Chapter 3: Vegetables

COOKING WITH CHEMISTRY

Most Americans do not eat the variety or amount of vegetables they need for healthy living. For this reason, it is important to learn about the science and nutrition of cooking vegetables. In this chapter, students will explore vegetables by learning about pigments, the physical and chemical changes that occur when acids and bases are cooked with vegetables, and the many health benefits associated with eating vegetables.

FOOD EXPLORATION LABS

Lab I: Exploring Acids & Bases

- Teacher Preparation
- Teacher Lab Answer Key
- Student Lab

Lab II: Cooking with Acids & Bases

- Teacher Preparation
- Teacher Lab Answer Key
- Student Lab

INVESTIGATING YOUR HEALTH

Fabulous Phytochemicals

- Teacher Answer Key

Try This At Home: Pita Pocket Bouquet

SUPPLEMENTAL MATERIALS

Teacher Preparation Slides

Student Pre-Lab Slides & Videos

pH Indicator Chart

Red Cabbage & Apple Recipe

Food Explorations Lab I:
Exploring Acids & Bases

TEACHER LESSON PREPARATION

Lesson Focus

Understand the concept of pH, and the impact of acids and bases on plant pigments.

Lesson Description

This lesson is separated into two parts. In Part A, students will put cabbage juice indicator in two unknown samples. Using a pH chart, students will then determine if the samples are acids or bases. In Part B, students will view the cabbage indicator results, determine pH using a chart, and classify additional household substances as acids, bases, or neutral. They will also identify the two unknowns.

Academic Content Standards

ELA Common Core Standards for Literacy in Science and Technical Subjects (R-reading, W-writing, SL-speaking and listening, L-language) Grades 6-8

R-1 Cite specific textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

R-3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

R-4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical content relevant to grade (6-8) text and topics.

R-10 Read and comprehend complex literary and informational texts independently and proficiently.

W-2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

SL-1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade (6-8) topics, texts, and issues, building on others' ideas and expressing their own clearly.

L-1 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Next Generation Science Standards

Performance Expectations

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Disciplinary Core Ideas

PS1.A Structure and Properties of Matter

- Each substance has characteristic physical and chemical properties that can be used to identify it.
- Substances react chemically in a characteristic way. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

Science and Engineering Practices

Analyzing and Interpreting Data: Analyze and interpret data to determine similarities and differences in the findings.

Scientific knowledge is based on logical and conceptual connections between evidence and explanation.

Crosscutting Concepts

Macroscopic patterns are related to the nature of microscopic and atomic-level structure.

Background Information

Acids and **bases** are determined by the gain or loss of hydrogen ions on the **pH scale**. The pH scale ranges from 0-14. A pH of 7 is considered neutral, a pH below 7 is an acid, and a pH above 7 is a base. Acids lose hydrogen ions while bases gain hydrogen ions. Cooking in acidic or alkaline solutions can affect the color and structure of a vegetable. Depending on the pigment the vegetable contains, its color may or may not change when cooked in an acidic or basic solution. For example, when a red cabbage is cooked or heated in a liquid, the color of the liquid can indicate **pH**. If an acid is added the the liquid, the color will turn red; however, if a based is added to the liquid, the color will turn blue.

The most common base used in cooking is **baking soda**. Its primary function in cooking is to leaven and raise baked products. When green vegetables are cooked in baking soda, the color will become bright green. This occurs because alkaline substances break down **chlorophyll** into chlorophyllin. Chlorophyll is the pigment found in green vegetables. The most common acid used in cooking is **cream of tartar**. Its primary function in cooking is to activate baking soda or to stabilize egg whites. Cream of tartar and baking soda are the components that make baking powder. Other acids used in cooking include vinegar and lemon juice, but these foods can greatly impact taste. Cooking green vegetables in an acid can cause the color to become dull green and the texture to become mushy. This occurs because acidic substances break down chlorophyll into **pheophytin**. Pheophytin is the gray-green color of chlorophyll after it has been broken down. Typically acids are not recommended when

cooking green vegetables due to its negative effect on texture and color. Acids and bases also affect purple, red, and white vegetables containing the **flavonoid** pigment. The effect of acids and bases on this pigment, however, is opposite of that on chlorophyll. Orange and yellow vegetables containing the **carotenoid** pigment are not affected by cooking with acids and bases.

