

Lesson 1: Pretest and Expressing Ideas and Questions

Overview

Students complete the unit pretest, observe a demonstration of burning ethanol, and use the Expressing Ideas and Questions Tool to document their ideas about what happens when ethanol burns.

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of Lesson 1
Teacher's Guide

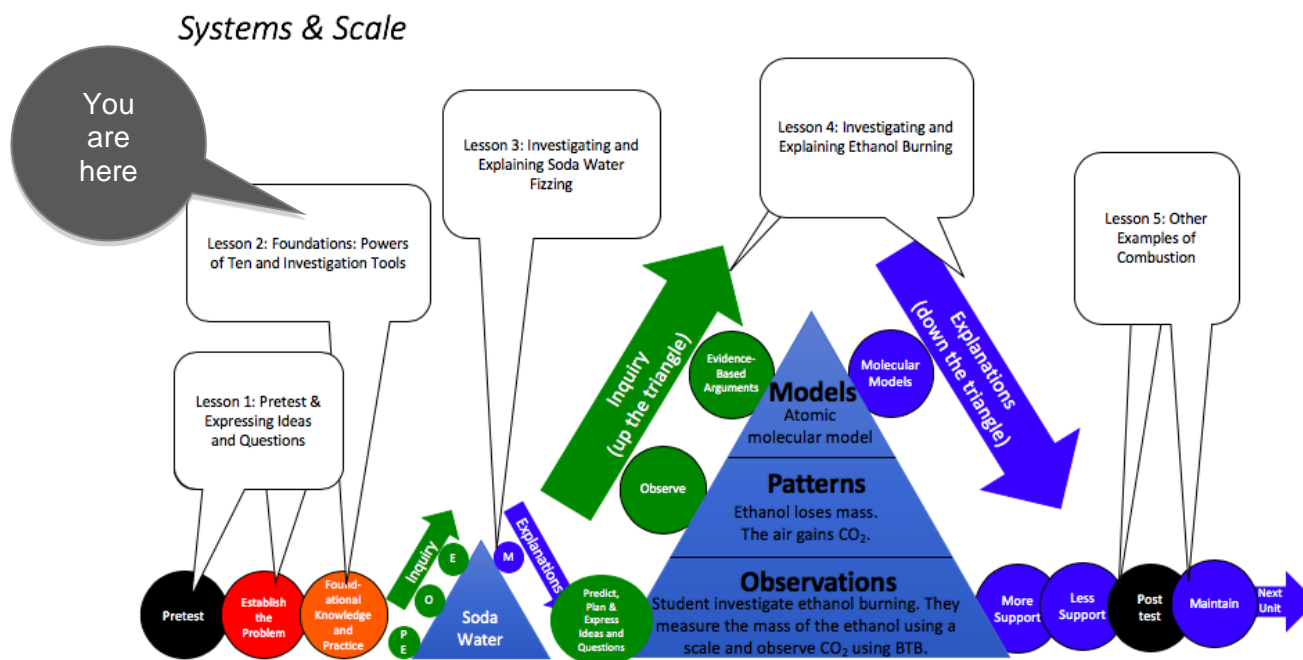
Guiding Question

What happens when ethanol burns?

Activities in this Lesson

- Activity 1.1: Systems and Scale Unit Pretest (20 min)
- Activity 1.2: Expressing Ideas and Questions about Ethanol Burning (40 min)

Unit Map



Learning Goals

Target Performances

Activity	Target Performance
<i>Lesson 1 – Pretest and Expressing Ideas and Questions (students as questioners)</i>	
Activity 1.1: Systems and Scale Unit Pretest	Students show their initial proficiencies for the overall unit goal: Questioning, investigating, and explaining how matter and energy changed during combustion of organic materials.

Activity	Target Performance
Activity 1.2: Expressing Ideas and Questions about Ethanol Burning (40 min)	Students ask and record specific questions about changes in matter and energy in response to the unit driving question: What happens when ethanol burns?

