

## Ethics in Science and Education

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Students are highly encouraged to review the materials on MIT's Academic Integrity website, [integrity.mit.edu](http://integrity.mit.edu).

When you read the report of a physics experiment in a reputable journal, you can generally assume it represents an honest effort by the authors to describe exactly what they observed. You may doubt the interpretation or the theory they use to explain the results but at least you trust that if you repeat the manipulations as described, you will get essentially the same experimental results.

*Nature is the ultimate enforcer of truth in science.* If subsequent work proves a published measurement is wrong by substantially more than the estimated error limits, credibility is questioned. If fraud is involved, a career may be ruined. Thus, most professional scientists are very careful about the records they maintain<sup>1</sup>, and the results they publish.

Junior Lab is designed to provide preprofessional training in the art and science of experimental physics. What you record in your lab book and report in your written and oral presentations must be exactly what you have observed, *including the date, the time, and the name of experimenter.*

Sometimes you will get things wrong because of an error in manipulation, equipment malfunction, misunderstanding, or a miscalculation. Simply cross out errors using a diagonal line in your notebook and start again. The instructor's job is to help you figure out what went wrong so you can do better next time. If circumstances in an experiment are such that you cannot get your own data (*e.g.* broken equipment, bad weather), you may request your instructor's permission to use another group's data, provided you acknowledge it.

*Fabrication or falsification of data, using the results of another person's work without acknowledgement, and copying from "the files" are intellectual crimes as serious as plagiarism, and possible causes for dismissal from the Institute. This includes using another group's data without your instructor's explicit permission.*

The precaution regarding the acknowledgement of other people's data also applies to acknowledging other people's rhetoric. The appropriate way to incorporate an idea which you have learned from a textbook or other reference is to study the point until you understand it and then put the text aside and state the idea in your

own words.

One often sees in a scientific journal phrases such as, "Following Albert Einstein ...". This means that the author is following the ideas or logic of Einstein, not his exact words. If you quote material, it is not sufficient just to include it in the list of references at the end of your paper. You should use the following formatting:

The quote should be indented on both sides or enclosed in quotation marks. Attribution must be given immediately.<sup>2</sup>

*Importing text from a published work, from other student papers, or from the lab manual without proper attribution is a serious breach of ethics and will be dealt with by the Committee on Discipline.*

Many Junior Lab experiments are concerned with measurements of well known fundamental constants such as  $\hbar$ ,  $e$ ,  $k_B$ , and  $c$ , or of significant physical quantities such as the mean life of the muon or the cross section of an electron for scattering a photon. There is nothing wrong with "peeking" at any of the many relevant reference to see what your experiment should have yielded. In fact, in your conclusions, you should compare your values with the established ones — as you would in any professional scientific publication. One way to get maximum benefit from your Junior Lab experience is to play it as a game in which you squeeze the most accurate measurement you can get out of the available equipment and the practical limits of analysis, make a rigorous estimate of the error, and then compare the results with the established value. If the established value is outside your error range, try to find out what went wrong, fix it, and try again. If the established value is in your error range, do not rest easy, but do whatever may be necessary to prove it is not an accident. Repetition is the essential key to attaining confidence and meaningful uncertainties for a result, whether of a single measurement or an entire experiment! But whatever the outcome of an experiment is, you must tell exactly what you observed or measured when you present your oral or written report, regardless of how "bad" the results may appear to be. *Never fabricate results. Say what you did. Say what you saw. Always tell the truth.*

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<sup>1</sup> See the [Notebook Guidelines](#) document on the Junior Lab website.

<sup>2</sup> A. Einstein: Personal communication. Footnotes may be placed at the bottom of the page like this, or more typically at the end among the bibliography entries.