The color of the vegetable is also a sign of the phytochemical it contains. **Phytochemicals** may function as antioxidants or anticancer agents. Vegetable pigments provide many benefits for the body because of their phytochemical content. Some red vegetables, such as tomatoes, contain **lycopene**. Lycopene may reduce the risk of cancer and protect the heart and lungs against diseases. **Flavonoids** are found in red/purple vegetables and research has found that they may reduce the risk of heart disease, cancer, blood clots, and stroke. Some examples of red/purple vegetables are red cabbage and red bell peppers. Orange vegetables, like carrots and sweet potatoes, contain **beta-carotene**, which can help your immune system, protect your eyes, skin, and bones, and prevent heart disease. **Lutein** is found in yellow/green vegetables, such as corn, green beans, spinach, and green bell peppers. Lutein helps keep your eyes and heart healthy.

Green vegetables include broccoli, Brussels sprouts, cabbage, kale, and cauliflower. These green vegetables contain **indoles**, which may help to protect against cancer. Onions and other white vegetables contain **allicin**, which also may help to prevent cancer. Some red or yellow vegetables, such as beets, contain **betalains**. Researchers have found that betalains provide anti-inflammatory and detoxification properties, which helps to prevent disease. Orange vegetables, such as carrots, contain carotenoid pigments. **Carotenoids** may play a role in improving vision and aiding in the reduction of eye disease. White vegetables, such as onions, contain **anthoxanthin** pigments. Anthoxanthins may help lower cholesterol and blood pressure. Vegetables, such as asparagus, contain chlorophyll, which are green pigments. Research has shown that **chlorophyll** can provide cancer-fighting properties. It has been found to treat and prevent certain types of cancer when used as **chlorophyllin**. Chlorophyll is converted to chlorophyllin when cooked in an alkaline solution resulting in a bright green appearance. Vegetables, such as red cabbage, contain anthocyanins, which include red-purple and blue pigments. **Anthocyanins** are most notably known for their circulatory benefits. Research has found a relationship between anthocyanins and a reduction in blood pressure and prevention of cardiovascular diseases.

Materials

Teacher Materials

NOTE: Teacher material list is based on 6 groups of 4-5 students (24-30 students total).

Part A

1 head red cabbage (1 large head will make enough pH indicator for 4 classes)
1 bottle of vinegar (16 fluid ounces)
1 box of baking soda
3 ½ quarts water
12 - 9 oz. clear plastic cups (2 per group)

2 hot plates or 1 double burner
1 - 50 mL graduated cylinder or metric measuring cup
1 tablespoon
1 black permanent marker
1 pitcher to hold cabbage juice
1 - 2 large pots

Part B
Remaining red cabbage juice from Part A
1 bottle of vinegar from Part A
1 box of baking soda from Part A
1 container of cream of tartar
1 container salt
24 - 9 oz. clear plastic cups (4 per group)
1 - 50 mL graduated cylinder or metric measuring cup
1 teaspoon
1 black permanent marker

Student Materials

NOTE: Student material list is based on 1 group of 4-5 students. Refer to the "Equipment and Material Lists by Chapter" on page XIV of the FoodMASTER Middle Teacher Edition for whole class estimates (24-30 students divided into 6 groups) for perishable and nonperishable materials.

