- **For the Teacher:** Reversibility Power Point, Computer, and Projector
- Hot Oven / Cold Freezer Sheets
- 1 sheet of Reversibility Cards
- 1 Pair of Scissors
- 1 Glue Stick

Suggested Implementation

Begin by discussing with students the difference between a **reversible** change and an **irreversible** change. One possible example:

> Remove the snap-top from a magic marker while students watch. Ask if the marker has changed. Ask if the change can be reversed and demonstrate it can by putting the cap back in place. Then ask if braking the marker in half is a reversible change. Since you are unlikely to get it back together in any useful way, this can be considered an irreversible change.

Help students form groups of two or three and give each group a sheet of Reversibility cards. Students use scissors to cut the cards.

Give each group four Hot Oven sheets and four Cold Freezer sheets.

Groups select an object card and decide whether to heat the object by placing it in the Hot Oven or cool the object by placing it in the Cold Freezer.

After gluing the object card in place, students take turns describing the object's properties before it is heated or cooled. Each description is recorded with a word or two in the box labelled "Before".

Then students take turns describing the object's properties after it is heated or cooled. Their ideas are recorded in the "After" box.

Students then discuss and record their ideas about what has changed and whether these changes are reversible. These ideas are recorded in the final box.

Students do this for each of the eight object cards.

Begin the Reversibility slide show. At each slide, ask students what changes they would expect to see. Ask whether those changes are reversible. You may have each group express their opinion quickly by raising aloft either their "Reversible" card or their "Irreversible" card. Challenge them to reference the notes they recorded earlier when expressing an opinion. Note that each group will only have examined eight of the 16 scenarios.

For many of these scenarios, there is ample room for divergent opinions. The point is to have students explain their reasoning and defend their argument with logic. Of course using experimental

data is always desirable. If the teacher can bring in a cooler of ice, a hair dryer, or desk lamp with an

incandescent bulb, it will be possible to test at least some of the students' ideas.

Resources

Book suggestions from: http://www.kbs.msu.edu/wp-content/uploads/2017/02/NGSS-Interactive-Read-Alouds.pdf

- Hanson, A. (2011). *Melting matter.* This book describes what happens when objects experience different conditions (e.g. when an ice cream cone gets hot).
- Zoehfeld, K.W. (2015). *What is the world made of? All about solids, liquids and gasses.* Uses simple, fun diagrams to explain the difference between solids, liquids and gases. Includes a section with experiments designed to encourage further exploration and introduce record keeping.
- Ross, M.E. (2007). *What's the matter in Mr. Whiskers' room?* Using seven science stations, Mr. Whiskers encourages his kids to use all their senses to make observations and draw conclusions.
- Braun, E. (2012). *Joe Joe the wizard brews up solids, liquids and gasses.* Joe Joe the wizard has a problem. His spell to turn homework into chocolate bars has gone to syrup! Readers learn how solids, liquids, and gases help Joe Joe with his sticky mess.

Assessment

The following single point rubric can be used to assess student understanding. For each of the criteria listed below, either circle the proficient description or add notes to a box indicating why the student's performance was either lacking or exceptional.

Areas that need improvement. **Developing Performance**	Criteria for **Proficient Performance**	Evidence of exceeding standards. **Advanced Performance**
	Can construct an argument that supports the idea that changes in temperature can affect materials.	
	Can explain in simple terms how some changes to an object may be reversible or irreversible.	
	Can explain that in the examples given, temperature changes cause melting/freezing rather than the latter causing the former.	