

Renewable Fuels



Renewable Fuels Foundation



Renewable Fuels Association



Engine Performance

Unit 3 Lesson 2

Precepts

- A. Action
 - A5. Communicate effectively with others.
- E. Awareness
 - E1. Address issues important to the community.

National Standards

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- NL-ENG.K-12.2. Reading for Understanding.
 - NSS-EC.9-12.2. Effective Decision Making.

Student Learning Objectives

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- As a result of this lesson, the student will ...
1. Recognize that the quality of fuel used in any motor vehicle engine is very important to its long life and proper operation.
 2. Identify the benefits of using ethanol in automobile performance.
 3. Identify the user guidelines for properly filling vehicles with blends of fuel.

Time

Instruction time for this lesson: 50 minutes.

Resources

http://www.gasbuddy.com/gb_gastemperaturemap.aspx
<http://www.nwicc.com/pages/continuing/business/ethanol/module5.htm>
www.ethanolrfa.org
<http://www.ethanolfacts.com/ETHL2007/engine.asp#>

Tools, Equipment, Supplies

Writing surface
Overhead projector
TM.A
TM.B
TM.C
AS.A – one per student
Assess. A

Key Terms

The following terms are presented in this lesson and appear in ***bold italics***:
Antiknock Index

INTEREST APPROACH

Search gasbuddies.com or other similar gas price websites to determine where the most expensive and the least expensive gas is in the United States. You can determine this before class or if you are able to project the website to the class you may do this while having the students guess. Ask students why there are two or three choices of prices at the pump when they fill up. Ask if any of the students or their guardians use the ethanol blend when they fill up. Continue the conversation leading into why someone might choose the ethanol blend.



Where do you think is the most expensive place to buy gas in the United States? *Allow students to answer.* Where do you think is the least expensive place to buy gas in the United States? *Allow students to answer.* According to a website that posts current gas prices from across the United States the answers are (*share answers or show students on the website*). When we pull up to the pump to get gas there are usually a couple of choices. What are those choices? *Allow students to answer and briefly explain.* Do you know people that use the ethanol blend when filling up? *Allow students to answer.* Why might people use the ethanol blend? *Allow students to answer and briefly explain.* Often we don't think a lot about the fuel we are using in a vehicle except for maybe the cost. Let's roll up our sleeves and get ready to work because today we are going to look under the hood at ethanol.

OBJECTIVE 1. Recognize that the quality of fuel used in any motor vehicle engine is very important to its long life and proper operation.

Hand out AS.A to students to lead them through Objective 1. Facilitate a guided and interactive discussion using TM.A as a key.



Since you were a little child you probably have heard “eat your vegetables.” Now that you are older you have learned that the healthier you eat the better you will feel and you will have more energy. Vehicles are similar. The quality of the fuel that we put in them plays a large role in how well they will run and how long they will last. On the sheet I am passing out follow along and fill in the key terms as we discuss facts about fuel. *Hand out AS.A.*

Facilitate a guided and interactive discussion.

I. The quality of fuel used in any motor vehicle engine is very important to its long life and proper operation.

A. Auto manufacturers today are recommending ethanol-blended gasoline for the vehicles they sell.

1. A recent survey revealed that nine out of ten auto dealers use ethanol-blended gasoline in their personal vehicles.
2. More than half of the dealerships surveyed indicated their customers reported benefits that included: reduced knocking and pinging, improved gas mileage, better acceleration, and improved starting qualities.
3. Independent automotive technicians also trust their family cars to ethanol blends.

B. If the fuel is not right for the air temperature or if fuel changes to a vapor incorrectly, drivability will suffer.

C. Gasoline is most commonly rated based on their **Antiknock Index** (AKI), a measure of octane quality. The AKI is a measure of a fuel's ability to resist engine knock (ping).

