Which Fuel Burns Cleaner?

1. Using a digital scale, find the mass of each of your two 250-mL beakers and record the information on the chart below.
2. Use two burners, one containing kerosene (orange) and one containing ethanol (clear). Make sure the wick of the burners is just barely above the metal casing. Light the burners and check to make sure the flame height is about 2-3 cm above the burner. Extinguish the flame and adjust the wick if necessary.
3. Set up two ring stands with clamps. Set an alcohol burner in front of each ring stand. Invert the 250-mL beakers and clamp them into place with the opening facing downward. Clamp the beakers directly over each burner approximately 20 cm above the top of the burner. Make sure each beaker is at the same height.
4. Light each burner and start the timer. Let each fuel burn for 2 minutes. During this time, record any observations of what is happening as the fuels burn.
5. After 2 minutes, extinguish each flame. Give the beakers a couple of minutes to cool. Using a hot pad, or beaker tongs, carefully remove each beaker from its clamps. Set aside and **make sure the beaker is completely cool before setting it on a digital scale**. Use the digital scale to find the mass of each beaker and record the results. Subtract the final mass from the initial mass of each beaker to find the difference.

Initial mass of the beaker over the ethanol.			Initial mass of the beaker over the kerosene.	
Mass of the beaker after burning the ethanol			Mass of the beaker after burning the kerosene	
Difference in mass before and after burning fuel			Difference in mass before and after burning fuel	

What observations did you make as the two fuels were burning?

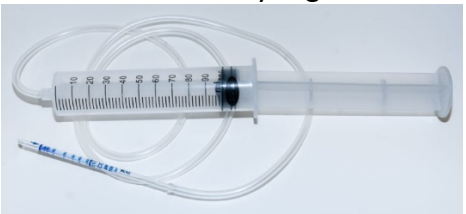
Were you able to observe any difference between the two beakers after three minutes? What was that difference?

What can you conclude about which fuel produces the most soot?

How might this affect the air quality in a city and human health?

Which Fuel Produces More Carbon Dioxide When Burned?

1. Measure the carbon dioxide level of the classroom. Break off the ends of the gas detection tube. Insert the gas detection tube into the end of the tubing connected to your 100-mL syringe. There is an arrow indicating the direction of air flow on one side of the gas detection tube. The tubing goes on the end opposite of the arrow. Extract 100 mL of air from the room. This will take a couple of minutes. Pull back on the stopper as far as you can and hold. This creates a vacuum. Over time, this will fill with air. As this happens, you will be able to pull the stopper back further. Hold the stopper at the 100- mL mark until the stopper is no longer being pulled back into the syringe.



2. Read the carbon dioxide level of the classroom. Take your reading from where the solid purple band stops. There will be a gradient of lighter purple going further up the tube. The measurement is read from where the solid purple ends and the gradient begins. (Picture below read about 500 ppm.)

3. Break off the ends of another gas detection tube. Insert the gas detection tube into the end of the tubing connected to your 100-mL syringe. Set aside.
4. Burn a glass fuel burner of ethanol in the vent pipe for 2 minutes.
5. Extinguish the flame and cover the top of the vent pipe.
6. Through the hole in the side of the pipe, insert the gas detection tube and extract 100 mL of air. Hold the stopper at the 100-mL mark until the stopper is no longer being pulled back into the syringe.
7. Read the carbon dioxide level.
8. Repeat the same procedure (steps 3-7) for the kerosene fuel.
9. Compare the carbon dioxide readings for all three tubes.

Fuel	**Carbon Dioxide Level**
Classroom CO_2	
Ethanol CO_2	
Kerosene CO_2	

What can you conclude about which fuel produces the most CO_2?

Which Fuel Burns the Hottest?

1. Use two burners, one containing kerosene (orange) and one containing ethanol (clear). Make sure the wick of the burners is just barely above the metal casing. Light the burners and check to make sure the flame height is about 2-3 cm above the burner. Extinguish the flame and adjust the wick if necessary.
2. Mass each burner and record the initial mass of each burner.
3. Use a graduated cylinder to measure and place 100 mL of room temperature water into the metal cup. (100 mL of water also has a mass of 100 g.)
4. Using a ring stand and ring clamp, position the cup 5 cm above the burner.
5. Use a clamp to suspend the thermometer in the water. The thermometer should not touch the bottom or side of the can. Measure and record the initial temperature of the water in the cup.
6. Light the burners and make sure the flame is centered under the cup. Set the timer for 5 minutes, then extinguish the flame. Measure and record the final temperature of the water.
7. Repeat this process for both fuels to develop an average. Use room temperature water for each test and make sure to clean the soot off the bottom of the cup each time.
8. Find the mass of the burner and record that under the final mass.

	Trial 1	Trial 2	Trial 3	Average
Initial mass of ethanol and burner				
Final mass of ethanol and burner				
Difference in mass (amount of fuel used)				
Initial mass of kerosene and burner				
Final mass of ethanol and burner				
Difference in mass (amount of fuel used)				

Ethanol	Trial 1	Trial 2	Trial 3	Average
Initial temperature of water				
Final temperature of water				
Change in water temperature				
Kerosene				
Initial temperature of water				
Final temperature of water				
Change in water temperature				

Calculate the amount of energy, measured in calories, given off during the burn and absorbed by the water.

Energy in calories = (100 g of water) x (average change in water temperature)
Divide the calories by the average amount of fuel used to get the amount of energy per g of fuel.

	Ethanol	Kerosene
Energy absorbed by the water	cal	cal
Mass of the fuel burned	g	g
Energy per gram of fuel	cal/g	cal/g

During the 5-minute burn time, did the ethanol or kerosene use more fuel?

What can you conclude about which fuel produces the most energy?

Which fuel would you conclude burns “cleaner”?

Based off of the data collected, which fuel do you think we should use in the future? What additional information would you need to help you reach a more informed conclusion?