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By Golly, By Gum

Topic

Food: sweeteners and flavorings in gum

Key Question

What happens to the mass of gum after it has been chewed for 10 minutes?

Learning Goals

Students will:

- use the scientific method to discover what happens to the mass of gum as it is chewed, and
- make a bar graph of data comparing the masses before and after chewing.

Guiding Documents

Project 2061 Benchmarks

- No matter how parts of an object are assembled, the weight of the whole object made is always the same as the sum of the parts; and when a thing is broken into parts, the parts have the same total weight as the original thing.
- Measurements are always likely to give slightly different numbers, even if what is being measured stays the same.

NRC Standards

- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.

NCTM Standards 2000*

- Understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute
- Collect data using observations, surveys, and experiments
- *Represent data using tables and graphs such as line plots, bar graphs, and line graphs*

Math

Measurement mass



Whole number operations Fractions Percent Graphs

Science

Life science health and nutrition Physical science changes in matter

Integrated Processes

Observing Predicting Collecting and recording data Interpreting data Comparing and contrasting Drawing conclusions Generalizing

Materials

For each group: balance metric masses pack of gum (see Management 5) calculator crayons or markers

Background Information

There are three things that could happen to the mass of gum when it is chewed. One possibility is that the gum might gain mass since it is picking up saliva from the mouth. Another possibility is that the mass of the gum might stay the same since saliva is being added while sweeteners are being swallowed. A third possibility is that the mass of the gum will decrease since sweeteners and flavorings are being dissolved and swallowed.

What actually happens may be surprising. Sweeteners and flavorings provide the majority of the gum's mass. Most gums containing sugar lose 60-75% of their mass after being chewed for 10 minutes. Sugar-free gum will lose about 50% of its mass in 10 minutes. Gum labels list all ingredients by amount, with the substances having the greatest amount being listed first. The mass that is lost while gum is being chewed is dissolved in saliva and swallowed in the form of sugar and artificial flavorings. Many brands of gum contain more than one type of sugar, with corn syrup, dextrose, and glucose often listed as ingredients. Sugar-free gum will contain artificial sweeteners such as aspartame, sorbitol, or saccharin.

Management

- 1. Caution: Be aware that the sugar in gum may cause problems for students with diabetes or hypoglycemia.
- 2. Some teachers like to use the small, half-teaspoon sized sugar cubes instead of gram masses.
- 3. Students should work in groups of five so that each member chews one stick of gum.
- 4. Use a variety of brands and flavors of gum. Bubble gum works well since it has the greatest mass per piece to begin with and loses more mass than other types of gum.
- 5. While it is possible to find the before-and-after mass of individual pieces of gum, the results are much more accurate and impressive if the before-andafter mass of a pack of gum is found. For sanitary reasons, place the gum on the individual wrappers whenever finding the mass.
- 6. This activity has three parts, each taking 20-30 minutes. In *Part One*, students use the scientific method when they make and test their predictions. In *Part Two*, students use the data collected by each group to calculate the percent of sweetener and flavorings. In *Part Three*, students make a bar graph of the beforeand-after masses of each group's pack of gum.
- 7. Overhead transparencies of the activity sheets are helpful for recording class data.

Procedure

Part One:

- 1. Discuss the *Key Question* and the three possible hypotheses (see *Background Information*).
- 2. Instruct students to record their predictions on the activity sheet.
- 3. Have the class discuss ways to test the predictions.
- 4. Decide on a class plan (or let each group come up with their own) for finding out what happens to the mass of gum after chewing. It is important that the beforeand-after mass of the gum is quantified in some way so that *Part Two* of the activity can be done.
- 5. Have students record their plan. One such plan might direct each group to:
 - a. Get a balance, masses, and a pack of gum.
 - b. Save the outside wrapper for checking on ingredients later.
 - c. Find and record the total mass of the five pieces of gum with individual wrappers.
 - d. Chew the gum for 10 minutes and then put it back in the wrappers.
 - e. Find and record the mass of the chewed gum.
 - f. Analyze data to check predictions.

- 6. Have students do the activity.
- 7. Discuss the results. Students should share their predictions and how they were either validated or shown to need revision.
- 8. Direct students to read the list of ingredients on the outside labels of the various packs of gum and discuss what mass was lost in chewing.
- 9. Have students write their conclusions.

Part Two:

- 1. Hand out the activity page. Share and record the data for each group: brand, flavor, mass before chewing, and mass after chewing.
- 2. Have students do the calculations with or without a calculator for the difference, ratio, and percent of sweetener and flavorings in each pack of gum.
- 3. Discuss the results.

Part Three:

- 1. Have students construct a bar graph showing the mass before and after chewing for each pack of gum.
- 2. Discuss the graph.

Connecting Learning

Before doing the activity:

- 1. What *could* happen to the mass of gum as it is chewed? [increase, decrease, stay the same]
- 2. What *could* cause the mass to increase? ...decrease? ...stay the same?
- 3. How can you find out what happens?

After doing the activity:

- 1. What *does* happen to the mass of the gum after it is chewed for 10 minutes?
- 2. How can you explain this?
- 3. What are the ingredients in your pack of gum?
- 4. What ingredient in your gum has the most mass?
- 5. What do you think happens to this ingredient as you chew? How can you tell?
- 6. How did the brand or flavor of gum affect the amount of mass lost?
- 7. What does your graph tell you?
- 8. What other questions can you think of that stem from this activity?

Extensions

- 1. Do By Golly, By Gum, By Time.
- 2. Chew gum for 20 minutes; compare results.
- 3. Do the activity using different types of gum, including sugar-free.
- 4. Students can make math word problems from data.
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By Golly, By Gum



• Key Question • What happens to the mass of gum after it has been chewed for 10 minutes?

Learning Goals

Sudants wille

- investigate what happens to the mass of gum as it is chewed, and
- make a bar graph of data comparing the masses before and after chewing.



By Golly, By Gum Part One
What happens to the mass of gum after it is chewed for 10 minutes?
Prediction: I think the mass will because
Plan for testing your prediction on the back of this paper.
Results: Mass of gum before chewing
Mass of gum after chewing
Conclusions:

	% Sweetener & Flavorings Ratio × 100 = %							
G Part	Ratio <u>Difference</u> Total							
IV B	Difference							
y Gol tener e in gum?	Chewed Mass of Pack (grams)							
B much swee	, Total Mass of Pack (grams)							
How	Flavor							
	Brahd	1.	2.	3.	4.	5.	6.	7.



JAW BREAKERS AND HEART THUMPERS



By Golly, By Gum

Connecting Learning

1. What could happen to the mass of gum as it is chewed?

- 2. What does happen to the mass of the gum after it is chewed for 10 minutes?
- 3. What are the ingredients in your pack of gum?
- 4. What ingredient in your gum has the most mass?
- 5. What do you think happens to this ingredient as you chew? How can you tell?

