



## THE TOMATO...FLAVORFUL OR FLAVORLESS?

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### Annotation

In this classroom activity, students will explore the principles of sensory evaluation as they conduct and analyze an intent to purchase evaluation—a type of consumer acceptability test that is used to determine the likelihood that consumers would purchase a particular product.

### Primary Learning Outcomes:

Students will be able to define the term *intent to purchase evaluation* and explain its use.

Students will be able to analyze data by calculating and interpreting arithmetic means and numerical ranges.

Students will be able to explain the importance of sensory evaluation in food science.

### Assessed Georgia Performance Standards:

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SCSh3. Students will identify and investigate problems scientifically.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

### *Physical Science Content*

SPS2. Students will explore the nature of matter, its classifications, and its system for naming types of matter.

### *Chemistry Content*

SC1 Students will analyze the nature of matter and its classifications.

### Related Topics:

Data Analysis

Organic Compounds

### Duration:

Preparation: 15 minutes

Introduction: 20 minutes

Student Activity: 10 minutes

Conclusion: 15 minutes

**Total Class Time: 45 minutes**

### Materials and Equipment:

For Teacher Preparation:

(Per class of 30 students)

1. 4 Supermarket tomatoes
2. Cutting board
3. Knife
4. 30 Paper plates
5. 30, 5-oz. Plastic cups
6. Gallon of drinking water
7. Saltine® crackers
8. Napkins
9. 4 Vine-ripened tomatoes (*For Optional Extension*)

Per Student:

1. *The Tomato...Flavorful or Flavorless* student handout
2. Tomato sample
3. 5-oz. Cup of water
4. 2 Saltine® crackers
5. Napkin

### **Safety:**

Because students will be allowed to eat during the activity, precautions should be taken to prevent materials from coming into contact with laboratory equipment or surfaces. Materials should remain in cups or on clean napkins at all times.

### **Technology Connection:**

Not applicable

### **Procedures:**

#### Teacher Preparation:

Use the attached template to prepare *The Tomato...Flavorful or Flavorless* student handout for each student. Slice each tomato into eight sections. For each student, place one section onto a plate.

#### *Estimated Time:*

15 minutes

#### Introduction:

Sensory evaluation, an important area of food science, is a tool used to analyze and interpret human sensory responses to food products based on the five senses: sight, sound, smell, taste, and touch. Sensory evaluation is used to improve existing food products or to determine consumer acceptability of new food products. Several types of sensory tests are used. Consumer acceptability tests measure the acceptability of a product to the consumer. An *intent to purchase evaluation* is a type of consumer acceptability test that is used to determine the likelihood that consumers would purchase a particular product. During an intent to purchase evaluation, panelists are presented with a sample and asked to rate, most often on a scale of 1 to 5 (1 being least likely and 5 most likely), the likelihood that they would purchase the item if it were available for purchase. Data is compiled from the panelists and

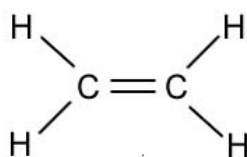
analyzed to determine the overall likelihood that consumers would purchase the product (the mean response), and thus, consumer acceptability of that product.

Do you eat tomatoes? Most Americans do. In fact, Americans consume more than 12 million tons of tomatoes annually, averaging per person roughly 18 pounds of fresh tomatoes and nearly 70 pounds in processed forms such as ketchup and tomato sauce.

Explain to students that they will be sampling tomato, *Lycopersicon esculentum*. Botanically a berry fruit, the tomato was domesticated in Mexico and is consumed as a vegetable. The tomato is among the most popular fruits and vegetables consumed in the world; however, that was not always the case. Upon introduction, Americans were reluctant to consume the tomato for fear that it was poisonous. This fear was based on the tomato's place in the Solanaceae family, a family that also includes poisonous nightshades. Not until September of 1820, when Robert Gibbon Johnson ate the fearful fruit and survived, did Americans begin to confront their tomato phobia. Today the tomato is the second-largest vegetable crop in dollar value consumed in the United States.

Although the tomato is a popular fresh produce item, consumers often complain that supermarket tomatoes lack the characteristic flavor of the “garden-grown” variety. Flavor is defined as the combination of taste, perceived on the tongue, and aroma, perceived in the nose. Fresh tomato flavor results from a combination of non-volatile taste compounds, such as sugars (glucose and fructose) and organic acids (citric and malic acids) and approximately thirty volatile aromatic compounds, including hexanal, *cis*-3-hexenal, and *trans*-2-hexenal. These compounds or their precursors are formed during ripening of the fruit.