NGSS Performance Expectations

This lesson helps prepare students to meet the NGSS performance expectations but does not feature a mastery of any of them.

Background Information

Three-dimensional Learning Progression

Lesson 1 is designed to (a) help students to anticipate and begin thinking about the questions that they will answer about burning ethanol, and (b) help you as a teacher see how your students reason about matter and energy in the context of the first carbon-transforming process, combustion. In the Instructional Model, Activities 1.1 and 1.2 in this lesson serve to “Establish the Problem” for the entire *Systems and Scale* unit.

Key Ideas and Practices for Each Activity

In Activity 1.1, the unit pretest is useful for two purposes. Your students’ responses will help you decide how much detail you want to include during the unit, particularly details about chemical structures of materials. If your students are mostly at Level 2 in the carbon learning progression, you may want to focus on the main ideas (like the Powers of Ten and the Three Questions) rather than chemical structures. Your students’ responses will also provide a starting point for discussions that take place later in the unit.

In Activity 1.2, students use the first process tool of the unit (Expressing Ideas and Questions) to document their thinking about what happens when ethanol burns. This phase of the unit should be treated like a brainstorming and elicitation session: the goal is to get students to express a wide range of ideas, even if they are incorrect. Ideally, students will come to recognize that they have many different ideas about what happens when ethanol burns, as well as unanswered questions. At this point in the unit, we expect many students to express Level 2 or Level 3 ideas: gas has no mass, ethanol disappears after it burns, and matter and energy are the same. We recommend using the pretest as well as the Expressing Ideas and Questions Tool to gauge how your students are thinking about matter and energy at different scales in the context of combustion.

Key carbon-transforming processes: Combustion

Content Boundaries and Extensions

Talk and Writing

At this stage in the unit, the students will be **Expressing Ideas and Questions**. The table below shows specific talk and writing goals for this phase of the unit.

Talk and Writing Goals for Expressing Ideas and Questions Phase	Teacher Talk Strategies That Support This Goal	Curriculum Components That Support This Goal
Treat this as brainstorming and	<i>Remember, there are no “right” answers at this point. We want to hear all ideas.</i>	Unit Pretest My Students’ Answers

elicitation of student ideas.		
Listen for student ideas about matter and energy at different scales , but do not correct wrong ideas.	<i>Where did the energy come from? Where does the matter go next? Are you talking about matter or energy? What about the atomic-molecular scale?</i>	Unit Pretest Expressing Ideas and Questions Tool
Elicit a range of ideas. Press for details. Encourage students to examine, compare, and contrast ideas with the ideas of other students.	<i>Who can add to that? What do you mean by _____? Say more. So I think you said _____. Is that right? Who has a different idea? How are those ideas similar/different? Who can rephrase _____'s idea?</i>	Unit Pretest Expressing Ideas and Questions Tool
Encourage students to provide evidence.	<i>How do you know that? What have you seen in the world that makes you think that?</i>	Expressing Ideas and Questions Tool
Document student ideas so they can be revisited later.	<i>Let's record our ideas so we can come back to them and see how our ideas change.</i>	Sticky notes on class poster or Activity 1.2 Presentation Expressing Ideas and Questions Tool

Activity 1.1: Systems and Scale Unit Pretest (20 min)

Overview and Preparation

Target Student Performance

Students show their initial proficiencies for the overall unit goal: Questioning, investigating, and explaining how matter and energy changed during combustion of organic materials.

Resources You Provide

- pencils (1 per student, for paper version)
- computer with an Internet connection (1 per student, for online version)

Resources Provided

- [Systems and Scale Unit Pretest](#) (1 per student or online)
- [Assessing Systems and Scale Unit Pretest](#)

Setup

Print one copy of the [Systems and Scale Unit Pretest](#) for each student.

