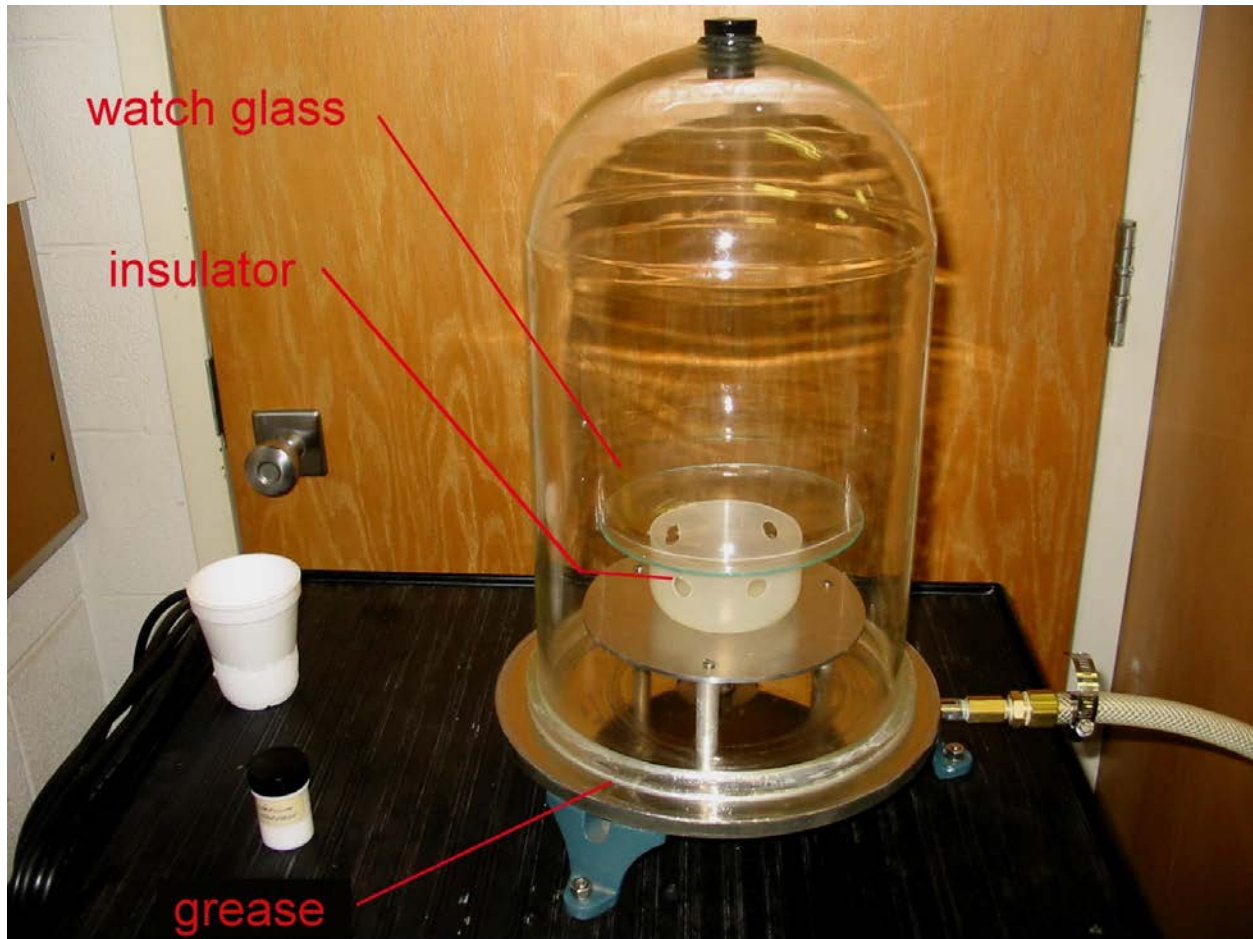


Freezing Air



Vacuum Chamber Setup

Purpose: Shows evaporative cooling, and the fun to be had with a vacuum. (“Do spacemen blow up?”)

This is the classic demo in which you boil water until it freezes. By lowering the vapor pressure the liquid boils, cools, and eventually freezes. Water is interesting, but using liquid nitrogen is really neat– quicker too!

(See the [movie clip](#))

Important Tricks: The reason this demo has a bad reputation for not working is because of heat loss from the liquid to the surroundings.

So, be sure to soak the watch glass first in the liquid you are going to freeze!

Set the watch glass on top of the plastic insulator!

If freezing water, be sure to *start* with ice-water!

Note: Do not be afraid of the jar of vacuum grease! If you are not getting a good seal, dip up a big dollop of grease and smear it around the belljar base.

Times:

Water is slow, and freezes around 2 Torr. It suddenly turns opaque and skims over.

LN₂ is quick, and the pump never goes below say 200 Torr. Because of the high vapor pressure, it is easy to boil/freeze the LN₂ dry with too many repetitions. If you do not have much of a pool, you can get a spectacular N₂ ice 'explosion' which should entertain the kids.

Extra Equipment: Pump cart M, ice water, liquid nitrogen – and paper towels. With larger audiences the camera is useful.

Location: Cart N – the bell jar's base is bolted to the cart.