Which Fuel for School Buses?

Students determine which fuel is best for new school bus purchases. Students grades 6-12.

INTRODUCTION

Culminating activity:
You are the Maintenance and Operations (M&O) Director for a school district located in a rural area. The community serviced by the school district is exceedingly poor and most students use the school buses to get to school. School bus routes are long. You have many older buses that need replacing, and the district is asking for your suggestions. You know that new buses are available that burn a variety of materials. The Superintendent wants you to present a PowerPoint presentation at the next board meeting informing the community which buses you think the district should purchase and why.

Objectives (Students will be able to...)

Students will compare various types of fuels for school buses using a Venn diagram.

- Students will make a claim about which alternative fuel is best and support their claim.

ACTIVITIES IN THIS LESSON

Vocabulary Development

Activity

Using a Frayer Model, students develop vocabulary: *diesel*, *alternative*, *retrofit*, *salient*, and *emissions*.

Checking for Understanding & Engagement

- In your own words, what is meant by *salient* in “the most salient feature of the article is that poverty and crime are connected.”
- In your own words, describe what is meant by *retrofit*.
- Use the words *alternative*, *diesel*, and *emission* in a sentence.
- Do you think the word *salient* is worth learning? Why or why not?
- Which word is hardest to spell? Why?

Note: Checking for Understanding and Questioning for Engagement, including techniques for deploying

them, are described in Chapter 6 of *The Art and Science of Lesson Design*.

Engage

Group Work

Activity

Working in groups of three or four, students ask themselves "What are the factors that should influence my decision on which fuel to use?"

Although students should arrive at their own conclusions, the following can be factors they identify:

- How much does it cost?
- How available is it?
- How dangerous is it?
- How friendly is it to the environment?
- How well does it store for longer periods?
- How expensive are the vehicles that burn it?
- Can we retrofit our existing buses, or do we have to buy new buses?

Checking for Understanding & Engagement

- What are the factors that should influence the decision on which fuel to use?
- Of the factors you found, which three are the most important and why?

Resources and Materials

- Green Diesel v. Biodiesel
- Biodiesel: A Better Choice for Children
- What's the Difference between Biodiesel and Renewable (Green) Diesel
- https://stnonline.com/blogs/biodiesel-offers-a-simple-switch-for-school-district-bus-fleets/
- Fuel Stability Problems Challenge FAME Biodiesel
- How Biodiesel Works (The Pros)

- How Biodiesel Works (The Cons)

Explore

Group Work

Activity

The purpose of this stage is to get students involved in the topic; providing them with a chance to build their own understanding.

Choosing one of the web articles listed in Resources, the teacher employs a think-aloud (Walkup & Squire, p. 108) to demonstrate to students how to identify the main topic, important points made by the author, and conclusion.

Checking for Understanding & Engagement

- On what basis did I select the most salient points in the article?
- Did you agree with my selection of the main point?
- Did you agree with my selection of the conclusion?

Explain

Group Work

Activity

The purpose of this stage is to provide students with an opportunity to communicate their understanding of what they have learned so far.

Students review the web articles found in the Resources and identify the main point, conclusion, and most salient points of each article.

Checking for Understanding & Engagement

- What is: diesel, renewable fuel, biodiesel, the difference between diesel and biodiesel?
- What is another name for renewable fuel?
- Choose one of the articles in the collection. What did you choose for the _____ (e.g. main point, conclusion, etc.) of this article and why?

Extend

Group Work

Activity

The purpose of this stage is to allow students to use their new knowledge and continue to explore its implications.

This activity employs the I Do, We Do, You Do instructional method. The teacher begins filling out a portion of the pros and cons Venn diagram, then students help the teacher, then students work independently.

Checking for Understanding & Engagement

- How did I go about filling out the graphic organizer?
- Explain what one item in your diagram means and why you placed it there.

Evaluate

Group Work

Activity

The purpose of this stage is for both students and teachers to determine how much learning and understanding has taken place. See the section Assessment below.

PowerPoint Preparation

Group Work

Activity

In their groups, students develop two PowerPoints slides, each containing the two Venn diagrams of three fuels they have chosen. One Venn diagram features the pros of each fuel, and the other the cons.

Checking for Understanding & Engagement

- Explain your Venn diagrams.

SUMMATIVE ASSESSMENT

Assessment Type: Writing Samples

Students review their Metacog Logs and adjust them based on what they learned and the confidence they gained (or lost) throughout the lesson.

Notes:

- Development of this lesson plan funded by The Fresno State Transportation Institute (FSTI).
- This lesson plan developed using the approach described in The Art and Science of Lesson Design by J. Walkup and S. Squire.
- Throughout the lesson, students will complete a Metacog Log (p. 112, Walkup & Squire) to assess their own understanding and confidence.

Lesson Times

Vocabulary Development: 15 minutes
Engage: 10 minutes
Explore: 35 minutes
Explain: 20 minutes
Extend: 20 minutes
Evaluate: 10 minutes

Industries / Subjects / Grades

Industries / Pathways

- Transportation

K-12 Subjects

- English-Language Arts
- Technology Education

Grade Levels

- 6, 7, 8, 9, 10, 11, 12

Standards and Objectives

Standards

California's 2013 CTE Standards

- **CTE.T.A.7.3** Define fueling infrastructure needed to move vehicles, equipment, goods, and services from one location to another
- **CTE.T.KPAS.5.2** Solve predictable and unpredictable work-related problems using various types of reasoning (inductive, deductive) as appropriate
- **CTE.T.KPAS.5.4** Interpret information and draw conclusions, based on the best analysis, to make informed decisions

California English Common Core Standards

- **WHST.11-12.7** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

- **WHST.6-8.1a** Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.

- **WHST.6-8.1b** Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

- **WHST.6-8.1e** Provide a concluding statement or section that follows from or supports the argument presented.

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