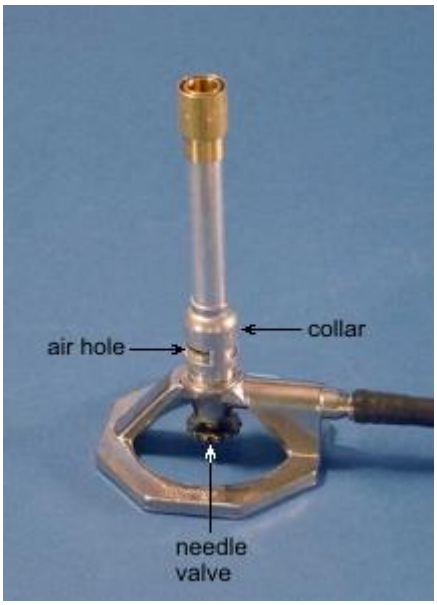
- **SOURCES OF HEAT IN THE LABORATORY**

The sources of heat that will be available to you in the laboratory include:

a) Bunsen burners b) Steam-baths c) Electric heating mantles and d) Electric hot plates

a) **Bunsen burner** quick link to video showing you how to set up and light a Bunsen burner

**Never heat organic solvents with a Bunsen burner. Use a hot plate or a hot water bath on a hot plate.**



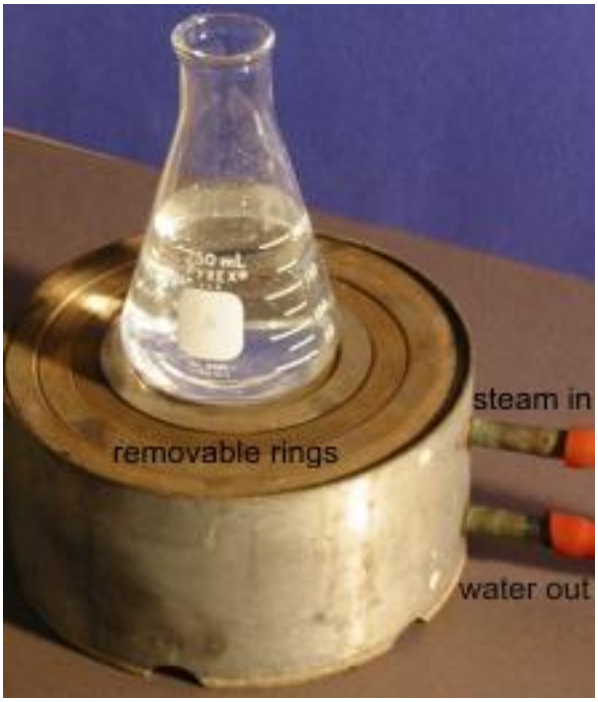

The use of a naked flame is strictly limited in the organic chemistry laboratory because of the danger of fire when handling highly flammable organic liquids. A flame should never be used to heat an organic liquid in an open beaker or test tube, however it is useful if water is the solvent being used or if a hot water bath is required. If you do light a Bunsen burner you must first ensure that **no one** in the vicinity is using a flammable liquid. Organic vapours can "creep" considerable distances along bench-tops or floors. If in any doubt whatsoever, check with your instructor before lighting a flame.

Light a Bunsen burner with the air hole closed by adjusting the collar - this gives a yellow flame. However, you should heat with the air hole of the Bunsen open as this is a hotter blue flame and will not deposit a layer of soot on your glassware. The size of the flame can be regulated using the needle valve in the base of the burner. A Bunsen flame has the disadvantage of being a very uneven source of heat. Use of a wire gauze spreads the flame to a large extent, however, the bottom of the flask will always be considerably hotter than the rest of the flask.

b) **Steam-baths**

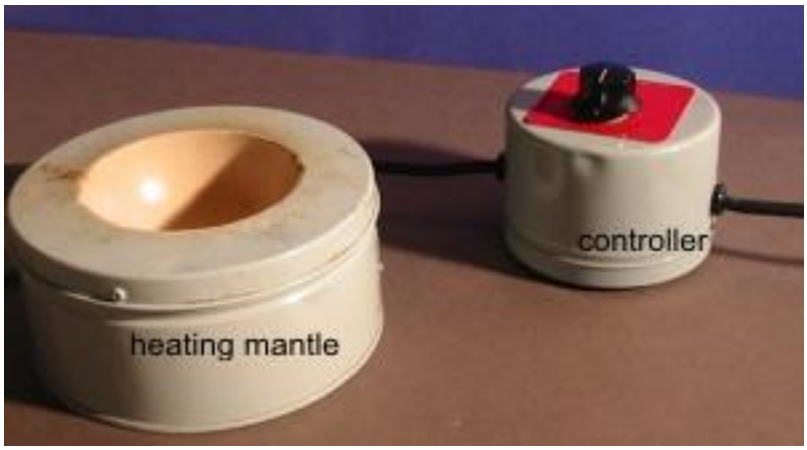
Steam-baths are located under the fume-hoods. These can be hooked up to the steam outlets in the fume-hoods or on the benches - the steam is input via the UPPER connection. The outlet pipe which drains the water as it condenses should be securely placed in a drain or sink and should be lower than the inlet pipe at all times. The removable metal rings can be removed in order to accommodate flasks of different sizes.

The main disadvantage of a steam-bath is that it will generate only one temperature, a little below 100°C. This is sufficient to distill liquids with boiling points around 80°C or below.




c) **Electric Heating Mantle**

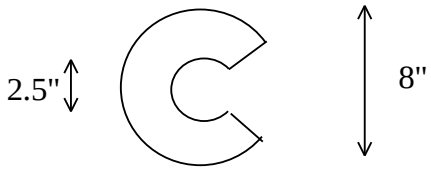
An electric heating mantle is a relatively safe form of heating. The mantles supplied in the laboratory are hemispherical and are lined with a ceramic covering to protect the heating element from mechanical and chemical damage. The mantles are designed to accommodate a 250 mL round bottom flask, but can be used with other sized flasks.




Place the smaller flask in the well of the heater and ensure that it touches the bottom of the heat shell, and in this way the flask will heat very effectively by radiant heat. For normal operations it is not

necessary to cover the open space at the top (except to protect against spillages during addition reactions) and the void between the flask and the heat shell wall should not be filled with any kind of heat transfer material.

When distilling high boiling liquids, or for rapid distillations of moderate boiling liquids, heating efficiency may be increased by up to 30% by placing an aluminium heat shield, made out of household aluminium foil, around the top of the flask. The column may also be loosely wrapped with foil. The heat shield may be cut from foil as follows:




Form this piece into the shape of a funnel and place over the top of the flask. Heating mantles are to be used for heating the contents of a round-bottom flask ONLY.

The heating element within the insulated mantle is wired to plug into a Variac controller which in turn is plugged into a 115 volt outlet. Never plug the mantle directly into a 115 volt outlet; you might burn out the heating element. In operating a heating mantle, the controller should initially be off and reading zero voltage. The mantle is then plugged in and the controller turned on and set to the desired voltage. Return the voltage to zero before turning the controller off.

d) **Electric Hot-Plate**


There are two sizes of hot plates in the organic laboratories, large "communal" and smaller "individual" hot-plates available (see left). The large ones are usually in or near the fumehoods, the smaller ones are stored in cupboards under the fumehoods. Some hot plates are spark-proofed, but those that are not are capable of igniting organic vapours, especially those denser than air *e.g*. benzene, toluene, and ether.