

How to successfully teach science labs so the reactions aren't explosive

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York University provides comprehensive programs in the Faculty of Health (<http://health.info.yorku.ca/>) and the Faculty of Science and Engineering (<http://science.yorku.ca/>) to over 4000 undergraduate students.

Undergraduate science courses often consist of two components, the lecture and the laboratory portions. These two parts of the course provide students with different atmospheres to learn, and as well, require differing methods of instruction. While teaching course content during lectures follows a specific flow, so to do the labs, which aid to provide hands on experience to the students. Beyond the textbook lies a whole world waiting to be discovered under the microscope.

- **Course Design**

To maximize the quality of instruction it is best to design a course outline. Although not all aspects of the lab warrant a structured design, but where possible it is beneficial to do so. The course outline is divided into three stages.

1. Introduction and familiarization
2. Performance of experiments
3. Summary and explanation

- **Introduction and Familiarization**

It is important to know whether the students have been taught the content behind the labs prior to beginning the labs. The majority of science labs are set up this way. As such, your introduction should not be a direct repeat of the lecture, rather you should provide a brief review and touch on the relative topics applicable to the labs. This is your opportunity to engage the students and magnify their understanding of science concepts.



During your introduction, it is also critical for your students to familiarize themselves with the laboratory equipment. Much of the instruments used during the labs are not readily available at your corner store and consequently may not be familiar to your students. It is important to not only teach your students the use of each piece of equipment, but the proper use and handling of the equipment/machines. For example, a sphygmomanometer (aka a blood pressure cuff) is useful at determining one's blood pressure, however if excessive or extended inflating occurs damage to your student's arm could occur. Furthermore, laboratory equipment is quite expensive, improper use could damage the apparatus and become costly to the university.

- **Performance of Experiments**

At this stage in the lab it is best not to be as “structured”. This is your students' opportunity to learn and try the experiments on their own or in a group setting. You want to ensure that the students have enough freedom to perform the experiments and learn, while at the same keeping a watchful eye on them. Remember it is ok if your students make an error, but if they deviate too far then help them. This is your students' opportunity to engage in science, allow them to explore.



- **Summary and Explanation**

During this final stage you should provide a summary of results obtained by your students. In human physiology labs in particular, you may see divergent results from your students. It is important to explain to your students that every student is different and as such their physiological results may vary slightly from their peers. To affectively apply the principals learned during the labs try to make them more applicable by:

- Leave your students with a take home message/important concepts
- Provide relevant and real-life situations
- Compare various students' results to explore the variability between subjects
- Allow your students to interpret results, then elaborate and expand on their conclusions
- Ask follow-up questions to challenge and interest your students

- **When your course outline doesn't go as expected**

As everyone in science is well aware, experiments do not always go as expected. This becomes even more of a concern when you are the TA responsible for teaching the lab. If/when you are in this situation:

- Remain calm
- Try to determine the cause of the problem-equipment, student error, unexpected results
- If the problem lies in the equipment and cannot be resolved, reorganize the classroom by grouping students together to share working equipment
- If the problem cannot be fixed and allows for unexpected results, then continue as planned. Allow the students to perform the experiments, if possible, in order to understand how to use the equipment.

It is ok if unexpected results arise, explain to your students the reason for the obtained results and explain what the results should have been, under ideal situations.

- **How to ensure student success**

- Encourage student involvement and engagement
- Establish a course outline
- Set a helpful and positive learning environment
- Provide opportunities for students to receive feedback

- **Concluding remarks**

The laboratory environment allows students to establish a connection between their lectures and research. It allows them to gain the knowledge necessary to understand scientific concepts and health information. By applying a multidimensional approach to learning we are allowing our students to explore and inquire in areas of science.

