

# **Chew On This**

*Lori Hypes*

**OVERVIEW:** Scientific Method. The students will explore and demonstrate the scientific method. Students will visit an interactive website constructed to test any hypothesis by Galileo. Students will design and test an experiment using the scientific method. Data will be graphed on a graphing calculator.

**GRADE LEVELS:** 6<sup>th</sup> – 8<sup>th</sup> grade

**TIME ALLOTMENT:** 3 – 45 minute blocks

**SUBJECT MATTER:** Science

## **LEARNING OBJECTIVES:**

Students will be able to:

- Collect data and organize into a table
- Define variables
- Identify dependent variables, independent variables, and constants are identified
- Identify variables, and constants
- Control variables to test hypothesis and repeat trials
- Construct and interpret continuous line graphs used to make predictions
- Evaluate and defend interpretations from the same set of data
- Accurately use SI (metric) units
- Identify sources of experimental error
- Process, store, retrieve data information

## **STANDARDS:**

The objectives listed may be used in part to address the Virginia Standards of Learning at <http://pen.k12.va.us>

The student will plan and conduct investigations in which

- Observations are made involving similar objects VA SOL 6.1
- Differences in descriptions and working definitions are made VA SOL 6.1
- Precise and approximate measures are recorded VA SOL 6.1
- Hypotheses are stated in ways that identify the independent (manipulated) and dependent (responding) variables VA SOL 6.1
- A method is devised to test the validity of predictions and inferences VA SOL 6.1
- One variable is manipulated over time with many repeated trials
- Data are collected, recorded, analyzed, and reported using appropriate metric measurement VA SOL 6.1
- Data are organized and communicated through graphical representation (graphs, charts, and diagrams) VA SOL 6.1

- Sources of experimental error are identified VA SOL LS.1
- Triple beam and electronic balances are used to gather data PS.1
- Data from experiments are recorded and interpreted from bar, line, and circle graphs VA SOL PS.1
- The student will use wide-area networks and modem-delivered services to access and retrieve information from electronic databases. VA SOL C/T8.4

### **MEDIA COMPONENTS:**

Video “*Here’s How - # 105 “Gum Chewing”*”

Web Site:

<http://www.k111.k12.il.us/king/science.htm>

At this site students will do background research on some of the work of Galileo and how he used the scientific method to solve a problem. Students will follow the directions on the “Website Lab Sheet” to navigate throughout the site.

### **MATERIALS:**

- VCR
- Television
- 1 Hot plate
- Two test tubes
- 1 Ring stand and 2 clamps
- ¼ cup sugar water
- ¼ water
- 20 mL Benedict’s solution
- One large beaker
- Three different types of chewing gum given to each group of three students
- A variety of gum that shows the ingredients
- Triple beam balance (one per group of 3 to 4)
- Graph paper (one/group)
- Timer (one/group)
- Computer- with Internet access
- Worksheet - *How Much Sugar is in Gum?* (included in this lesson)
- Worksheet – *Mass in Grams* (included in this lesson)
- Worksheet – *Design an Experiment* (included in this lesson)
- Worksheet – *Website Lab Sheet* (included in this lesson)
- Scientific Method Quiz (included in this lesson)

### **PREPARATION FOR TEACHERS:**

- ✓ Prior to teaching the unit, bookmark the websites.
- ✓ Cue videotape to the starting point.

- ✓ Photocopy all student handouts for distribution as needed during the lesson.
- ✓ Make sure you go through the instructions from the student materials handouts to make certain that you understand and are familiar with the lesson format and what the students need to do or understand for the lesson.
- ✓ When using media, always provide the students with a Focus for Media Interaction, which is a specific task to complete during or after viewing video segments, web sites, or other media material.
- ✓ Make a list of gums available in your area. Make a list of the sugar content for some popular foods your students consume such as cereal, soft drinks, candy bars, apples, Kool-Aide.
- ✓ Students should have a thorough understanding of the steps of the scientific method.
- ✓ Prior to this lesson, students should have been introduced to the following vocabulary words and concepts:
  - Variable
  - Dependent variable
  - Independent variable
  - Data
  - Scientific method
  - Control
  - Constant
  - Hypothesis
  - Conclusion
  - Predictions

