



Teaching Guide

For

Busted over Buses Module

**Illinois Transportation, Distribution and Logistics
Math and Science Project**

2008

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Acknowledgements

We would like to recognize the following people for their contribution to this module:

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Scenario Focus

Primary Career Pathway: Transportation Systems Planning, Management and Regulation

Occupation/Job Titles Related to this Scenario: Automotive service technicians and mechanics, Bus and Truck mechanics and Diesel Engine Specialists

Recommended Teaching Subject Areas: Math, Science, Industrial Technology

Teacher/Writer Information

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Scenario Problem Statement and Performance Elements

You are the Transportation Director for Reavis High School. The School Board has stated the cost of busing must be reduced and the schools dependence on gasoline must be reduced. The school bus drivers say they are running as efficiently as possible and with the gasoline engines they have now cost cannot be reduced. The School Board has stated in keeping with the AYP initiative that reducing the services to students to reduce cost is not an option. Therefore you can explore any option that does not change bus routes or reduce the number of bus runs. You are to make a proposal to the School Board with your recommendations. The best group proposal will present their proposal to the school board.

TDL Cluster Knowledge and Skills and Performance Elements

- Determine customer needs and requirements.
- Select fuels for transportation mode/modes.
- Develop a plan for implementation.

Illinois Learning Standards:

Mathematics

- Solve problems involving time, temperature, mass, speed, distance, density and monetary values. (H-7C.4)
- Solve simple problems involving rates and other derived measurements such as velocity and density. (H-7C.1)

- Solve problems involving scale drawings, models, maps or blue prints. (H-7C.5)

Science

- Interpret tables, graphs and maps in conjunction with related text. (H-11A-4)
- Communicate information and ideas with clarity and effectiveness. (H-11A-5)
- Explore policy, which affect local concerns collecting local data and analyze data. (H-13B-2)

Language Arts

- Communicate information and ideas in narrative informative and persuasive writing with clarity and effectiveness.
- Deliver planned and impromptu oral presentations. (4.B.3a)

What I Want Students to Know	What I Want Students to be Able to Do
<ul style="list-style-type: none"> • Definitions of fuels. • Understand the role of alternative fuel sources. • Understand the effect of fuel choice on the environment. • Relationship of engine type and fuel used. • Major types of alternative fuel. • Major costs of fuel. 	<ul style="list-style-type: none"> • Determine most appropriate type of fuel to be used. • Calculate cost of fuel for buses to run engine. • Describe the effect of fuel use choice on the environment. • Calculate cost of alternative fuel cost. • Read technical material for engine. • Use internet to research fuels and engine. • Write a business report • Make a professional presentation.

Objectives:

- Learn about the role of transportation systems and infrastructure planning and management planning.
- Acquire the skills needed to develop a plan for using alternative fuels in their communities.
 - Describe the major types of alternative fuels.
 - Describe and calculate the costs of using current fuel.
 - Describe and calculate the major costs of an alternative fuel.

- Describe and calculate the major advantages in changing to an alternative fuel.
- Use computers to estimate mileage between two locations.
- Prepare a written business report.
- Deliver an oral presentation of the Busing plan.

Measurement Criteria for an acceptable solution:

1. Evaluate alternative fuels to determine service level and cost differences.
2. Evaluate the major physical modification in changing to an alternative fuel.
3. Business report included a cover letter, introduction stating the purpose of the report, documentation to support recommendations, a detailed explanation of costs, and tables, charts and spreadsheets to more clearly communicate recommended fuel plan.
4. Presentation presented the information with visual aids and/or handouts.
5. The presentation met the 7 requirements of effective business presentations:
 - Evidence of preparedness and practice
 - Started on time
 - Dressed appropriately
 - Showed enthusiasm and confidence
 - Maintained eye contact, showed friendliness and respect
 - Spoke slowly and distinctly without grammatical errors or slang
 - Welcomed questions and answered completely; accepted reactions without being defensive.

Teacher Notes:

Students should have a good working knowledge of math. Additional content on fuel and making presentations may be necessary for some students. This can be done congruently with the scenario or prior to working on the scenario.

