Objective 2.1: Knowledge of the Liberal Arts Course: Physics 103, Physical Science Lab

Students will possess a broad understanding of how to think about the world, having studied the modes of inquiry characteristic of humanities, mathematics, natural sciences, and social and behavioral sciences.

Outcomes 2.1-D: Natural Scientific Mode of Inquiry

By graduation students will:	Not Proficient 1 Point	Developing Proficiency 2 Points	Proficient 3 Points	Exceeding Proficiency 4 Points
Identify essential characteristics of natural science questions (questions of empirical study and applications of scientific methodologies).	Addressed in Physics 102	Physics 102	Physics 102	Physics 102
Evaluate the merits of examples of natural scientific research at the level of an informed citizen.	Physics 102	Physics 102	Physics 102	Physics 102
Apply scientific methodology to a natural science question to increase understanding, make an informed decision, and/or solve a problem.	0-7 points scored on the table	8-11 points scored on the table	12-15 points scored on the table	16 points scored on the table

Assignment meeting Outcome 1:

Addressed in Physics 102

Assignment meeting Outcome 2:

Addressed in Physics 102

Assignment meeting Outcome 3:

A classic description of the scientific method can be described as follows: An individual makes an observation and asks a question (usually the question is “why?”), they first attempt to find out what is already known about that question (literature search for example), they then propose a possible explanation for the answer (hypothesis), and devise a way to test that explanation (experiment) where they can gather data, after performing the test and examining the data they can conclude whether the data agrees with or disagrees with their hypothesis and if it disagrees they can return to the answering step and make a new hypothesis to test. A good example of this occurs during the final lab of the 103 course which we call the moon lab. During this lab, students use a light at the front of the lab to represent the sun, they use their head as the earth and they use a styrofoam ball as the moon. The vast majority of students who come into the class either have never thought about how moon phases work or have the preconceived notion that different parts of the moon are blocked from sunlight by the earth (in my experience around 3/4ths of students believe this before the lab begins). They are shown the basics of how the earth rotates and how the moon revolves around the earth using the models they are holding, then the students are told to stand up and practice moving everything into different positions and attempt to fill in a series of tables that describe the different phases of the moon as seen at different times from the earth. As an example, suppose that a student believes a third quarter moon (the left half of the moon is lit up while the right half is dark) is caused by half the moon being in the shadow of the earth is asked to complete the table below. If they try to do it without attempting the experiment they will almost certainly give the wrong answer. To satisfy their hypothesis, their head would have to be between the sun (light bulb) and moon (Styrofoam ball) to shadow the right half of the moon, but when they look at the first question of the table and turn so that their left cheek faces the sun and the Styrofoam ball is immediately in front of their nose they will observe a third quarter moon. One of the reasons that this lab is so fun to teach is because it is one where I frequently hear thing like “Oh! I see!” or other similarly excited expressions. To understand how the three dimensional arrangement of the sun and moon and earth cause different phases of the moon requires students to repeatedly hypothesize how to set up the orientation, stand up and try it, then assess if it fits the previous data they have gathered. The final table of the lab exercise is shown below:

Part IV: Phases Throughout the Day

Time of Day	Observation	Phase
Sunrise	Moon directly overhead	
Sunset	Moon rising	
Noon	Moon setting	
Midnight	Moon directly overhead	
3:00 PM	Moon setting	
3:00 AM	Moon rising	
9:00 AM	Moon directly overhead	
9:00 PM	Moon directly overhead	

Students fill in the phase of the moon for each setup and each correct answer is worth 2 points (16 points possible).