Safety goggles
Aprons (optional)

Part A per group
1 clear plastic cup containing Unknown Sample A (baking soda)
1 clear plastic cup containing Unknown Sample B (vinegar)
1 – 250 mL beaker or jar containing 200 mL of red cabbage juice
1 – 100 mL graduated cylinder or metric measuring cup
2 plastic spoons
1 pH color chart

Part B for class
1 clear plastic cup containing Unknown Sample A (baking soda) from Part A
1 clear plastic cup containing Unknown Sample B (vinegar) from Part A
2 or 3 labeled plastic cups, beakers, or jars containing baking soda and cabbage juice
2 or 3 labeled plastic cups, beakers, or jars containing vinegar and cabbage juice
2 or 3 labeled plastic cups, beakers, or jars containing cream of tartar and cabbage juice
2 or 3 labeled plastic cups, beakers, or jars containing salt and cabbage juice
1 pH color chart

Teacher Pre-Lab Preparation

1. Review teacher background information, teacher preparation slides, student pre-lab slides/videos, student introduction, suggested instructional plan, and the student *Food Exploration* lab investigation procedures.

2. You will need to produce at least 200 mL per group of students (Part A), plus an additional 1000-2500 mL for Part B. Boil shredded red cabbage in large pots for 5-10 minutes with 2.5-4 liters of water and pour liquid into pitcher (this will be the pH indicator). If you do not have a pot large enough to hold 2.5-4 liters of water, the indicator can be made in smaller batches. The water should be a deep purple color. Remember to save some cabbage for tasting!

3. **Part A** - Prepare the following for each group:

   - Plastic cup with Unknown Sample A- put in ½ Tbsp. baking soda (label cup "Unknown Sample A" with permanent marker)
   - Plastic cup with Unknown Sample B- put in 50 mL vinegar (label cup "Unknown Sample B" with sharpie)

TIMESAVER: To save time, pre-measure 200 mL of cabbage juice for student groups ahead of time in a beaker or jar.

4**. Part** B - Prepare the following for the class:

   - 2 or 3 labeled plastic cups, beakers, or jars containing 1 tsp. of cream of tartar and 100 mL of cabbage juice
   - 2 or 3 labeled plastic cups, beakers, or jars containing 1 tsp. baking soda and 100 mL of cabbage juice
   - 2 or 3 labeled plastic cups, beakers, or jars containing 1 tsp. of salt and 100 mL of cabbage juice
   - 2 or 3 labeled plastic cups, beakers, or jars containing 50 mL of vinegar and 100 mL of cabbage juice

TIP: The number of observational containers needed depends on class size. A minimum of two is recommended. Preparing the containers may be a class demonstration. If time and materials allow, Part B may be done as a lab investigation by providing each student group with 4 labeled clear plastic cups containing the baking soda, cream of tartar, salt and vinegar, 500 mL beaker or jar containing 400 mL of cabbage juice, 1 – 100 mL graduated cylinder or measuring cup, and 6 plastic spoons.

Suggested Instructional Plan

1. Review scientific vocabulary and knowledge prerequisites:

Acid	**Base**	**pH Scale**
Physical Change	**Chemical Change**	

2. Consider having your students research common acids and bases prior to beginning the lab investigation. You may also want them to investigate the health benefits of vegetables (see *Investigating Your Health*).

3. Distribute Materials:

   It is recommended that materials are organized into stations for easier distribution. Materials are recommended based on the amount needed for 1 class of 30 students. Students should be arranged in small groups of 4-5.

   Each group should receive:

   - Student Lab Investigation Worksheets (1 per student)
   - Part A Materials

4. Ask students to read *Cooking with Chemistry* and complete the focus questions for this lab investigation.

5. Before beginning the lab investigation:

   a. Require students to wash their hands.

   b. Allow students to taste a sample of the red cabbage prior to beginning any investigation procedures. This process is important for increasing student exposure to healthy foods and decreasing the likelihood that students will be tempted to taste foods included as investigation materials.

   c. Emphasize the importance of practicing good food safety behaviors by not consuming substances used as part of the lab investigation.