Please review the materials needed prior to starting the problem solving activity so that you can make copies or obtain items needed. Notify students of the date that presentations will be made. Give students the opportunity to make their own cause and effect connections as various consequences present it.

Time Required to Complete Problem: 12 hours

Types of Materials included in this Module:

1. Lesson plans for each topic with discussion questions and student activities.

2. Copy of student handouts with activities for duplication.
3. Copy of material describing problem for students.
4. Evaluation with measurement criteria and scoring guide.
5. Teacher materials to assist in evaluation of problem and possible solution steps.
6. Glossary of terms related to this module.

Support Materials and Resources Necessary for Completion of Scenario:

- Community fuel source
- Computer access to internet and map programs
- Excel or similar spreadsheet software
- Handouts (see each lesson)
- Websites for Teacher Information (See Lesson 3)
- Video "Dirty Jobs: Bio-diesel" with Mike Rowe, Discovery Channel website

Lesson 1

TOPIC	Introduction to Fuel and Alternate Fuel Options	TIME ESTIMATE	1 $\frac{1}{2}$ hour
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OBJECTIVES	
<ul style="list-style-type: none"> • Students will be able to develop a basic understanding of problem based learning. • Students will understand the definitions of fuel. • Students will have a basic understanding of major types of conventional and alternative fuels. 	

MATERIALS & RESOURCES	
<ul style="list-style-type: none"> • Handout #1, The Problem Scenario • Handout #2, Glossary of Terms • Handout #3, Glossary Crossword 	

LESSON DESCRIPTION & ACTIVITIES		
Steps	No. of Minutes	ACTIVITIES
1	20	<ul style="list-style-type: none"> - Introduce the concepts of the PBL Project - Distribute Handout 1, The Problem Scenario. - Give background information on the Bus Project
2	20	<ul style="list-style-type: none"> - Discuss the role of fuel and the importance of having a fuel that meets customer requirements. - Brainstorm with student's things they would expect a fuel to provide. - What would make you want a fuel to do? - May want to write these on the board.
3	20	<ul style="list-style-type: none"> - Distribute Handout 2, Glossary of Terms. - Discuss as a class different types of fuel. - Discuss as a class the possible environmental impacts of each type of fuel.
4	20	<ul style="list-style-type: none"> - Distribute Handout 3, Glossary Crossword. - Allow time for students to complete.

		- Discuss as a class
5	20	- Read the "Problem Scenario" - Discuss and/or brainstorm possible solutions

Reavis High School

To: Transportation Director

From: Margarte Bruaer, Manager

We are in need of your help to come up with a plan to reduce costs of fuel for our buses. The School Board has stated the cost of busing must be reduced and the schools dependence on gasoline must be reduced. The school bus drivers say they are running as efficiently as possible and with the gasoline engines they have now cost cannot be reduced. The School Board has stated in keeping with the AYP initiative that reducing the services to students to reduce cost is not an option. Therefore you can explore any option that does not change bus routes or reduce the number of bus runs.

You are to make a proposal to the School Board with your recommendations. The best group proposal will present their proposal to the school board.

If you have any questions, please let me know.

GLOSSARY of TERMS Related to this Scenario

Acetaldehyde:

A colorless, flammable liquid, C₂H₄O, used to manufacture acetic acid, perfumes, and drugs.

Alternate Fuel:

Known as non-conventional fuels, are any materials or substances that can be used as a fuel, other than conventional fuels. Some well known alternative fuels include bio-diesel, bio-alcohol (ethanol), chemically stored electricity (batteries and fuel cells), hydrogen, non-fossil methane, non-fossil natural gas, vegetable oil and other biomass sources.

Bio-diesel

Non-petroleum-based diesel fuel consisting of short chain alkyl (methyl or ethyl) esters, made by trans-etherification of vegetable oil, which can be used (alone, or blended with conventional petrol-diesel) in unmodified diesel-engine vehicles.

Bio-fuel:

Fuel, as wood or ethanol, derived from biomass.

Chemical Energy:

The energy in a substance that can be released by a chemical reaction.

Conventional fuels:

Include: *fossil fuels* (petroleum (oil) coal, LPG, Propane)

Electricity:

Electric current used or regarded as a source of power.

