

Force, Acceleration, and Mass Lab

(Based on the Argument-Driven Inquiry Force, Mass, and Acceleration Lab.)

Your Task:

Use what you know about forces and motion, causal relationships, and the importance of scales, proportions, and quantity in science to design and carry out an investigation that will allow you to determine the mathematical relationship among the net force acting on an object, its mass, and its acceleration.

The guiding question of this investigation is, *What is the mathematical relationship among the net force exerted on an object, the object's inertial mass, and its acceleration?*

Materials:

- LabQuest 2
- Vernier dynamics track
- Motion encoder
- Motion encoder cart (green)
- Plunger cart (grey)
- Weights and weight set
- Pulley attachment
- Small rope

Proposal:

Submit an experimental proposal as a group for at least two experiments you want to conduct and how those experiments will answer the guiding question. Things to think about while designing each of your experiments are: the independent variable, the dependent variable, any variables held constant, how to measure force, mass, velocity, and acceleration. How will you change the mass of the cart? How will you change the net force acting on the cart. Be sure to do at least three replicates of each measurement for your error analysis. Proposals must be approved by the teacher before any experiments can be conducted.

Initial Argument:

Analyze the data once it has been collected. Create a poster on a white board following the template below. **DO NOT** make a data table! Create graphs to illustrate the relationship between your independent and dependent variables. Be prepared to present your poster to the teacher and answer follow up questions.

The Guiding Question:	
Our Claim:	
Our Evidence:	Our Justification of the Evidence:

Final Report

As a group, create a final report from the information on the poster. Based on the feedback you receive from the teacher you may need to repeat some experiments. This is the time to do that. The laboratory report is an important way for scientists to record data collected to make determinations about the physical world. Each report should contain each of these sections.

Title: The main job of the title is to describe the content of the report. In science, a title usually tells the reader what the subject of the experiment and the key research variables are, and it often gives an indication of what research methodology was used.

Scientific Question: State the scientific question that is given to you for this experiment.

Introduction: The first section of your lab report is called the "Introduction". This section states what your experiment will attempt to do and how you expect it to turn out. State the theory or hypothesis that you are attempting to test and add information about previous scientific studies or experiments that are relevant to your theory.

Procedure with Diagram: List your materials in the "Materials" section. Explain your "Procedure." This section is a step-by-step explanation of your experiment as you carry it out. Write the steps in order, unnumbered, as a paragraph, without frivolous narrative. Include any variables and controls. Also add any safety information in this section, and any sketches or diagrams of your method.

Data: Record the measurements that you are collecting typically in a table format.

Analysis: This is a complete analysis of the collected data. In most labs a relationship between pieces of data can be expressed. Use the Graphical Analysis app to analyze graphically (typically line or bar graphs), quantitatively (formulas and equations), and qualitatively (in words). This section is where you describe what happened during the experiment and whether the results turned out as you expected. Even mistakes or undefined results should be listed here - presume that everything that happened is relevant and propose theories for unexpected results. Solve any equations brought up in the experiment. Explain any problems or complications that prohibited an action from occurring. Include graphs here. Include your error analysis. Also, inform the reader of estimations you made to come to your results and why you made those estimations.

Conclusion: In this section you write about the significance of your results. Answer the scientific question that is stated at the beginning of the report and support your answer to the scientific question by pointing to specific results from your experiment(s).