Tomatoes are either allowed to ripen on the vine (vine-ripened) or are picked green and artificially ripened. The method of ripening greatly impacts tomato flavor. In contrast to vine-ripened tomatoes, most supermarket tomatoes are artificially ripened. Artificially ripened tomatoes are harvested while they are still green and ripened with ethylene (C<sub>2</sub>H<sub>4</sub>; Figure 1) to enhance yield, fruit size, lack of defects, and disease resistance. During this artificial ripening process, ethylene, a naturally occurring plant hormone that is responsible for plant ripening, is applied to fruit in the form of ethylene gas. Early harvest and gas treatment of supermarket tomatoes blocks the production of many important tomato flavor compounds, thus greatly decreasing the overall flavor of the fruit. In addition, artificial ripening greatly impacts the color and texture of the fruit.



**Figure 1: Ethylene**

After harvest, tomatoes are often transported long distances before reaching the consumer. Green, unripened tomatoes have a firmer flesh that softens during ripening. Thus, picking tomatoes early and shipping while still firm prevents physical damage to the fruit. This however, provides consumers with a less flavorful product. In 1994, the Flavr Savr tomato, the world's first genetically modified fruit or



vegetable approved by the FDA, was introduced in the United States. The Flavr Savr tomato, developed using antisense technology, was designed to provide supermarket shoppers with a genuine vine-ripened product. The tomato was modified to block the gene that produces polygalacturonase, an enzyme that degrades pectin and softens fruit. This allowed the tomato to ripen longer on the vine, thus enhancing the flavor, while also maintaining firmness of the fruit and preventing damage to the fruit during transport. The Flavr Savr tomato was removed from the market after only three years due to business complications and lack of consumer interest.

Explain to students that their task is to sample the tomato and indicate the likelihood that they would purchase that particular tomato.

*Estimated Time:*  
20 minutes

**Activity:**

Provide each student with the materials listed above. Ask students to sample the tomato and indicate on *The Tomato...Flavorful or Flavorless* student handout the likelihood that they would purchase that particular tomato. Students should use the water and crackers to cleanse their palates before sampling.

*Estimated Time:*  
10 minutes

*Optional Extension: If possible, obtain vine-ripened tomatoes from a local farmer's market or produce stand. Have students sample the vine-ripened tomatoes and indicate their likelihood of purchase. As a class, compile and compare results with those for the supermarket tomatoes.*

**Conclusion:**

As a class, compile the data on the board. Discuss with students reasons for their selections. Have students individually answer the post-laboratory questions found on *The Tomato...Flavorful or Flavorless* student handout.

*Estimated Time:*  
15 minutes

**Assessment:**

Assessment should be based on completion of *The Tomato...Flavorful or Flavorless* student handout.

**References:**

- Cardulla, F. 1999. Spoiled Produce – The Long and Short of It. *ChemMatters*. April: pp. 7-8.
- Meilgaard, M., Civille G.V., and Carr B.T. 1991. *Sensory Evaluation Techniques*. CRC Press. Boca Raton, Florida.
- Petro-Turza, M. 1987. Flavor of tomato and tomato products. *Food Reviews International*. 2(3): pp. 309-351.



## THE TOMATO...FLAVORFUL OR FLAVORLESS? *Student Handout*

### **Introduction:**

Sensory evaluation, an important area of food science, is a tool used to analyze and interpret human sensory responses to food products based on the five senses: sight, sound, smell, taste, and touch. Sensory evaluation is used to improve existing food products or to determine consumer acceptability of new food products.

An intent to purchase evaluation is a type of consumer acceptability test that is used to determine the likelihood that consumers would purchase a particular product. During an intent to purchase evaluation, panelists are presented with a sample and asked to rate, most often on a scale of 1 to 5 (1 being least likely and 5 most likely), the likelihood that they would purchase the item if it were available for. Data is compiled from the panelists and analyzed to determine the overall likelihood that the consumers would purchase the product (the mean response), and thus, consumer acceptability of the product.

In this activity, you will be sampling tomato. Your task is to determine the likelihood that you would purchase a particular tomato.

### **Purpose:**

To use intent to purchase testing to determine the likelihood of purchase of a tomato sample.

### **Materials:**

1. Tomato sample
2. Cup of water
3. 2 Saltine® crackers
4. Napkin

### **Tomato Intent to Purchase Evaluation:**

On a scale of 1 to 5 (1 being least likely and 5 being most likely), indicate with an “X” the likelihood that you would purchase this product if it were available for purchase.

1      \_\_\_\_\_  
2      \_\_\_\_\_  
3      \_\_\_\_\_  
4      \_\_\_\_\_  
5      \_\_\_\_\_

### **Post-Laboratory Questions:**

1. What is the average likelihood of students in the class to purchase the tomato? Include in your answer the mean score and range for the class data.
2. Based on the class data, how well do you think the tomato would sell in a local supermarket?

