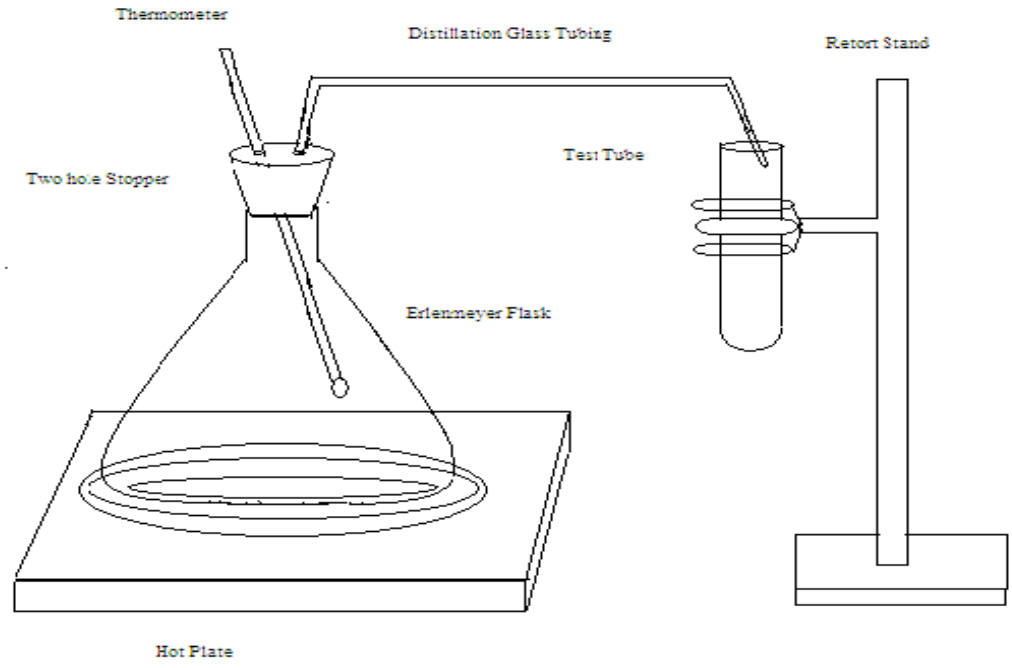
Appendix A: Lab for Lesson 2 "Distillation of Copper Sulphate"

Apparatus needed:

125ml $CuSO_4$ solution (1 molar)
500 ml Erlenmeyer flask
Clamp for test tube, and for the flask
Cobalt chloride paper (not essential)
Cork Borer
Distillation tubing (glass only) sodium glass3-4mm across is easily cut and shaped
Hot plate (do not use a Bunsen burner)
Rubber stopper(2- hole)
Safety gloves
Safety glasses
Test tube
Thermometer



Procedure:

1) Assemble the thermometer and distillation tubing in the cork using a cork borer and lubricant as a demonstration as to how students should assemble their own apparatus. The alternative is that you do the assembly.
2) Assemble their apparatus' according to the demonstration and diagram above.

3) Pour 125ml of cold $CuSO_4$ solution into a 500ml flask (There is no specific molarity requirement for this experiment; suggestion would be 1M solution).
4) Turn the hot plate on a medium setting (CAUTION: DO NOT USE A BUNSEN BURNER AND DO NOT TURN THE HOT PLATE ON A HIGHER SETTING).
5) Record the temperature from the thermometer every minute until boiling. Continue to measure the temperature every minute for at least 4 more minutes.
6) Once enough distillate is obtained (4-5 ml) turn off the hot plate and observe the color of the distillate.
7) While the equipment is cooling graph the warming curve with time on the x-axis and temperature on the y-axis; compare with the hypothesis.
8) Test the distillate with Cobalt chloride paper to determine its composition. (The paper will turn pink in the presence of water).
9) Once the equipment is completely cool, disassemble the equipment carefully and properly and put away in its proper location.

Observations: Draw a warming curve and describe the distillate

Conclusion:

1) A) What did you determine the composition of the distillate to be?
   B) Would you expect the same results if the hot plate was on high instead of medium heat? Explain.
2) According to the classification of matter what category would the initial
3) $CuSO_{4\ liquid}$ fall into? (Heterogeneous mixture, solution, compound or element) What category would the distillate be in?
4) In fractional distillation of crude oil, what would $CuSO_4$ represent? What would the distillate represent?
5) High octane gas is a product of fraction distillation. Is high octane gas a mixture or a compound? (Internet search).

