Thermodynamics

FIRE SYRINGE

Materials:

- ✓ Fire Syringe
- ✓ Cotton Fuel
- ✓ Tweezers
- ✓ Something to push fuel down

Background Research:

1. Define the following terms.
    a. Kinetic Molecular Theory
    b. Temperature
    c. Limiting Reactant
2. Develop a hypothesis about if the fire syringe represents the concepts of gasoline combustion engine or a diesel combustion engine? Fibers of cotton will represent your fuel source for the experiment, not gasoline or diesel.
3. Explain how the concepts or temperature and kinetic energy are the same.
4. @ what temperature does cotton burn at? Provide °C & °F
5. Explain the process if adiabatic compression.
6. Research combustion chemical reactions, what do all of these reactions have in common?
7. What is the ignition point of Gasoline and Diesel Fuel?

Scientific Investigation:

- ➔ Put on protective eyewear
- ➔ Pull apart some cotton strands.
- ➔ Do not ball it up, you want it aeriated.
- ➔ Pull out syringe piston and place a few fibers at the bottom of the cylinder. You could take into consideration length of fibers as well (like 5 mm).
- ➔ Insert the end of the piston part way into cylinder and screw on the top.
- ➔ Darken room to increase visibility.
- ➔ Place unit base on stable flat surface. Push the piston straight down with force and speed.
- ➔ You will need to compare relative amounts/size of cotton used for each trial. It is not dense enough to use mass.
- ➔ You will need to have just the right amount of cotton for the experiment to succeed. To little or too much and nothing will happen.
- ➔ Experiment with varying amounts to identify the amount that will provide the most complete combustion.

Amount of Cotton	% Combustion

Reflection/Conclusion:

8. Graph your results.
9. Research the chemical formula and develop a balance chemical equation that represents the combustion of cotton.
10. Discuss the limiting reactant throughout your various trials. Was it the same every time or did it depend on the variables? Elaborate on this.
11. A gasoline combustion engine uses a spark plug to ignite fuel. A diesel engine does not have spark plugs, but relies on adiabatic compression. Did your hypothesis turn out to be true or false? Explain…
12. Was the piston able to reach the bottom of the cylinder when experimenting? Why? Why Not?
13. The initial temperature in the cylinder is @ room temperature. What is the minimum increase in temperature required to cause ignition of the cotton?
14. Why doesn't slow compression of the gas inside the cylinder result in the ignition of cotton. Think about the dissipation of heat. Remember the Law of conservation of energy, the total amount of energy (heat) in this closed system does not change, it must remain constant, include this in your reflection as well.
15. Create a loom video in which you we reenact the experiment and discuss the physics of how it works. You should include topics of combustion engines and law of conservation of energy in your video. Max video length is 5 minutes. Copy and past video link into google form in google classroom for thermodynamics unit.