Directions (*accordion for individual steps in directions*)

1. Explain the unit pretest.

Explain the purpose of the unit pretest to students:

- It will help you as a teacher understand how students think about what happens when ethanol burns.
- It will help them think about what they know and what questions they have.

2. Have students take the unit pretest.

Administer the test online or distribute copies of [Systems and Scale Unit Pretest](#) to be completed with paper and pencil.

Assessment

Use the [Systems and Scale Unit Pretest](#) to assess students' understanding of combustion in terms of learning progression levels. You should not give your students grades on the pretest or expect your students to know the correct answers. The document [Assessing Systems and Scale Unit Pretest](#) has assessment guidelines and identifies correct responses and explaining how students' responses reveal their learning progression levels. If you administer the test online (<http://carbontime.org/>) you can use the My Students' Answers feature to interpret your students' ideas.

Differentiation & Extending the Learning

Differentiation

Modifications

Extending the Learning

Activity 1.2: Expressing Ideas and Questions about Ethanol Burning (40 min)

Overview and Preparation

Target Student Performance

Students ask and record specific questions about changes in matter and energy in response to the unit driving question: What happens when ethanol burns?

Resources You Provide

- sticky notes (1 per student)
- ethanol, 95% (10-15 ml)
- water (10-15 ml)
- lighter (1)
- Petri dish, glass (1)
- Petri dish, plastic (1)

Resources Provided

- [1.2 Expressing Ideas and Questions Tool for Ethanol Burning](#) (1 per student)
- [1.2 Assessing the Expressing Ideas and Questions Tool for Ethanol Burning](#)
- [1.2 Expressing Ideas and Questions about Ethanol Burning PPT](#)
- [1.2 Systems and Scale Storyline Reading: Learning from the Work of Elizabeth Fulhame](#) (1 per student)
- [Carbon TIME Burning Ethanol and Water Demonstration Video](#)

Recurring Resources

- [Learning Tracking Tool for Systems and Scale](#)
- [Assessing the Learning Tracking Tool for Systems and Scale](#)
- (Optional) [Big Idea Probe: Fill 'Er Up](#)
- (Optional) [Assessing the Big Idea Probe: Fill 'Er Up](#)
- [Questions, Connections, Questions Student Reading Strategy](#)

Setup

Print one copy of the [1.2 Expressing Ideas and Questions Tool for Ethanol Burning](#), [Big Idea Probe: Fill 'Er Up](#) (optional), and [1.2 Systems and Scale Storyline Reading](#) for each student. Prepare a computer and projector to display the presentation.

Directions

1. Have students discuss the pretest.

Ask students to write down questions they have after taking the pretest (for instance, on the back of their [1.2 Expressing Ideas and Questions Tool](#)). Explain that we will try to answer most of those during the *Systems and Scale* unit.

2. Use the instructional model to show students where they are in the course of the unit.

Show slide 2 of the [1.2 Expressing Ideas about Ethanol Burning PPT](#).

3. (Optional) Have students complete the Big Idea Probe: Fill 'Er Up.

If you decide to use the [Big Idea Probe: Fill 'Er Up](#), have students complete it and share their ideas. See [Assessing the Big Idea Probe: Fill 'Er Up](#) for suggestions about how students' choices on Big Idea Probe reveal their thinking about combustion.

4. (Optional) Have students share and discuss their ideas about the Big Idea Probe.

See the educator resource [Using Big Idea Probes](#) for suggestions about how to use sticky notes and a poster for tabulating and discussing the probe.

5. Have students watch as you try to burn water and ethanol (ethyl alcohol).

Show slide 3 of the [1.2 Expressing Ideas and Questions about Ethanol Burning PPT](#).

- Take two Petri dishes and pour a small amount of water in one and a small amount of ethanol in the other (note: the ethanol petri dish should be glass).
- Use a lighter or match to attempt to burn each sample. The ethanol should burn.
- Extinguish the ethanol flame by covering it with the top of a glass petri dish.