6. Launch **Part A** of the lab by asking students to observe and respond to the lab question. See *Food Exploration* lab for specific investigation procedures for students.

   a. *Sample B:* When vinegar is mixed with the indicator (cabbage juice), the solution should turn ruby red.

   b. *Sample A:* When baking soda solution is mixed with indicator, the solution should foam and turn a bluish color. The color change may be faint and similar to the purplish color of the pH indicator. Encourage students to hold the jar up to a light source to determine a true color change.

7. Allow students to work in small groups on the Student Lab Investigation worksheet to further explore the topic and respond to lab questions.

8. After completing initial acid/base observations and conclusions, students should be prepared to begin Part B.

9. **Part B** should begin by showing students the provided video lab demonstration *(Part I: Exploring Acids & Bases Demonstration Video)* or allowing students to observe the pre-prepared containers that contain pH indicator mixed with cream of tartar, baking soda, salt, or vinegar. See *Food Exploration* lab for specific investigation procedures for students.

10. Distribute additional materials needed for Part B and allow students to work in small groups on the Student Lab Investigation worksheet to further explore the topic and respond to lab questions.

11. Follow-up with a class discussion about pH and the impact of various acids and bases on pigments. Follow-up this lesson with the *Investigating Your Health* investigation. See *Teacher Bites* for ideas on how to further extend this lesson.

Teacher Bites: Lesson Extension

- Do all acids and bases have the same pH value?
- Using the pH scale, which values indicate an acid?
- Using the pH scale, which values indicate a base?
- Brainstorm other examples of acids and bases that you might eat.
    - Lemon juice -2
    - Vinegar- 3
    - Rainwater- 5
    - Milk- 6
    - Pure water- 7
    - Egg whites- 8
    - Baking soda- 9
    - Ammonia- 11
    - Sodium hydroxide- 14
- Instruct student to mix acidic (red) and basic (green/blue) solutions to produce a neutralized solution (purple). This step will further demonstrate the range of the pH scale.
- Explore pH further by making indicator paper. Simply prepare the fluid pH indicator as usual. Briefly soak white construction paper in the indicator fluid. Set paper out to dry. Once dry, the paper can be cut into strips (2 inches long x ½ inch wide) and used as indicator paper to identity liquid acidic and basic solutions.

Food Explorations Lab II:
Cooking with Acids & Bases

TEACHER LESSON PREPARATION

Lesson Focus

Explore the impact of acids and bases on plant cell structure.

Lesson Description

Students will compare the appearance and texture of raw vegetables and vegetables cooked in acidic and basic solutions. Using a microscope, students will also view organelles of onion skin cells to better understand how the acidic and basic solutions may affect the cell wall.

Academic Content Standards

ELA Common Core Standards for Literacy in Science and Technical Subjects (R-reading, W-writing, SL-speaking and listening, L-language) Grades 6-8

R-1 Cite specific textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

R-3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

R-4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical content relevant to grade (6-8) text and topics.

R-7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g. in a flowchart, diagram, model, graph or table).

R-10 Read and comprehend complex literary and informational texts independently and proficiently.

W-2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

SL-1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade (6-8) topics, texts, and issues, building on others' ideas and expressing their own clearly.

L-1 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Next Generation Science Standards

Performance Expectations

MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Disciplinary Core Ideas

PS1.A Structure and Properties of Matter:

- Each substance has characteristic physical and chemical properties that can be used to identify it.
- Substances react chemically in a characteristic way. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

Science and Engineering Practices

Analyzing and Interpreting Data:

- Analyze and interpret data to determine similarities and differences in the findings.
- Scientific knowledge is based on logical and conceptual connections between evidence and explanation.

Crosscutting Concepts

Macroscopic patterns are related to the nature of microscopic and atomic-level structure.