1. A typical average octane number of 87 would contain a research octane of 92 and a motor octane of 82.
2. These different blends can affect engines differently, depending on the octane requirement of that particular engine, and explains why engines can perform differently with a change of fuel.
3. Ethanol is believed to reduce engine knocking at the E10 blend.



This defines some of the common terms used when talking about fuels and gives us a background to work from for the rest of the lesson. As we continue, let's use our decision making brains and be thinking of what we might do the next time we are with someone when they are going to put fuel in a vehicle.

OBJECTIVE 2. Identify the benefits of using ethanol in automobile performance.

Use a Little Professor Moment to present the information for Objective 2 and Objective 3. Students will need to work in pairs for the teaching strategy. One student will be Eddie Ethanol and the other Terry Technician. Ethanol will instruct Technician pertaining to Objective 2.



We now understand that quality fuel is important to keep an engine running in top condition and aids in the lifespan of the engine. But what are some benefits of ethanol and are there fueling recommendations we should know about? It is time for you to take an active teaching role when it comes to ethanol. Grab a partner and take turns teaching each other about why we should use ethanol and about fueling recommendations. One of you will be Eddie Ethanol and the other will be Terry Technician. Grab the steering wheel because here we go.

Make sure students pair up for the strategy and lead them through the information using the Little Professor Moment. During Objective 2 Ethanol will be teaching Technician. Information for Objective 2 can be found on TM.B.

II. Ethanol has many benefits to a vehicle engine and system besides environmental and price influences.

A. Ethanol is a good cleaning agent. In newer vehicles it helps keep the engine clean. In older vehicles it can sometimes loosen contaminants and residues that have already been deposited in a vehicle's fuel delivery system. Occasionally, these loosened materials collect in the fuel filter, and can then be removed simply by changing the fuel filter.

B. All alcohols have the ability to absorb water. Condensation of water in the fuel system is absorbed and does not have the opportunity to collect and freeze. Since ethanol blends contain at least 10 percent ethanol, they are able to absorb water and eliminate the need for adding a gas-line antifreeze in winter.

C. Ethanol is a fuel for old and new engine technology. Automotive engines older than 1969 with non-hardened valve seats may need a lead substitute added to gasoline or ethanol blends to prevent premature valve seat wear. Valve burning is decreased when ethanol blends are used because ethanol burns cooler than ordinary unleaded gasoline. Many high performance racing engines use pure alcohol for that reason.

D. Modern computerized vehicles of today, when operating correctly, will perform better than non-computer equipped vehicles. Improved performance is due to the vehicle's computerized fuel system being able to make adjustments with changes in operating conditions or fuel type.

E. Some of the chemicals used to manufacture gasoline, such as olefins, have been identified as a cause of deposits on port fuel injectors. Most gasoline contains detergent additives that are designed to prevent fuel injector and valve deposits.

Upon completion have Technician thank Ethanol and move into Objective 3.



Fine job Eddie Ethanol. You did a great job teaching about the benefits of Ethanol to Terry Technician. Mr. Technician, thank Mr. Ethanol for the wisdom he has shared. We will now switch roles.

Objective 3. Identify the user guidelines for properly filling vehicles with blends of fuel.

Continue the Little Professor Moment with Objective 3. Information for Objective 3 can be found on TM.C. Terry Technician will now instruct Eddie Ethanol.

III. To help ensure proper engine operation and keep fuel costs to a minimum, follow these guidelines:

- A. Purchase fuel from a busy station to be sure fuel is fresh and less likely to be contaminated with moisture.
- B. Keep the fuel tank above one-quarter full, especially during cold weather, to help reduce condensed moisture and gas line freeze-up.
- C. Do not purchase a fuel with a higher octane rating than is necessary.
- D. Do not purchase fuel from a retail outlet when a tanker truck is filling the storage tanks. Dirt, rust, and water may be stirred up.
- E. Do not overfill the gas tank. After the nozzle clicks off, add just enough fuel to round up to the next dime. This will prevent damage to the vehicle's fuel evaporative system.

