

Data Acquisition, Retention, Ownership & Sharing*, Part 2

Lab Notebooks and Design of Scientific Experiments

*Acknowledgments/Resources

The following slides are largely taken from Lecture 2 of GRAD544, shared with me by Dr. Kathy Partin

Acknowledgments (from original): Some content taken from

- <http://ccnmtl.columbia.edu/projects/rcr/index.html>
- *M. J. Zigmund and B. A. Fischer: Teaching Ethics and Survival Skills, University of Pittsburgh, 2006*
- *H. M. Kanare, Writing the Laboratory Notebook, American Chemical Society*

Key Points on Record Keeping

- Far better to collect too much data than too little.
- Keep records of physical data and “mental activity.”
- Show progress of research
- Include physical and intellectual activity (tangible and intangible)
- Must convince a reviewer of
 - Accuracy
 - Replication
 - Reliability
 - Your contributions to the project
- Pretend you are recording the data for someone else
 - *you just might be!*

Best Practices for Data Collection

- There is no one way to keep data, but data should:
 - Explain why research was done
 - How it was done
 - Where primary data are kept
 - What happened and did not happen
 - Interpretation of the data
 - Future work (what is or should be next)
- Data/records should
 - Allow another researcher the ability to repeat the experiment
 - Be kept in a way that is easy to understand.
 - Legally, federal research sponsors can audit data and examine records relevant to a grant
- Data can also be important commercially
 - new drug applications to the FDA
 - patents on new technologies

Data & Record Keeping

It's a notebook, not a neat book...

I spend a lot of time preparing. I think a lot about what I want to do. I have prep books, little notebooks in which I write everything down before a sitting. Otherwise I would forget my ideas.

-Helmut Newton (photographer)

It was on **March 12, 1862**, in the laboratory of the Royal Institution that Faraday carried out this experiment. The notes in his notebook, although not quite clear, **leave no doubt** that he was attempting to demonstrate by means of a spectroscope that magnetism has a direct effect on a light source.

-Pieter Zeeman (Physicist)

Bad record-keeping costs...

LeMonnier, French astronomer who gets no credit for the first sightings of the planet *Uranus* (in the 1760's). His notes were so bad that he thought it was a comet. Discovery of *Uranus* is instead awarded to Sir William Herschel in 1781.

Francois Arago (1786-1853), a French astronomer and biographer wrote: "...LeMonnier's records were the picture of chaos....one of the observations of the planet Uranus was written on a paper bag which once upon a time held powder to powder the hair, bought at a perfumer's..."

Bad record-keeping costs

Gordon Gould (American physicist, 1920-2005) had many ideas related to the production and use of lasers (coined word laser). Began when he was a graduate student at Columbia in 1957; he foresaw that lasers could cut steel or ignite fusion reactions. His notes were witnessed by a candy store notary instead of a colleague. He had undocumented meetings with the "maser people." He did not get around to the patent process until 1959. Years and years of legal proceedings (1977 won first battle for patent rights) were required to get him *some* of the credit he deserved. Did not start receiving royalties until 1988.

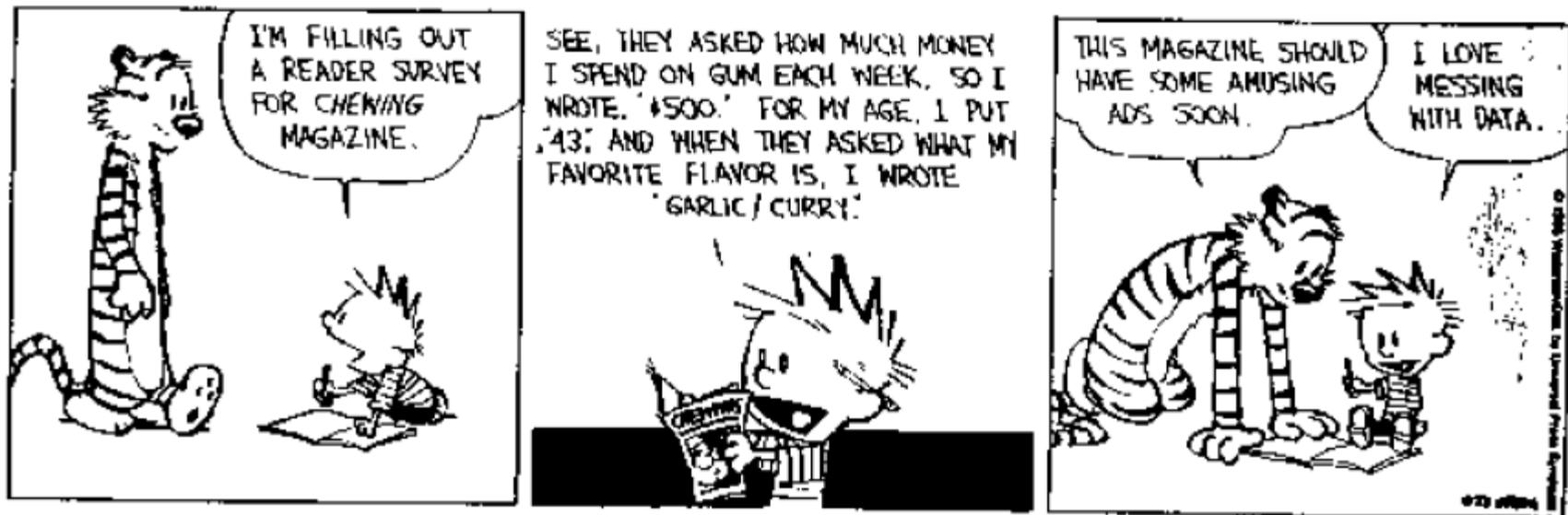
But certainly the laser proved to be what I realized it was going to be. At that moment in my life I was too ignorant in business law to be able to do it right, and if I did it over again probably the same damn thing would happen.

