Under Pressure

Supplies per table:

in the room
Laptop
Vernier interface box
Thermometer or temperature probes
graph paper
ruler
Clamp
Table clamp
90 degree clamp
metal rods x2

stockroom
Large beaker
hot plate
Erlenmeyer flask
Pressure sensor (should have a cork too)

It's helpful to have a few extra beakers by the sink so students can bring water to fill theirs after the setup is in place.

Teaching points:

- Discuss making the graph big enough. A good graph here is necessary to make a good prediction.
- Students want to put zero on the graph but they can't do that and have a meaningful graph. This is a good time to mention that graphs show the useful part, and you don't always have to have 0,0 on the graph.
- They may need a reminder about "best fit lines"
- Students have trouble with cause and effect in question 2, and solving the equation for question 3. Question 4 doesn't usually cause much trouble.

There is a lot of "dead" time as the temperature rises. At the same time they need to be paying attention to record data. If you want you can discuss topics could be:

- Pressure
- Hydrostatic equilibrium
- Relation to solar system formation or solar physics
- The idea of absolute zero and what it means

Troubleshooting tips:

- **Logger Pro will not recognize some or all of the sensors if another student is logged on** and has logger pro up and running. If another student is logged onto the computer the fastest solution is just to reboot the computer.
- Most common problem is the cork is not tight. They need to have the stopcock open when they shove it in or it won't be tight. Also, students tend to be afraid they'll break the beaker and so won't shove it in very tight. If you can get it to about ¼ inch only outside the flask, the seal should be good.
- Do not let the rubber tube touch the hot plate. This will also blow the seal.
- The flask should not be touching the beaker.
- Be sure the temperature is going up at a reasonable rate. They will go too fast sometimes and then their gas to not be in equilibrium wit the water
- Be sure they are taking measurements every 4-5 degrees, not a set period of time
- The thermometer can sit on the bottom of the beaker. If using the temperature probe, it must be in the water, not touching the bottom or beaker.