What's the Fastest Way to Cool a Soda?

Areas of Science	Physics (http://www.sciencebuddies.org/science-fair-projects/project-ideas/physics)
Difficulty	
Time Required	Very Short (≤ 1 day)
Prerequisites	None
Material Availability	Readily available
Cost	Low ($20 - $50)
Safety	No issues

Abstract

So you've just finished mowing the lawn on a hot summer day, and you'd like a cold, refreshing drink as a reward. You look in the are still sitting in the cupboard, at room temperature. What's the fastest way to get that soda down to a cold, drinkable temperatur

Objective

The goal of this project is to determine the fastest method to cool a can of soda starting at room temperature.

Credits

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Sources

This project was based on an entry to the 2007 San Mateo County Science Fair (project authors names not shown).

Cite This Page

General citation information is provided here. Be sure to check the formatting, including capitalization, for the method you are using and upd

MLA Style

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Introduction

This project is all about heat transfer. How can you cool off a can of soda to take it from room temperature down to a nice, cold, d materials that are readily available in your house?

Sure, you could put the soda in the refrigerator, but you probably know from experience that it's going to take awhile to get really you're willing to wait on a hot summer day. You could also try the freezer, since it's colder, it may cool faster than the fridge. What the soda on ice, or immersing it in an ice-water bath? Which method do you think would be most efficient at cooling a soda?

In order to get the most out of this project, you will need to do some background research on heat and heat transfer. Here is a qu with the terms you will encounter. All matter is made of atoms and molecules that are constantly in motion. Even in solids, the mo measure of the average molecular motion of matter. Heat can be transferred from one piece of matter to another by four different

- Conduction
- Convection
- Evaporation
- Radiation

Conduction is heat transfer by direct molecular interactions, without mass movement of matter. For example, when you pour hot warm. The water molecules colliding with the inside surface of the cup transfer energy to the cup, warming it up.

Convection is heat transfer by mass movement. You've probably heard the saying that "hot air rises." This happens because it is rises, it creates currents of air flow. These circulating currents serve to transfer heat, and are an example of convection.

Evaporation is another method of heat transfer. When molecules of a liquid vaporize, they escape from the liquid into the atmosp since a molecule in the vapor phase has more energy than a molecule in the liquid phase. Thus, as molecules evaporate from a l liquid, cooling it.

Radiation is the final way to transfer heat. For most objects you encounter every day, this would be infrared radiation: light beyon objects—like light bulb filaments, molten metal, or the sun—radiate at visible wavelengths as well.

In both the freezer and the refrigerator, cold air is removing heat from the room-temperature soda can by convection. (There is al conduction, where the can is in direct contact with the shelf.) The molecules in a gas, such as air, are spread out over a much lar other words, air (at standard temperature and pressure) is much less dense than water. If you immerse the can of soda in a cold much greater number of molecular interactions would result. Will the soda cool off faster as a result?

Terms and Concepts

To do this project, you should do research that enables you to understand the following terms and concepts:

- Kinetic theory of matter
- Heat
- Heat transfer
    - Conduction
    - Convection
    - Evaporation
    - Radiation

Questions

- How does the kinetic theory of matter relate to heat transfer?
- How does a refrigerator or freezer work to keep things cold?
- Which do you think would be more efficient for cooling: a mass of cold air, or a mass of cold water?

Bibliography

- These sites have information on heat and heat transfer:
    - Hand, J., date unknown. "Convection, Conduction, and Radiation," Mansfield Middle School, Storrs, CT [accessed . *http://www.mansfieldct.org/schools/mms/staff/hand/convcondrad.htm* *(http://www.mansfieldct.org/schools/mms/staff/hand/convcondrad.*
    - Hand, J., date unknown. "How Atoms and Molecules Are Affected by Heat," Mansfield Middle School, Storrs, CT [a *http://www.mansfieldct.org/schools/mms/staff/hand/atomsheat.htm* *(http://www.mansfieldct.org/schools/mms/staff/hand/atomsheat.htm)*.
- It's always a good idea to understand your experimental apparatus. Since you'll be using a refrigerator/freezer for your exp
    - HowStuffWorks, Inc., 2007. "How Does a Frost-Free Refrigerator Work?" HowStuffWorks.com [accessed August 1(*http://home.howstuffworks.com/question144.htm* *(http://home.howstuffworks.com/question144.htm)*.

Materials and Equipment

To do this experiment you will need the following materials and equipment:

- 12 cans of soda at room temperature
- Instant-read digital thermometer, such as a digital pocket thermometer from Carolina Biological Supply Company (http://www.s url=http%3a%2f%2fwww.carolina.com%2flab-thermometers%2fdigital-pocket-thermometer%2f745360.pr%3fs_cid%3dptnr_scibuddies&ref=%2fscience-fair-projects%2fproject-i soda)
- Two styrofoam coolers
- Ice cubes
- Water
- Clock or timer
- Plastic wrap

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https://www.sciencebuddies.org/science-fair-projects/project-ideas/Phys_p057/physics/fastest-way-to-cool-a-soda (http://w ideas/Phys_p057/physics/fastest-way-to-cool-a-soda)

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Experimental Procedure

1. Do your background research so that you are knowledgeable about the terms, concepts, and questions, above.
2. Prepare an ice-only bath by adding enough ice to a styrofoam cooler to completely cover three cans of soda.
3. Prepare an ice-water bath by adding the same amount of ice to a second styrofoam cooler, then covering the ice with wate
4. Use the instant read thermometer to measure the starting temperatures of:
    - the freezer compartment,
    - the refrigerator,
    - the ice-only bath,
    - the ice-water bath, and

- each room-temperature can of soda. You'll need to open the cans of soda to take the temperature of the liquid insid opening with a wad of plastic wrap after taking the temperature.

In each case, make sure that the temperature has stabilized before recording the result. For example, it may take a minute reaches equilibrium when the water is first added to the ice.

5. Place three cans of soda in each of the cooling devices to be tested, i.e.:
    - The freezer compartment
    - The refrigerator
    - The ice-only bath
    - The ice-water bath
6. Note the starting time for each cooling device.
7. At regular intervals (e.g., every 5 minutes), quickly remove each set of cans from their cooling device and measure the ten temperature reading, then quickly put the cans back in the cooling device. Tips:
    - Minimize the amount of time that the refrigerator and freezer doors are open.
    - It is a good idea to periodically re-check the temperatures of the cooling devices.
8. The experiment is complete when the temperature reading of the soda stabilizes.
9. For each cooling device, calculate the average temperature of the three soda cans for each time point.
10. Make a graph of the average temperature of the soda (y-axis) vs. elapsed time (in minutes) since the beginning of the exp for each cooling device.
11. Which cooling method worked the fastest?

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If you like this project, you might enjoy exploring these related careers:

(http://www.sciencebuddies.org/science-engineering-careers/earth-physical-sciences/physicist)

Physicist (http://www.sciencebuddies.org/science-engineering-careers/earth-physical-sciences/physicist)

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