Ethanol:

a colorless volatile water-soluble liquid aldehyde used chiefly in the manufacture of acetic acid and perfumes and drugs [acetaldehyde]

Glossary of Terms Continued

Fossil Fuels:

Mineral fuels are fossil source fuels, that is, hydrocarbons found within the top layer of the Earth's crust

Fuel:

Source of energy, something that is burned to provide power or heat

Fuel cell: is an electrochemical conversion device. It produces electricity from fuel (on the anode side) and an oxidant (on the cathode side)

Hydrogen:

A colorless, odorless, flammable gas that combines chemically with oxygen to form water: the lightest of the known elements.

Symbol: H; *atomic weight:* 1.00797; *atomic number:* 1; *density:* 0.0899 g/l at 0°C and 760 mm pressure.

Nuclear power:

Is any nuclear technology designed to extract usable energy from atomic nuclei via controlled nuclear reactions. The most common method today is through nuclear fission

Petroleum:

Is a naturally occurring, flammable liquid found in rock formations in the Earth consisting of a complex mixture of hydrocarbons of various molecular weights, plus other organic compounds.

Propane:

Is a three-carbon alkane, normally a gas, but compressible to a liquid that is transportable. It is derived from other petroleum products during oil or natural gas processing. It is commonly used as a fuel for engines, barbecues, and home heating systems. When sold as fuel, it is commonly known as liquefied petroleum gas (LPG or LP-gas),

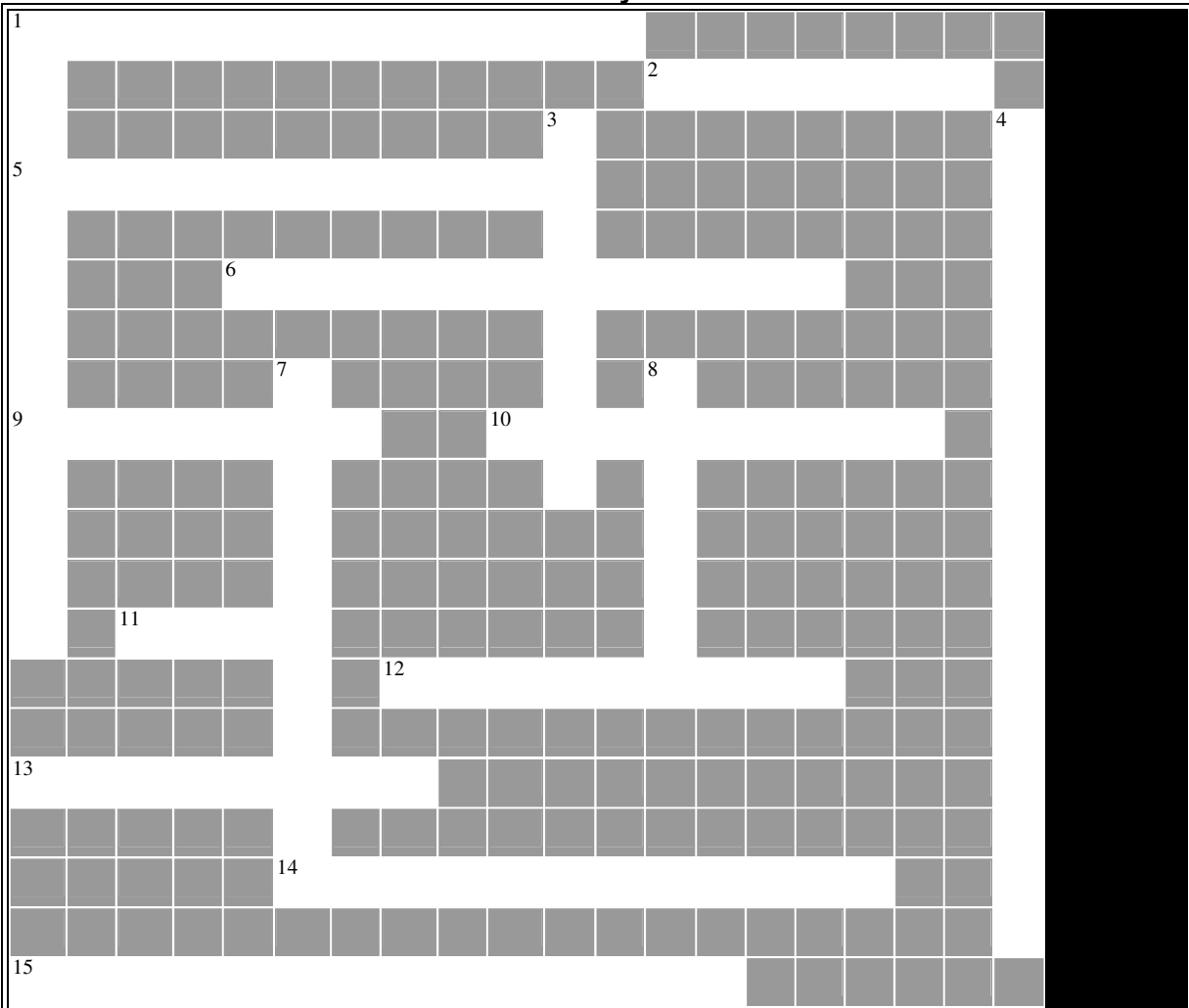
Solar Energy:

