

# Propane Use in the Home and Agribusiness

**LESSON 10**

**UNIT: PROPANE**

**PROBLEM AREA: PROPANE USE IN AGRICULTURE**



### STUDENT LEARNING OBJECTIVES

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

1. Describe the use of propane in the home and basic safety measures.
2. Describe the use of propane in agribusiness applications.
3. Describe the use of propane in recreational and related applications

### NATIONAL SCIENCE STANDARDS ADDRESSED IN THIS LESSON

All students should develop an understanding of:

#### Physical Science: Content Standard B

- Structure and properties of matter
- Interactions of energy and matter

#### Science in Personal and Social Perspectives: Content Standard F

- Environmental quality

### LIST OF RESOURCES

The following resources may be useful in teaching this lesson:

- [HowStuffWorks.com/Hot-Air-Balloon1](http://HowStuffWorks.com/Hot-Air-Balloon1)
- [Propane.com/VirtualTour](http://Propane.com/VirtualTour)
- [Propane.com/Agriculture](http://Propane.com/Agriculture)
- [Energy.gov](http://Energy.gov)
- [PropaneSafety.com](http://PropaneSafety.com)

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

- Copies of sample test
- Visuals from accompanying masters
- Copies of student lab sheet

### TERMS

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

1. carbon dioxide
2. combustion
3. dehydration
4. greenhouse gas
5. particulate matter
6. pilot light
7. tankless water heaters

**TELL STUDENTS...**

*"Today we are going to look at the various uses of propane in the home, on the farm or other agricultural facility, and for recreational purposes."*

**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.

**LISTING PROPANE USES**

1. After making three labeled columns on the board, ask the students to name propane uses in the home, in agribusiness, and for recreational activities. Have the students write their ideas in the appropriate columns.
2. Next, tell them that propane fuel is used for grain dryers, weed control equipment, grills, laundry dryers, fireplaces, generators, furnaces, water heaters, outdoor lighting, patio heaters, hot air balloons, camp stoves, hot tub heaters, forklifts, greenhouse heaters, and refrigerators because it is a convenient, reliable, clean, and versatile fuel.

# Summary of Content and Teaching Strategies

## OBJECTIVE 1

Describe the use of propane in the home and basic safety measures.

### ANTICIPATED PROBLEM

***What are the uses of propane in the home? What are some basic safety measures?***

Propane is versatile and is used by more than 14 million families

- A. Propane offers many advantages over other fuels. For instance, using propane can reduce greenhouse gas emissions (e.g., carbon dioxide, water vapor, methane, chlorofluorocarbons, and hydrochlorofluorocarbons) that absorb and re-emit infrared radiation, warming the earth's surface and contributing to global warming. When burned, propane emits less than half of the greenhouse gas emissions as an equivalent amount of electricity produced by coal-fired power plants (Energetics 2007). In contrast to gasoline or diesel fuel (which can contaminate water, land, and crops), propane leaks vaporize instantly. Propane has been recognized as a "green" energy and is an approved alternative fuel with the following benefits:
1. Propane is clean burning and nontoxic.
  2. Propane works when and where other energy sources do not; it is reliable.
  3. Propane can offer significant savings over the alternatives.
  4. Propane has built-in safety properties and stringent safety regulations.
- B. Propane clothes dryers are more efficient. They are also gentler on clothes and on the environment than electric models. The moist heat reduces the risk of scorching or discoloring the clothes.
- C. Heating a home with gas costs an average of two times less than heating with electricity (U.S. Department of Energy), although this is highly dependent on the location. Propane furnaces can heat air up to 25 degrees warmer than electricity and emit nearly 70 percent less carbon dioxide than electric furnaces (Energetics). Carbon dioxide (CO<sub>2</sub>) is a colorless and odorless atmospheric gas that is about one and one-half times as dense as air under ordinary conditions; it results from the combustion of organic matter when sufficient oxygen is present.
- D. Professional chefs and many domestic cooks prefer propane ovens and ranges because they provide greater control with precise temperatures and even heat distribution. Instant gas flames allow for cooking without waiting for burners to warm up. When turned off, propane burners also cool faster than electric burners.
- E. Propane water heaters are up to 30 percent less expensive to operate than electric water heaters. In terms of operation, propane tankless water heaters can cost 60 percent less than electric ones (U.S. Department of Energy). Homeowners spend 10 to 20 percent of their annual water heating costs just to keep storage tank water hot. In contrast, the tankless units heat water directly – on demand. Because water is heated only when needed, standby energy loss is reduced by up to 20 percent, costing approximately 60 percent less to operate and emitting 60 percent fewer greenhouse gas emissions than electric models.