### **INTRODUCTORY ACTIVITY: SETTING THE STAGE**

- While students are watching, set up a hot-water bath using a hotplate. Fill one test tube half full with water. Fill the other test tube half full with a sugar water mixture. Clamp both test tubes to a ring stand. Fill a beaker half full of water and place on hotplate on medium heat. While water is heating say, “I’m going to test two substances with an indicator solution. An indicator solution is specifically designed to detect the presence of a certain substance. In this experiment, we are going to use Benedict’s Solution. Benedict’s Solution detects the presence of sugar in a substance. “One sample is water and the other sample is a mixture of water and sugar. Have the students predict which test tube contains the sugar before you begin the experiment. Add 10 mL of Benedict’s solution to each of the samples and lower the test tubes into the beaker of simmering water. Say, “The Benedict’s solution will turn both samples blue before they are heated. After the tubes are in the water for about five minutes, the solution with the sugar will turn green to yellow if a small amount of sugar is detected or turn orange to red if a large amount of sugar is detected in the unknown samples.” Ask, “How many of you made the correct prediction?” Say, “The Benedict’s solution cannot tell us the amount of sugar in a substance, only if sugar is present or not. Lead students

into a discussion about the sugar content of something they chew everyday – CHEWING GUM.

- Begin a discussion about how long people have been chewing gum. (Answer: 3000 years). Give examples of people who have chewed gum. (Ancient Greeks; Myans, Indians that Columbus found in South America, Egyptians who carried bags of Frankincense.)
  - Have students make a list of all the chewing gums they can think of.
  - Ask students “Have you ever wondered what ingredients make up chewing gum?” Allow students time to discuss what they think goes into chewing gum. (Make a list on board to compare later.)
1. **Focus for Media Interaction:** Say, “Today, we’re going to take a closer look at chewing gum. I’m going to show you parts of a video that will help give us a better idea of just what bubble gum is made up of. Listen to this first part of the video for the number of ingredients in just one stick of gum. **Start** the video, *Here’s How Program # 105* where you see a balloon floating in the air and the mouse says, “It makes my jaw ache just thinking about it.” **Stop** the video when you see the mouse again and the narrator says: “...one stick might have 30 different ingredients in it.” Ask: “How many ingredients are there in a stick of gum?” (As many as 30 different ingredients may be in gum.) Compare with list on board that you made earlier about what goes into gum. Note: Not all ingredients are listed on gum package. Some are secret ingredients, and others may not be required to be disclosed by law.)
  2. **Focus for Media Interaction Focus:** Say, “In this next clip we’re going to learn what you are actually chewing on when the flavor is all gone from your gum. Listen and be able to give me the name of this ingredient.” **Resume** and **Pause** when you see the girl pick up a piece of the gum base and smell it and says, “It’s kind of yellow and crumbly looking.” Ask, “What is the name of the ingredient that is left when the flavor is out of the gum? (Gum base).”
  3. **Focus for Media Interaction:** Say, “Listen in this next clip for what gum base tastes like and what ingredients make up gum base. **Resume** and **Pause** when the balloon appears on screen and the girl says, “You get a block of yellow, crumbly, tasteless gum base.” Ask, “What does gum base taste like?” (nothing, it is tasteless) Ask, “What ingredients make up gum base?” (chicle from the sapodilla tree, waxes, fat, and even rubber)
  4. **Focus for Media Interaction:** Say, “In this next clip, listen for what is being added to the gum base.” Have students guess what is being mixed into the gum base. **Resume** and **Pause** when the narrator says, “and the coloring” and you see a whitish blob of gum being mixed. **Fast Forward** until you see someone pulling a cart of trays through double doors and narrator says “It just cools down and sits.” **Stop** video. Ask, “What was the first clear liquid being added?” (Glycerin)

Ask, “What was the white power being added?” (Sugar or imitation sugar) Ask, “What was the second liquid being added?” (Flavoring)

5. **Focus for Media Interaction:** Say, “The gum must rest for awhile before it can be made into chewing gum. In this next segment I want you to answer three questions. How many times does the gum get sprayed? With what does the gum get sprayed? What is happening in the drums? **Start** tape and **Stop** when multiple colored Chiclets appear. Ask, “How many times does the gum get sprayed? (five times) With what does the gum get sprayed? (sugar mixture) What is happening in the drums? (polishing) **Fast Forward** to where you see a long rope of bubble gum and **Pause** tape.
6. **Focus for Media Interaction:** Say, “In this last segment the gum is cut and packaged and the narrator asks three questions. After listening to the video clip, I want to hear your responses concerning the questions.” (Have students listen for the questions without giving them the questions.) **Start** tape and **Stop** when narrator says, “What would you call it?” Ask, “If you were making gum, how would it taste? What would you call it? What would the package look like?” (Accept all answers.)

