 Materials
  - The syringe
  - Extra black o-rings
  - Steady table
  - Tweezers (~5 inches long and less than half an inch wide)
  - Long cotton Q-tips (~5 inches long)
  - Cotton balls to clean the plunger
  - Toilet paper (1 roll would last a long time)
  - Safety goggles- 1 pair
  - Rubber mallet
  - Small waste container (for the small toilet paper pieces, Q-tips and cotton swabs)
  - Wider base for the syringe (may need to be built)

 Set-up Instructions
  1. Clean the syringe of moisture (use Q-tips for cylinder & cotton swabs for the plunger).
  2. Use tweezers to grab 1 cm square of toilet paper and put it in the bottom of the cylinder.
  3. Place the plunger on top of the cylinder and screw on the blue collar.

 SAFETY!
  - DON’T use flash paper, may cause syringe to shatter.
  - Safety goggles are recommended.

 Lesson’s Big Idea
  - Gasses can release potential energy when compressed (this is how a diesel engine works.)
  - Air gets warmer when we push down the plunger.
**Background Information**

- **Compression:** A sudden reduction in volume and increase in pressure.
- **Auto-ignition temperature:** The lowest temperature at which a material will ignite without a spark.
- **Charles’ Law:** An equation which describes how the temperature of a gas changes with compression.
- **Diesel engine (also known as a compression-ignition engine):** An internal combustion engine that uses the heat of compression to initiate ignition and burn the fuel that has been injected into the combustion chamber.

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**Instructional Procedure**

1. Ensure that the syringe base is steady.
2. Put on safety goggles.
3. Use rubber mallet to push plunger down hard and fast—you should see the toilet paper ignite.
4. If the toilet paper only smokes, pull the plunger out again to let some oxygen back in the cylinder, and try again.
5. If the ignition still does not work, take out the paper, clean the cylinder and plunger, put in new dry paper, and try again.

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http://cfbt-us.com/wordpress/?p=1126
**Assessment/sample questions you can ask**

1. Do you think the temperature inside the cylinder will get colder or warmer when we push down the plunger?
2. Can the paper ignite without a spark?

**Clean Up**

- Clean the cylinder and plunger with the Q-tips and cotton swabs.
- Throw away the used toilet paper, Q-tips, and cotton swabs.
- Store the toilet paper, Q-tips, and cotton swabs in an air-tight bag or container provided, to keep moisture out.

**References**


**Next Generation Science Standards**

- **K-5**
  - 2-PS1-4
  - 3-PS2-3
  - 5-PS1-1
- **6-8**
  - MS-PS2-5
  - MS-PS3-5
- **9-12**
  - HS-PS3-3/4/5