Coconut Oil

COLLEGE OF NATURAL SCIENCES
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Overview

Teaching phase changes without a lot of equipment and time can be challenging. Water is widely available, but requires pretty low temperatures (relatively speaking) to freeze, and the freezing process takes quite a while. Melting will occur at room temperature, but slowly. Our alternative of choice: coconut oil.

Theory

Water has a melting/freezing point of 0˚C (32˚F), but coconut oil's melting/freezing point is ~26˚C (~78˚F) — just a bit above room temperature. This makes coconut oil a very handy model substance for studying melting and freezing in the classroom. (Unfortunately, it's not so useful for studying evaporation: grease fires are definitively bad, and coconut oil's smoke point is 175˚C, nearly 350˚F.) When coconut oil is warmed above 78˚F, it will melt (undergo a solid-to-liquid phase transition). When coconut oil is cooled below 78˚F, it will freeze (undergo a liquid-to-solid phase transition).

Doing the activity

SAFETY NOTE: Ensure that no students in your class have coconut or tree nut allergies before doing this activity. *Allergic reactions to coconut oil are thought to be uncommon, and coconuts are not nuts botanically speaking. However, some people do have coconut (or coconut and tree nut) allergies, and it's of course better to take extra precautions.*

Necessary materials:

- coconut oil
- small glass container
- mug warmer or other gentle, safe heat source

***Ensure that no students in your class have coconut or tree nut allergies before doing this activity.**

1. Put a small amount of coconut oil into the glass container. Show your students the oil, and ask them what state of matter the oil is in. Your students will likely identify that it is solid. How do they know this?
   - Be aware that, if your room or bowl are on the warm side, the coconut oil may start melting right away.
2. Place the container on the mug warmer. The mug warmer only needs to reach ~8˚C (~15˚F) above room temperature to achieve rapid melting; you should be able to successfully melt the oil with the mug warmer set on low. As the coconut oil melts, it will become transparent and flow easily. Ask your students: What phase change is taking place? Why do you think this is happening? (The mug warmer adds energy to the coconut oil. When there's enough energy, molecules in the coconut oil become less tightly-bound to one another. They can slide around and make new molecular neighbors — i.e., they become a liquid.)
3. If removed from the mug warmer, the coconut oil will re-freeze relatively quickly, especially if placed in a cool area. Ask your students to observe this process. Why is the coconut oil freezing? (The liquid coconut oil is warmer than the environment, so the oil gives energy away to the environment. As this happens, the molecules in the oil make tighter, more organized bonds to one another — i.e., they become a solid. This is a more-stable — lower-energy — state.) The coconut oil probably has a different shape than when the experiment started. Is it the same state of matter that it was at the start? (Yes! The coconut oil has a different shape because it went through a liquid stage, during which it took the shape of its container, but it's now a solid again. If you could see the molecules in the coconut oil, the way they're organized would look the same as they did at the start of the experiment.)

Summing up

Students can gain a much deeper understanding of phase changes by experiencing them, but providing this opportunity in a classroom with limited time and resources can be difficult. We've found that coconut oil is a great solution for a quick, low-cost exploration of phase changes.

For more information

Little Shop of Physics: https://www.lsop.colostate.edu

Colorado State University College of Natural Sciences: https://www.natsci.colostate.edu