National Institute of Environmental Health Sciences

Ethics in Citizen Science

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This research is supported by the Intramural Program of the National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health (NIH). It does not represent the views of the NIEHS, NIH, or US government.

What is Citizen Science?

Traditional Science	Partnership Model	Citizen-Driven Science
Professional scientists plan, design, and conduct the research. Government agencies, private companies, academic institutions, or philanthropic organizations fund the research and may have substantial input into study planning and design. Citizens are not substantially involved in planning, designing, or conducting research.	Professional scientists partner with citizens or citizen groups to plan, design, or conduct research. Government agencies, or other groups fund the research and may have substantial input into study planning and design. Although citizens participate substantially in research, they are not driving the research. Examples: community-based participatory public health research; neuroimaging research, finding galaxies and asteroids in telescope data.	Citizens plan, design, and conduct the research. Citizens or citizen groups fund research or seek funding from other sources. Professional scientists may assist with the research but they are not driving the research. Examples: Do-it-yourself science in biomedicine; amateur astronomy, bird counting; citizen science projects involving sharing genomic and health data

What is Ethics in Research?

- Following ethical and professional norms for research.
- Making ethical decisions when faced with dilemmas in research.
- Displaying ethical virtues in one’s research conduct.

Why is Ethics Important in Research?

- To obtain the goals of research, e.g., knowledge, truth.
- To promote collaboration and trust among members of research teams and in the research community.
- To foster public trust in and support for research.

Concerns about Ethics in Professional Science

Infamous cases of data fabrication and falsification (e.g., Breuning, Poisson, Hwang, Schön, Poehlman, Wakefield, Potti, Obokata, Boldt)

Corrupting influence of private funding and financial interests on research

Abuses of human and animal subjects (e.g., Nazi Experiments, Tuskegee Study)

Dangerous or controversial research (e.g., gain of function experiments in virology, research on race and intelligence)

Growing number of retractions since 2000

Reproducibility “crisis”

Response to these Concerns

- Federally mandated training in responsible conduct of research
- Funding agency policies concerning misconduct, conflict of interest, data sharing, human subjects, etc.
- Professional association ethics codes and guidelines
- Journal ethics policies concerning misconduct, authorship, data sharing, etc.
- University policies
- Research on research ethics and integrity

Ethical Concerns about Citizen Science

Citizens are not trained in scientific methods, techniques, and ethics, so there could be issues with

- Data quality
- Record keeping
- Data fabrication and falsification
- Data analysis and interpretation
- Rigorous study design
- Safety: physical, chemical, biological
- Protection of human and animal subjects

Ethical Concerns about Citizen Science

Citizens who work with professional scientists may be taken unfair advantage of, so there could be issues with

- Exploitation of labor
- Authorship and acknowledgment
- Intellectual property, patents, copyrights
- Data access, sharing, and ownership

Ethical Concerns about Citizen Science

Citizens and scientists who work together may have different values and interests which can lead to conflict over issues such as:

- Research aims
- Research design
- Publication
- Data sharing
- Intellectual property

Ethical Concerns about Citizen Science

Citizen science is often conducted in response to environmental, social, or political concerns. This is a good thing, but it can raise issues of:

- Bias, political
- Public perception of research

Response to the Concerns

Education for citizens in scientific methods and ethics

Codes of conduct for citizen scientists, see Citizenscience.org

Ethical Principles for Research

- Honesty
- Objectivity
- Carefulness
- Rigor
- Openness
- Transparency
- Confidentiality
- Accountability
- Credit
- Respect for colleagues
- Respect for intellectual property
- Protection of human and animal research subjects
- Safety
- Stewardship
- Respect for the law
- Professional responsibility
- Social responsibility

Research Misconduct and Questionable Research Practices

Research misconduct is behavior that is widely regarded as seriously unethical in research

Questionable research practices (QRPs) are behaviors that ethically suspect but not widely regarded as seriously unethical

Research Misconduct	Questionable Research Practices	Ethical Research
Data fabrication or falsification	Inappropriate exclusion of outliers Poor record keeping “P-hacking” and other questionable uses of statistics Careless preparation and selection of images Overstating the significance of one’s results Refusing to share data or materials after publication	Honest, unbiased, transparent, and open reporting, analysis, and interpretation of data and images
Plagiarism	Inappropriate authorship Text recycling or “self-plagiarism”	Appropriate citation and authorship attribution
	Poor supervision or mentoring	Good mentoring and supervision
	Not disclosing a significant conflict of interest	Appropriate disclosure of conflicts of interest

