

4.5 Grading the Explanations Tool: What Happens to Ethanol When It Burns?

This tool has “grading” in the title because at this point, students can be held accountable for correct answers. Level 4 (correct) responses to the questions are in **blue bold italics** below.

Red italics suggest ways to grade student responses by giving them points for correct or partially correct answers.

Carbon TIME Discourse Routine around the Explanations Tool:

- 1. Introduction: Students review their Evidence-Based Arguments Tools. Establish the purpose for completing the tool as developing a complete explanation for the unit phenomenon.*
- 2. Private thinking and writing: Students complete the Explanations Tool individually.*
- 3. Partner or small group work: Students share and compare ideas in pairs/small groups, with the goal of improving their explanations.*
- 4. Sharing ideas in whole-class discussion: Class discussions serve to elicit, clarify, and compare explanations from individual students and/or student groups*
- 5. Consensus-seeking discussion accompanied by public writing: Class discussions focus on coming to consensus around a correct, coherent explanation that answers the Three Questions while addressing the 4 steps. We recommend that students revise their explanations in a different colored pen/pencil.*

These are difficult questions, so even the most successful students will miss a few of them. You should decide how to translate the number of points that students earn into grades for report cards. Here are some ideas about levels of points that represent excellent, good, and adequate performance.

Total possible: 16 points	For higher demand high school courses	For middle school or lower demand high school courses
Excellent	14 points	11 points
Good	11 points	8 points
Acceptable	8 points	6 points

The Matter Movement Question

The diagram shows a petri dish containing ethanol. A flame is shown above the dish. Three arrows point upwards from the flame: one labeled H₂O, one labeled CO₂, and one labeled O₂. A green arrow points downwards from the O₂ label into the flame. A blue arrow points upwards from the ethanol label into the flame.

Draw and label arrows that show molecules moving into, through, and out the flame when ethanol burns.

- Show and label molecules with carbon atoms
 - moving into the flame.
 - leaving the flame
- Show other, relevant molecules.

Grading arrows

- **1 point for arrow labeled “ethanol” or “C₂H₅OH” going into the flame**
- **1 point for arrow labeled “oxygen” or “O₂” going into the flame**
- **1 point for arrow labeled “CO₂” or “carbon dioxide” going out of the flame**
- **1 point for arrow labeled “H₂O” or “water” going out of the flame**

4 points total



The Matter Change Question

Name the chemical change that happens when ethanol burns: **combustion**

1 point for correct answer

Write the chemical equation for this change: **$C_2H_5OH + 3 O_2 \rightarrow 2 CO_2 + 3 H_2O$**

1 point for correct answer

What molecules are carbon atoms in before the chemical change?

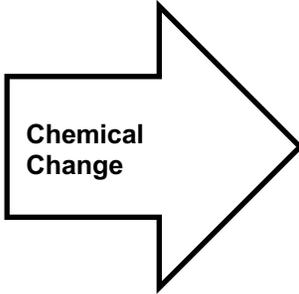
Ethanol or C_2H_5OH

1 point for correct answer

What other molecules are needed?

Oxygen or O_2

1 point for correct answer



Chemical Change

What molecules are carbon atoms in after the chemical change?

Carbon dioxide or CO_2
1 point for correct answer

What other molecules are produced?

Water or H_2O

1 point for correct answer

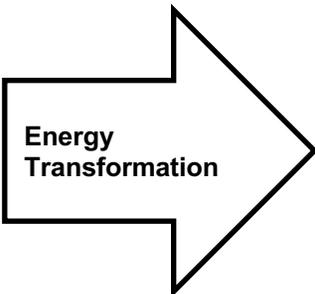


The Energy Change Question

What forms of energy go into this chemical change?

Chemical energy

1 point for correct answer



Energy Transformation

What forms of energy come out of this chemical change?

Heat and light

1 point for correct answer

Explain in words: What happens to ethanol when it burns? (Answer on the back).

Level 4 responses should include answers to each of the four numbered steps on the Three Questions poster and handout:

- 1. Matter movement: Ethanol evaporates and goes into the flame and oxygen goes into the flame from the air.**
- 2. Matter change: Ethanol reacts with oxygen to produce carbon dioxide and water.**
- 3. Energy change: Chemical energy in ethanol is transformed into light and heat energy.**
- 4. Matter movement: Carbon dioxide and water leave the flame.**

1 point for each correct answer

4 points total

Use this Explanations Tool to help guide your written explanation, being sure to answer the Three Questions.

Remember: **Atoms last forever** (so you can arrange atoms into new molecules, but can't add or subtract atoms).

Energy lasts forever (so you can change forms of energy, but energy can't appear or go away).