

**Objective 2.1: Knowledge of the Liberal Arts****Course: Physics 102 Physical Sciences**

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**

<b>By graduation students will:</b>	<b>Not Proficient 1 Point</b>	<b>Developing Proficiency 2 Points</b>	<b>Proficient 3 Points</b>	<b>Exceeding Proficiency 4 Points</b>
Identify essential characteristics of natural science questions (questions of empirical study and applications of scientific methodologies).	0-8 correct answers of the 20 questions described below	9-12 correct answers of the 20 questions described below	13-16 correct answers of the 20 questions described below	17-20 correct answers of the 20 questions described below
Evaluate the merits of examples of natural scientific research at the level of an informed citizen.	0-8 points earned on the subset of the group writing project  Student isn't able to demonstrate evidence for energy problems nor link cause/effect of greenhouse gases and climate change	9-11 points earned on the subset of the group writing project  Student demonstrates incomplete or poor evidence for energy problems or can't link cause/effect of greenhouse gases and climate change	12-14 points earned on the subset of the group writing project  Student demonstrates most evidence for energy problems and links cause/effect of greenhouse gases and climate change	15 points earned on the subset of the group writing project  Student demonstrates complete well referenced evidence for energy problems and perfectly describes cause/effect of greenhouse gases and climate change
Apply scientific methodology to a natural science question to increase understanding, make an informed decision, and/or solve a problem.	See below	See below	See below	See below

### Assignment meeting Outcome 1:

This CLO will be assessed with 20 multiple choice questions on the 4 exams given throughout the course that will test both understanding of scientific theory and the practice of solving scientific questions using those concepts. Example questions are below:

In the absence of a force, a moving object will:

- a. slow to a stop.
- b. continue moving at the same speed in the same direction.
- c. eventually fall to the ground.
- d. none of the above.

If you stand on a tall building and throw a 1 kg ball directly North parallel to the ground at 20 m/s, after 3 seconds, ignoring air resistance and assuming it doesn't hit anything (including the ground) how fast is the ball moving and in which direction(s)?

- a. it's moving north only at 30 m/s
- b. it's moving north at 30 m/s and down at 20 m/s.
- c. It's moving down only at 30 m/s
- d. it's moving north at 20 m/s and down at 30 m/s

If you double the velocity of a moving object, its kinetic energy changes by a factor of:

- a. 1/2
- b. 2
- c. 4
- d. 1/4

If the frequency of vibration of a mass on a spring is 0.33 Hz, what is the period of one cycle of the spring's motion?

- a. one second
- b. 3 seconds
- c. 0.33 seconds
- d. 33 seconds

In a vacuum, radio waves and x-rays have the:

- a. same frequency
- b. same speed
- c. same wave length
- d. none of the above

The specific questions used for the assessment will be:

Exam 1 questions 5, 7, 19, 27, 44

Exam 2 questions 1, 5, 14, 31, 49

Exam 3 questions 3, 13, 19, 30, 47

Exam 4 questions 14, 28, 30, 38, 41

### **Assignment meeting Outcome 2:**

To assess this outcome the students will have to join a small group to write a research paper on energy use and climate change in our country. Students will need to find appropriate scientific sources and discuss benefits and consequences of our current electricity and transportation systems as well as report the current scientific consensus on climate change science. They will need to demonstrate an understanding of the causes and effects of climate change as well as showing the data to support their positions. The paper should be about 10 pages long, should follow all appropriate rules of standard writing styles and will be worth 30 points in the class. A simplified rubric that is used gives up to 5 points for spelling and grammar, 5 points for appropriate sources and citations, 5 points for describing how we generate electricity and problems associated with it, 5 points for describing the energy sources used for transportation and problems associated with it, 5 points for describing the causes and consequences of climate change, and 5 points for describing an effective plan for trying to solve these problems. As you can see there are 15 points available from the sections on energy sources, transportations sources and climate change and most of the points from this subset of the grade require a rational argument describing the production of greenhouse gases by energy use in electricity production and transportation, a description of the greenhouse effect and radiative forcing and a discussion of the negative consequences that will result. The presence of this argument along with appropriately referenced data shows that the student has the ability to accurately analyze scientific research and synthesize

a thesis at the level of an informed non-scientist. This “subset” of points (15 possible) from the large writing project can be used to assess outcome 2 for the student.

**Assignment meeting Outcome 3:**

As per a note on a previous e-mail from Brad Will (“The third outcome for the Natural Scientific Mode of Inquiry (2.1-D) must be satisfied by a lab or field course of at least 1 credit hour in addition to and separate from the course that satisfies the first two outcomes of Objective 2.1-D.”) a separate course proposal is being prepared for Physics 103, Physical Science Lab.