## LEARNING ACTIVITIES

Note to teacher: Have the web sites bookmarked on the computers to be used by the class. Students may work individually or in groups of two.

1. **Focus for Media Interaction:** After the video, tell the students. “We are now going to use the computer to find out more about using the scientific method. You will have questions that are to be answered at the web site. These questions will be evaluated for a grade.”
2. Have students work in groups of two. Pass out “Website Instructions” sheet. Say, “Be sure to follow the directions on the worksheet and not those found at the web site.”

## CULMINATING ACTIVITY

1. Give each student the “Design an Experiment” worksheet. Openly lead students through steps 1-6 as a class. Seven and eight will be completed individually. Students will discover that they will be testing the sugar content of different gums by chewing and weighing the gum. The problem is “How much sugar is in gum?” When students finish answering question 1-6 on the “Design Experiment” worksheet, they will be ready to do an experiment using chewing gum.
2. Give each group a triple balance and the worksheet “How Much Sugar is in Gum”. Give each student in each group a different type of gum (piece or stick) and Gum Data Chart. Students are NOT to put gum in their mouths yet.)

3. Using the Gum Data Chart, have students predict the mass of the gum at 0, 2, 4, 6, 8, 10 minute intervals.
4. The students are to weigh the mass of each piece or stick of gum, including the wrapper. Record the mass on the worksheet. Now, have the students unwrap the gum, making sure that the wrapper is kept in one piece to be weighed with the gum after each chewing.
5. Have a timer set for two minutes. (Students will chew for two minutes, weigh the gum and wrapper, record the mass, and will chew again for two minutes. This will be done five times for a total of 10 minutes.) This will be recorded each time on the Gum Data Chart.
6. After the gum has been chewed and weighed 5 times, the students will use this data from the Gum Data Chart to fill in the chart How Much Sugar is in Gum? Each student will record the brand he/she chewed, the flavor, etc.
7. After the charts are completed, each group will graph their data. The student will use the information from the Gum Data Chart to create a graph. Each graph will contain all the data collected from that group... The independent and dependent variables are identified. (Independent – time; dependent – mass lost). Data may be graphed on the graphing calculator.

## ASSESSMENT

- ❖ Check graph on graphing calculator
- ❖ Identify the components of the scientific method.
- ❖ Quiz on scientific method?
- ❖ Web Site sheet evaluated
- ❖ Experiment Lab Sheet Evaluated

## CROSS-CURRICULAR EXTENSIONS

### Extensions

**Art:** Have students create a new type of gum and design its wrapper or box.

### Science:

- Have students research brown, raw, turbinado sugar, molasses, syrups, and other concentrated sweeteners like dextrose (glucose), fructose, galactose, maltose, lactose, dextrin, dextrans, and honey.
- Have students contact American Diabetes Foundation for diseases that are affected by sugar.

**Social Sciences and Math:** Have groups of students conduct research on the development of gum companies such as Wrigley's. Students may include in this report the diversity of products, financial growth charts and stockholder reports, etc.

**Math:** Sugar Sleuths: Have students determine the amount of sugar in soft drinks, cereal, candy bars, Kool-Aid, etc. Divide the amount of sugar in grams by four. The

answer will be in teaspoons. Have students count out the actual amount of sugar so they can see it.

**Economics:** Have students market a gum they invent. Take the gum through all stages of marketing.

## COMMUNITY CONNECTIONS

- ❖ Local medical personnel could explain and demonstrate how these processes affect actual medical situations.
- ❖ Agricultural extension agent who could review the effects of these processes on crops and forestry management, which in turn can effect the production of livestock and other food sources.
- ❖ Environmental Protection Agency personnel could outline an emergency management or evacuation policy in regard to hazards chemical spills.
- ❖ Arrange for a dentist to address the class on the effects of sugar and gum chewing on teeth and gums. Have students visit internet site <http://www.wrigley.com/gum/benefit.htm> and read article THE BENEFITS OF CHEWING GUM. Have students prepare a list of questions based on this article and their other research before the speaker arrives.
- ❖ A Dietician may inform the class on the sugar content of all foods. The school's Family Life instructor may serve in this capacity.

