Handout H03-1: Answer Key/Evaluation
Water, Combustion, and the Global Carbon Cycle

1. Write one paragraph that explains what is going on in the white columns of smoke in this photo. Use what you know about where heat goes and what chemicals are produced by combustion.

Answer: The smoke is rising because heat usually does rise, as we observed in an earlier experiment. The model says that combustion produces water vapor, and we saw that in the demonstration that the water condenses into droplets when it cools. Water vapor produced by the fire must be cooling and condensing as it rises. The model also says that combustion produces carbon dioxide, so that must be in the plume too – even though we can't see it.

Optional details: Smoke contains partly-burned particles of fuel. Water vapor condenses especially well on surfaces, so it condenses on the smoke particles. A wildland fire may produce so much water vapor that it eventually condenses in the cold upper atmosphere and creates rain that falls along the edges of the fire.

2. Write a few sentences that explain how the chemical processes of combustion, cellular respiration, and photosynthesis are related.

The chemical reactions of combustion are basically the same as those in cellular respiration. The chemical process of photosynthesis is the reverse of combustion and cellular respiration.

3. Read the article on **Handout H03-2** (or the full article online). Then write 1-2 paragraphs that answer these questions. Use specific evidence and quotes from the article to support your answers.

a) Based upon the information in the article, how does stand-replacing fire affect whether forests are a source or sink for carbon?
b) Does a forest change over time from source to sink, or from sink to source?
c) What is the most important variable that makes an ecosystem gain or lose carbon after fire?

Answer: Forests are usually a carbon sink. Stand-replacing fires convert forests into a carbon source for about 30 to 40 years, and then – if trees regenerate successfully - the forest gradually changes back into a carbon sink after about 80 to 100 years. During a severe wildfire, a lot of carbon is released, and then even more carbon is released through decomposition that follows the fire. That is why, during this time, the forest is a carbon source. As the forest grows back, it manufactures and stores a lot of carbohydrates. Eventually, the pace of storing new carbohydrates surpasses the pace of decomposition. That means the forest has become a carbon sink again.

The most important variable that determines whether the ecosystem gains or loses carbon after fire is tree regeneration. If trees grow back successfully after a stand-replacing fire, forests usually become carbon sinks again in about 80 to 100 years. If trees do not regenerate and the forest becomes a grassland or shrubland, it may remain a carbon sink for many centuries. It may not ever store as much carbon as before the fire.