Upon completion of Objective 3 have Ethanol thank Technician.



Awesome job Terry Technician. Your teaching should be commended and Eddie Ethanol now has new knowledge relating to the recommendations to keep in mind when fueling. Mr. Ethanol, thank Mr. Technician for his crafty teaching.

We now understand how important quality fuel is in engine operation. We have also witnessed the benefits that come with ethanol and have a list of recommendations when it comes to fueling a vehicle. All of these are factors to keep in mind and use in the decision making process the next time we go to put fuel in a vehicle.

REVIEW/SUMMARY

Use a Mother Goose Moment to review and summarize the content from the lesson.



It is time to rev up the new knowledge you have about ethanol. You will have eight minutes to take the ethanol knowledge you have learned today and transform it into a nursery rhyme. Think of all the nursery rhymes you know and then decide which one would work best for the challenge you have been given. You do not need to include all the information from today but make sure to include at least one characteristic, benefit and recommendation pertaining to ethanol use. When you hear the words “start your pencils” work with your partner and develop the next great nursery rhyme. What questions are there? Start your pencils!

Allow students to prepare their nursery rhymes and help them as needed. Upon completion have the students share their nursery rhymes with the class. Have students thank each other and mention they will continue to learn about ethanol in future lessons.



Great job. Tell your teaching partner thank you for helping with the ethanol nursery rhyme. We have added knowledge from under the hood today by discussing that the quality of fuel is important, we discovered the benefits to using ethanol, and great fueling recommendations. We will continue to build on this knowledge in future lessons.

APPLICATION

Extended classroom activity: *Bring in print copies of vehicle owners manuals or go online and find several copies of different manuals. Look through the fuel sections within the manuals and determine what different types of manufacturers recommend for their specific vehicles when it comes to fuels. Then compare results for commonalities and differences.*

FFA activity: *Work with local vehicle dealerships to design a flyer that could be given out at events that share the benefits of ethanol use. Include manufacturer tips about proper and safe ways to fuel a vehicle. These could be given out at public events, local dealerships and at local gas stations.*

SAE activity: *Shadow or interview a local vehicle dealer and technician to learn more about vehicle maintenance and upkeep. Ask questions related to this lesson dealing with ethanol use, benefits and fueling recommendations. Use the additional information to put together a report and to evaluate whether this may be a career option in the future.*

EVALUATION

Assess. A

Answers to Assessment:

True or False.

1. True
2. True
3. False
4. True
5. True

Multiple Choice:

1. C
2. A

TM.A

The quality of fuel used in any motor vehicle engine is very important to its long life and proper operation.

1. Auto manufacturers today are recommending ethanol-blended gasoline for the vehicles they sell.
 - a. A recent survey revealed that nine out of ten auto dealers use ethanol-blended gasoline in their personal vehicles.
 - b. More than half of the dealerships surveyed indicated their customers reported benefits that included: reduced knocking and pinging, improved gas mileage, better acceleration, and improved starting qualities.
 - c. Independent automotive technicians also trust their family cars to ethanol blends.
2. If the fuel is not right for the air temperature or if fuel changes to a vapor incorrectly, drivability will suffer.
3. Gasoline is most commonly rated based on their ***Antiknock Index*** (AKI), a measure of octane quality. The AKI is a measure of a fuel's ability to resist engine knock (ping).
 - a. A typical average octane number of 87 would contain a research octane of 92 and a motor octane of 82.
 - b. These different blends can affect engines differently, depending on the octane requirement of that particular engine, and explains why engines can perform differently with a change of fuel.
 - c. Ethanol is believed to reduce engine knocking at the E10 blend.

TM.B

Ethanol has many benefits to a vehicle engine and system besides environmental and price influences.