Other Misconduct

Other misconduct is behavior that is widely regarded as seriously unethical but is not unique to research, such as:

- Sexual and other harassment
- Bullying
- Inappropriate personal relationships
- Discrimination based on gender, sex, sexual orientation, race, ethnicity, religion, age, or disability
- Financial fraud, mismanagement of funds

Research Misconduct: Federal Definition (45 CFR 93.103)

- Research misconduct means fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results.
- Research misconduct does not include honest error or differences of opinion.

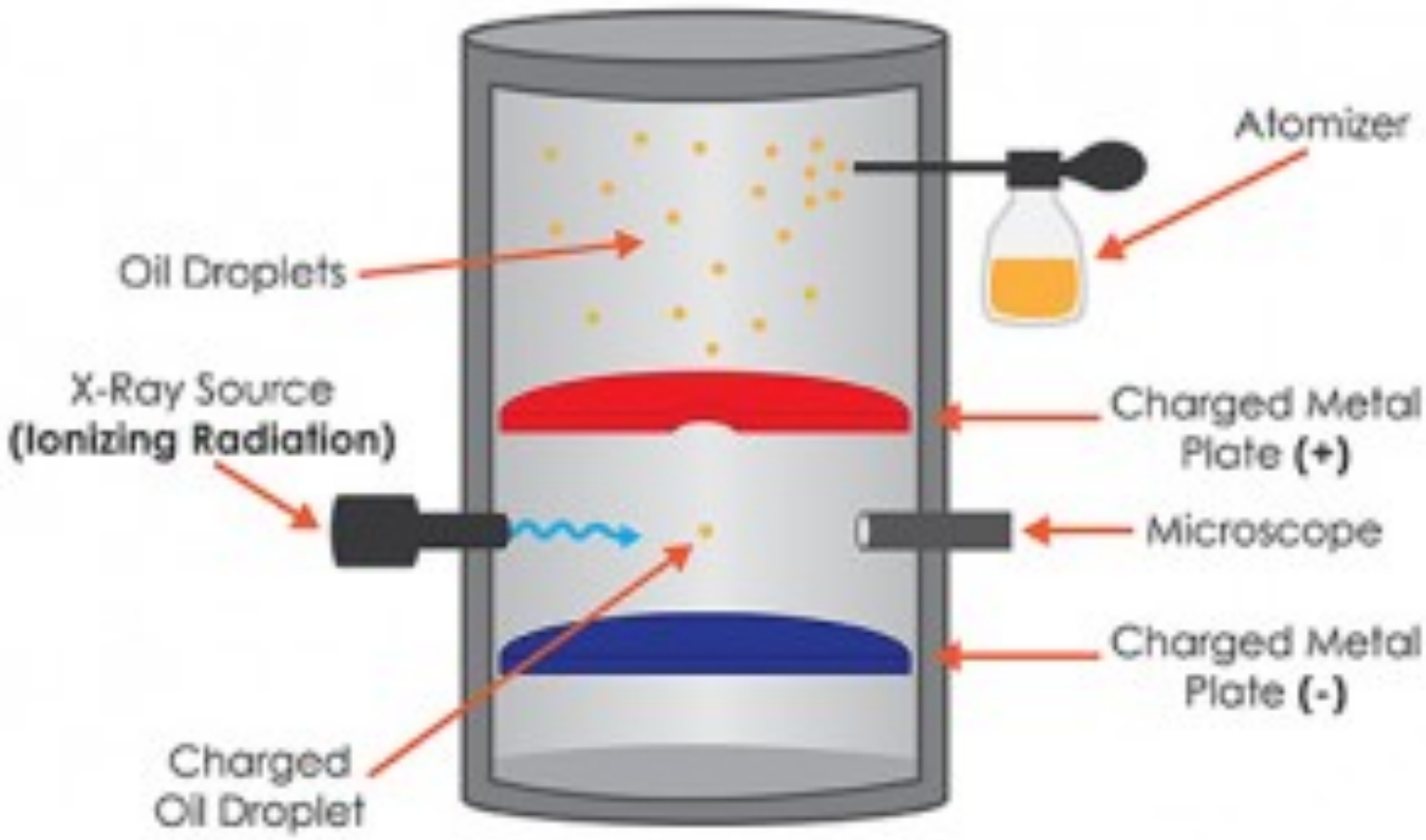
- Fabrication is making up data or results and recording or reporting them.
- Falsification is manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record.
- Plagiarism is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit.

