

Science Experiments – The low-down 4th Grade

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Benchmarks:

SLC 2: A. Students will select appropriate instruments and provide written justification of the advantages or disadvantages of those instruments when observing an event, object or organism. B. Students will describe and organize objects and events using observations, data & inferences.

SLC 6: A. Students will design and conduct experiments using scientific methods and will discuss the "fairness and validity" of the experiments. B. Students will identify constants and variables within experiments and demonstrate ability to limit variables.

SLC 7: Students will select appropriate resources and tools to make accurate observations to gain desired results given the stated conditions (i.e., if a desired result is to build an outdoor greenhouse to start seeds, the design would have to promote the correct amount of sunlight.)

SLC 8: B. Students will use observations and data when explaining answers and formulating conclusions.

Objectives:

The students will come away from the activities with a more comprehensive understanding of experiments in science and the ability to apply their understanding to create their own science experiment plans. The goal is to help the students come up with, and understand, what a good science experiment needs.

Materials:

- Baking soda
- Vinegar
- Red food coloring
- 2 long boards
- Pull-back cars

Day 1:

Initial Activity:

Ask the students, "what do we need to do to make this a good experiment?" Make a list on the board of what makes a science experiment. Not all of the "Target Observations" need to be listed here – they will come out later when tests are done.

Target Model:

- Question – Experiments start with a question the experimenter wants answered.*
- Variables – Things that can change in an experiment.*
- Hypothesis/ Educated Guess – The experimenter probably has some expectation of either the outcome, or at least what possible outcomes would conclude.*
- Methods & Materials – Students should plan their experiments carefully.*
- Test – Actually perform the test or experiment*

-Data Collection (Observation) – Students should keep careful track of what they observe.

-Conclusion (Data Analysis) – Students should try to answer their question.

-Revision – Students should review their experiment, make adjustments and repeat their experiments to improve their accuracy and fix problems.

Procedure:

We are now going to use these things that a good science experiment needs to design a science experiment. I have here a couple of pull-back cars, and some different surfaces (carpet and tile floor) and some different incline planes. What are some things we want to find out about this? What part of a science experiment is this?

Target Observations:

- How far can a pull-back car travel?
- This is the “Question” part of a science experiment.

Procedure:

What are some things that may affect how far the car travels? Pick one. How do you think this will affect the distance the car travels? Why? What parts of a scientific experiment are these?

Target Observations:

- The type of car, type of surface, amount pulled back, uphill different ways or downhill, lint in the wheels, etc... can affect how far the car travels. These are called “variables” – things that can change in an experiment.
- The carpet will slow the car down because it has more friction. This is a “hypothesis”.

Procedure:

If I want to check the hypothesis, how should I set up my experiment? Which things from our variable list should I change? Which things should I not change? What do I need to do my experiment? What exactly should I do during the experiment? What parts of a science experiment are these?

Target Observations:

- You should pull the cars back the same amount, on flat ground, and use the same car (clean out the lint!).
- You should place the car at a starting line, pull it back, let go, and measure how far the car goes for both the carpet and the tile.
- You will need only one pull-back car, some carpet, some tile, and a ruler to measure how far the car travels.
- These are the “Methods and Materials” for the science experiment.

Target Revised Model:

-Question – Experiments start with a question the experimenter wants answered.

- Variables – Things that can change in an experiment. *Only one variable should be tested at a time – all others should not be changed.*
- Hypothesis/ Educated Guess – The experimenter probably has some expectation of either the outcome, or at least what possible outcomes would conclude.
- Methods & Materials – Students should plan their experiments carefully.
- Test – Actually perform the test or experiment
- Data Collection (Observation) – Students should keep careful track of what they observe.
- Conclusion (Data Analysis) – Students should try to answer their question.
- Revision – Students should review their experiment, make adjustments and repeat their experiments to improve their accuracy and fix problems.

Procedure:

Have students come up to the front of the class and perform the experiment, taking measurements and collecting data. What do the measurements show us? What did we learn? Did we answer our question? How could we make this experiment better? What other surfaces might slow the car down, and how could we test them?

Target Observations:

- We found that the car went further on the tile than on the carpet.
- We answered part of our question – how far can a pull-back car travel.
- We could make the experiment better by making a track to be sure that the pull-back car travels in a straight line, and by doing the experiment several times.
- Foam, sandpaper, grass, and dirt might also make the car go not as far as the one on the tile. We could test them the same way we tested the carpet.

Day 2:

Demonstration:

Since the students now have some familiarity with developing an experiment, they may now be able to apply their knowledge to evaluating other experiments. To do this, use a “terrible” experiment such as the infamous baking soda and vinegar experiment (also known as the Scientific Thinking Volcano of Death): Baking soda and vinegar, when they meet, undergo a chemical reaction with crowd-pleasing bubbles and fizzes. With the addition of a little red food coloring and a clay-molded volcano, one has the archetype “science experiment” seen at science fairs.

