

Crush the Can

https://www.youtube.com/embed/VfFW_SGjIp0

Materials

- An empty aluminum can
- a small aquarium filled with water
- heat resistant gloves
- propane torch
- a ring to hold the can
- small blast shield

Safety Precautions

Refer to the [Demonstration Safety](#) page.

Science Theatre demonstrators must keep the safety of themselves and their audience in mind at all times. All Science Theatre demonstrators must have read through the Safety Training page. The ST Safety Box with first aid kit, fire extinguisher, etc. should always be available to demonstrators. Always wear safety gloves, glasses, and a labcoat if handling chemicals; always perform potentially dangerous demonstrations at a safe distance from the audience; and always keep a very close eye on any volunteers you call from the audience. This demonstration uses a propane torch, thus there is a hot flame. You must have the fire extinguisher at hand. Make sure the audience is far enough away. When you turn the can upside down to put it in the water, make sure not to splash anyone (this should be easy to avoid but its important to be aware of the possibility and be careful). Moreover you must be wearing the heat resistant gloves, a lab coat, and goggles. Hold the end of the ring with which you are holding the can to keep the distance between the flame and you a maximum. You should put up the small blast shield in front of the aquarium.

Preparation

Before the show, fill the aquarium 2/3 or so with water. It's an awkward size and shape, so you'll need a larger sink if you can find one. If one is not at hand, it may be necessary to use a smaller container to collect water which can be poured into aquarium. It would be helpful to assemble the torch by connecting the fuel container to the torch by simply twisting it tightly, but do not turn it on yet. Put the shield in front of the aquarium.

Demonstration

Fill the can with 3 centimeters of water. It is best to listen to the water as you shake the can gently. You should hear and feel some water moving in the can, but not an amount that makes it substantially heavier.

Put the can through the ring. Put on the heat resistant gloves, attach the torch to the fuel container if not yet done and turn the switch on the side of the torch to its "on" position. Holding the can with the ring and the torch with the other, position the torch so that it is aimed toward the bottom of the can, but not your fingers, your body, or the audience. Holding down the trigger of the torch begin to heat the bottom of the can. Try to evenly distribute the heat, not focusing on one spot, so that you do not burn a hole through the can.

Soon the water will begin to boil (maybe a minute or so). You will feel the water boiling, possibly hear it, and begin to see substantial amounts of water vapor leaving the can. Once it begins to boil, wait awhile, maybe 15-30 seconds, continuing to heat evenly. Now putting down the torch, move the can toward the aquarium. In a smooth motion, making sure not to spill any remaining water on the audience, turn the can upside down into the water. The can must be upside prior to entering the water but don't do it too soon. The can will implode if you did it right. Let the can sit in the water. Turn off the torch, detach it from the container and take off the gloves.

What to Say

Ask the audience what they think will happen if you heat a can of water. If the answer is not given, explain that eventually the water will boil and water vapor will fill the can, escaping through the opening. Then ask them what they think will happen if they put a can full of water vapor into a cold container of water. Now begin the demo. As you set up the safety equipment, comment on why you are doing what you are doing-gloves to protect you from the flame, the shield to protect the audience, etc. As the can heats, explain what's going on- the water molecules are gaining energy. When it begins to boil comment of the water vapor (it's not steam) that is escaping. When you are about to turn the can over, comment on the fact that much of the water is now water vapor and has either escaped or has filled the can and is moving around energetically.

After the can implodes, ask what happened. Tell them that when the can was placed in the water, the water vapor condensed into water. Say that this caused a change in pressure that happened so quickly the can imploded. Prior to entering the water, the can was being pushed from the outside by the air and the inside by the water vapor. Once in the water, when the vapor was quickly condensed, only the pressure of the water remained on the can, pushing inward. Because this

change happened so suddenly, the can imploded.

Why This Works

When the can is heated it becomes filled with water vapor. This vapor occupies approximately 1000 times more space than it did as a liquid. When you turn the can over into the cool water the water vapor turns back to liquid water very quickly creating a partial vacuum in the can.

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