1. Visit the following addresses on the Internet. Follow directions for each site.

- <http://www.wrigley.com/gum/began.htm> Locate article HOW CHEWING GUM BEGAN
- <http://www.wrigley.com/gum/war.htm> Read THE STORY OF CHEWING GUM. Write a brief history of its origin.
- <http://www.bubblegum.com/qanda/howmade/> Read article WHAT GOES INTO A STICK OF BUBBLE GUM? and make a list of the ingredients that make up chewing gum.
- <http://www.sugar.org/scoop/typesug.html> Read article TYPES OF SUGAR and list and describe the different types of sugar. What are they used for?
- <http://www.sugar.org/scoop/scoopfaq.html> Locate article QUESTIONS MOST FREQUENTLY ASKED ABOUT SUGAR. Answer questions 1 – 13.

# DESIGN AN EXPERIMENT

**1. STATE THE PROBLEM IN THE FORM OF A QUESTION.**

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**2. STATE YOUR HYPOTHESIS – REMEMBER THIS IS AN EDUCATED GUESS WHERE YOU STATE WHAT YOU THINK WILL HAPPEN.**

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**3. MAKE A LIST OF THE MATERIALS NECESSARY TO CARRY OUT THIS EXPERIMENT.**

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**4. WRITE DOWN THE PROCEDURE IN DETAIL. LIST THE STEPS IN CHRONOLOGICAL ORDER AS YOU PLAN TO DO THE EXPERIMENT.**

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**5. INDICATE THE VARIABLES: RECOGNIZE THE DEPENDENT VARIABLE AND INDEPENDENT VARIABLE.**

**A. INDEPENDENT VARIABLE:**

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**B. DEPENDENT VARIABLE:**

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**6. INDICATE WHAT WILL SERVE AS THE CONTROL PART OF YOUR EXPERIMENT.**

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**7. CREATE CHART AND GRAPH TO RECORD YOUR OBSERVED RESULTS.**

**8. STATE YOUR CONCLUSION.**

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## Quiz on Scientific Method

***MATCHING: MATCH THE FOLLOWING WORDS WITH THEIR PROPER STATEMENT.***

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|---------------------|--|
| 1. ____ EXPERIMENT  | A. RECORDING OF THE OBSERVATIONS ON TABLES   |
| 2. ____ DATA        | B. THAT PART OF THE EXPERIMENT WHICH IS LEFT UNCHANGED                               |
| 3. ____ CONTROL     | C. THE OBJECTIVE STATED IN THE FORM OF A QUESTION                                    |
| 4. ____ PROBLEM     | D. COLLECTING THE NEEDED MATERIALS AND FOLLOWING PROCEDURES                          |
| 5. ____ CONCLUSION  | E. USING THE SENSES SUCH AS SIGHT, HEARING, SMELLING, ETC., TO RECOGNIZE ANY CHANGES |
| 6. ____ RESEARCH    | F. EDUCATED GUESS SOLUTION TO THE PROBLEM  |
| 7. ____ HYPOTHESIS  | G. USE OF RESOURCES TO INVESTIGATE THE PROBLEM                                       |
| 8. ____ OBSERVATION | H. RESULTS WHICH SUPPORT OR DISPUTE THE HYPOTHESIS                                   |

**LIST THE STEPS OF THE SCIENTIFIC METHOD IN PROPER SEQUENCE. (FIVE (5) BONUS POINTS)**

## TESTING FOR SUGAR



1. Set up a hot-water bath using a Bunsen burner or hot plate, ring stand, beaker, water, and wire gauze.
2. While the water bath is heating, make a mixture of sugar water and add to test tube one. Then add 10 mL of Benedict's solution (an indicator for sugar) to test tube.
3. Gently swirl the contents of the test tube.
4. In test tube two, just add water. Then add 10 mL of Benedict's solution.
5. Gently swirl the contents of the test tube.
6. Place both test tubes in the hot-water bath for about 5 minutes. After 5 minutes, observe the color of the mixtures. If small amounts of sugar are present, the color of the mixture changes to green or yellow. If larger amounts of sugar are present, the color of the mixture changes to orange or red. Record your observations.

