Learning Commentary # 2: Cycle 2: Interactions and forces

Through the engagement of the activities in Cycle 2 of *Physics for Elementary Teachers*, I now comprehend a great deal of information relating to mechanical interactions, forces, and transfers of energy. As a student studying to become an educator, not only am I learning the scientific concepts supporting various phenomena in order to instruct, I am also correcting many of the incomplete representations that I held about the subject matter prior to enrolling in this course; I continue to build better scientific models and ideas. It is important for students to understand how force, motion, and energy affect them on a daily basis in order to make the information they are learning about meaningful and relevant.

An "AHA!" moment that I experienced throughout this series of activities addressed the concept of motion with a continuous force. My groups members and I were asked to predict what the motion of a cart would be like if we were to interact with it by pushing the cart continuously from behind with a constant strength push. We imagined that the cart would initially increase in speed (as it was at rest); we then thought the speed of the cart would remain constant. We tested our prediction ***and still believed*** that the speed of the cart remained constant while it was being given a constant strength push. We were then asked to attach a fan to the cart to act as a continuous strength force. After observing the fan unit push the cart along the track, we ***still inferred*** that the speed of the cart increased as it accelerated (it was initially stationary), then traveled at a constant speed. Since we knew that a constant strength push was exerted on the cart as it moved down the track, it made sense to us that the cart would travel at a constant speed. This scenario demonstrates the idea that sometimes, we see what we want to see while conducting science experiments despite conflicting observations and evidence. We believed this concept, and even though we had evidence for an opposing idea, we still supported our original thought.

We were then asked to open the motion sensor data collection file for this activity. We were instructed to gather data while the fan unit pushed the cart away from the sensor by means of a speed versus time graph. We were shocked to observe the results: as a constant strength force (the fan unit) acted on the cart, the speed of the cart continued to increase. This did not confirm our prediction that the cart traveled down the track at a constant speed. Despite this evidence, we believed that the speed of the cart would *eventually* have to travel along at a constant speed if the cart traveled along a longer track. We were incorrect again: the speed of the cart continued to increase over time as it traveled down three tracks. Based on the experiments throughout this activity, we were able to conclude that while a single force (constant strength) is acting on an object in the same direction as its motion, the speed of the object will continue to increase. We sketched two graphs that provided evidence for this notion (please see attached sheet).

Comment [DSA1]: This paragraph is nice, but not needed. It sets up the context for the rest of the essay, but does not respond directly to the assignment.

Comment [DSA2]: oops

Comment [DSA3]: oops. Misused this word.

Comment [DSA4]: This is the central idea this person is following the development of. It's clear what she's thinking about the topic before instruction from this paragraph. This is a key ingredient in a learning commentary. There's lots of evidence supporting the key idea, too!

Comment [DSA5]: The first step on the person's journey to a new understanding (followed by more evidence and other steps in the person's growth in understanding about the central idea.

If an object is given a constant strength push, it will continue to increase in speed because it is as if individual "pushes" are continuously acting on the object. Imagine that a cart is placed on a track at rest; a fan unit attached to it is turned on, causing the cart to increase in speed to 1 cm/s. As the cart is traveling at 1 cm/s, it is given the same strength push, causing it to travel at 2 cm/s. As the cart is traveling at 2 cm/s, it is given the same strength push, causing it to travel at 3 cm/s; etc. If an object is given a push (force) in the same direction as its motion, its speed will increase. This increased speed is then given a (same strength) push, which further causes it to increase in speed. This increased speed is then given a (same strength) push, which further causes it to increase in speed; etc. This constant strength force acts on accumulated speed. As a constant strength force is applied to an object at rest or in motion, speed accumulates as the constant strength force acts upon each increased speed.

Comment [DSA6]: The author's new understanding is clearly stated.

The funny thing about "AHA!" discoveries is that once I experience them, I have a difficult time understanding my original ideas, because they no longer make sense in accordance with the newly gained, accurate information. But I think that this is part of the beauty of the nature of science: uncertainty and partial comprehension are expected throughout the process of learning. I know that one of the major themes throughout this class is the understanding that errors are occasions for learning and that students ought to be encouraged to take risks without the concern of failure or humiliation.

Comment [DSA7]: WOW! This is quite reflective. The author examines her learning process and draws parallels with the nature of science.

One of the reasons that I love the curriculum of this course is because I find myself looking at everyday objects in my immediate surroundings thinking, "How/why does this work?" I have gathered a true appreciation for investigating items in such detail in the classroom, which has carried over into my world at home, work, and school. Before learning about mechanical interactions, forces, and energy, I took these phenomena for granted because I did not understand the scientific processes involved. It is important to inquire about our surroundings. Our curiosities and inquisitions will lead us to discover great things. It will be my job to instill this notion into my elementary-age students.

Rubric for Learning Commentaries

Element	Excellent ↔			Inadequate
Physics Content	Essay demonstrates deep understanding of physics covered in class; essay addresses the complexity and ambiguity implicitly raised by class activities. (7 points)	Essay demonstrates solid understanding of physics covered in class; central idea is worth developing, but may be limited to material explicitly covered in class. (5 or 6 points)	Essay demonstrates surface understanding of physics explicitly covered in class, perhaps with some minor mistakes; central idea may be too obvious or simple. (3 or 4 points)	Essay exposes flawed thinking about basic physics ideas covered in class or the essay contains little or no physics. (0 to 2 points)
Reflection	Essay critically analyzes the limits/strengths of the author's own learning process and the author's current understanding about a physics subject. (7 points)	Essay examines the author's own learning process about a physics topic, including some description of author's prior knowledge and current understanding. (5 or 6 points)	Essay demonstrates some thinking about the author's learning process concerning a physics topic. (3 or 4 points)	Essay does not examine or is uncritical about the author's learning process concerning a physics topic. (0 to 2 points)
Focus	Essay coherently follows the development of the author's own thinking concerning a single physics concept *or* explores the author's learning during a single class activity; details clearly relate to the central theme. (2 points)	Essay follows the development of the author's own thinking concerning a single physics concept *or* explores the author's learning during a single class activity, but details may not clearly relate to the central theme of the essay. (1 point)		Essay lacks coherence or addresses too many topics. (0 points)
Support	Essay uses evidence appropriately and effectively; evidence convincingly supports central idea of essay. (3 points)	Essay uses evidence to support the essay's central idea. Essay begins to explain connections between central idea and evidence. (2 points)	Essay often uses generalizations to support ideas; connection between evidence and essay's main idea may not be readily apparent. (1 point)	Evidence is missing or does not support central idea of essay. (0 points)
Clarity/Mechanics	Essay is easy to read. Uses words precisely and effectively. Sentences are well structured and w style makes the logical structure of the ideas presented evident. Paper is almost entirely free of punctuation, spelling and grammar mistakes. (3 points)	Essay is generally easy to read, but has imperfections. The writing style might obscure the logical structure of ideas. Essay may contain some errors which may annoy the reader, but do not impede understanding. (2 points)	Essay contains some errors that temporarily confuse the reader but do not impede overall understanding. (1 point)	Essay is difficult to read or interpret. Essay contains many errors that block the reader's ability to see connections between thoughts. (0 points)

To construct a grade from this rubric:

- If the student gets a *zero in any box*, the student must *rewrite* the Learning Commentary.
- Otherwise, add the scores for each category together. Scores of 20 and up are considered "perfect papers." To get percentages, divide the score by 20.