## *Teaching Activity: Methane Gas Production*

***Introduction:*** The production of methane gas from biomass (standing vegetation aquatic crops, forestry and agricultural residues and animal wastes) has been suggested as a means of lessening our demand for natural gas and utilizing reservoirs of methane in the environment. Methane, the chief component of natural gas, is produced in nature by the bacterial decay of vegetation and animal wastes in the absence of atmospheric oxygen. This process is called anaerobic digestion. The conditions necessary for optimizing this anaerobic process include temperature, type of biomass used, mixing ratios, amount of moisture added, acidity, stirring, etc. The by-product of this process is a mineral rich fertilizer.

The interesting thing about anaerobic digestion is that it recognizes the fact that life is a part of a cycle. By taking the end products of life - manure, grass clippings, saw dust, plant stalks- and affording them suitable conditions for anaerobic digestion to occur, we are changing them into useable energy and life-supporting fertilizer. Soon new life takes form. At the same time, materials are being made that feed the methane generator.

***Objective:***

- To build a simple methane generation system;
- To simulate methane production in the natural environment;
- To determine some of the conditions necessary for the optimum production of methane;

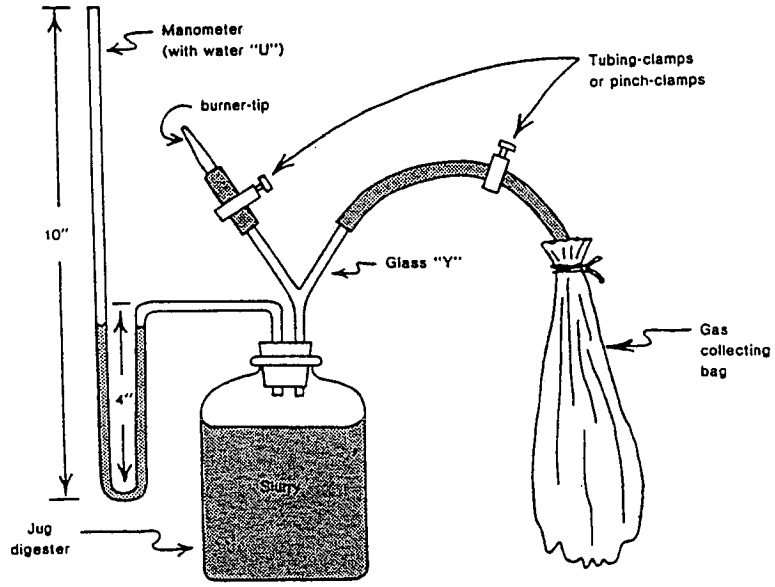
***Important Terms:*** Methane, biomass, natural gas, anaerobic digestion, fertilizer, manometer, slurry;

***Materials:*** 1-Glass jug (gallon cider or jug that chemical regeants come in); you may wish to wrap the jug with strong tape; 1-gass collecting bag (heavy-duty plastic bag), 1-two hole rubber stopper of appropriate size, 1-manometer (made from glass tubing, 2-lengths of rubber tubing, 2-tubing clamps, 1-glass "Y", 1- sack of manure, grass clippings, garbage or dried steer manure, 1-book of matches;

***Procedure:***

**NOTE: This is a demonstration activity only!!!**

1. Assemble the materials listed above.



2. The manometer is made from glass tubing and is constructed as is shown in the diagram.
    - The glass will have to be heated and bent to create the correct configuration.

3. When the manometer is constructed and the glass has cooled, fill the "U" with water so that you have a perfectly shaped water "U" of maximum size.
    - Movement of water up the long side of the manometer will let you know when methane is being produced.
    - The higher the water column rises, the greater the pressure of the gas.
    - The manometer also acts as a safety valve since excess pressure will push the water out of the manometer.
    - The 4-inch manometer dimension shown in the drawing should b e considered a maximum for both safety and practical reasons.
    - Filling the "U" with water as indicated will give you up to eight inches of pressure, which is more than sufficient. Gas appliances usually work on pressures of less than eight inches and there's no reason to risk blowing the jug apart with gas compressed beyond this amount.

4. Make the "burner tip" by drawing out a piece of heated glass tubing.
    - Make the tip quite long as a precaution against flashback.
    - Attach the burner-tip to one arm of the glass "Y" with a short piece of rubber tubing on which a clamp is placed to act as a valve.

5. Attach the gas collecting bag to the other branch of the "Y" with a short piece of tubing on which the second clamp is placed to act as a valve.

6. Prepare the slurry.
    - Mix the manure, garbage, dried steer dung or whatever bio-material you are using with water until you have a slurry that has the consistency of cream.
    - Carefully pour the slurry into the jug "digester".
    - Leave a 4-6 inch space between the slurry and the bottom edge of the glass tubing that protrudes through the rubber stopping. There will be some initial foaming, and you want to keep it out of the tubing.

7. Place the entire methane production apparatus in a warm place.
    - Optimum production takes place when the slurry is 90° F - 100° F.
    - If the temperature drops much below 80 ° F, the gas production will be slow or nonexistent.
    - **KEEP IN MIND THAT YOU ARE GENERATING METHANE GAS - A GAS THAT CAN EXPLODE IF HANDLED CARELESSLY!**

8. Start the generator with all the valves (clamps) closed.
    - Watch the water in the manometer for an indication of pressure build-up, indicating gas production.
    - It may take a couple of weeks or more before significant production begins.
    - Test the gas by holding an ignited match by the burner-tip and opening its clamp.
    - The initial production is carbon dioxide, which will not burn.
    - Continue the test until the match at the burner-tip does ignite the gas.

9. When you are satisfied that methane production is underway, open the clamp to the gas collecting bag and begin collection.
    - Once you have a bag-full, you can open the valve to the burner tip and place a brick or a board on the collector bag.
    - The manometer will indicate the resulting pressure.
    - Ignite the gas jet with a match and observe the visual proof of methane production.

10. It is now up to you to decide how long you want to continue the demonstration.
    - How long gas production will continue before the digester must be recharged?
    - How much gas does one charge produce?
    - What are the best materials for gas production?
    - Can you collect enough gas to cook something?