- A finding of research misconduct made under this part requires that
- There be a significant departure from accepted practices of the relevant research community; and
- The misconduct be committed intentionally, knowingly, or recklessly; and
- The allegation be proven by a preponderance of the evidence.

Case 1: Robert Millikan

- Robert Millikan won the Nobel Prize in Physics in 1923 for measuring the charge on an electron.
- To measure the charge of an electron, Millikan dropped negatively charged oil droplets through positively charged plates. When a droplet was suspended in the air, the electrical force would be equal to the force of gravity. Millikan was able to determine the charge of an electron by calculating these forces. https://www.archives.gov/nhprc/projects/catalog/robert-millikan

•https://www.sciencefacts.net/oil-drop-experiment.html



- Historians who examined Millikan's laboratory notebooks for these experiments found that he did not report 49 out of 189 observations (26%) that were marked as "fair" or "poor", even though he said he reported all of his observations in the paper.
- Millikan's results have been validated many times by other scientists.
- Some historians and journalists have argued that Millikan's conduct was deceptive and that he falsified data.
- Others have argued that Millikan had a good understanding of his equipment and knew when it was working properly. He probably decided not to report observations resulting from experimental error or inconsistency. Also, the exclusion did not affect his overall results.

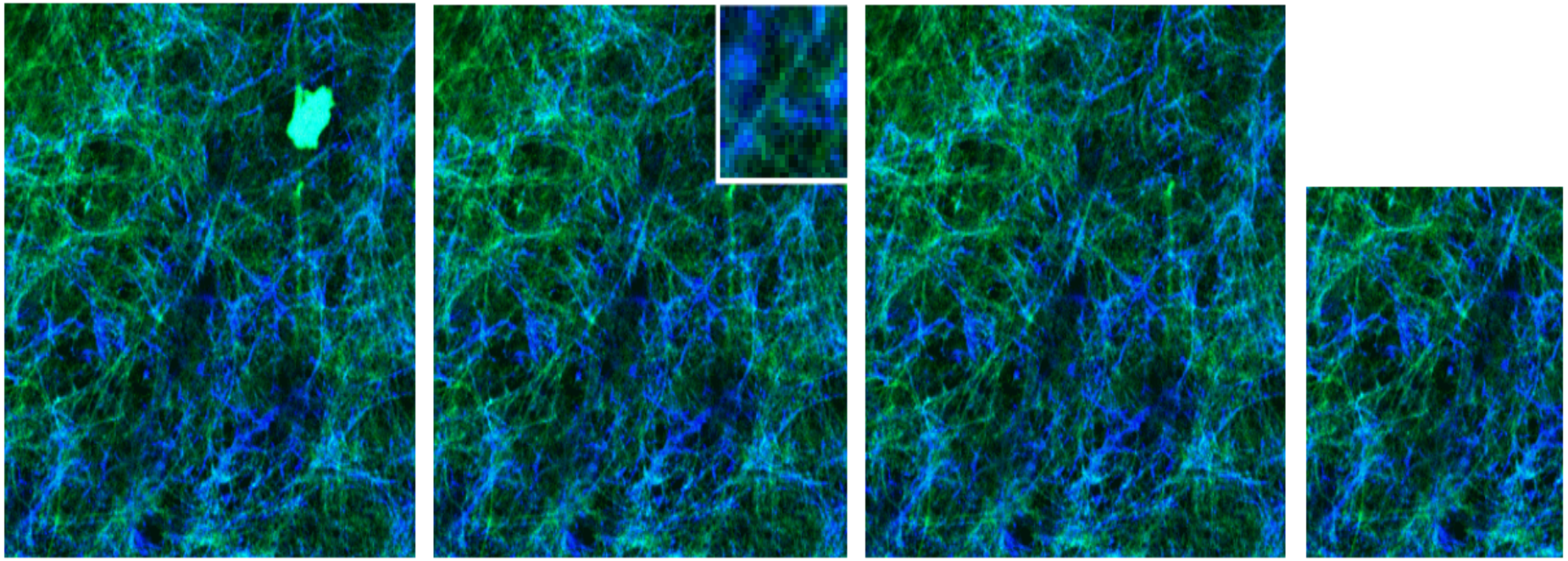
Discussion

- Do you think Millikan falsified data?
- Do you think we can judge Millikan's conduct by today's research standards?
- How should have Millikan reported and discussed his data?

