

Some Guidelines for Scientific Research

Overview

Scientific research should produce well-documented data, and ultimately well-documented presentations and papers, that are relevant to questions for which the answers are not yet known.

Samples and Records

Field samples should be labeled immediately when taken in the field. Clear records of locations and contexts of field sampling are essential. Photographs of field sites and sample locations are very useful.

A sample for which the field/contextual origin is not certain should not be analyzed.

There should be a constant train of sample identification from field sample or specimen to processed subsamples analyzed in the lab. Analytical results should be recorded immediately on a permanent medium.

All research activity should be documented in lab records or logbooks.

Where records are hand-written, they should be in ink, not pencil, and they should be copied, and those copies should be stored away from originals. Where records are digital, they should be copied to media stored away from originals.

Replicate sampling, and analysis of replicate samples, are important because,

- 1) they assure that results from one specimen or sample were not a fluke, and
- 2) they provides an estimate of the natural variability or range of results from the material sampled. Projects leading to statistical tests of data are best conducted after calculation of the number of measurements (n) needed to allow a statistically significant test.

Authorship

Authors on abstracts and papers should include and be limited to persons who made a substantive contribution to the research. When an author omits fellow researchers, those fellow researchers and other potential collaborators have little motivation to help the author with future research.

In the sciences, authors typically include

Persons who physically did the research (who, with a mental focus on the purpose of the research, took field samples or analyzed samples in a laboratory),

Persons who wrote the abstract or paper (where "writing" is generation of new text, as opposed to editing),

Persons who envisioned and/or obtained funding and/or pushed forward the research from concept to completion,

Persons who provided significant and multiple insights and advice,

Persons who, without their specific participation in and unique contributions to the research, the research could not have been done.

Authorship typically does not extend to people who were paid on an hourly or piece-work basis to process samples. If someone, when asked, would not be able to explain the purpose of the specific research, they should not be a co-author. If you can imagine a mechanical and/or chemical robotic apparatus that could have done what they did, their participation is not sufficient for co-authorship. A friend who drove a vehicle or carried sample bags, a parent who paid for field expenses, or a fellow student who weighed samples would not be co-authors.

Obligations to co-authors/collaborating researchers

The text of an abstract or paper should be sent to all co-authors for their approval prior to submission. That text should include a title and a list of authors with their affiliations.

The requirement above imparts time constraints on both the principal author and on her or his co-authors. For the author, a decision to write an abstract a day or two before a submission deadline is untenable. For co-authors, timely reply becomes a responsibility. With regard to the latter, the author driving the preparation of the abstract or paper commonly sets a deadline for feedback from co-authors. For an abstract, that deadline may be two weeks after the abstract is distributed to the co-authors; for a paper, the deadline is best set to be thirty to sixty days after the manuscript is distributed.

At submission of an abstract or paper, inclusion of a co-author who has not agreed to be a co-author is considered unethical, because it would allow unscrupulous authors to include well-respected scientists as co-authors and thereby falsely enhance the possible credibility of the research. In this context, a reply from a potential co-author (i.e., from someone whose name appeared in the list of authors on the distributed text) with that potential co-author's comments on the text is implicitly an agreement by that person to be a co-author.

Things That Should Not Happen

The whole enterprise of scientific research and generation of new knowledge hinges on the honesty and integrity of the researchers. Among the activities that undermine this process and cannot be tolerated are

Fabrication: generation and report of results that in fact were never generated – the "making up" of data.

Falsification: change of, or deletion of, results obtained previously. Fabricating data and falsifying data send science, and the scientific community, toward untruths. Fabrication and falsification are the greatest possible betrayal of science, in that all science assumes that the data presented in papers are correct.

Theft: Publication of unpublished ideas, data, or results of other researchers. Scientists cannot incorporate in their research the data or ideas that they have read in proposals or manuscripts that they were asked to review. We are given unpublished results in proposals and manuscripts as a matter of trust in which the scientific community must engage for peer review to happen. Using those data or ideas is theft, just as much as is plagiarism from a published document. The same applies to the work of others presented at meetings but not yet published.

Plagiarism: publication, without citation, of results or text previously published by others. Scientists are rewarded for new data and interpretations with academic degrees, job offers, promotions, and increases in salary. Presenting the data or interpretations of others without crediting them, and thereby gaining for oneself the rewards earned by others, is theft, and it eliminates the motivation of working scientists to generate new data and interpretations

Methods

For ordinary research in which the goal is to generate new data (as opposed to research with the goal of generating a new method), the research optimally follows methods previously published in scientific journals. This assures the researcher of the credibility of her or his methods, and it makes writing the methods section of a paper easy, as in "We used the method of Meticulous et al. (20XX)".

Presentation of results

Scientific research should lead to presentations and papers that report the research and that explain its relevance to scientific questions. The typical format of a paper is

- An introduction that prospectively explains why a reader should be interested in the paper's topic and results,
- An explanation of the context of the materials studied,
- An explanation of the methods of the research,
- The results (key field observations, results of laboratory analysis, etc.),
- A discussion that explains the significance of the results to broader scientific understanding,
- and a list of conclusions.

Preceding all this on paper, but written afterwards, is an abstract briefly reporting the key points.

Abstracts for presentations and papers for publication should be original text; copying from the work of others without citation is plagiarism.

Publication

The goal of scientific research is publication of one's results in a scholarly journal, so that one's results are available to others and thereby a contrition to scientific knowledge. One generates a manuscript, an as-yet-unpublished paper, and submits it to the editor(s) of an appropriate journal. The editor(s) then ask two or more scientists to review the manuscript and to evaluate its suitability for publication. With that in mind . . .

One cannot submit a manuscript for publication to two or more journals or other outlets at the same time. Journal editors and reviewers put in an enormous amount of time processing submitted manuscripts. Multiple submission betrays their trust that they are doing all this work for a reason. Withdrawal of a manuscript from one journal if accepted at another would be exactly that betrayal.

One cannot submit for publication to a journal or other outlet a manuscript previously published elsewhere. Journal space is a precious resource, and journals must commonly reject good science for lack of page space. Re-publication consumes that page space and thus betrays the scientific mission to disseminate as much new data as possible. Re-publication is also likely to involve violation of copyright, in that it involves publication of text or figures to which the first journal already holds the copyright. Most journals will therefore require a signed statement concerning the originality of the work submitted.