- F. Gas inserts in fireplaces can improve indoor air quality in contrast to wood-burning fireplaces, which may increase particulate matter and allergens. Particulate matter is a mixture of solid particles and liquid droplets found in the air. Some particles (e.g. dust, dirt, soot, and smoke) are large or dark enough to be seen with the naked eye; other particles are so small they can be detected only with an electron microscope. A sealed combustion chamber in the insert guarantees 100 percent of combustion (the act or process of burning) byproducts are released outside of the home. In addition, propane fireplaces turn off easily with a switch or a remote control, eliminating the mess and concerns about igniting embers.
- G. More than 63 percent of homeowners who cook outdoors use a propane gas grill (Hearth, Patio, & Barbecue Association) because there is no waiting, no ash to clean up, and no harmful pollutant being expelled.
- H. For safety purposes, all propane supply valves should be closed if the homeowners are leaving for an extended period. Upon return, homeowners should contact a propane retailer or a qualified service technician to conduct a leak check and to relight the pilot lights.
- I. Carbon monoxide detectors can improve safety by sounding an alarm when they detect excessive levels of CO in the air. A CO detector, listed by UL, is recommended for each level of the home. The manufacturer's instructions should be followed regarding installation, location, and maintenance.

### SUGGESTED TECHNIQUES TO HELP STUDENTS MASTER THIS OBJECTIVE

1. Before revealing the information above, have the students explain the uses of propane gas in their homes.
2. The virtual home tour at [Propane.com/VirtualTour](https://www.propane.com/virtualtour) may be used as an interactive visual to supplement the discussion.
3. Use **VM-A** and **VM-B** to assist students in comprehending this objective.

## OBJECTIVE 2

Describe the use of propane in agribusiness applications.

### ANTICIPATED PROBLEM

***What are the uses of propane in agribusiness applications?***

Propane is used on more than 660,000 U.S. farms (80 percent) for items such as grain dryers, fruit dehydrators, incubation and brooding heating systems, fuel for vehicles/machines, irrigation, and greenhouses.

- A. Available as batch dryers (where grain is dried in batches ranging from 80 to 1,000 bushels) or continuous-flow dryers (wet grain is fed into the dryer in a steady stream), propane-powered grain dryers are capable of drying virtually any grain type, which is an important part of most farming operations. Propane is most often used to fuel heated air-drying systems because it is portable, can be stored easily, and is readily accessible in rural areas where natural gas may not be available. Grain must be stored at the correct percent moisture to prevent the growth of aflatoxins—a type of toxic mold.
- B. Propane is used as fuel for the burners of fruit dehydrators. Dehydration is the process of removing water from products like fruits, vegetables, and nuts at accelerated rates and stabilizing the products at low-moisture content without damaging them. Because propane is nontoxic and safe around food, it is an excellent choice for fueling fruit dehydrators.
- C. Propane is used extensively to fuel heating systems (standard convection air or radiant models) for poultry incubation and brooding. Propane-powered poultry brooders, for example, offer more coverage, more even heating, and lower costs than other systems.
- D. Gasoline-powered cars, trucks, tractors, and indoor machines (e.g., forklifts) can be converted to function as dual-fuel vehicles or to operate solely on propane. In a properly modified engine, tractors may exhibit an increase in horsepower because propane has a higher-octane rating than gasoline. Farmers often report that they can pull larger loads at faster speeds after a propane conversion. Unlike propane, other engine fuels emit dangerous fumes; however, because propane produces fewer engine deposits than gasoline and diesel fuel, it results in lower maintenance costs and typically doubles an engine's lifespan. Disadvantages of converting to a propane system are the expense and requirement of certain expertise. Also, distance to suppliers in rural areas can create issues with emergency refueling, and propane bulk tanks can take up a large amount of space. Even with these disadvantages, there are many advantages of using propane-powered vehicles:
  1. Propane is safer because it burns slower, and it has a higher ignition temperature than gasoline.
  2. Propane burns cleaner than diesel fuel and gasoline.
  3. Propane engines can produce as much power as diesel or gasoline engines, but with lower emissions.
  4. Propane leaves no residue or fumes, and fuel spills are not a concern.
  5. Propane's clean-burning properties mean less oil and filter changes.
  6. Propane-powered vehicles generally have long engine life spans (180,000 to 200,000 miles).