# GUM DATA CHART

Brand /Flavor of Gum \_\_\_\_\_

<b>Predict Mass</b>						
<b>Actual Mass</b>						
<b>Time (Min.)</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>10</b>



## Quiz on Scientific Method

### KEY

1. D
2. A
3. B
4. C
5. H
6. G
7. F
8. E

## Website Instructions

1. Key in <http://www.k111.k12..il.us/king/science.htm>
2. Choose "Science"
3. Choose "Scientific Method." This will take you to number 25 at the site.
4. Choose "Scientific Method Help" from the pick list.
5. Read all information at this site. Answer question 1 through 7 on "Website Lab Sheet."
6. Click on "Leaning Tower of Pisa Experiment".
7. Try this experiment by clicking on all the choices. Answer question 8 through 9 on lab sheet.
8. Go back to pick list that you choose "Scientific Method Help" from and pick "Scientific Method Game."
9. Choose "Matching." Find the matching squares by clicking on the definition and finding the term that it explains. When all matches have been made, go back to game choices and choose "Flashcards."
10. When "Flashcards" appear, read instructions at the site. Begin by reading the definition. When you think you know the answer, click on the flashcard. The correct term will appear. Discard, if you were correct by clicking on "Remove Card." If incorrect click on "Try again later." When all cards have been answered correctly, go back to game choices and choose "Concentration."
11. When "Concentration game appears, click on tow cards at a time until matches are made.
12. Print out the answer sheet by clicking on answers.

## Website Lab Sheet

1. What is it that science does? *Science defines a way of thought.*
2. What is the process called in which experiments are used to answer questions? *Scientific Method*
3. What is an observation? *The first step in the scientific method leads you to a question about some event or characteristic of the world.*
4. An attempt to answer a question is a *hypothesis.*
5. What is an experiment designed to do? *An experiment is designed to test the hypothesis.*
6. Before Galileo's experiment, what was the belief concerning falling objects? *Gravity caused heavier objects to fall faster than lighter ones.*
7. What did Galileo hypothesize? *Forces acting on a falling object were independent of the object's weight.*
8. What happened when the objects were dropped? *They fell at exactly the same rate.*
9. What had Galileo discovered? *The force of gravity was constant.*
  - Continue to work at the website by following the directions on the instruction sheet.

## DESIGN AN EXPERIMENT KEY

STATE THE PROBLEM IN THE FORM OF A QUESTION. How much sugar is in chewing gum?

STATE YOUR HYPOTHESIS – REMEMBER THIS IS AN EDUCATED GUESS WHERE YOU STATE WHAT YOU THINK WILL HAPPEN. If you chew a stick of gum for 10 minutes, then the mass of the gum will be less due to the loss of sugar.

MAKE A LIST OF THE MATERIALS NECESSARY TO CARRY OUT THIS EXPERIMENT.

3-5 different chewing gums	-	chart to record individual data
4 triple beam balances	-	chart to record groups data
timer, pencil, graph paper		test subjects

WRITE DOWN THE PROCEDURE IN DETAIL. LIST THE STEPS IN CHRONOLOGICAL ORDER AS YOU PLAN TO DO THE EXPERIMENT.

Suggestions:

1. Weigh gum with wrapper on triple beam balance and record mass.
2. Unwrap gum, set timer for 2 minutes, chew gum.
3. Weigh gum again on triple beam balance with wrapper.
4. Repeat steps 2 & 3 four more times for a total of 10 minutes. Record data on Gum

Data Chart.

5. Each group will complete the chart, “How Much Sugar is in Gum?”
6. Construct line graph with data from the Gum Data Chart. (Bar graphs may also be constructed.

INDICATE THE VARIABLES:

INDEPENDENT VARIABLE: Time

DEPENDENT VARIABLE: Amount of mass (sugar) lost.

INDICATE WHAT WILL SERVE AS THE CONTROL PART OF YOUR EXPERIMENT. Weight of gum with wrapper before it is chewed.

**CREATE CHART AND GRAPH TO RECORD YOUR OBSERVED RESULTS.**

**STATE YOUR CONCLUSION. Approx. 60% of chewing gum is sugar.**

