



**Lesson Title:** Testing Murphy's Law: does bread *always* land butter side down?

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**Grade Level:** 4<sup>th</sup>/5<sup>th</sup> grade

**Type of Lesson:** STEM (FOSS kit, Variables Module)

**Goals & Essential Understandings:**

The main objectives of this lesson are to help students recognize cause and effect relationships through experimentation in addition to, introducing concepts related to variables (independent and dependent) and controlled experiments. Students will also be introduced to background information on gravity, mass, and Newton's laws of motion. This lesson requires students to practice scientific skills such as writing questions, making predictions, designing and conducting experiments, controlling variables, interpreting data and developing logical conclusions. These are all part of the National Science Education Standards for 4<sup>th</sup> and 5<sup>th</sup> grade science. Additionally, this lesson addresses the BVSD Essential Learnings for science curriculum and addresses the concept listed below which is part of the prepared graduate competencies in the physical science standard:

Observe, explain, and predict natural phenomena governed by Newton's laws of motion, acknowledging the limitations of their application to very small or very fast objects.

**Background Information:**

Educators will want to give a brief review of the scientific method (listed below). Educators should also introduce and define the term variable, and give explanations and examples for controlled experiment, dependent variable, and independent variable. Any other vocabulary listed below that might be new for students should be defined and/or reviewed. Finally, students should be given a brief background on gravity and Newton's laws of motion (see below).

**Review of the scientific method**

1. Define the question
2. Gather information and resources
3. Form a hypothesis
4. Perform experiment, collect data
5. Analyze data
6. Interpret data and draw conclusions

## **Background on gravity and Newton's laws of motion**

When an object falls to the ground, there are two forces acting on the object, air resistance and gravity. Newton's first law states that an object at rest wants to stay at rest. The air below a falling object does not want to move out of the way. Therefore objects with less air resistance will fall to the ground faster. Objects with varied air resistance can sometimes orient themselves in a particular manner when falling; for example, a person using a parachute always falls below the parachute because of less air resistance.

**References:** Background information on the scientific method, variables, and Newton's laws of motion can be found on: [www.wikipedia.org](http://www.wikipedia.org)

## **Lesson Vocabulary (from 4<sup>th</sup> and 5<sup>th</sup> grade science curriculum essentials document):**

**Conclusion**-a judgment or decision reached by reasoning

**Controlled experiment**-an experiment that isolates the effect of one variable on a system by holding constant all variables but the one under observation

**Dependent variable**-the observed or measured variable in an experiment or study whose changes are determined by the presence of one or more independent variables

**Data**-factual information (as measurements or statistics) used as a basis for reasoning, discussion, or calculation

**Evidence**-information acquired through objective experience

**Explanation**-a statement based on scientific evidence and logical argument about causes and effects or relationships between variables

**Fair test**-an investigation in which the investigator changes only one factor at a time while keeping all other conditions the same

**Force**-an influence tending to change the motion of a body or produce motion or stress in a stationary body; a push or a pull

**Gravity**-the force that attracts a body towards the center of the earth, or towards any other physical body having mass

**Independent variable**-a manipulated variable in an experiment or study whose presence or degree determines the change in the dependent variable

**Mass**-the quantity of matter which a body contains, as measured by its acceleration under a given force or by the force exerted on it by a gravitational field

**Observation**-the act of making and recording a measurement

**Prediction**-a statement about what one thinks will happen in an investigation

**Record**-to set down for preservation in writing or other permanent form

**Testable**-able to be tested or investigated by a scientific investigation

**Variable**-A factor or condition that can change and might affect the outcome of an experiment

**Materials Required:** Below is the list of all materials required for 40 students to complete the lesson. Supplies can be purchased at any grocery store.

1. 4 loaves bread (does not matter white or wheat, but all loaves should be the same kind)
2. 2-3 lbs. of butter

3. 10-15 plastic butter knives
4. Toaster
5. Several measuring tapes
6. Several permanent markers (Sharpies)
7. Tarp/sheet or something to put on ground to catch buttered bread (if doing experiments inside)

**Preparation before the lesson:** 1-1.5 hours. Educators should purchase necessary supplies ahead of time, and also conduct a test run of the experiment at home. They should review the background information on controlled experiments and variables (5<sup>th</sup> grade BVSD FOSS kit, Variables Module), and come up with some pertinent examples of independent and dependent variables that the students will be able to relate to. Educators should also be prepared to answer questions or give further explanation on Newton's laws of motion.

**Set-up time:** 15 minutes

**Safety Information:** There is no safety information needed for this activity.

**Engagement:** Begin the lesson by asking students the question "If you drop a piece of buttered bread will it always land butter side down?" Ask students to explain their reasoning, and lead into an explanation of Newton's laws and the force acting on a dropped object. Have students re-evaluate their explanation, and identify the variables or parameters influencing the dropped bread. The primary variables for this activity include the amount of butter added, the height from which the bread is dropped, the position the bread was in when it was dropped (butter side up or down), and whether or not the bread was toasted. Students will come up with most of these on their own (and perhaps more); the idea is to have 3-4 different parameters to test. Explain to the students about dependent and independent variables, and tell them they will be conducting a controlled experiment. Emphasize with students the importance of keeping everything the same, except for the variable they are testing. List all the variables on the board and tell students to think about which one is most influential (make sure students choose only one variable to test). Once they have decided on a variable to test, have them partner up with someone who is testing the same variable. In their science notebooks, have students write a hypothesis related to the experiment and also a simple chart for recording their data or trials (can give an example on the board). An example of a good hypothesis would be that the buttered side of the bread has more mass and bread should fall favoring the side with more mass. In this experiment they will also evaluate what, if any, variables other than the presence or absence of butter affect these results. Provide the class with the following instructions before beginning the experiment.

1. Work together in groups of 2-3 (no larger than 3 people).
2. Each group collects bread and prepares according to which variable your group is testing. For example, a group testing the amount of butter would have two pieces of bread, one with lots of butter and one with little butter. A group testing the influence of height would have two pieces of equally buttered bread and would drop them from two different heights. The toasted group would have two

different pieces of equally buttered bread, one toasted and one untoasted. The group testing the position would have two pieces of equally buttered bread which would be dropped either face up or face down.

3. Remind the students that repeatable results are important and therefore, they should drop each piece of bread multiple times and record the results of each trial.

**Exploration:** Have students conduct the experiment in groups, either outside (weather permitting) or inside. Make sure that each group is recording data in their science notebooks. When finished with trials, have students enter data into master chart on board. The educator can perform control trials with a piece of bread marked only on one side with a sharpie, but no butter on it. Make sure students thoroughly clean up before proceeding to class discussion of data.

**Explanation:** Go over the data on the board with students and analyze the data together as a class. Identify any trends in the data, and discuss how this relates to what students have just learned about Newton's laws of motion. Also discuss the results of the control performed by the educator, if applicable. This could also serve as an opportunity to review the scientific method, and how science advances via rejection or acceptance of hypotheses.

**Elaboration, Extension:** Students can watch and discuss the Mythbuster's video on buttered toast. <http://www.youtube.com/watch?v=zzwuiqsLCE0> (minutes 1:40-9:15)

**Evaluation:** Ask the students to write in their journal about what they found and why they think they got the results they did. Next, have them write how they would perform the test differently if they were to run the test again. Finally, have them explain why it is important for scientists to have many trials and why different scientists need to repeat experiments.

**Wrap-up:** Ask the students to consider how they would perform the lab differently if they were testing whether or not a quarter lands heads up or heads down more often. What variables do they think would be important to test and what results might they get?