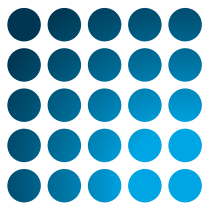


# Cloud Chambers



# ICECUBE

## Directions

Styrofoam tortilla warmers (shown below) can be found at discount stores like K-Mart or Wal-Mart. If they are not available, a cylindrical version is offered online at <http://crafthouse.com/noname16.html> among other sites. They're very inexpensive, and just the right size for keeping small cloud chambers cold on the bottom and warm on the top. Because of their low aspect ratio, they won't tip over once students start pushing to see cloud trails



## Materials

- Styrofoam tortilla warmer
- Nut can
- Clear plexiglass
- Denatured alcohol\* or Methanol/Ethanol \*\*
- Black construction paper
- Dry ice
- Bright flashlight with Kryptonite bulb
- Extra batteries

\*From paint store

\*\*From chemistry teacher

<- Get nuts in a can with a metal base; pick them up from K-Mart while you're there. Eat the nuts, and wash the can. Trace the nut can onto the lid of the warmer then cut out a hole. It's best if the can fits tightly, so you can wiggle it to make it level. If it turns out loose, you can fold a piece of cardboard to wedge between the can and styrofoam. Cut the black construction paper to cover one layer on the bottom of the can, and a layer around the inside wall of the can.

-> Cut a piece of Plexiglas big enough to completely cover the open top of the can. To cut Plexiglas, score it; hold the edge above a table edge, and snap! It's easy.



Check your Plexiglas well before you do another year's worth of cloud chambers. Sometimes, with exposure to alcohol vapor, the Plexiglas will cloud up during a year of storage.

Get some dry ice from a food market, butcher or fish shop, or a welding supplier. Dry ice doesn't last long, so don't buy it any earlier than the night before. Warn students not to touch the dry ice. If you need small pieces, put it in a cardboard box, put on safety goggles, and whack it with a hammer. Put a chunk under the can, put the can in the lid, and push the can down so it is in contact with the dry ice. Wiggle the can around to get it close to level, add just enough alcohol to wet the paper at the bottom & sides, put the top on, and wait about 10 minutes.

**Notes:** Plan on have eight to ten cloud chambers set up. They won't all work at the same time, but you can count on several working pretty well. Remember to practice on your own before doing cloud chambers with students.

In the picture, the tortilla warmer lid is upside down exposing the upper portion of the nut can. This is good, because you want the bottom of the can to be very cold, and top to be warm. If you use the cylindrical version, you may need to prop up the dry ice. About half of the can needs to be exposed, and the bottom of the can should rest on the dry ice.

The trick is to get lots of alcohol evaporating, so the air in the interior of the can is saturated. When the saturated vapor cools down near the bottom of the can, it's just waiting for an excuse to condense. The ionized air molecules created by the passage of high energy cosmic rays causes the alcohol to condense and, Voila! Faint trails of falling alcohol droplets are left in the wake of the original particle.

It's easiest to see the trails if the room is dark. Place a flashlight on the Plexiglas, and peer in at an angle. You should see tracks of varying length and different widths depending on the energy and type of radiation. Find a piece of radioactive stuff (orange fiestaware from the late 1930's, glazed with Uranium Oxide is what we use). This will generate more predictable trails than those from cosmic ray events.

**Troubleshooting:** Not seeing any trails? The bottom is too cold or the top is not warm enough. There needs to be a temperature gradient in the can. Just right is when you see the "rain" of little droplets near the bottom of the can.