Performance Expectations

MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

Disciplinary Core Ideas

LS1.A Structure and Properties of Matter: Within cells, special structures are responsible for particular functions, and the cell forms the boundary that controls what enters and leaves the cell.

Science and Engineering Practices

Develop and use a model to describe phenomena

Background Information

See Teacher Lesson Preparation under *Food Lab Explorations Part I.*

Materials

Teacher Materials

NOTE: Teacher material list is based on 6 groups of 4-5 students (24-30 students total).

2 large heads of broccoli
1 bag of baby carrots

2 white onions
¼ cup baking soda (base)
4 Tbsp. white vinegar (acid)
1 cup water
18 plastic sandwich bags
4-Quart pot (or larger)
2 hot plates or 1 double burner
tongs/large spoon for cooked vegetables
cutting board
1 knife

Student Materials

NOTE: Student material list is based on 1 group of 4-5 students. Refer to the "Equipment and Material Lists by Chapter" on page XIV of the FoodMASTER Middle Teacher Edition for whole class estimates (24-30 students divided into 6 groups) for perishable and nonperishable materials.

Safety goggles
Aprons (optional)
1 sandwich bag containing raw vegetables to taste
2 paper plates
1 black permanent marker
pre-labeled sandwich bags of cooked vegetables (for class to take samples from)

Lab Extension
1 microscope slide with cover slip
1 microscope
cell stain
2 medicine droppers
1 plastic sandwich bag containing a very thin slice of onion

Teacher Pre-Lab Preparation

1. Review teacher background information, teacher preparation slides, student pre-lab slides/videos, student introduction, suggested instructional plan, and the student *Food Exploration* lab investigation procedures.

2. Cut broccoli, carrots, and white onion into small pieces for each group.

3. Make a plastic sandwich bag of raw vegetables containing 1 sprig (small shoot) of broccoli, 2 small carrots, and 1 piece of white onion for each group.

4. (Optional) Make a plastic sandwich bag of very thinly sliced onion (to be used for lab extension). To cut, lay a piece of onion flat on a cutting board. Run the blade of a knife across the top of the onion to slice a thin piece (with the grain).

5. Begin boiling vegetables before or at the start of the lesson. Boil vegetables for 5-10 minutes. Vinegar (4 tbsp. - acid) and baking soda (1/4 cup – base) should be added to one pot of vegetables each before boiling.

   TIP: Vegetables may be cooked the day before. Cover and refrigerate overnight.

6. Prepare samples of each vegetable type for students to observe. Place cooked vegetable samples into each of the bags labeled "acid" and "base". If possible, refrigerate samples until you are ready to use them for observational purposes.

   TIP: One set of vegetables cooked in vinegar and baking soda is recommended; however, if your class size is smaller or larger, a different number may be needed.

TIMESAVER: Paper plates with cooked vegetables for each group can be prepared before class ahead of time. Cover with plastic wrap and refrigerate. Another option is to have the first class prepare the paper plates as indicated by the directions and save the plates for use in other classes. Both of these methods will save on the amount of vegetables needed.

Suggested Instructional Plan

1. Review scientific vocabulary and knowledge prerequisites:

Acid	**Base**	**pH Scale**
Physical Change	**Chemical Change**	**Microscope**
Cells	**Organelles**	**Cell Wall**

2. Consider having your students review example vegetable recipes that include an acidic or basic ingredient prior to making lab predictions. An example of an acid-containing recipe is provided for you. See *Teaching Training* slides for photographs. Vegetable recipes do not commonly include basic substances because these substances result in a breakdown of cell structure (e.g. mushy texture) and nutrient composition. However, in some cases the addition of base can actually improve the availability of nutrients in the vegetable. For example, as stated earlier, adding baking soda when cooking a green vegetable (i.e. asparagus and green beans) will result in chlorophyll breaking down to chlorophyllin. This reaction increases the availability of the antioxidant/phytochemical indole.