Energy derived from the sun in the form of solar radiation.

MPG:

Miles per gallon, the distance a vehicle can go on one gallon of fuel.

Glossary Crossword



ACROSS

1. A colorless, flammable liquid, C₂H₄O, used to manufacture acetic acid, perfumes, and drugs.
2. Fuel, as wood or ethanol, derived from biomass.
5. Electric current used or regarded as a source of power.
6. Is any nuclear technology designed to extract usable energy from atomic nuclei via controlled nuclear reactions. The most common method today is through nuclear fission
9. a colorless volatile water-soluble liquid aldehyde used chiefly in the manufacture of acetic acid and perfumes and drugs [acetaldehyde]
10. Is a naturally occurring, flammable liquid found in rock formations in the Earth consisting of a complex mixture of hydrocarbons of various molecular weights, plus other organic compounds.
11. Source of energy, something that is burned to provide power or heat
12. Non-petroleum-based diesel fuel consisting of short chain alkyl (methyl or ethyl) esters, made by trans-etherification of vegetable oil, which can be used (alone, or blended with conventional petrol-diesel) in unmodified diesel-engine vehicles
13. is an electrochemical conversion device. It produces electricity from fuel (on the anode side) and an oxidant (on the cathode side)
14. Energy derived from the sun in the form of solar radiation
15. The energy in a substance that can be released by a chemical reaction.

DOWN

1. Known as non-conventional fuels, are any materials or substances that can be used as a fuel, other than conventional fuels. Some well known alternative fuels include bio-diesel, bio-alcohol (ethanol), chemically stored electricity (batteries and fuel cell
3. A colorless, odorless, flammable gas that combines chemically with oxygen to form water: the lightest of the known elements.
4. Include: fossil fuels (petroleum (oil) coal, LPG, Propane)
7. Mineral fuels are fossil source fuels, that is, hydrocarbons found within the top layer of the Earth's crust
8. Is a three-carbon alkane, normally a gas, but compressible to a liquid that is transportable. It is derived from other petroleum products during oil or natural gas processing. It is commonly used as a fuel for engines, barbecues, and home heating systems.

Lesson 2

TOPIC	How Our Bus Works	TIME ESTIMATE	90 minutes
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OBJECTIVES	
<ul style="list-style-type: none"> • Students will have a basic understanding of the relationship of engine type and fuel used. • Students will understand gasoline and diesel engine similarities and differences. • Students will be able to determine the effect of fuel choice on the cost and on the environment. 	

MATERIALS & RESOURCES	
<ul style="list-style-type: none"> • Handout #4, "How Our Bus Works" • Access to Computer • Calculators 	

LESSON DESCRIPTION & ACTIVITIES		
Steps	No. of Minutes	ACTIVITIES
1	45	<ul style="list-style-type: none"> - Distribute Handout 4, "How Our Bus Works" and have students read. - Discuss as a class the information in Handout 4.
2	30	<ul style="list-style-type: none"> - Break students into 3 person teams. - Have groups working to answer questions Handout 3. - Discuss as a whole class answers from each group.
3	20	<ul style="list-style-type: none"> - Conduct class discussion on engines in the buses now. - Discuss possible changes needed for buses to use a new fuel.

