

# Today's Propane Industry

**LESSON 2**

**UNIT:** PROPANE

**PROBLEM AREA:** PROPANE USE IN AGRICULTURE



### STUDENT LEARNING OBJECTIVES

Instruction in this lesson should result in students achieving the following objectives:

1. Trace the history of energy sources in agricultural production.
2. Identify careers associated with energy and fuel usage in agriculture.
3. Outline the development of the propane industry.

### NATIONAL SCIENCE STANDARDS ADDRESSED IN THIS LESSON

All students should develop an understanding of:

**History and Nature of Science: Content Standard G**

- Historical perspectives.

### LIST OF RESOURCES

The following resources may be useful in teaching this lesson:

- [Propane.com/Agriculture](http://Propane.com/Agriculture)
- [Energy.gov](http://Energy.gov)
- [NPGA.org](http://NPGA.org)

### LIST OF EQUIPMENT, TOOLS, SUPPLIES, AND FACILITIES

- Copies of sample test
- Copies of student lab sheet

### TERMS

The following terms are presented in this lesson (*shown in bold italics throughout the lesson*):

1. Agricultural power applications
2. Agricultural production applications
3. Crop and food conditioning applications
4. Internal-combustion engine
5. Moldboard plow
6. Nutrient and waste management applications
7. Propane Education & Research Council
8. Scythe
9. Steam tractor

**TELL STUDENTS...**

*"In this lesson you are going to learn about the development of the propane industry and its relationship to agriculture. You will be expected to trace the history of energy sources in agricultural production, identify careers associated with energy and fuel usage in agriculture, and outline the development of the propane industry."*

**INTEREST APPROACH**

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible interest approach is included here.

1. Ask students what they remember about propane from the previous lesson. Have a student write answers on the board or on a large Post-it® easel pad or other easel pad. Possible answers are:
  - Propane is liquefied petroleum gas.
  - Propane is made up of carbon and hydrogen atoms.
  - Propane is a fuel and an energy source.
2. Ask if anyone remembers the chemical formula for propane (Answer:  $C_3H_8$ ).
3. Display a three-dimensional model of propane that is.
  - Constructed from a commercially available kit,
  - Constructed from colored marshmallows and toothpicks, or
  - Constructed from jelly candies and toothpicks.
4. You may also have time for groups of students to construct their own models of propane, depending on the length of your class periods.

**Note:** Computer simulation models are also available if you can access one and project it on a screen at the front of the room while students recall facts about propane.

# Summary of Content and Teaching Strategies

## OBJECTIVE 1

Trace the history of energy sources in agricultural production.

### ANTICIPATED PROBLEM

*What is the history of energy sources in agricultural production?*

In early agriculture, types of energy used for production processes included human and animal muscle power; however, technologies soon developed that greatly lessened dependence on these early power sources.

#### A. Early Technologies

1. In the late seventeenth and early eighteenth centuries, the only source of power for cultivation or transportation was animals, such as horses and oxen. Farmers used a **moldboard plow**, an implement with a wedge formed by a curved plow blade, to break and till many types of soil. Thomas Jefferson designed early versions of the moldboard, while John Deere is credited with inventing the all-steel version. The moldboard plow was pulled by horses or oxen and steered from behind by the farmer. It was a great advancement because it provided mechanical advantage to muscle power. However, planting was done by hand. Harvesting was also done by hand using the **scythe**, a tool that cuts grain shoots off near the ground.
2. Agriculture advanced as technology increased. In the mid-1800s, steam power was applied to agriculture in the form of the steam engine. This steam power became the energy source for the first-known traction engine, which was used in the **steam tractor**. The steam tractor, invented by James Watt, was the first farm equipment to carry the engine within its machinery, transforming agricultural production. All previous steam-engine power used a stationary engine that ran machinery from afar through a series of belts. The fuel source for the steam engine was wood or coal.

3. Steam tractors were soon replaced by gasoline tractors with internal-combustion engines. An **internal-combustion engine** is a heat engine that converts the heat from the combustion of fuel inside the engine into mechanical power. An internal-combustion engine and a motor are not the same thing; an internal-combustion engine is far more complex. The gasoline tractor was invented in 1892 by John Froelich, but it did not become truly popular until 1911. With the advances in petroleum refinement to produce gasoline, the new tractor was more powerful and more efficient. Farm production saw a dramatic increase as technologies advanced, and many farm workers were soon replaced with machines.
- B. Propane was first discovered in 1857 and first identified as a volatile component in gasoline by Walter O. Snelling of the U.S. Bureau of Mines in 1910. At first, it was used for cutting metals. It was soon discovered that propane had other uses, as well, and by the 1920s it was being used for household purposes, such as heating and cooking. Propane gradually came to be applied to both household and agricultural generators and machinery. Today, propane is considered one of the cleanest burning energy sources. It is portable and cost effective. Its wide variety of uses makes for a very adaptable energy source. Propane is currently the third most popular vehicle fuel in the world, directly behind gasoline and diesel fuel.
- C. Propane is used on 80 percent of American farms in four major ways.
1. **Agricultural production applications** include all uses of propane that support production of crops and livestock. Protecting crops from frost, as well as eliminating weeds and pathogens with heat, are example uses in crop production. Heating buildings and water and sanitizing buildings are applications in animal agriculture.

