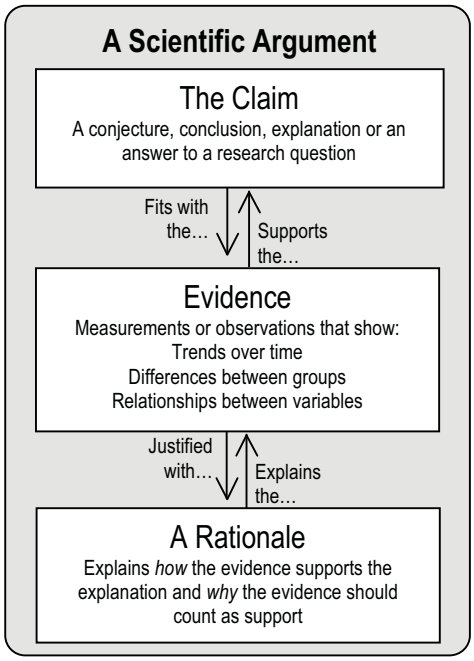
An Argument-Driven Inquiry: Why do some pendulums swing faster than others?

Introduction: Over the course of human history, scientists have developed many important and useful ideas about the world. Those ideas have enabled the following generation of scientists to understand more and more about the way the world works. The ways scientists develop these ideas are based on particular methods of observing, thinking, investigating, and justifying. These methods represent the nature of science and make science different than other ways of knowing.

An important part of this process is peer review. In other words, scientists review and critique the ideas and work of other scientists in order to ensure that these ideas are valid or acceptable. Once reviewed, these ideas can become part of the body of knowledge that scientists use to understand how or why the world works. Scientists therefore rely on scientific arguments to persuade other scientists of the merits of their work. Figure 1 highlights the components of a scientific argument (see below). In this class you will learn how to generate these types of arguments and how to critique scientific arguments using the criteria used by the scientific community.



Questions to ask when evaluating a scientific argument

- Is the claim ***sufficient***? In other words, does it answers everything it needs to?
- Does the argument include ***genuine evidence***?
- Does the argument include ***enough evidence***?
- Is the evidence of ***high quality***?
- Is there any ***counterevidence*** that does not support the claim?
- How well does the claim ***fit with other theories and laws*** that are used in science to explain or describe how the world works?
- Is rationale ***sufficient***? In other words, does it explain why the evidence was used and why it supports the explanation?
- Is the rationale ***appropriate*** (rational and sound)?

Figure 1: The components of a scientific argument and questions to ask when evaluating a scientific argument

Although scientists differ greatly from one another in what they investigate and in how they go about their work (e.g., whether they rely on experiments or systematic observations in the field), the exchange of techniques, information, and concepts goes on all the time among scientists, and there are common understandings among them about what counts as well-supported scientific knowledge and what types of practices should or can be used to generate this type of knowledge. This is how quality control is maintained in science. Therefore, it is important for you to learn how to generate scientific knowledge through inquiry and to engage in scientific argumentation in order to justify, evaluate, and revise this knowledge. This course will help you do this. In fact, this lab is designed to not only serve as an

introduction to the concept of frequency and the equipment available in our lab, but also as an introduction to inquiry and argumentation in science.

The Problem: A swinging string with a weight on the end is called a pendulum. The number of times it swings from one side to the other and back in one second is called the frequency. Some pendulums have different frequency than others.

The guiding question of this investigation is: ***Why do some pendulums swing faster than others?***

Materials available for use: You may use the following materials during your investigation.

- Ring Stand
- String
- Various weights
- Stop watch

Safety Precautions: There are no specific safety issues related to the materials that you will be using during this activity.

Getting Started: In order to answer the guiding question for this investigation, you need to develop a way to gather the data you will to need develop and support your claim. Use the space below to keep track of what you did and what you observed.

What we did	**What we observed**

Interactive Poster Session: Once your group has completed your work, prepare a whiteboard that you can use to share and justify your ideas. Your whiteboard should include all the information shown Figure 2.

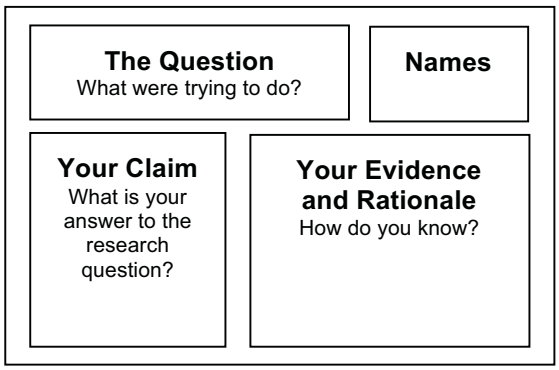


Figure 2: Information needed on a Whiteboard

To share your work with others, we will be using a **Round-Robin** format. This means that one member of the group will stay at your work station to share your groups' ideas while the other group members will go to the other group one at a time in order to listen to and critique the explanations developed by your classmates.

Remember, as you critique the work of others, you have to decide if their conclusions are valid or acceptable based quality of their explanation and how well they are able to support their ideas. To do this, ask yourself the following questions:

- Is their explanation ***sufficient*** (it explains everything it needs to) and ***coherent*** (it is free from contradictions)?
- Did they use ***genuine evidence*** (they have data that shows a trend over time, a relationship between variables, or a difference between groups) and did they use ***enough evidence*** to support their ideas?
- Is their evidence of ***high quality***? In other words, is their evidence valid (they used appropriate methods to gather the data) and reliable (they attempted to reduce error in their measurements or observations)?
- Is there any ***counterevidence*** that does not support their explanation?
- How well does their explanation ***fit with other theories and laws*** that are used in science to explain or describe how the world works?
- Is their rationale ***adequate*** (they explain why the evidence was used and why it supports the explanation) and ***appropriate*** (rational and sound)?

Once the Round-Robin poster-session is complete, the ***Presider*** of the session (which might be your teacher or one of your classmates) will lead a discussion in an effort to synthesize all the various claims into one "class" explanation that is the most valid or acceptable way to scientifically explain *why some pendulums swing faster than others*.

Report: Once you have completed your research, you will need to prepare an ***investigation report*** that consists of three sections. Each section should provide an answer for the following questions:

Section 1: What were you trying to explain (or figure out) and why?

Section 2: How did you go about your work and why did you conduct your investigation in this way?

Section 3: What is your argument?

Your report should answer these questions in 2 pages or less. This report must be typed and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your explanation is acceptable or valid!