How Our Bus Works

Petroleum fuel, or crude oil, is naturally found in the Earth. When crude oil is refined at refineries, it can be separated into several different kinds of fuels, including gasoline, jet fuel, kerosene and, of course, diesel. If you have ever compared diesel fuel and gasoline, you know that they are different. They certainly smell different. Diesel fuel is heavier and oilier. Diesel fuel evaporates much more slowly than gasoline -- its boiling point is actually higher than the boiling point of water. You will often hear diesel fuel referred to as "diesel oil" because it is so oily.

"What is the difference between a gasoline and a diesel engine?"

Diesel's story actually begins with the invention of the **gasoline engine**. Nikolaus August Otto had invented and patented the **gasoline engine** by 1876. This invention used the four-stroke combustion principle, also known as the "Otto Cycle," and it's the basic premise for most car engines today. In its early stage, the gasoline engine wasn't very efficient, and other major methods of transportation such as the **steam engine** fared poorly as well. Only about 10 percent of the fuel used in these types of engines actually moved a vehicle. The rest of the fuel simply produced useless heat.

In 1878, Rudolf Diesel was attending the Polytechnic High School of Germany (the equivalent of an engineering college) when he learned about the low efficiency of gasoline and steam engines. This disturbing information inspired him to create an engine with a **higher efficiency**, and he devoted much of his time to developing a "Combustion Power Engine." By 1892 Diesel had obtained a **patent** for what we now call the diesel engine.

Diesel Engines vs. Gasoline Engines

In theory, diesel engines and gasoline engines are quite similar. They are both **internal combustion engines** designed to convert the chemical energy available in fuel into mechanical energy. This mechanical energy moves pistons up and down inside cylinders. The pistons are connected to a crankshaft, and the up-and-down motion of the pistons, known as linear motion, creates the rotary motion needed to turn the wheels of a car forward.

Diesel engines and gasoline engines function by converting fuel into energy through a series of small explosions or combustions. The major difference between diesel and gasoline is the way these explosions happen. In a gasoline engine, fuel is mixed with air, compressed by pistons and ignited by sparks from spark plugs. In a diesel engine, however, the air is compressed first, and then the fuel is injected. Because air heats up when it's compressed, the fuel ignites.

The diesel engine uses a four-stroke combustion cycle just like a gasoline engine. The four strokes are:

Intake stroke -- The intake valve opens up, letting in air and moving the piston down.

Compression stroke -- The piston moves back up and compresses the air.

Combustion stroke -- As the piston reaches the top, fuel is injected at just the right moment and ignited, forcing the piston back down.

Exhaust stroke -- The piston moves back to the top, pushing out the exhaust created from the combustion out of the exhaust valve.

Remember that the diesel engine has no spark plug, that it intakes air and compresses it, and that it then injects the fuel directly into the combustion chamber (direct injection). It is the heat of the compressed air that lights the fuel in a diesel engine. In the next section, we'll examine the diesel injection process.

Compression

When working on his calculations, Rudolf Diesel theorized that higher compression leads to higher efficiency and more power. This happens because when the piston squeezes air with the cylinder, the air becomes concentrated. Diesel fuel has high energy content, so the likelihood of diesel reacting with the concentrated air is greater. Another way to think of it is when air molecules are packed so close together, fuel has a better chance of reacting with as many oxygen molecules as possible. Rudolf turned out to be right -- a gasoline engine compresses at a ratio of 8:1 to 12:1, while a diesel engine compresses at a ratio of 14:1 to as high as 25:1.

Which one of these buses is powered with GASOLINE, which is DIESEL and which is powered with a BIO-FUEL?
How do you know what fuel a bus uses?



Lesson 3

TOPIC	Fuel Problem Analyzed	TIME ESTIMATE	3 hours
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OBJECTIVES

- Students will be able to calculate cost of conventional & alternative fuel for buses to run.
- Students will be able to determine cost to environment of running buses.
- Students will be able to determine most appropriate type of fuel to be used.

