

## *SciGuides Lesson Plan*

### *Guide: Science and Our Food Supply: Grades 5-8* *Theme: Processing and Transportation*

**Title:** Ultra High Pressure Treatment

**Author(s):** FDA/NSTA

**Grade Level:** 5-8

**Subject Area:**

Life Science/Health

#### **Standards Alignment-National Science Education Standards:**

- Life Science
  - Diversity and Adaptation of Organisms
    - Millions of species of animals, plants, and microorganisms are alive today. Although different species might look dissimilar, the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry.
- Science in personal and social perspectives
  - Personal health
    - Natural environments may contain substances (for example, radon and lead) that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.
  - Risks and Benefits
    - Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes, and volcanic eruptions), with chemical hazards, pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacterial, and parasites), social hazards (occupational safety and transportation), and with personal hazards (smoking, dieting, and drinking).
  - Science and Technology in Society
    - Technology influences society through its products and processes. Technology influences the quality of life and the ways people act and interact. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development.

**Time Required:**

One 45-minute class period

**Overall Lesson Goal:**

Students will explore various ways that have been used to preserve food over the ages. They will also learn about techniques used to process food today and hypothesize about other methods scientists might use to safely process food in the future. Finally, students will conduct a simulation of high-pressure treatment and discover how it destroys bacteria without crushing the food.

**Individual Learning Objectives:**

- Students will be able to explain different methods of food preservation.
- Students will be able to explain current food processing techniques.

**Prerequisite Knowledge; Misconceptions/Preconceptions:**

**BACKGROUND**

Use this information to help guide students through this activity and to help them understand the new technology of ultra high pressure treatment.

**Preservation Methods**

- Preservation methods, such as salting, smoking, drying, canning, and freezing, have been used over the years to preserve food. As our scientific knowledge and engineering skills have advanced, so have food-preservation methods. All the early methods preserve food by affecting one or more of the variables needed for bacterial growth, such as temperature, moisture, pH, and nutrients. Many of the preservation methods have a relationship to the four Cs of Food Safety.
- In order for preservation methods to be accepted, foods need to look and taste good. Scientists need to consider the taste, texture, and nutritional value of the food after it's been processed.

**Ultra High Pressure Treatment (UHP)**

- The benefits of using pressure in the production of foods have been known for over 100 years. However, scientists and engineers have only recently developed the equipment necessary to efficiently and reliably generate the high pressure required to kill bacteria. The most recent use of ultra high pressure treatment is to kill both spoilage microorganisms and harmful pathogens, such as *E. coli* O157:H7 and *Listeria monocytogenes*, in foods.
- Ultra high pressure treatment (UHP) works by exposing foods to pressure from 50,000 pounds per square inch (psi) to 100,000 psi for a short time (30 seconds to slightly more than 2 minutes).
- High pressure can impact the life processes (protein function, enzyme action, and cellular membrane function) of living bacterial cells, thus causing the bacteria to die.
  - You could compare this to a fish accustomed to living in shallow waters suddenly being transported seven miles down into the ocean, where the

water pressure is about 18,000 psi. The fish could not withstand the pressure and would die.

- Small macromolecules that are responsible for flavor and nutrition in food are typically not changed by pressure. Thus, high pressure can kill bacteria without affecting the nutrition, color, or texture of food.
- The example of the grape in the water bottle (see procedure on page 46) illustrates that water in foods protects the food structure from physical damage during compression. As long as the food is mostly air-free and contains water, ultra high pressure processing does not “crush” the food. Foods such as deli meats, potato salad, salsa, and fruit pieces, can be exposed to high pressure to reduce spoilage and increase food safety without change to their structure. However, living bacteria can be destroyed by the effects of high pressure on their cellular functions.
- UHP is particularly useful for foods that might be damaged or affected by heat. It’s currently being used to preserve juices, salad dressings, fruit jams, salsas, soups, oysters, guacamole, and yogurt. Its application for other foods is currently being researched.

### **Procedures/Instructional Strategy:**

#### **INTRODUCTION**

Start a discussion by asking: *How do you suppose your great, great, great grandparents kept their food safe without refrigerators, sophisticated manufacturing processes, or without even having electricity?* (Students may suggest salting, drying, canning, chilling, or freezing, etc. Ice houses kept foods chilled year round, and foods could freeze outside during the winter. List students’ responses.)

- *What do all these methods have in common?* (They either kill bacteria or slow down their growth. Plus, they all change the taste or texture of the food.)
- *In addition to destroying bacteria, what are some other issues scientists have to think about when they’re developing methods to preserve food?* (Scientists are continually searching for new methods to kill harmful bacteria in food without damaging the look, taste, texture, or nutritional value of food.)
- Show a variety of foods preserved in different ways and discuss how each method may affect the texture, taste, nutritional value, color, etc., of the food. *What are the positive and negative aspects of each method?*

#### **PROCEDURE**

Let’s see how ultra high pressure treatment works:

1. Ask two students to fill two plastic bottles completely to the top with water, put a grape in each bottle, and tightly close the caps. The water bottle represents the ultra high pressure equipment and the grape is the food being pressurized.
2. Ask: Who thinks they can crush the grape by squeezing the bottle? Why can’t you crush the grape?
3. Why is pressure being applied to the food? How are bacteria killed by the high pressure?

## **SUMMARY**

Throughout the ages, people have found ways to preserve food. Scientists are continually developing new, improved methods of preserving foods. In addition to pasteurization and irradiation, bacteria are now also killed by a new process called ultra high pressure treatment.

### **Outcome/Assessment:**

1. Have the students answer the following questions (this can be done individually or in teams) *Why is pressure being applied to the food* (Pressure is applied to kill the bacteria.)? *How are bacteria affected by the high pressure* (Bacteria are living organisms and the pressure affects their cellular functions. When high pressure is applied to all sides, the enzymes are inactivated.)?

### **Extensions:**

Research and write about food preservation methods in different periods of time. Hypothesize about other ways you can think that science might help us preserve foods in future. How would you design an experiment test your hypothesis? Indicate which foods use your “process” for. Relate your pathogen to this experiment and record the information in your food safety portfolio.

### **Internet Resources:**

- *Food Safety A to Z Reference Guide* (See the following terms: *Bacteria, Canning, Freezing, Irradiation, Pasteurization, Pathogen, Preservation, Ultra High Pressure Treatment.*) Also see the four Cs section on pages 54–63.  
[www.foodsafety.gov/~fsg/teach.html](http://www.foodsafety.gov/~fsg/teach.html)
- *Dr. X and the Quest for Food Safety* video Module 3 - Processing and Transportation.  
[www.foodsafety.gov/~fsg/teach.html](http://www.foodsafety.gov/~fsg/teach.html)

### **Classroom Resources:**

- Two empty plastic soda bottles (not rigid bottles)
- Two grapes
- A variety of foods preserved in different ways, for example:
  - Tomatoes: fresh, sun-dried, canned
  - Fish: salted, fresh, canned
  - Fruit: fresh, dried, canned
  - Herbs: fresh, dried\
- *Dr. X and the Quest for Food Safety* video, Module 3 — Processing and Transportation