-Gordon Gould

Best Practices: Record-Keeping

- The ORI (NIH) states that data should be stored in such a way that it permits a complete retrospective audit, and that it is monitored regularly to ensure completeness and accuracy.

CALVIN and HOBBS



A note about electronic notebooks

- “legal” electronic lab notebooks certainly are available, e.g., <http://www.labtrack.com/>
- RICRO at CSU does not have much experience with these to date (probably rather expensive and thus not yet widely used at CSU?)
- Any software must have an audit function
 - it is vital to know that the date and timestamp on documents cannot be altered
 - a stamp must occur every time a doc is opened, and a record of how the doc was changed must be recorded
 - there needs to be a way for an auditor to know when and how each entry occurred.
- More typical electronic notes must be well-integrated with hard copy material (i.e., can keep both, but make sure the hard copy meets the audit standards and you can cross-check between the 2 records)

The Right Stuff – General Rules

- ❑ Notebooks have to last 23 years after patent issue.
 - Patents take time to get, so figure 30 years longevity.
- ❑ Paper has to be very good (much paper today is junk by the standards of a hundred years ago).
- ❑ Notebook should be bound.
 - No spiral notebooks! No loose-leaf!
- ❑ Page layout easy to graph, date, sign, etc.
- ❑ Pages should be numbered
- ❑ Table of contents!

A proper notebook page

- Written as the work is performed
- Dated and signed by author
- Each section has a clear, descriptive heading
- The writing is legible and grammatically correct
 - In pen (**no pencils or crayons**)
- Active voice in first person:
 - “I added the two ingredients...”
- Read by witness and signed/dated
- Do Not** write over (**no white out!**)
- Do** cross out, and write above (**and initial**)

What goes in the notebook?

- Plans
- Realities (deviations from the plan)
- Observations
- Sketches and photographs
- “Links” to the notebooks of others in your group
- “Links” to instrument logbooks and data on disks
- Ideas: a notebook is a repository of creativity
- E-mails (& conversation notes) from collaborators (tape or paste them in)
- Plot-as-you-go graphs: do it!
- Summaries of papers you have read
- Hints and tips you may get from science friends
- Concerns and personal data....be careful to delineate fact from fiction/opinion. Personal info could become embarrassingly public

Some additional points

- Recording should be done as soon as possible after data are collected
 - Note whether date of the recording or date of collection
- A second loose-leaf notebook should be kept for data that cannot fit into the primary record book.
- Methodologies used should be written down
 - Reference to how deviations from standard techniques
 - Lot numbers recorded with attention to hazardous-substances
 - Equipment calibrations need to be recorded.
- Data go directly into notebooks – no napkins/scraps
 - All raw data should be included. Be honest – include bad data.
- Consent forms should be kept with raw data (locked)
- Electronic records need to be carefully monitored
 - Electronic data – back it up; relevant software must be retained for future access, and data security an issue

Notebook Checklist

- Black, ballpoint pen used? Legible handwriting?
- Table of contents up-to-date?
- Entries signed/dated (October 13, 2002 better than 10/13/02)
- NO BLANK PAGES
- Clear headings saying what this page is about?
- Written in first person?
- Complete sentences?
- Could the work be followed by another scientist? (avoids jargon?)
- Is the researcher correctly “thinking in the notebook”—i.e., ideas and plans and observations integrated and written down.
- Are entries witnessed appropriately?
- Is the notebook stored safely when not in use?