

How to build a Cloud Chamber

The cloud chamber is an airtight tank containing a mixture of air and alcohol. The isopropyl alcohol on the roof of the tank diffuses in the container. The dry ice under the chamber (solid carbon dioxide = $-79\text{ }^{\circ}\text{C}$) creates a temperature gradient with a cold layer of supersaturated alcohol vapor near the base of the tank - an unstable 'sensitive layer'. When a charged particle (muon) enters this layer it causes the cold vapor to condense into liquid droplets. To our eyes it looks like a white trail in the mist.

Materials:

- 2 gallon rectangle glass fish tank
- Aluminum cooking tray (1 mm thick)
- Black felt
- Silicone-Based glue (not alcohol-soluble)
- Black duct tape
- Cardboard box that can fit inside the cooking tray
- Flat styrofoam to hold the dry ice against the tray
- Dry ice
- 99% isopropyl alcohol
- Work lamp

Safety note: This experiment should be completed in a well-ventilated room. Please do not conduct near any fire or sparks due to the presence of isopropyl alcohol.

1. Cut a piece of black felt to fit on the bottom of the tank. Attach with the silicone-based glue.
2. Cover the bottom of the aluminum cooking tray with black duct tape. This will create a dark viewing surface.
3. Cut the flat styrofoam to fit in the box. The dry ice block will need to be in contact with the cooking tray so several pieces of flat styrofoam may be needed depending on the thickness of the dry ice.
4. Soak the felt with 99% isopropyl alcohol. All of the felt should be wet but not so much that it will drip down the sides of the tank.



5. Place the dry ice on the styrofoam and cover it with the upside down cooking tray. Make sure to use thick gloves when handling the dry ice.



6. Flip the tank upside down and lay on top of the cooking tray. Seal all four sides with duct tape. Make sure to seal quickly as the metal will become very moist and cold. Creating an air-tight chamber is **critical** to this experiment.



7. Place a work lamp near the top of the chamber to create a greater temperature gradient. Allow the chamber to sit for 10 minutes. When you observe a light grey mist near the bottom of the chamber is it time to start watching for muon trails.



Adapted from <http://www.scienceinschool.org/2010/issue14/cloud>