MATERIALS & RESOURCES

- Handout #5, "Bus Fuel Consumption for Route Form"
- Handout #6, "Analyzing the Fuel Problem"
- Handout #1, Problem Scenario from Lesson 1
- Bus route maps
- Internet Access
- "Dirty Jobs: Bio-diesel" video with Mike Rowe from the discovery channel website

Teacher Resources: Illinois Environment Protection Agency website and the following websites will provide resources for teacher: www.epa.gov/smartway; www.biodiesel.org; www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm; www.evaa.org; www.afdc.nrel.gov; www.fueleconomy.gov/feg/flextech/shtml; www.eere.energy.gov/afdc/altfuel/ethanol.html

LESSON DESCRIPTION & ACTIVITIES

Steps	No. of Minutes	ACTIVITIES
1	40	<ul style="list-style-type: none"> - Introduce & View "Dirty Jobs: Bio-diesel" - Have students list the benefits of using Bio-diesel
2	10	<ul style="list-style-type: none"> - Reread the "Problem Scenario" - Give background information on the Bus Project.
3	40	<ul style="list-style-type: none"> - Assign each group a bus and route and provide Handout #5, "Bus Fuel Consumption for Route Form" - Review the bus route maps. - Each 3 person group should use the bus route maps determine the average distance traveled per day by their bus.

4	40	<ul style="list-style-type: none"> - Using the distance their bus travels each day students should calculate the amount of fuel used by the bus per trip. - Have students calculate the cost per; day, week, and month to run the bus they were assigned. - As a class calculate the approximate cost of fuel for the school buses per school year.
5	40	<ul style="list-style-type: none"> - Distribute Handout 6, "Analyzing The Fuel Problem." - Have student working in their 3 person teams to complete Handout 6. - Discuss Handout 6; Cost Availability and Environmental impact of the fuels they choose to research

Bus Fuel Consumption for Route Form

Using the map of your town, determine the distance each bus will drive today (Remember students get picked up and dropped off)

Bus Route Number	Bus route # of miles	Number of stops	Fuel amount	MPG

Analyze the Fuel Problem

Group Members: _____

Find 8 ways to power the buses here at School. Answer the question in the grid and as a group decided which fuel you wish to do more research on.

<u>Alternative OR Conventional fuel</u>	<u>Fuel Name</u>	<u>Cost per Gallon/Unit</u>	<u>MPG Gallon/Unit</u>	<u>Environment</u> Exhaust emissions Carbon Footprint	<u>Where can you get this fuel?</u>	<u>Sources</u>
1	<i>Gasoline</i>					
2	<i>Diesel</i>					
3	<i>Bio-diesel</i>					
4	<i>E-85</i>					
5						
6						
7						
8						

Fuel chosen to research: _____

Lesson 4

TOPIC	Preparing the Report and Presentation	TIME ESTIMATE	2-3 hours
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OBJECTIVES	
<ul style="list-style-type: none"> • Students will be able to write a business report. • Students will conduct research on fuels and engines. 	

MATERIALS & RESOURCES	
<ul style="list-style-type: none"> • Handout #7, "Making a Business Presentation" • Handout #8, "Rubric for Alternative Fuel Project" • Access to Computers with word processing and Presentation software and Internet • Bus route maps 	

LESSON DESCRIPTION & ACTIVITIES		
Steps	No. of Minutes	ACTIVITIES
1	20	<ul style="list-style-type: none"> • Distribute Handout 7 and have students read. • Discuss as a class a business report & business presentation.
2	40	<ul style="list-style-type: none"> • Have students use the internet to research one alternative fuel to power buses. • Students should collect information on; cost of fuel, environmental impact of fuel, availability of fuel, changes to the buses to use the new fuel and future projections of the fuel.
3	90	<ul style="list-style-type: none"> • Review Teacher created Rubric, Handout 8, for grading report and presentation. • Allow time for students to work in their groups to create a business report, including a bibliography, about the alternative fuel they chose. • Allow time for student groups to create a power point presentation to present with their report. • Allow time for students to practice with groups.

