

Bio/Diversity Project
The Scientific Method: A Tootsie Pop Experiment

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Grade Level: 4th grade – 5th grade

Common Core Standard:	<i>Strand 1:</i> <ul style="list-style-type: none"> • <i>Concept 1: Formulate predictions, questions, or hypothesis based on observations.</i> • <i>Concept 2: Participate in planning and conducting investigations, and recording data. Design and conduct controlled investigations.</i> • <i>Concept 3: Organize and analyze data; compare to predictions. Analyze and interpret data to explain correlations and results; formulate new questions.</i>
Content Objective: Math, Reading, Science, Writing, Other:	<ul style="list-style-type: none"> • <i>Students will be able to describe the steps of the scientific method.</i> • <i>Students will be able to apply the steps of the scientific method to the prompt “How many licks does it take to get to the center of a Tootsie Pop?”.</i> • <i>Students will communicate the results of their experiment with the class.</i>
Language Objective: (Optional)	N/A

Vocabulary	Materials
<ul style="list-style-type: none"> • Analyze • Communicate • Conclusions • Data • Experiment • Hypothesis • Observation • Question • Science • Scientific Method 	<ul style="list-style-type: none"> • 4 Corners Cards (A, B, C, D) • Blank paper • Pencil • PowerPoint (optional) • Tootsie Pops (enough for each student to have one)

<p>Guiding Questions:</p> <ul style="list-style-type: none"> • What is your hypothesis to the question: “How many licks does it take to reach the center of a Tootsie Pop?” • How can we test this question to answer our hypothesis? • How does the number of licks that it took you compare to how many licks it took your classmate? • Why do you think that all of the numbers/results are different? • Did you reject or fail to reject your hypothesis? (Hypotheses can never be proven with 100% accuracy, so instead of saying, “I proved my hypothesis” it is more correct to say, “I failed to reject my hypothesis”.) • How would you communicate your results to other people so that they can build off of your work? • Why is communicating results an important part of science?

**Engagement/Introductory Activity:**

- “Scientist of the Week” PowerPoint presentation (optional): choose a diverse scientist whose work illustrates the importance of making observations, developing hypotheses, testing hypotheses, coming up with results, and communicating results.
- Build on previous week’s introduction to the scientific method with a game called “Vocabulary Swat”. This game tests the knowledge retained from the prior week and gives the educator a better understanding of concepts that students may struggle with throughout the remainder of the lesson.

Prepare:

- Draw a line down the middle of the smartboard and write vocabulary words in different spots on each side of the line; each side of the smartboard will contain the same vocabulary words as the other side, but the words will be organized randomly.
- Divide the students into two teams and have each team line up on a side of the board.

How to play:

- One student from each team go up to the board and grab a fly swatter.
- The instructor will read the definition of a given vocabulary term. After the instructor has finished reading the entire definition, students will swat the correct word. The first student to correctly swat a word gets a point for their team. Each student passes the swatter to the next person in line and returns to the end of the line.

Exploratory Activity:

Introduce the question, “How many licks does it take to reach the center of a Tootsie Pop?” by showing the students a commercial for the candy. YouTube Link: <https://youtu.be/O6rHeD5x2tI> (also provided in attached PowerPoint)

Use this experiment to apply the vocab terms that were reviewed in the first activity.

Tootsie Pop Experiment: For this experiment, students will each get one tootsie pop and will record the number of licks that it takes for them to reach the center of the tootsie pop. Once the students have completed their experiment, they will share their results with the class. As a group, the class will calculate the overall average of their results.

Explain:

- Why might it have taken you more licks to reach the center than it took your classmate?
- How did the way you licked your Tootsie Pop impact the number of licks it took?
- What can we learn from the class average number of licks?
- Why is it important for scientist to communicate their results?

Extension Activity/Questions:

- What other questions could we answer through experimentation?
- What can you observe in this classroom or on the playground that you can form a question about?
 - Can you form a hypothesis to explain this question?
 - How can you test that hypothesis?
 - This is an opportunity to have students evaluate their own environment and focus on what it means to make observations, form a hypothesis, then test it.

Evaluation Activity:

Play the Four Corners game to review topics that were discussed in the first two lessons.

- Place cards (with A, B, C, D printed on them) in each of the four corners of the room. Ask the students multiple choice questions regarding the lesson/vocabulary of the day; students will answer by walking to the corresponding corner of the room.
- The questions are listed on individual slides in the provided PowerPoint