- E. Farmers in some parts of the United States rely on irrigation systems to deliver precise amounts of water at just the right time to ensure a productive harvest. They have a variety of energy options to power these systems. Through research funded by the Propane Education & Research Council (PERC) and tools created by the organization, more farmers are realizing the benefits and potential cost-savings of propane systems. Current research and development activities of PERC include emissions reduction, thermal agriculture, fuel cells, and new heating and cooling technologies.
- F. Propane, as a hydrocarbon, yields  $\text{CO}_2$  and water when it burns. Because plants use  $\text{CO}_2$  for photosynthesis, the addition of a propane  $\text{CO}_2$  generator in a greenhouse can increase production by up to 50 percent. Propane heaters (or those fueled by any other hydrocarbon), whether used individually or in multiple units, must be vented to the outside for safety purposes.

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

1. Have the students identify the uses of propane in agriculture and other food, fiber, and natural resources applications.
2. Ask them to explain why propane is a desirable fuel for home and farm use.
3. Use **VM-C** and **VM-D** to show how propane is used in greenhouses.

## OBJECTIVE 3

Describe the use of propane in recreational and related applications.

### ANTICIPATED PROBLEM

*What are the uses of propane in recreational and related applications?*

Propane is used in many outdoor recreational activities by conveniently attaching a fuel cylinder to the appliance. Propane is also used to eliminate mosquitoes and to fuel hot air balloons.

- A. Uses of propane by campers include, but are not limited to, the following:
1. Propane lanterns offer consistent light output regardless of the weather. A 16.4-ounce propane cylinder generally lasts up to 8 hours.
  2. Propane stoves are portable and lightweight, making them ideal for camping. They also offer consistent cooking performance.
  3. Propane portable skillets last up to 2.5 hours on high with a 16.4-ounce propane cylinder.
  4. Most camping applications use 1-pound cylinders.
- B. New mosquito eliminators use propane to protect up to an acre of land. The propane insect-control devices turn propane into CO<sub>2</sub>, heat, and moisture, which are primary mosquito attractants and the same things that attract mosquitoes to humans and animals. The mosquitoes are vacuumed into a net and die of dehydration as they fly toward the eliminator.
- C. Many recreational vehicles (RVs) use propane to fuel cooking and air conditioning units either as the primary energy source or as a backup to electricity.
- D. Another recreational use for propane is to heat air for hot air balloons. The propane is stored in lightweight cylinders positioned in the balloon basket in compressed liquid form. The burner on a hot air balloon is located under an open balloon known as an envelope. When the burner is started, the propane is ignited by a pilot light (a small flame that remains lit to ignite a burner when it is turned on), heating propane that circulates through attached tubing. Hot air does not escape from the hole at the bottom of the balloon because of buoyancy, which allows the hot air balloon to rise and then continue moving upward.

### SUGGESTED TECHNIQUES TO HELP STUDENTS MASTER THIS OBJECTIVE

1. Begin with a discussion. Ask the students how many of them have been camping and if they used a propane camping stove.
2. Ask them for other examples of propane that is used in recreational activities.
3. Use **VM-E** and **VM-F** to assist in the comprehension of this objective.
4. Assign **LS-A** to illustrate the use of propane in hot air balloons.



## 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 visual masters 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. b
2. a
3. e
4. c
5. f
6. g
7. d

### PART TWO: SHORT ANSWER

1. Answers will vary, but they may include three items from the following list or others. Propane is used in the home for furnaces, water heaters, air conditioners, outdoor grills, fireplaces, dryers, and range tops.
2. Answers will vary, but they should include the following information. Propane is clean burning and nontoxic. It is also reliable and will work when and where other energy sources do not. Propane offers a good value over other alternatives. It has built-in safety properties and stringent safety regulations.
3. Answers will vary, but they should include the following information. Propane is a good choice because in contrast to gasoline or diesel fuel spills-which can contaminate water, land, and crops-propane leaks vaporize instantly. Propane is nontoxic and safe around food materials, making it an excellent choice for fueling fruit dehydrators.
4. Propane is beneficial for indoor machinery because it does not emit dangerous fumes like many engine fuels.