- Ethanol is a good cleaning agent. In newer vehicles it helps keep the engine clean. In older vehicles it can sometimes loosen contaminants and residues that have already been deposited in a vehicle's fuel delivery system. Occasionally, these loosened materials collect in the fuel filter, and can then be removed simply by changing the fuel filter.
- All alcohols have the ability to absorb water. Condensation of water in the fuel system is absorbed and does not have the opportunity to collect and freeze. Since ethanol blends contain at least 10 percent ethanol, they are able to absorb water and eliminate the need for adding a gas-line antifreeze in winter.
- Ethanol is a fuel for old and new engine technology. Automotive engines older than 1969 with non-hardened valve seats may need a lead substitute added to gasoline or ethanol blends to prevent premature valve seat wear. Valve burning is decreased when ethanol blends are used because ethanol burns cooler than ordinary unleaded gasoline. Many high performance racing engines use pure alcohol for that reason.
- Modern computerized vehicles of today, when operating correctly, will perform better than non-computer equipped vehicles. Improved performance is due to the vehicle's computerized fuel system being able to make adjustments with changes in operating conditions or fuel type.
- Some of the chemicals used to manufacture gasoline, such as olefins, have been identified as a cause of deposits on port fuel injectors. Most gasoline contains detergent additives that are designed to prevent fuel injector and valve deposits.

TM.C

To help ensure proper engine operation and keep fuel costs to a minimum, follow these guidelines:

- Purchase fuel from a busy station to be sure fuel is fresh and less likely to be contaminated with moisture.
- Keep the fuel tank above one-quarter full, especially during cold weather, to help reduce condensed moisture and gas line freeze-up.
- Do not purchase a fuel with a higher octane rating than is necessary.
- Do not purchase fuel from a retail outlet when a tanker truck is filling the storage tanks. Dirt, rust, and water may be stirred up.
- Do not overfill the gas tank. After the nozzle clicks off, add just enough fuel to round up to the next dime. This will prevent damage to the vehicle's fuel evaporative system.

AS.A

Fill in the following key terms pertaining to fuels.

The quality of fuel used in any motor vehicle engine is very important to its _____ and _____.

1. Auto manufacturers today are recommending _____ gasoline for the vehicles they sell.
 - a. A recent survey revealed that _____ out of ten auto dealers use ethanol-blended gasoline in their personal vehicles.
 - b. _____ of the dealerships surveyed indicated their customers reported benefits that included: reduced _____, improved _____, better _____, and improved _____.
 - c. Independent automotive technicians also trust their family cars to _____.
2. If the fuel is not right for the _____ or if fuel changes to a _____ incorrectly, drivability will suffer.
3. Gasoline is most commonly rated based on their _____ (AKI), a measure of octane quality. The AKI is a measure of a fuel's ability to _____ engine knock (ping).
 - a. A typical average octane number of _____ would contain a research octane of _____ and a motor octane of _____.
 - b. These different blends can affect engines differently, depending on the octane requirement of that particular engine, and explains why engines can perform differently with a _____.
 - c. Ethanol is believed to reduce _____ at the E10 blend.

Assess.A

True / False:

Determine if each of the statements are true or false.

- _____ 1. Ethanol's original automotive use was as an octane booster.
- _____ 2. When lead was removed from gasoline, ethanol was used as a product extender.
- _____ 3. Automakers are introducing more flexible fuel vehicles capable of operating on E85 fuel.
- _____ 4. Ethanol is a gasohol that is a high-octane, water-free alcohol made by fermenting sugar.
- _____ 5. Ethanol is used as a blend with gasoline or as a raw material to make high-octane additives.

Multiple Choice

Choose the best answer that completes the statement:

1. Ethanol has the ability to absorb water which eliminates:
 - A. Carburetor icing
 - B. The need to use a gas line antifreeze
 - C. Engine ping
 - D. Changing fuel filters
2. The use of a higher octane gasoline:
 - A. Will result in increased fuel economy and performance only if engine knock or ping was previously present.
 - B. Will decrease fuel economy and performance.
 - C. Decreases deposits on intake valves and fuel injectors.
 - D. Will decrease vapor lock.