**2. Crop and food conditioning applications**

- a. A majority of farmers who dry grain do so with clean-burning propane. Propane crop drying or curing equipment has become more efficient over the years and offers precise control of moisture and temperature to ensure crops are dried to the desired level of moisture to preserve quality and maximize value.
- b. Pest management can be achieved through propane heat treatments, as an alternative to chemical fumigation. Large food processing plants have performed these heat treatments to control insects. This innovative technology offers the agriculture community a safe, effective, and environmentally friendly crop storage treatment that may be incorporated into a comprehensive pest management program.

**3. Nutrient and waste management applications**

involve methods to manage farm waste through incineration or more creative ways to convert waste into value-added products. Propane can provide complete and environmentally responsible destruction of high-risk materials that can help stop the threat of exposure during an outbreak of disease. Propane also supports the conversion of waste to energy by providing the reliable start-up and back-up fuel for biodigesters or other waste-to-energy incinerators.

4. **Agricultural power applications** are numerous in the agriculture industry for the operation of machinery and other technologies that enable farms to run as efficiently as possible. Propane is both an economical and efficient fuel well suited to power many types of technology. Some examples of use are with engines, electrical generators, forklifts, and lawnmowers.

**SUGGESTED TECHNIQUES TO HELP STUDENTS MASTER THIS OBJECTIVE**

1. Lead students in a short discussion about the first equipment developed to plow fields.
2. Ask the students to tell what inventions led to the development of the engines we have today. Drawing a timeline may be helpful. Students should take notes on this information.
3. Have students research one of the many tools listed and do a poster presentation on the invention. Make sure they include the name of the inventor and the year in which the tool was invented. Create a timeline using their posters.
4. Student teams could also make posters or a booklet on the major uses of propane on a farm for distribution in the school.

## OBJECTIVE 2

Identify careers associated with energy and fuel usage in agriculture.

### ANTICIPATED PROBLEM

*What careers are associated with energy and fuel usage in agriculture?*

Many career opportunities are associated with fuel and energy usage in agriculture; this section will focus on careers dealing with propane.

- A. The propane industry is composed of nearly 8,000 companies nationwide that employ 56,000 people who provide propane gas to farmers, homeowners, builders, vehicle and forklift fleet managers, and other customers. The propane industry is decentralized, and many of the companies are small, family-owned independent businesses. Propane workers are in demand, and there is a large variety in the types of jobs available, from customer service representatives, to large and small truck drivers, to accountants, to field representatives. Since the majority of farms in the United States use propane, the agriculture and propane industries are closely linked.
1. Propane is unique in that it is not produced for its own sake but is a byproduct of natural gas processing and petroleum refining. Ninety percent of the country's propane supply is produced in the United States. Ample domestic production means plentiful jobs.
  2. The propane industry has transportation jobs available. These jobs involve transporting propane from refineries to local businesses, households, and suppliers. The primary mode of transporting propane within the United States is by approximately 70,000 miles of interstate pipelines. Other modes of transport include about 22,000 rail tank cars, 6,000 highway bulk transports, 36,500 local delivery trucks, about 90 inland-waterway barges, and several oceangoing tankers.
  3. Local supplier jobs provide goods and services needed in the purchase of propane, tanks, and accessories.
  4. Other related jobs include safety personnel, equipment manufacturers, pipeline workers, and railroad transportation specialists.
- B. The propane industry has many marketing careers. Opportunities include sales and advertising.
1. Propane marketing often involves advertising on television and in newspapers. Generally entire teams of workers within the marketing division of the propane industry are responsible for these advertisements.
  2. Propane sales careers are available at both national and local levels from either refineries or propane suppliers.

### SUGGESTED TECHNIQUES TO HELP STUDENTS MASTER THIS OBJECTIVE

1. Encourage students to create presentations on jobs within the propane industry. Many regional and state-based companies have Web sites that list current openings, thus illustrating the wide variety of opportunities.
2. Make certain that students understand that many jobs in the propane industry can be considered as jobs in the broad agriculture, food, fiber, and natural resources system.
3. Have students complete **LS-A**.

## OBJECTIVE 3

Outline the development of the propane industry.

