

Ethanol: The Cleaner Burning Alternative?

Dr. Barbara Nagle

Director SEPUP
Lawrence Hall of Science
Berkeley, California

Issue-oriented Science: SEPUP Model

- Science courses, units, or activities that involve students in learning science concepts and processes and applying them to a problem, issue, or decision.
- The issues are not add-ons, but are woven into the curriculum. The issues and content are closely related.

Why use issue-oriented science?

- Integrates sciences and integrates science with other subjects, portraying a realistic view of how science contributes to solving problems and of the role of science in careers.
- Makes real-world connections and shows students how science is useful in daily life.
- NRC, AAAS, and NSTA policy
- More authentic science, for ALL students.

Context

- Alternate energy sources
- Different biofuel sources
- Energy production from kerosene vs. ethanol
- How combustion occurs at the molecular level

What is combustion?

Complete combustion:

Hydrocarbon + oxygen → carbon dioxide + water

Methane + oxygen → carbon dioxide + water

CH₄

Ethanol + oxygen → carbon dioxide + water

C₂H₅OH

Kerosene + oxygen → carbon dioxide + water

2 C₁₂H₂₆

All release energy

Modeling Combustion

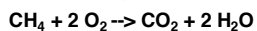
- Students have learned previously how to model O₂, CO₂, and H₂O, and know that all available electrons form bonds
- Do Activity 31.3: Steps 1–4

What is combustion?

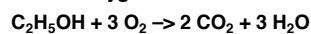
Complete combustion:

Hydrocarbon + oxygen → carbon dioxide + water

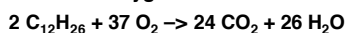
Methane + oxygen → carbon dioxide + water



Ethanol + oxygen → carbon dioxide + water



Kerosene + oxygen → carbon dioxide + water



All release energy

So, now we are going to check out the cleaner burning claim...

- What is a by-product?
- If you combust something, what could be some examples of by-products?
- We are going to focus on **particulate matter** and **CO₂**.

Safety precautions

- Always use caution when working with the burners and be sure to check local regulations.
- Use only in a well-ventilated room.
- Point out the safety cautions in the student pages.

Particulate Matter

- Read steps 1-3 and set up your data tables.
- **Use caution with the burners!**
- Any questions? Let's investigate combustion.
- Do steps 1-3 and **STOP!**
- Let's share data.
- Who is the winner of this test?

CO₂ Emissions

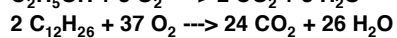
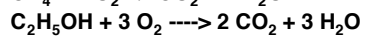
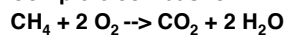
- Read steps 4 - 10 and set up your data table.
- **Use caution with the burners!**
- Okay, let's stop and think for a minute...plastic plus a hot flame = what?
- Any questions? Great - time to investigate!
- Let's share data.
- Who is the winner of this test?

Analysis

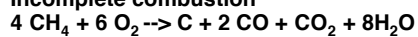
- What **EVIDENCE** do you have for the existence of by-products of combustion?
- Which fuel do you think burns cleaner? Use **EVIDENCE** to support your answer.

More chemistry

- **Complete combustion**



- **Incomplete combustion**



Issue-oriented science

- Engages all students in the process of learning science
- Educates tomorrow's citizens about the application of science to everyday life
- **Shows** students that science is relevant to their lives--students experience it themselves