Name ____ Date __________ Period ______

LAB: Evidence vs. Inference

C O N C E P T U A L   P H Y S I C S :   U N I T   1

BACKGROUND: In textbooks, much is said about the role of experimentation in science—but there is less about observation, and often little to nothing about inference or argumentation. The goal of science is not merely to describe an object or phenomenon, but to understand how the object was formed, or how and why the phenomenon occurs. Thus, it is necessary not only to collect data, but also to make and test inferences and convince other scientists that your interpretation is correct. In the following activity, you will be guided through four cycles of gathering evidence and making inferences about an object, initially hidden from view, during which you will learn the value of data representations and collaboration.

Evidence versus inference

Evidence is obtained from empirical observation of objects or phenomena using our five senses. It can be gathered by our senses directly, or with the assistance of tools that extend our senses ***qualitatively*** or ***quantitatively***. For example, using a microscope to see objects too small for our eyes is a qualitative extension—it improves the quality of what we are observing. Quantitative extension, on the other hand, involves the use of some sort of measuring device— a spectrometer to measure the wavelength of light is one example.

An inference is a conclusion, explanation, or judgment formed from evidence. There are two types of ***inferences***: ***inductive*** and ***deductive***. Inductive inferences (or induction) involve forming a rule from the evidence (i.e., a generalized conclusion from particular instances). This type of inference is responsible for most of the major breakthroughs in science. Deductive inferences (or deduction) involve categorizing or interpreting evidence based on a preexisting rule (i.e., a conclusion about a particular instance that follows from a general premise) and therefore involves background knowledge. Both play a role in research, often in the same investigation. For example, the size and shape of the DNA helix could be deduced from x-ray crystallography mages, but inductive inference was needed to combine several lines of evidence to determine its structure. Scientific argumentation requires that one know how to make decisions about which data to admit as evidence, state claims, and support those claims based on the evidence. In the classical system of education, logic and rhetoric were core subjects. In our modern discipline-based orientation, however, these subjects are often marginalized to nonrequired classes, such as debate, so most students have very little exposure to the principles of argumentation. Current research in science teaching demonstrates the need to reverse this trend (Duschl and Osborne 2002).

PROCEDURE:

1. Form groups of 3-4 students
2. Each group will locate a lab station (There will be 12 different numbered stations)
3. ***Observation*** (about 10 minutes): One person feels the first object and describes the size, shape, surface features, texture, and density, and records the observations in Data Table #1. Remember that the statements "this is made of…" and "this is" are not observations, but inferences. List instead the observations that lead you to infer that the object is made of a certain material. Have each member of the group repeat process.

4. ***Inference*** (1 min. each member) Members of the group should work together to infer what each object is, based only on the descriptions, and record their initial guess in the notebook.

5. ***Representation*** (3 min): Each person should try to draw a picture of the object they observed, feeling it again if necessary.

6. ***Inference*** *(1 min. each member):* Groups should again try to infer what the object is. Is it easier now? Why?

7. ***Visual observation*** *(3 min):* Open the box, and examine each object visually. Add you descriptions to Data Table #1 of characteristics can you see that were not possible to observe by touch?

8. ***Conclusion*** *(5 min):* Groups should again try to infer what the object is. (**Note:** Try to make your inferences as thorough and complete as possible. For example, rather than simply describing an object as a “bone,” try to identify the type of bone, the organism it may have come from, the biological classification of the organism, and so on.) If you are not exactly sure what the object is, can you at least place it in a kingdom? What background information are you drawing on to make that identification? What further information would you need to be sure of your identification? How did it get to the form it is in now? Was it modified after it stopped growing?

9. ***Reflection*** *(5 min):* Discuss how this lab is similar to the process of scientific investigation. What are the roles of finding additional evidence, and of collaboration? Many of the objects are not complete, or are changed in some way since they were alive, making identification harder. How is this similar to real investigation?

DATA TABLE #1 LAB STATION # ____

Observation	
Inference	
Representation (draw)	

Inference	
Visual Observation	
Conclusion	
Reflection	

Taken from: http://www.indiana.edu/~ensiweb/lessons/mys.box.rau.art.pdf