

Introduction

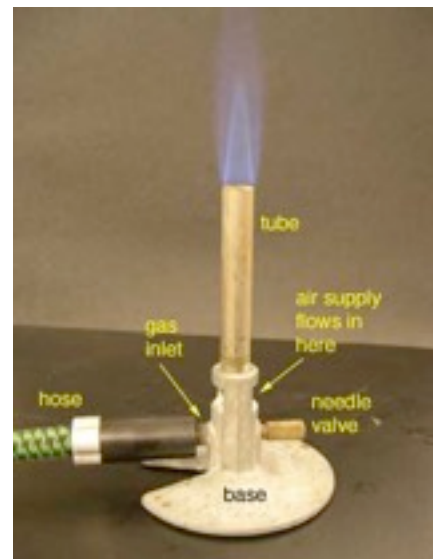
A flame occurs when a "flammable" substance reaches its ignition temperature and burns. A flame represents a chemical change because the original substance that is being burned will be changed into something new. A flame results from a combustion reaction – hot gases form and “glow” – the glowing gases are the flame that you see. Combustion reactions require oxygen, occur quickly, and produce lots of heat. A good source of heat has always been a requirement for many experiments. Robert Bunsen developed a new laboratory burner in 1853. The Bunsen Burner is now a standard piece of laboratory equipment. The burner allows a flammable gas (usually natural gas, aka methane) to be burned in a controlled manner. The Bunsen Burner was an important innovation in chemistry because it provided a convenient, safe source for a very hot flame. Up until that time, alcohol burners and candles had been used to provide heat. These sources provided inefficient, cooler flames. Our laboratory burner is actually a later adaptation of the standard Bunsen Burner called a Tirrell Burner. The main differences are that the Tirrell Burner has gas control valve in its base (the Bunsen has none) and it is a sturdier, more durable burner. On occasion, we may choose to use a hot plate, which provides less intense heat, but does so without the danger associated with the open flame and the higher temperatures of a Bunsen Burner. In this activity, you will learn how to safely use a laboratory burner and you will study the flames and their characteristics

Part 1: Learning the Parts of the Burner

Obtain your burner in four separate parts: hose, tube, needle valve, and base. Put the burner back together. Do NOT try to shove the hose all the way up to cover all the “ridgies” of the gas inlet, or we will never get it back off. There is a rubber O-ring seal on the needle valve – you will need to *push* the valve into the base, feel it slide in past the O-ring seal, and then twist all the way in and then back it off one half turn. Be sure and screw the tube all the way to the bottom and back it off one turn.

Part 2: Preparing the Burner for Lighting – Eyewear is not optional

1. Connect the rubber hose to one of the gas jets. Just push it on gently – do NOT try to shove the hose all the way up to cover all the “ridgies” of the gas jet, or we will never get it back off. Observe the pictures so that you understand that the jet is open when the handle is in line with the spout. Obtain some matches. Make sure the burner is not positioned close to anyone or anything flammable. If you have long hair, make sure it is tied back with a rubber band. If you have loose clothing, such as a tie or a shirt that hangs at the elbows, take the necessary steps to ensure that the clothing will not get acquainted with the flame. Put on eyewear.
2. Make sure the needle valve is open a half turn so that the gas will be able to enter the tube. Adjust the air vent so that there is only a small slit visible at the base of the tube.
3. Decide which member of the lab team will be responsible for the match and which member will be responsible for controlling the gas supply. Light a match (or the lighter) and place it just over the top *edge* of the tube. Your partner should now turn on the gas valve on the lab bench to the completely on position to introduce the flammable natural gas. The gas should ignite. Then adjust the level of gas vs. air to get the flame you want. You should always turn the gas valve on the lab bench all the way on and adjust the gas flow at the base of the burner. Refer to the pictures to the right for the on and off positions of the gas supply. Off is when the handle is turned to either side.



If you used matches instead of a lighter, DO NOT PUT USED MATCHES IN THE SINK. Set them on the lab bench to cool, then put them in the trash.

4. If the gas blows out your match (or lighter) without igniting, immediately turn off the gas supply. Adjust the tube by turning it downward to reduce the supply of air. If you leave the gas running while your partner is lighting the match then a flammable cloud of gas will form around your lab station and possibly cause an accident.
 - A. you have a lit match ready to start the burner flame or
 - B. your burner is in operation and producing a controlled flame.
5. Note: Sometimes a burner will "burn back". "Burn back" is when the gas ignites at the base of the burner and burns inside the barrel. The base and barrel of the burner will get hot. A properly functioning burner will not get hot except at the very top of the barrel. If this happens, turn off the gas at the lab bench, and turn the defective burner into the teacher, then acquire a new burner.
6. If your flame goes out during an experiment, immediately turn off the gas supply until you have a new match lit.
7. Do not ever leave flames unattended

Part 4: Turning the Burner Off

Always turn the burner off at the lab bench supply, not at the needle valve of the burner. This way no jet will ever be left on inadvertently and the supply hose will be cleared of the gas.

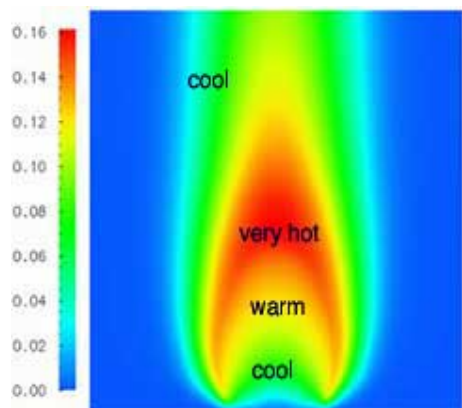
Part 5: Adjusting the Flame – ALL partners must learn how to adjust the burner.

Relight your burner. Your burner flame can be adjusted two ways: gas and air

Gas You should turn the gas jet all the way on (the handle should be in line with the gas outlet nozzle), and adjust the gas flow at the base of the burner. Do NOT use the gas valve on the lab bench to adjust your burner.

Air You can adjust how much air (oxygen) is feeding the flame by opening or closing the air control vent.

1. Adjust the air intake by screwing the tube closed (downward) and then opening the vent wide (upward). Observe what happens to the flame as it gets less and more oxygen.
2. Adjust your flame to be of medium height and have an "inner blue cone". All members of your lab team should learn how to light and adjust the burner. Call the teacher over to check the quality of your flame. See the picture on page 1 for an example of a good inner blue cone.
3. Test your lab partner by shutting off the burner, having them turn away while you "mess up the adjustments" by adjusting the barrel and the inlet valve, then ask them to light and readjust for a good flame. Repeat the test for the other lab partner.



Part 6: Studying the Characteristics of the Flame

1. The burner flame burns at different temperatures in different parts of the flame.
 - a. To test that indeed certain parts of the flame are cooler than others, you can hold a paperclip in the flame at various locations, it will easily get red hot in some places, and in other locations, it won't get red at all.
 - b. In another test, you can pierce a match with a pin in the position indicated in the right picture. BE CAREFUL – do not puncture your hand. Shut your burner off but shutting the gas off at the gas-jet handle on the lab bench, not using the needle valve, then place the match down in the barrel resting with the pin across the tube as demonstrated in the right picture. Relight the burner and observe. If there is not much breeze in the room, causing your flame to "wobble", the match should not light.
2. Remember, the burner is NOT a toy and should be used appropriately. Inappropriate and unapproved materials should never be burned. Remember, matches do NOT go into the sink. Let them cool on the lab bench top and then clean up by throwing them into the trash.