### PART THREE: COMPLETION

- |                       |                    |
|-----------------------|--------------------|
| 1. 80 percent         | 6. propane         |
| 2. carbon dioxide     | 7. forklifts       |
| 3. 1                  | 8. 100             |
| 4. particulate matter | 9. 63              |
| 5. 20                 | 10. greenhouse gas |

# Handling Propane Fuel

## PART ONE: MATCHING

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

- |                   |                           |
|-------------------|---------------------------|
| a. dehydration    | e. particulate matter     |
| b. greenhouse gas | f. carbon dioxide         |
| c. combustion     | g. tankless water heaters |
| d. pilot light    |                           |

- \_\_\_\_\_ 1. Something that absorbs infrared radiation and traps the heat in the atmosphere
- \_\_\_\_\_ 2. The process of removing water from products like fruits, vegetables, and nuts
- \_\_\_\_\_ 3. A mixture of solid particles and liquid droplets that are found in the air
- \_\_\_\_\_ 4. The act or process of burning
- \_\_\_\_\_ 5. The results from the combustion of organic matter, if sufficient oxygen is present
- \_\_\_\_\_ 6. Devices that heat water directly and on demand
- \_\_\_\_\_ 7. A small flame that remains lit to ignite a burner when it is turned on

## PART TWO: SHORT ANSWER

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

1. List three places where propane is used in the home.
  
  
  
  
  
  
  
  
  
  
2. Explain why propane is beneficial for home use.

3. Why is propane a good choice for fueling food dehydrators?

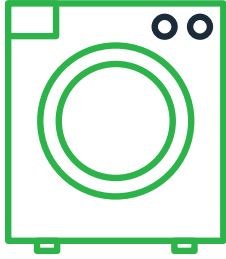
4. What is one benefit of using propane to fuel machinery that is used indoors?

**PART THREE: COMPLETION**

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

1. Approximately \_\_\_\_\_ of U.S. farms use propane.
2. New propane mosquito eliminators turn propane into \_\_\_\_\_, heat, and moisture.
3. Propane mosquito eliminators protect up to \_\_\_\_\_ acre(s) of land.
4. Propane fireplaces can improve indoor air quality and may decrease \_\_\_\_\_ and allergens.
5. Propane tankless water heaters increase the water temperature only when needed, thereby reducing energy loss by up to \_\_\_\_\_ percent.
6. Hot air balloons burn \_\_\_\_\_.
7. Propane is used on the farm for machinery that is used indoors, such as \_\_\_\_\_.
8. Gas inserts in fireplaces have a sealed combustion chamber that guarantees \_\_\_\_\_ percent of combustion byproducts are expelled outside of the home.
9. More than \_\_\_\_\_ percent of homeowners who cook outdoors use propane gas grills.
10. A propane water heater emits 60 percent fewer \_\_\_\_\_ emissions than the electric model.