Making a Business Presentation

1. Organize your presentation.

- a. Introduction; You want to tell the audience:
 - i. Your name and the name of your group
 - ii. The purpose of your presentation
 - iii. The major topics you will cover
 - b. Body of the presentation; You want to tell the audience:
 - i. The most critical information for the purpose of the presentation
 - ii. Explain the importance of the information for the purpose of your presentation
 - c. Conclusion; In the conclusion you:
 - i. Summarize the most important parts of the presentation
 - ii. Summarize your conclusions and recommendations
 - iii. Ask for questions, reactions and comments
 - d. Bibliography
- Keep the presentation to the point.***
 - USE NOTE CARDS***
 - Your presentation should be completed in the planned time.***

2. Visual support materials for your presentation:

- a. Presentation Outline:
 - i. Communicate clearly
 - ii. Highlight your major points
- b. Support your ideas:
 - i. Figures, graphs, charts, and tables
 - ii. Pictures to illustrate your ideas

- You should be able to clearly see all information on the slide.***
- Keep the background simple***
- Print large***

3. Making your presentation

a. You must deliver the presentation to the class:

- i. Start on time.
- ii. Project a professional image
- iii. Show enthusiasm and confidence
- iv. Maintain eye contact
- v. Show friendly respect
- vi. Use effective speaking (NO SLANG)
- vii. Use your visual aid (DO NOT READ IT)
- viii. Answer QUESTIONS COMPLETELY
- ix. END ON TIME.

b. Practice:

- i. Run through the presentation with an audience before giving it at school.
- ii. Ask for feedback.

- Was the presentation clear?***
- Did everyone speak?***
- Did we all maintain eye contact?***
- Was the information too technical?***

Rubric for Alternative Fuel Project

	A	B	C	D	F
Content	Comprehension of facts. All information correct. Well thought out and organized in a complete way.	All information correct. Well thought out and organized.	All information correct. Organized	Most information is correct.	Don't go there.
Creativity	Good use of resources. Interesting presentation. Attention to details.	Good use of resources. Interesting presentation	Uses resources.	Uses resources in limited manner.	Don't go there.
Clarity	Explanation of material in cohesive way. Answer question with confidence. Know your information.	Explanation of material. Answer question. Know your information.	Answer question. Know your information.	Know your information.	Don't go there.
Cooperation	All members work well together. Each group member takes responsibility for their part as well as the group as a whole.	All members work. Each group member takes responsibility for part	Each group member takes responsibility for part	Each group member part	Don't go there.
Presentation	The group gives an interesting professional presentation. All members present and participate. Speaking in a voice that is interesting and audible.	The group gives a professional presentation. All members present and participate in some way. Speak in a voice that is audible.	The group gives a presentation. All members present. Speak in a voice that is audible.	The group gives a presentation.	Don't go there.

Lesson 5

TOPIC	Making the Presentation	TIME ESTIMATE	1 ½ hours
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OBJECTIVES	
<ul style="list-style-type: none"> • Students will make a professional presentation. • Students will identify new careers and/or new information about these careers. 	

MATERIALS & RESOURCES	
<ul style="list-style-type: none"> • Copy of Handout 8, Rubric for report and presentation. • Computer access. • Area to have audience view presentations. 	

LESSON DESCRIPTION & ACTIVITIES		
Steps	No. of Minutes	ACTIVITIES
1	10	<ul style="list-style-type: none"> - Review Handout 8, Teacher created Rubric for report and presentation. - Review audience behavior goals.
2	75	<ul style="list-style-type: none"> - Have each student group present their business presentation. - Allow time for each group to set up & take down. - Allow time for questions and answers.
3	10	<ul style="list-style-type: none"> - Conduct a class discussion with students on what they learned and how they felt about the project; ask them what they would recommend be changed in the future implementation of this project. - Discuss the careers they identified as part of this project and new information they learned about these careers.

Teacher

Assessment Materials

FINAL EVALUATION

Problem Statement to be Solved:

The School Board has stated the cost of busing must be reduced and the schools dependence on gasoline must be reduced. The school bus drivers say they are running as efficiently as possible and with the gasoline engines they have now cost cannot be reduced. The School Board has stated in keeping with the AYP initiative that reducing the services to students to reduce cost is not an option. Therefore you can explore any option that does not change bus routes or reduce the number of bus runs. You are to make a proposal to the School Board with your recommendations. The best group proposal will present their proposal to the school board.

