> "...writing means joining a conversation of persons who are, in important ways, *fundamentally disagreeing with each other,* or, to make the matter less agnostic, *jointly seeking answers to shared questions that puzzle them*."
>
> — John C. Bean, Engaging Ideas

3 Introductions, Methods, Results/Discussion

3.1 Introductions

The **introduction** convinces the reader that this paper will be interesting to read. It also **provides the necessary background to understand the project.** A general discussion of any techniques or theories used should be included. Summarize the relevant theory and equations. You may want to look up and cite some other references that provide you with added theoretical grounding for the project. Any information presented that is not your original idea must be cited.

The introduction also includes a statement of what the purpose of your report is, with a clear connection to all prior introduction material, and how you accomplish this goal. The reader should be able to clearly distinguish between what was already known and what you show them in this paper.

For more on introductions, please see the excerpt from *A Short Guide to Writing About Science* by David Porusch.

3.2 Methods vs. Results/Discussion

The purpose of a **methods** section is to provide enough information for another scientist to **completely replicate your experiment**. The **methods** section describes as briefly as possible all materials, instrumentation (including programs), and procedures used during data collection. Be detailed but succinct in your description. Passive voice is preferred in some fields, though past tense is acceptable in many cases, including in this class. Only refer to material that is available to the general public. Include an apparatus drawing with appropriate labels. If the key equations used in calculations are not derived in your text, they should be derived in this section of the report.

In the **results and discussion** section, key pieces of data are reported and results are examined and interpreted. Rather than presenting all results followed by a discussion of all results, you should briefly introduce or motivate a single result and discuss that result. Explain what that result means, compare to the literature (if possible), and discuss any sources of uncertainty. When you feel that you have thoroughly discussed a result, then write a smooth transition to the next result.

3.3 Where to draw the line?

Here are some mini-reports of experiments you have done in class so far. Where you would draw the line to define where the Methods section ends, and the Results and Discussion section begins?

1. "... We loaded the coul004.mov file into Logger Pro, and then scaled the video using the meter stick shown in video. We clicked on the center of the ball hanging from the string to determine the position of the ball, x_{ball} and y_{ball} at each frame. We repeated the data collection for the probe as well. Using Equation 1 (in the Introduction) we calculated the electrostatic force F^{elec} on the ball at each frame, as a function of x_{ball}. Using modelingWorksheet.xls, we modeled the result as:

$$F^{elec} = C/r^2 \tag{1}$$

By Coulomb's law, the modeled constant, C, will be equal to kq^2, where the charge on both the ball and probe are equal to q. Therefore, the charge on each ball can be found using the equation:

$$q = \sqrt{C/k} \tag{2}$$

Figure 1 shows F^{elec} vs. r, the distance between the ball and probe. As expected, the F^{elec} appears to vary as $1/r^2$. Our modeled equation came out to be $F^{elec} = 1.15 \times 10^5$ N/m^2. The charge q on each ball, using Equation 2, must be 3.57×10^{-8} C... "

2. "... For each trial, we made sure that the temperature probe was equilibrated by making sure the temperature vs. time graph in Logger Pro was flat for at least ten seconds. Next, we switched on the heating coil for a given amount of time, Δt, then switched it off. We waited until the temperature vs. time graph was once again flat for at least ten seconds. The average of first flat section was recorded as T_i, and the average of the second flat section was recorded as T_f. For each trial, we calculated the specific heat, c, using the equation:

$$c = \frac{P\Delta t}{m(T_f - T_i)} \tag{3}$$

where P was the power of the heating coil, Δt was the time the coil was on, m was the mass of the liquid. The average, standard deviation, and standard deviation of the mean for each liquid's set of trials was calculated in Excel. Our measured value of c for water was 4.5 ± 0.2 J/(g·°C). The data for each trial is shown in Table 1. This value is slightly higher than the accepted value, which may be due to one of the following reasons..."

3.4 Equations, Figures, and Tables

These two sections will likely contain the majority of your figures and tables, though some might appear in the Introduction. All equations, tables, and figures should be clearly numbered. These elements are numbered separately. A table or figure may not appear before it is introduced in the report; the reader should know what they will be seeing before they see it. Graphs and tables must be included in the appropriate places in the main body of the text rather than tacked on at the end. There should not be gridlines or titles present in figures, and all data should be legible. Each table or figure should be accompanied by a short caption that very briefly summarizes the data.