### ANTICIPATED PROBLEM

*What significant events have shaped the development of the propane industry?*

In 1910, Dr. Walter O. Snelling, of the U.S. Bureau of Mines, was contacted to investigate vapors coming from a gasoline tank vent of a newly purchased Ford Model T. Dr. Snelling filled a glass jug with the gasoline from the automobile and discovered on his way back to the lab that volatile vapors were forming in the jug, causing its cork to pop out repeatedly. He began experimenting with these vaporous gases to find methods to control and hold them. After dividing the gases into their liquid and gaseous components, he discovered that propane was one component of the liquefied gas mixture. He soon learned that the propane component could be used for lighting, metal cutting, and cooking. That discovery marked the birth of the propane industry.

- A. With this discovery, the propane industry began to grow and develop.
    1. In 1912, Dr. Snelling and his colleagues established the American Gasol Co., the first commercial marketer of propane. In just three years, propane sales nearly doubled.
    2. Propane was initially used for metal cutting, but by the mid-1920s it was widely used in homes for heating and cooking. In 1927, the Tappan Company began production of the gas cooking stove.
    3. The end of World War II (1945) brought great industrial development, leading propane into its “golden years.” Sales of propane reached 1 billion gallons annually during this period.
    4. Sixty-two percent of all U.S. homes were equipped with either natural gas or propane ranges by 1947. The sale of water heaters rose, and the first propane-
  - B. Congress passed the Propane Education and Research Act (PERA) in 1996, prompting the industry to form the Propane Education & Research Council (PERC). The purpose of PERC is to promote the safe, efficient use of propane as a preferred energy source. Among PERC’s top priorities is the continuing development of programs to enhance consumer and employee safety and training, to provide for research and development of clean and efficient propane, and to educate the public about safety and other issues associated with the use of propane.
  - C. Propane is a \$10 billion industry in the United States and is growing. The United States consumes more than 11 billion gallons of propane annually for home, agricultural, industrial, and commercial uses. Of the 101.5 million U.S. households, 50 million depend on propane for one use or another.
- fueled clothes dryer entered the marketplace. National propane sales reached 7 billion gallons annually in 1958, a little over a decade later.
5. In 1962, the propane industry celebrated its fiftieth anniversary.
  6. The National Liquefied Petroleum Gas Association (NLPGA) became the National Propane Gas Association (NPGA) in 1987. The NPGA is the national trade association representing the propane industry and approximately 2,800 companies in all 50 states. Companies represented by NPGA include small and large producers, wholesalers, transporters, and retailers of propane gas, as well as the manufacturers and distributors of associated propane equipment, appliances, and alternative-fueled vehicles.
  7. Propane was listed as an approved alternative clean fuel in the 1990 Clean Air Act and was listed again as an alternative fuel in the Energy Policy Act of 1992.

### SUGGESTED TECHNIQUES TO HELP STUDENTS MASTER THIS OBJECTIVE

1. As an introduction to this objective, ask students to brainstorm a list of any companies, people, and important dates they may already know that are associated with the propane industry. These can be written on the board, or students can take notes.
2. Prepare a PowerPoint presentation, one slide for each decade, and list important dates and events associated with the propane industry.
3. Lead students into a discussion of the development of the propane industry.
4. Have students complete **LS-B**.

## REVIEW/SUMMARY

Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. The anticipated problems can be used as review questions.

## APPLICATION

Use the included lab sheets to apply the information presented in the lesson.

## EVALUATION

Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.



## ANSWERS TO SAMPLE TEST

Use the included lab sheets to apply the information presented in the lesson.

### PART ONE: MATCHING

1. d
2. a
3. e
4. f
5. c
6. b

### PART TWO: SHORT ANSWER

1. a. Moldboard plow—a horse- or oxen-drawn plow steered from behind by the farmer.  
The moldboard plow was a great advancement because it provided mechanical advantage to muscle power.  
b. Steam tractor—the first farm equipment to carry the engine within its machinery. It transformed agricultural production.  
c. Internal-combustion engine—a heat engine that converts the heat from the combustion of fuel inside the engine into mechanical power. Tractors using this engine became popular in 1911 and ran on gasoline.
2. Answers will vary but possibilities include protecting crops from frost, eliminating weeds and pathogens with heat, heating buildings and water, sanitizing buildings.