Measurement Criteria that would describe an acceptable solution

1. Evaluate alternative fuels to determine service level and cost differences.
2. Evaluate the major physical modification in changing to an alternative fuel.
3. Business report included a cover letter, introduction stating the purpose of the report, documentation to support recommendations, a detailed explanation of costs, and tables, charts and spreadsheets to more clearly communicate recommended fuel plan.
4. Presentation presented the information with visual aids and/or handouts.
5. The presentation met the 7 requirements of effective business presentations:
 - Evidence of preparedness and practice
 - Started on time
 - Dressed appropriately
 - Showed enthusiasm and confidence
 - Maintained eye contact, showed friendliness and respect
 - Spoke slowly and distinctly without grammatical errors or slang
 - Welcomed questions and answered completely; accepted reactions without being defensive.

Suggested Scoring Guide

1. Solving the Problem—55 points
 - Fuel selected represented the most cost effective means School (10 points)
 - Define fuel correctly in Identifying potential benefits and drawbacks to choice. (10 points)
 - Evaluate alternative fuels and determined cost differences. (15 points)
 - All calculations were correct. (20 points)

2. Business Report—25 points

3. Presentation -20 points

SEE Rubric, Handout 8, for detailed information on Evaluation

Solution Example

Attached to this document is an acceptable student report/presentation. That project is Biodiesel Student Report for IL Busted Over Buses Project.ppt

A P P E N D I X

GLOSSARY of TERMS Related to this Scenario

Acetaldehyde:

A colorless, flammable liquid, C_2H_4O , used to manufacture acetic acid, perfumes, and drugs.

Alternate Fuel:

Known as non-conventional fuels, are any materials or substances that can be used as a fuel, other than conventional fuels. Some well known alternative fuels include bio-diesel, bio-alcohol (ethanol), chemically stored electricity (batteries and fuel cells), hydrogen, non-fossil methane, non-fossil natural gas, vegetable oil and other biomass sources.

Bio-diesel

Non-petroleum-based diesel fuel consisting of short chain alkyl (methyl or ethyl) esters, made by trans-etherification of vegetable oil, which can be used (alone, or blended with conventional petrol-diesel) in unmodified diesel-engine vehicles.

Bio-fuel:

Fuel, as wood or ethanol, derived from biomass.

Chemical Energy:

The energy in a substance that can be released by a chemical reaction.

Conventional fuels:

Include: fossil fuels (petroleum (oil) coal, LPG, Propane)

Electricity:

Electric current used or regarded as a source of power.

Ethanol:

A colorless volatile water-soluble liquid aldehyde used chiefly in the manufacture of acetic acid and perfumes and drugs [acetaldehyde]

Fossil Fuels:

Mineral fuels are fossil source fuels, that is, hydrocarbons found within the top layer of the Earth's crust

Fuel:

Source of energy, something that is burned to provide power or heat

Fuel cell: is an electrochemical conversion device. It produces electricity from fuel (on the anode side) and an oxidant (on the cathode side)

Hydrogen:

A colorless, odorless, flammable gas that combines chemically with oxygen to form water: the lightest of the known elements. Symbol: H; atomic weight: 1.00797; atomic number: 1; density: 0.0899 g/l at 0°C and 760 mm pressure.

Nuclear power:

Is any nuclear technology designed to extract usable energy from atomic nuclei via controlled nuclear reactions. The most common method today is through nuclear fission.

Petroleum:

Is a naturally occurring, flammable liquid found in rock formations in the Earth consisting of a complex mixture of hydrocarbons of various molecular weights, plus other organic compounds.

Propane:

Is a three-carbon alkane, normally a gas, but compressible to a liquid that is transportable. It is derived from other petroleum products during oil or natural gas processing. It is commonly used as a fuel for engines, barbecues, and home heating systems. When sold as fuel, it is commonly known as liquefied petroleum gas (LPG or LP-gas),

Solar Energy:

Energy derived from the sun in the form of solar radiation.

MPG:

Miles per gallon, the distance a vehicle can go on one gallon of fuel.