Appendix B: Lab for Lesson 3 "The Production and Incomplete Combustion of a Hydrocarbon"

Apparatus needed:

10ml of water
Ca_2C lumps (DO NOT USE POWDER)
Candle
Matches
Metal test tube rack (in which a student can see the bottom of the test tube)
Splint
Test Tube

Procedure:

1) Place clean test tube on a metal test tube rack
2) Pour 10ml of water in the test tube
3) Add one or two lumps of Ca_2C into the test tube with water and place your thumb over the top of the test tube and hold it there to trap all the gases in the tube.
4) Light the candle. Hold the splint over the flame until it catches fire.
5) Remove thumb and very quickly hold the splint over the open end of the test tube on the rack to ignite the gas that is escaping the test tube. (CAUTION: DO NOT TOUCH THE TEST TUBE, IT IS VERY HOT)
6) Blow on the resulting flame and observe what happens.
7) Students can relight the splint and ignite the test tube repeatedly until the teacher stops the experiment.
8) Observe the test tube contents, and the top of the test tube, and the black 'ribbons' in the air as the experiment proceeds.
9) Return to your seats and start to write the observations and answer conclusion questions as the equipment cools.
10) Once the equipment is cooled, clean the test tubes using a test tube brush, soap and water. Calcium Hydroxide should be properly disposed of in a disposal container.
11) Put the equipment away in their designated areas.

Observations:

1) Compare the cleanliness of the test tube before the reaction and after the reaction is complete.
2) Observe the black ribbons that form in the air and the black soot that forms on the test tube during incomplete combustion.
3) Observe what happens when you blow on the flame in an attempt to blow it out.

Conclusion:

1) Incomplete combustion occurs when oxygen is limiting. When an engine is not running properly, the oxygen sensors are often the problem. What would the inside of the engine look like, if the oxygen sensors were not working properly?
2) Why should a person make sure their oil furnace is properly cleaned and maintained?
3) How must wood stoves be maintained to avoid incomplete combustion, which can result in chimney fires?
4) A breathing filter is found in all lawn mowers. How must this breathing filter be maintained to avoid incomplete combustion? This causes the motor to operate poorly.

Appendix C: Lab for Lesson 4 "Incomplete Combustion of Fossil Fuels Using Natural Gas or Propane"

Hypothesis:

1) Which situation will transfer energy most efficiently, complete or incomplete combustion?
2) What physical evidence will you observe, that will allow you to distinguish between complete and incomplete combustion? Will the flame colour be different?

Apparatus needed:

200ml of water
400ml Beaker
Bunsen burner, one that can adjust the air flow
Iron ring
Retort stand
Screen to fit the iron ring
Second ring or beaker clamp to hold the beaker
Thermometer

Procedure:

1) Set up the equipment to heat up a beaker of water- Attach the iron ring on the retort stand and place the screen on top of it. Clamp the beaker to the retort stand and place on top of the wire (CAUTION: MAKE SURE THE BEAKER IS CLAMPED). Place the Bunsen burner underneath the beaker of water and attach the Bunsen burner to the gas outlet.
2) Fill the beaker with 200ml of water.
3) Place the thermometer into the beaker of water and record the initial temperature.
4) Light the Bunsen burner with a well oxygenated flame (hot fame) and record the temperature every minute for five minutes.
5) Shut off Bunsen burner and allow for the equipment to cool.
6) Repeat steps 2-5 but reduce the oxygen being supplied to the Bunsen burner.
7) Once the equipment is cooled put away the equipment in its designated areas.

Observations:

Record the data in a proper format such as a table comparing the temperature with the corresponding times of the highly oxygenated and reduced oxygenated flames.

1) Graph the data in the table using two different color curves, one for the highly oxygenated flame and one for reduced oxygenated flame.

2) In each instance (high or low oxygen conditions) what physical evidence was observed to help distinguish the two conditions?
3) Were there any other products visible on the outside of the beaker? Did the quality of air in the room decrease or increase?

Conclusion:

1) Comparing the two experiments (high and low oxygen conditions), which was more efficient? How do you know?
2) Diesel trucks burn a low quality fuel. What kinds of products are formed when a truck burns diesel? (Internet search).
3) Overnight some people may put a large piece of wood in their wood stove and shut the vents off (limiting supply of oxygen). With your knowledge of the efficiency of combustion, is this advisable? Explain.

Appendix D: Sample Evaluation

Sample questions for the 'Are You Ready?' sheets are:

1) Describe the levels of oxygen necessary for fossil fuels to form.
2) What geological tetonic plate activity is found at many successful drilling sites?
3) From what materials were fossil fuels formed?
4) In a drilled well, oil surges to the top. How is this pressure maintained? What resources are used to maintain this?
5) In the 1990's, a ship went aground off the coast of Alaska.
6) Name the ship
7) What was its country of origin? Where was it bound for?
8) What was the immediate impact on the environment?
9) How was it cleaned up and at what cost?
10) Is this area still suffering from this disaster?

Sample test questions:

1) What conditions were necessary for fossil fuels to form?
2) Describe one environmental impact associated with fossil fuel extraction.
3) Currently the transportation of fossil fuels occurs by pipeline, trucks and ships. Describe in detail one ecological disaster associated with fossil fuel transportation.