The Chemistry of Combustion and Respiration

Cellular respiration, the breakdown of glucose into high energy molecules called ATP, is a complex and abstract concept. The ability to visualize this process is difficult, yet essential to fully comprehend this phenomenon. This activity is designed to simulate the process of respiration by examining the process of combustion.

PROCEDURE FOR COMBUSTION EXAMPLE:

1) Attach a small candle to an open paper clip as follows:

![Diagram of candle attachment]

Light the candle. As you watch the candle burn, realize that it is using up two requirements or reactants. In combustion we will also see the formation of 4 products. Your task will be to determine the two requirements and four products of combustion.

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<th>Reactants</th>
<th>Products</th>
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One of the products of combustion should be apparent when you observe the flame. What is it?

2) Locate a test tube and be sure it is clean and perfectly DRY inside. Find the cork or stopper that will fit this tube. Collect some smoke from the burning candle in a test tube. Use some paper towels to hold the test tube up side down with the mouth over the flame of the candle. Lower the tube slowly until it covers the flame. Allow the flame to touch the inside edge of the tube. After 10 seconds, cork the tube. DO NOT TOUCH THE LIP OF THE TUBE. IT'S HOT!

3) Examine the inside of the test tube carefully. You should be able to observe 2 products of combustion. Look CAREFULLY. One is black and the other has collected in the inside of the tube. Name these 2 products. Blow out the candle.

4) There is one more product of combustion to be identified. Open the corked tube just long enough for me to pour 1 mL of dilute bromthymol blue indicator into the tub. Bromthymol blue is yellow when CO2 is present and blue when there is not CO2 present. Shake the tube and observe the results.
5) List all four products of combustion

Now you will determine the two requirements of combustion. The first requirement is not difficult to determine. Remember that requirements are used up in reactions. Consider the following observation of a candle burning in air.

What is one of the reactants of combustion?

6) We will do the last requirement together as a demonstration. It will take a little more discovery to determine what it is.

- Why does the water rise in the glass?

- Why does the candle go out eventually?

- What is the 2nd requirement for combustion?

7) Fill in the blanks below to correctly write the chemical equation for combustion.

________ + _________ → ______ + _______ + _______ + _______

8) However, the equation is not yet complete. Set your candle in front of you. It is surrounded by oxygen in the air, and yet it does not begin to burn. Why?

Now... what does a burning candle have to do with how you obtain energy from respiration?

Now that you understand how a burning candle uses the requirements _______ and _______, you should be able to understand how animals (including humans) obtain energy in a very similar manner. This energy producing process in animals is called respiration. Just as in combustion, cellular respiration requires fuel and oxygen. The fuel in this case is glucose (C6H12O6). The products of respiration are CO2, H2O and energy (in the form of ATP).

9) Write the equation for respiration and then write the equation for combustion just below it to compare the similarities and differences. What are the similarities? What are the differences?