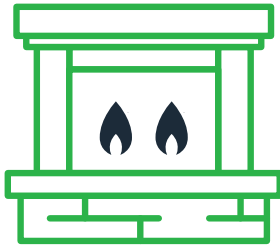
## Propane Uses In The Home



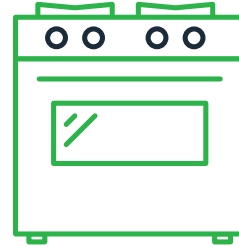
Clothes Dryers



Grills



Fireplaces



Cooking Ovens and Ranges

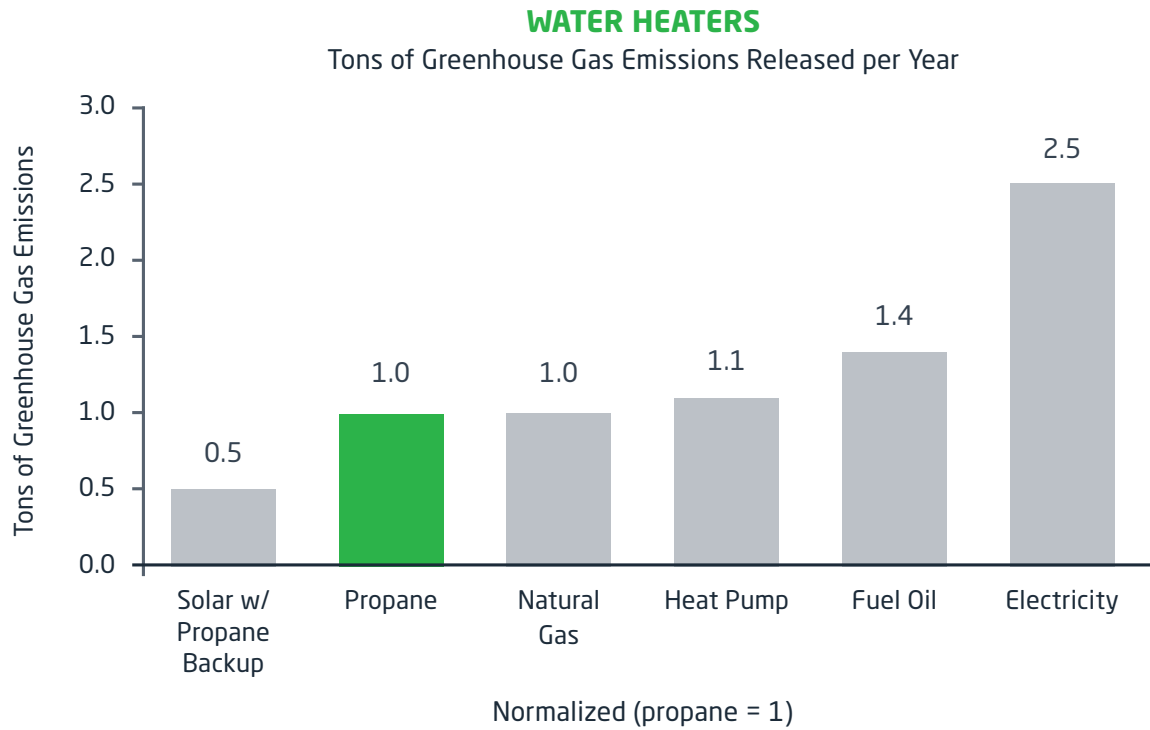


Outdoor Lighting



Hot Water

# Propane Water Heater And Emissions



Source: Energetics, June 2007

## Vented Propane Greenhouse Heater





## Recreational Uses of Propane



Propane Lantern



One-Pound Propane Cylinder



Propane Stove

## Propane Insect Control



# Hot Air Balloon

## PURPOSE

The purpose of this activity is to demonstrate how a hot air balloon works.

## OBJECTIVE

1. Create a hot air balloon that will fly.
2. Explain what happens when air or other gases are heated.

## MATERIALS

- Scissors
- Tape
- Plastic cup
- Lightweight plastic bag
- Hair dryer
- Stopwatch
- VM-G, VM-H, VM-I, and VM-J
- Paper
- Writing utensil

## PROCEDURE

1. To make the basket, cut a plastic cup in half with scissors. The purpose of this is to make the basket lighter, so discard the top portion of the cup.
2. Tape one handle of the plastic bag to the inside of the plastic cup. Then tape the other handle of the bag to the opposite side of the plastic cup on the inside.
3. Hold the plastic bag and fill it with warm air from a hair dryer. The warmer the bag, the higher it will rise when released.
4. Release the bag once the air inside the bag has been heated, and let it rise into the air. Direct hot air into the bag as it rises.
5. After the bag has fallen to the ground, repeat Step 4. This time have your partner push "start" on the stopwatch when the bag is released. Push "stop" when it hits the floor. Record how long it stayed in the air.
6. Repeat Steps 3, 4, and 5. However, use cold air this time. Make sure you change the hair dryer's setting to cool.
7. Write a short report on your procedure and about what you learned. Be sure to explain the cool air and hot air differences in terms of balloon flight.

## Teacher Information Sheet

1. Explain how a hot air balloon rises. The air in hot air balloons is heated by propane. The balloon rises because it contains warmer, less dense air than the cool air around it. The hot air balloon will come down when the air inside the balloon becomes cool.
2. When air or any other gas is heated, it expands. As a result, the air becomes less dense (lighter) because the same amount of air occupies a larger space.
3. This activity can be modified by having the students work in pairs to design a hot air balloon. Have the pairs assemble their designs and test them with a hair dryer. Give each pair a stopwatch, and have them time how long the bag stays in the air. This can be a competition for the best design or for the balloon that flies the highest.

## Cut The Plastic Cup



## Tape The Plastic Bag To The Cup



## Heat The Bag



## The Bag In The Air