Perform the “experiment.” The students love the reaction, but the teacher should call attention to the list of what a good science experiment has. Going through the list, one by one, the class should find that the “experiment” isn’t really a science experiment at all (it might have “Methods and Materials,” but that’s about it).

(The students may try and “save” the “experiment” once they realize it is going to lack things from the list. This is fine – they’re figuring out how to create science experiments. However, the teacher should call attention to what was changed and added in order to make it have those things, noting that it didn’t have those before.)

Target Observations:

- The volcano “experiment” only has one part of a science experiment: “Methods and Materials”
- An “experiment” with only one part of science experiment is not scientific, it is entertainment.

Target Revised Model:

- Question – Experiments start with a question the experimenter wants answered.
- Variables – Things that can change in an experiment. Only one variable should be tested at a time – all others should not be changed.
- Hypothesis/ Educated Guess – The experimenter probably has some expectation of either the outcome, or at least what possible outcomes would conclude.
- Methods & Materials – Students should plan their experiments carefully.
- Test – Actually perform the test or experiment
- Data Collection (Observation) – Students should keep careful track of what they observe.
- Conclusion (Data Analysis) – Students should try to answer their question.
- Revision – Students should review their experiment, make adjustments and repeat their experiments to improve their accuracy and fix problems.

-If an experiment only has one of the above it is not a science experiment.

Extension:

Often times students can come up with science “experiments” that have all of these components, but lack meaning – a “so what?” experiment. For example, the experiment could involve 2 volcanoes identical except for one thing – one has plastic dinosaurs around it, another doesn’t. The student’s question: “To see if the dinosaurs fall down or not.” This can be made to have all of the components of the list, yet it still isn’t a science experiment. What is needed here is a refinement of the “Question” item – the question needs to be useful. What does useful mean? It seems to be hard to define – more of an “I know it when I see it.” Presenting the students with many different “good” science questions can perhaps develop student’s intuition about this.

Target Observations:

- Sometimes the “Question” of an “experiment” isn’t useful. In this case, it needs to be made useful.

Target Revised Model:

- Question – Experiments start with a question the experimenter wants answered.
The question must be relevant.
- Variables – Things that can change in an experiment. Only one variable should be tested at a time – all others should not be changed.
- Hypothesis/ Educated Guess – The experimenter probably has some expectation of either the outcome, or at least what possible outcomes would conclude.
- Methods & Materials – Students should plan their experiments carefully.
- Test – Actually perform the test or experiment

- Data Collection (Observation) – Students should keep careful track of what they observe.
- Conclusion (Data Analysis) – Students should try to answer their question.
- Revision – Students should review their experiment, make adjustments and repeat their experiments to improve their accuracy and fix problems.

-If an experiment only has one of the above it is not a science experiment.

Day 3:

Procedure:

This day will use a “good” experiment that the students will help design to cement the qualities that a science experiment needs into the students’ heads. Ask the students to solve a problem: “You are late for dinner, and there are 2 paths home. One path has a steep slope down toward your house, and the other takes a much less steep path to your house. Which path will get you there faster?” Break the class up into groups of ~2-3 students per group. The groups should be given the following materials: steep incline plane, flatter incline plane, stopwatch, and a toy car. Ask the students to design an experiment to test which path you should take home by filling out the attached worksheet. Remind students to follow the list of things that are needed for a good science experiment.

Additional “Take-home” experiment worksheet:

Devise and do an experiment using any type of coin (penny, nickel, dime, quarter, Sacagawea, Silver Dollar, Canadian Dollar) that you want (but be sure to isolate just one variable). Be sure to include the following:

1. A clear idea of what is being tested in an experiment
 2. How a procedure isolates the variable being tested
 3. The basics of data collection, scientific honesty, and how we interpret raw results
 4. Evaluating the experiment’s implications for the variable being tested and further tests and refinements
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Car Stuff

Setup:

- You will need one or two pull-back cars
- A large space to let the cars roll
(Like a carpet or hallway)
- Some masking tape (for starting lines)
- Anything else that would
Be good to experiment with!



What are some things you want to find out about the cars?



As a class, pick one
Thing to find out –



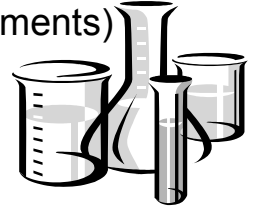
Write this here also



What might affect
Why do you think so?
Try to list at least 3:

What you want to find out:

How can you test this? (Design an experiment with measurements)



Collect measurements:





What have I learned?

Why does this happen?



What other things could I do?