### PART THREE: COMPLETION

1. gasoline, diesel fuel
2. scythe
3. 11

# TODAY'S PROPANE INDUSTRY

## PART ONE: MATCHING

**INSTRUCTIONS:** Match the term with the correct definition.

- |                   |   |
|-------------------|---|
| a. Steam Tractor  | b. internal-combustion engine                 |
| c. Scythe         | d. Propane Education & Research Council       |
| e. Moldboard Plow | f. nutrient and waste management applications |

- \_\_\_\_\_ 1. A heat engine that converts the heat from the combustion of fuel inside the engine into mechanical power
- \_\_\_\_\_ 2. The first tractor to carry the engine within its machinery
- \_\_\_\_\_ 3. The organization whose purpose is to promote the safe, efficient use of propane as a preferred energy source
- \_\_\_\_\_ 4. Methods to manage farm waste
- \_\_\_\_\_ 5. An implement pulled by horses or oxen and steered from behind by the farmer
- \_\_\_\_\_ 6. A handheld tool used to cut grain

## PART TWO: SHORT ANSWER

**INSTRUCTIONS:** Provide a short written answer to the following questions.

1. List and describe, in the order of their development, the three early technologies used in agriculture?

2. Give an example of an agricultural production application.

**PART THREE: COMPLETION**

**INSTRUCTIONS:** Provide the word or words to complete the following statements.

1. Propane is currently the third most popular vehicle fuel in the world, directly behind \_\_\_\_\_ and \_\_\_\_\_.
2. Early harvesting was done by hand using the \_\_\_\_\_, a tool that cuts grain shoots off near the ground.
3. The United States consumes more than \_\_\_\_\_ billion gallons of propane annually for home, agricultural, industrial, and commercial uses. Give an example of an agricultural production application.

# A Career in the Propane Industry

## PURPOSE

The purpose of this activity is to select and conduct an in-depth study of a career in the propane industry.

## OBJECTIVE

Create a poster showing your in-depth knowledge of a career in the propane industry.

## MATERIALS

- Pencil
- Notebook paper
- Poster board
- Markers
- Construction paper
- Scissors
- Glue
- Paint

## PROCEDURE

1. Select a career in the propane industry that interests you.
2. Research the career on the Internet or in the library, and keep appropriate notes. Some things to look for include job title, education and training required for the job, list of companies where the job is available, description of duties and the working environment, and benefits. You may need to look for a generic job title, such as customer service representative or truck driver, and then check propane company websites for more detailed descriptions of that job in the propane industry.
3. Print or collect photos relating to the career for use on your poster.
4. On a sheet of notebook paper, sketch your design for a career poster. Ask your teacher to approve your design.
5. Lay out your design on poster board by lightly sketching with a pencil.
6. Create a title/headline on the poster with the name of your selected career.
7. Paste on photos or drawings, and add text to complete your poster. Be sure to include important characteristics about the career from your notes.
8. When called on by your teacher, give a short presentation to the class on your career poster. Explain the information on your poster.
9. Display your poster on the classroom wall or at another location if directed by your teacher.

# The Propane Industry

## PURPOSE

The purpose of this activity is to conduct an in-depth study of the propane industry.

## OBJECTIVE

Create a brochure, newsletter, or newscast showing your in-depth knowledge of the propane industry.

## MATERIALS

- Pencils and pens
- Notebooks
- Access to computers and printers
- Magazines

## PROCEDURE

### General

1. Divide into teams of three or four students, as instructed by your teacher. Each team should brainstorm ideas about the propane industry that it may wish to investigate. Some possible ideas include the discovery of propane, one or more agricultural uses of propane, and propane use in the home.
2. Decide whether you will create a brochure, write a newsletter, or develop a newscast about the propane industry.
3. On the Internet or in the library, research the area of the propane industry you have chosen, and keep detailed notes. Print or collect photos relating to your project.

### For Brochure

1. On a sheet of notebook paper, sketch a design for your brochure. Lay out the information in short pieces with headings, and leave places for a few pictures. Ask your teacher to approve your design.
2. Produce your brochure using the computer and a word-processing program such as Word, which has ready-made brochure templates available for you to use.

3. Copy and paste or insert clip art and photos, and add text to complete the brochure. Be sure to include important facts and characteristics about the propane industry from your notes.
4. When called on by your teacher, give a short presentation to the class about the propane industry, using your brochure as a visual aid.

### For Newsletter

1. On a sheet of notebook paper, sketch a design for your newsletter. Lay out the information in sections with headings, and leave places for a few pictures. Ask your teacher to approve your design.
2. Produce your newsletter using the computer and a word-processing program such as Word, which has ready-made newsletter templates available for you to use.
3. Copy and paste or insert clip art and photos, and add text to complete the newsletter. Be sure to include important facts and characteristics about the propane industry from your notes.
4. When called on by your teacher, give a short presentation to the class about the propane industry, reading from your newsletter.

### For Newscast

1. On a sheet of notebook paper, develop an outline for the information you will include in your newscast. Come up with an interesting headline. Ask your teacher to approve your outline.
2. Use the computer and a word-processing program such as Word to type the notes for your newscast. Once you have an outline or notes typed, you can then type the actual script that you will read.
3. Find some pictures in books, magazines, or on the computer that you can use to illustrate your newscast as you are talking. Be sure to include important characteristics about the propane industry from your notes.
4. When called on by your teacher, present your newscast about the propane industry to the class.