Accommodation: Use the Carbon TIME: Burning Water and Ethanol Demonstration Video if doing an in-person demonstration is not possible, or to support absent students.

6. Reveal the chemical identities of the two substances.

Explain to students that one Petri dish had water and the other had ethyl alcohol or ethanol—the kind of alcohol that is in biofuels and in alcoholic beverages.

Discussion Questions: As a whole class, ask students for their ideas and questions about water and ethanol.

1. What are similarities and differences between water and ethanol?
2. Why do you think ethanol burned even though it looks like water?

Record their ideas on slide 4 of the [1.2 Expressing Ideas and Questions about Burning Ethanol PPT](#). We will revisit these ideas in Lesson 5.

Accommodation: Do a Think, Pair, Share to allow students a chance to think and share with a partner before answering the questions as a whole group.

7. Students complete the Expressing Ideas and Questions Tool on their own.

Show slide 5 of the [1.2 Expressing Ideas and Questions about Burning Ethanol PPT](#).

Tell students that now they will take a few minutes to think and record their ideas about what happens when ethanol burns on their own.

- Give each student one copy of [1.2 Expressing Ideas and Questions Tool for Ethanol Burning](#).
- Give students about 5 minutes to complete the tool as individuals.
- Encourage students to think about things they have seen in the world to help inform their ideas.

8. Students compare their own ideas and questions with the ideas and questions of a partner.

Show slide 6 of the [1.2 Expressing Ideas and Questions Tool about Ethanol Burning PPT](#).

- Tell students that now that they have had a chance to record their ideas and questions on their own, it is important to compare their ideas to their classmates' to see how they are similar and different, and also so we know how many different ideas there are in the class.

- Divide students into pairs and have students compare their ideas on the [1.2 Expressing Ideas and Questions Tool for Ethanol Burning](#) with each other.
- At this point, do not correct any wrong ideas; treat this as brainstorming.
- Pay attention to patterns in students' ideas, or specific individual ideas that diverge from the patterns as both may be valuable to discuss as a whole class later.

9. Post ideas for class discussion.

Tell students that now that they have had a chance to write their ideas as individuals and as pairs, it is important to look at the range of ideas in the class. Again, at this point, do not correct any wrong ideas. Treat this as brainstorming: all ideas are on the table.

- Show slide 7 of the [1.2 Expressing Ideas and Questions about Ethanol Burning PPT](#).
- Give each pair 2 sticky notes.
- Tell students to write their most important idea from their Expressing Ideas and Questions Tools on a sticky note and put it on the board under the "Your Ideas" column.
- Tell students to write their most important question from their Expressing Ideas and Questions Tools on a sticky note and put it on the board under the "Your Questions" column.

10. Class discussion

Lead a whole class discussion to examine the variety of student ideas and questions on the poster. Use the talk and writing moves at the beginning of this lesson to help with facilitating the class discussion – see the Notes part of the slide.

- Show slide 8 of the [1.2 Expressing Ideas and Questions about Ethanol Burning PPT](#). Note that this slide is a duplicate of the previous one but with a new heading. Take this time to discuss students' ideas, organize them according to patterns, etc.
- Later, you can use this duplicate slide as a record of class ideas for the future, either by saving the post-it notes or by taking a picture of them.

11. Students read the Systems and Scale Storyline Reading

Show slide 9 of the [1.2 Expressing Ideas and Questions about Ethanol Burning PPT](#). Have students read [1.2 Systems and Scale Storyline Reading](#) using the [Questions, Connections, Questions Student Reading Strategy](#). See the [Question, Connections, Questions Reading Strategy Educator Resource](#) document for information about how to engage students with this strategy.

- After pairs are finished reading, have students share with the class what they found interesting and any questions they have. Have a class discussion about quotation in the "Fulhame was an explainer." Ask students what they think Fulhame meant and what it says about the process of science.

