Filling out your Activity Guide

As stated in the course syllabus, physics is fundamentally an experimental science. The format of this course has been designed to not only teach you how the world works, but also to give you a chance to try and "discover" the laws and theories of nature on your own. You will be learning physics, and you will be learning *how to do* physics, and science in general.

When scientists study the world and how it works through observations and experiments, they always keep a journal or notebook containing everything they do – their current understandings, predictions, observations, drawings, measurements, data, calculations, analysis, reflections, etc. Part of learning and doing science is keeping this notebook.

Since this course is an introductory course, you will not be asked to produce a formal notebook. Instead, you will practice doing a notebook when you fill out your Activity Guide. Almost all of the activities in the Activity Guide ask you to do the following things, which would normally be included in a scientist's notebook:

- Make predictions based on your current understandings.
- Make observations and measurements.
- Do calculations with your data or model your data.
- Organize your measurements and results in a table and graph.
- Discuss your observations and data and use them to come to some conclusion.
- Reflect upon your conclusion and how it compares to your predictions and previous understanding.

The following outline is a guide to help you properly include the above items when you fill out your Activity Guide.

Predictions

- When asked for a prediction, we are looking for what *you* think, not what your partner thinks. It is essential that you investigate your own ideas and understanding about a phenomenon before you can build a more comprehensive understanding. Therefore, although it is encouraged to discuss things with your partner, it is also important for you to answer many of the questions on your own.
- Make sure all your predictions are clearly stated, using complete sentences and proper grammar.
- Always support your predictions using one or more of the following:
  1. Previous observations (usually in the previous activity, and sometimes in a previous unit).
  2. Data or equations.
  3. Some sort of logical reasoning, usually based on past experiences.
- Re-read your prediction to make sure it says what you want and that there are no conflicting statements.

Observations and measurements

- Give a complete description of your observations. Your goal is to make sure someone with your same physics background can understand what it is that you saw if they read your Activity Guide.
- Make your description clear and unambiguous. For example, the statement "The cart moved" is not nearly is clear as "The cart moved from rest to the right, increasing its speed at a constant rate when the force was applied to the right.
- Make sure you use complete sentences and proper grammar.
- If it helps in describing your observations, make some sort of sketch or drawing. However, a drawing is not a replacement for the actual description.
- When making a measurement (for example, the mass of a cart), if possible make at least 3 measurements and report the average as the measured value and the SDM as the uncertainty.
- Make sure your measurements have:
  1. The proper units.
  2. An uncertainty.
  3. The correct number of significant figures.

Calculations and derivations

- All your calculations (and equation derivations) should progress in an organized manner, and not be scattered all over the page. Your calculations should start with the equation in symbol form, with any manipulations also being done in symbol form, then the number values plugged in (*with proper units and significant figures*), and finally the final result should be clearly marked (*with proper units and significant figures*).

Data organization

- Your data should be organized in a table, *with proper headings and units* in each column. Sometimes the Activity Guide provides the table outline for you, sometimes it doesn't. If there is no table outline, you must make your own.
- Make sure that all your numbers have the correct number of significant figures.
- Make sure that all your numbers are reported with an uncertainty. (The uncertainty will determine how many significant figures to report.)
- Quite often, a graph is an additional way to organize your data, particularly if you want to see if the data follows some sort of trend (i.e., linear, parabolic, or whatever). Whether the Activity Guide provides a graph outline for you, or you have to make your own graph, be sure that it includes:
    1. A descriptive title.
    2. The proper scale on each axis.
    3. The proper labels, *with units*, one each axis.
    4. A legend, particularly if there is more than one data set on the graph.
    5. Usually the only time a line or curve should go through your data is if it is the result of a model or a curve fit.

Discussion and reflection

- Your discussion and conclusion should be clearly stated, using complete sentences and proper grammar.
- All your conclusions need to be supported by your observations and your data and graphs.
- You should always compare your conclusion with your initial prediction.
- Re-read your conclusion to make sure it says what you want and that there are no conflicting statements.
- Keep in mind that we are looking for evidence that you have a clear understanding of what you are observing and analyzing.

ADDITIONAL REMARKS

Have Fun—We hope your experience in this course will be stimulating. Take the time to have some fun and try not to get overly stressed if you run into problems while working on your activities. Part of the process of science is learning to deal with the problems you run into. Try to be resourceful and develop creative solutions to any problems that arise. Science is very much an artistic endeavor and scientists often derive tremendous satisfaction in becoming deeply involved in projects.

Ask Questions—In this course, the format is designed so that you are actively engaged in discussions and activities with your fellow students. You will find times when everyone seems to be confused and yet it seems perfectly clear to you. Of course, there will be times when you are the one feeling frustrated and everyone else seems to have "gotten it." It is important to be able to explain things to others as well as to be able to understand another students explanation. This interactive process is intellectually beneficial to both parties and you should engage in discussions whenever appropriate.

Use Your Head—This course is designed on the assumption that you will make an honest effort to answer the questions in your Activity Guide with intelligent thought. You will learn little if you decide to just "whip through" the questions without having given them much thought. *You will be forced to think in this class!!* On the other hand, try not get too bogged down on any one question. If you are really having problems with something, it is possible you are interpreting the question differently than anticipated. Ask your instructor!

Talk to the Instructor—If you are having serious problems, come and talk to the instructor. Their job is to help you overcome your difficulties. Your frustration and anger can spread to your classmates and result in a bad experience for everyone. On the other hand, enthusiasm and excitement are equally contagious, so keep that in mind and lend a hand when your partner is having difficulties. Remember, your instructor cannot be held fully responsible for your learning. If you are having problems, do not wait until you are so lost and frustrated that nothing can be done to help.