Case 2: Figures for Publication

Dr. Smith is preparing a manuscript for submission to a prominent journal and is trying to decide the best way to present her image and gel data. She comes to you for advice about the following potential figures. She complains that the best fluorescence images of her protein called “excitin” often have an unexplained bright blob of material that looks like junk and will be distracting to readers. She debates what to do, including covering it up with an inset, fixing the problem by masking the junk using the “clone” function in Photoshop, or by cropping the picture.

Discussion: What is the best practice for reporting image reporting? Would any of these images be deceptive? Would they constitute data fabrication or falsification?



Original with “junk” | Covered up by inset | "Fixed“ with Photoshop | Cropped out

Data Management

- **Collection**
- **Ownership**
- **Storage**
- **Sharing**
- **Protection**

Data Management

Good data management is essential for research integrity.

Poor data management can lead to problems with reproducibility and allegations of research misconduct.

Research Records

- Research records include all of the records needed to document research. Records include:
  - **Data**
  - Protocols
  - Research proposals and grant applications
  - Standard operating procedures
  - Preliminary analyses
  - Software used in statistical analysis
  - Questionnaires, informed consent documents
  - Audit reports
  - Drafts of papers
  - Correspondence with journals
  - Correspondence with research committees and funding organizations
  - Plans for future research

Research Data

Data are recorded observations used to document and support research findings. Data may be recorded in:

- Lab notebooks—paper and electronic
- Patient records, case reports
- Computer files, e.g. WORD, EXCEL, digital imaging software
- Machine outputs, e.g. DNA sequencers, DNA microarrays, flow cytometry, x-ray crystallography, gas chromatography, magnetic resonance imaging, CAT scans
- Videotapes, audiotapes

Good Recordkeeping

Research records should allow others to re-execute your experiments.

Records should be:

- Clear
- Consistent
- Thorough [annotated if appropriate]
- Accurate
- Well-organized [indexed if appropriate]
- Signed
- Dated
- In English (for US)

Review of Data

Reviewing data is essential for quality control.

Data (including raw data) should be reviewed by the leader of the research team or others on a regular basis.

Auditing data can be a valuable tool for detecting errors, inconsistencies, and other problems.

Storage of Data

Data should be securely stored.

Security may be physical (e.g., locked file cabinet) or electronic (password protection, encryption).

Electronic data should be backed up.

Data and other research records should be kept for at least 7 years after completion of the project.

Discussion

- Do you feel like you have received sufficient guidance on how to collect and store data?
- Do you know who to contact if you have questions about data collection and storage?
- Is your data available to other members of the research team?
- Is it reviewed on a regular basis?
- Is it audited?

Authorship

Authorship is important for giving people credit for their intellectual contributions to research and holding people accountable if there are questions about the research.

Authorship can help promote collaboration and is crucial for career advancement in science.

Unethical authorship practices, such as honorary authorship (authorship without substantial contribution) and ghost authorship (substantial contribution without authorship), undermine the integrity of research.

Authorship

- Authorship has become more complex and contentious due to the increasing number of authors and the range of different disciplines contributing to a single paper and the types of contributions.
- Most journals have authorship policies, but these don’t solve all the problems.
- Authorship disputes are common in science because so much is at stake.

Authorship Guidelines from the International Committee of Medical Journal Editors

Authorship should be based on:

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
- Drafting the work or revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

- All those designated as authors should meet all four criteria for authorship, and all who meet the four criteria should be identified as authors. Those who do not meet all four criteria should be acknowledged.

Discussion

- Do you think citizen scientists meet or could meet the criteria for authorship?
- What do citizens need to do to qualify?
- Should citizen scientists be acknowledged if they are not listed as authors?
- Have you been treated fairly with respect to authorship and acknowledgment?
- Have you ever been involved in or know about authorship disputes?
- How were these resolved?

Questions and General Discussion

Further Reading

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