12. Save the Expressing Ideas and Questions Tool for later.

Show slide 10 of the [1.2 Expressing Ideas and Questions about Ethanol Burning PPT](#).

- Tell students that they will revisit these ideas later in the unit to see how their thinking changes.
- The class can also return to shared ideas on Slide 8.

13. Have a discussion to complete the Learning Tracking Tool for this activity.

Show slide 11 of the [1.2 Expressing Ideas and Questions about Ethanol Burning PPT](#).

- Pass out a [Learning Tracking Tool for Systems and Scale](#) to each student.

- Explain that students will add to the tool after activities to keep track of what they have figured out that will help them to answer the unit driving question.
- Have students write the activity name, "Expressing Ideas and Questions" and their role, "questioner" in the first column.
- Have a class discussion about what students did during the activity. When you come to consensus as a class, have students record the answer in the second column of the tool.
- Have a class discussion about what students figured out during the activity that will help them in answering the unit driving question. When you come to consensus as a class, have students record the answer in the third column of the tool.
- Have a class discussion about what students are wondering now that will help them move towards answering the unit driving question. Have students record the questions in the fourth column of the tool.
- Have students keep their [Learning Tracking Tool for Systems & Scale](#) for future activities.
- Example Learning Tracking Tool

Activity Chunk	What Did We Do?	What Did We Figure Out?	What Are We Asking Now?
Expressing Ideas and Questions Questioner	Take a pretest and share initial ideas on the Expressing Ideas and Questions Tool about what happens when ethanol burns.	Ethanol burns and water does not. We have many initial ideas and questions.	What is ethanol?

14. Have students complete an exit ticket.

Show slide 12 of the [1.2 Expressing Ideas and Questions about Ethanol Burning PPT](#).

- Conclusions: What is one interesting thing that you learned about Elizabeth Fulhame?
- Predictions: What is one question that you want to answer about ethanol and how it burns?
- On a sheet of paper or a sticky note, have students individually answer the exit ticket questions. Depending on time, you may have students answer both questions, assign students to answer a particular question, or let students choose one question to answer. Collect and review the answers.
- The conclusions question will provide you with information about what your students are taking away from the activity. Student answers to the conclusions question can be used on the Driving Question Board (if you are using one). The predictions question allows students to begin thinking about the next activity and allows you to assess their current ideas as you prepare for the next activity. Student answers to the predictions question can be used as a lead in to the next activity.

Assessment

Use the student responses to the class discussions and also their ideas on the [1.2 Expressing Ideas and Questions Tool for Ethanol Burning](#), as well as the [1.2 Assessing the Expressing Ideas and Questions Tool for Ethanol Burning](#) to assess their thinking at the beginning of the unit. By the end of the unit, students should be able to explain that ethanol is an organic material and water is inorganic. For now, listen to students' ideas, with attention to how they describe matter and energy. In particular, suggestions that ethanol is "flammable" or "a fuel" are ideas that you will be able to build on. It will be unusual at this point for students to be able to

identify properties that predict or explain why some materials are flammable and others or not (for instance, that flammable materials largely originated in living things—recently or millions of years ago—or specific chemical properties of flammable materials). They will learn to do this in this unit.

Differentiation & Extending the Learning

Differentiation

- If you are teaching this to multiple classes, you can save different versions of the PPT, with Slide 8 completed for each block. Alternatively, have all classes combine their answers and have students look for similarities and differences.
- Do a Think, Pair, Share to allow students a chance to think and share with a partner before answering the questions as a whole group.

Modifications

Extending the Learning

Students can read more about Elizabeth Fulhame, whose work contributed to the development of photography and scientists' understanding of chemical changes. Some additional resources with information about Elizabeth Fulhame:

- <http://www.sia.edu/news-and-events/news/the-woman-behind-photography/>
- <http://bip.cnrs-mrs.fr/bip10/fulhame.htm>