3. Distribute Materials:

   It is recommended that materials are organized into stations for easier distribution. Materials are recommended based on the amount needed for 1 class of 30 students. Students should be arranged in small groups of 4-5.

   Each group should receive:

   - Student Lab Materials
   - (Optional) Lab Extension Materials

4. If applicable, ask students to read or review *Cooking with Chemistry* and complete the focus questions for this lab investigation.

5. Before beginning the lab investigation:

   a. Require students to wash their hands.

   b. Allow students to taste a sample of raw broccoli, carrots, and onion *prior to beginning* any investigation procedures. This process is important for increasing student exposure to healthy foods and decreasing the likelihood that students will be tempted to taste foods included as investigation materials.

   c. Emphasize the importance of practicing good food safety behaviors by not consuming substances used *during* the lab investigation.

6. Launch the lab by showing students the provided video lab demonstration, *Part II: Cooking with Acids & Bases Demonstration Video*.

7. Allow students to make predictions about what will happen to each vegetable when cooked in acidic and basic solutions. See *Food Exploration* lab for specific investigation procedures for students.

8. Pass out plates containing cooked vegetables and allow students time to observe the cooked vegetable samples and work in small groups on the Student Lab Investigation worksheet.

   Tip: Students may be directed to cover the cooked vegetable plates with plastic wrap so that the plates can be used with other classes.

9. For conclusion question #4, pass out a copy of the Red Cabbage and Apples Recipe. Instruct students review it prior to answering the question.

10. (Optional) Launch the lab extension by allowing students time to observe a plant cell (onion) under the microscope. Students should examine the plant cell for the nucleus, cytoplasm, and cell wall.

11. Follow-up with a class discussion about the impact of various acids and bases on cell structure. Follow-up this lesson with the *Investigating Your Health* investigation. See *Teacher Bites* for ideas on how to further extend this lesson.

Teacher Bites: Lesson Extension

- If time permits, also observe an onion cooked in an acid and a base under the microscope and compare to observation of raw vegetable (onion).

- Demonstrate the concept of leaching. Leaching refers to the loss of water-soluble nutrients that can occur when boiling plant-based foods (e.g. vegetables).

Investigating Your Health:
Fabulous Phytochemicals

STUDENT HEALTH INVESTIGATION

Lesson Focus

Explore the health benefits of consuming vegetables. Students will keep a log of the number and types of vegetables they eat over a period of one week.

Lesson Description

Students will research the health benefits and vegetable sources of the phytochemicals. Students will keep a diary for a week identifying the vegetables they eat, each vegetable's phytochemical, and each vegetable's health benefits. The students will also evaluate their diet to determine if they are eating the recommended daily amount of vegetables.

Academic Content Standards

ELA Common Core Standards for Literacy in Science and Technical Subjects (R-reading, W-writing, SL-speaking and listening, L-language) Grades 6-8

R-1 Cite specific textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

R-4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical content relevant to grade (6-8) text and topics.

R-10 Read and comprehend science/technical texts in the grades 6-8 text.

W-2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

W-7 Conduct short research projects to answer a question (including a self-generated question) drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

W-9 Draw evidence from informational texts to support analysis, reflection, and research.

Next Generation Science Standards

Performance Expectations

MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

Disciplinary Core Ideas

LS1.C Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, support growth, or release energy.

Science and Engineering Practices

Analyzing and Interpreting Data: Analyze and interpret data to determine similarities and differences in the findings.

Suggested Instructional Plan

1. Review Scientific Vocabulary and Knowledge Prerequisites:

   Phytochemicals **Pigments**

2. See the Teacher Edition workbook for answers to the *Investigating Your Health* lab questions.

3. If completed in-class, allow students to work in small groups on the Investigation worksheet to further explore the topic and respond to questions.

4. Follow-up with a class discussion about student findings related to the health benefits of vegetables and student generated ideas for increasing vegetable consumption.