Scientific Integrity

How to behave in an ethically responsible and safe way when doing research

Paolo Pescarmona

p.p.pescarmona@rug.nl

Learning objective: understand and meet the requirements for proper behaviour in conducting scientific research.

Content

- What is scientific integrity?
- Examples of scientific misconduct
- Does misconduct happen a lot and what causes it?
- Consequences of scientific misconduct
- How to avoid it?
- Practical implementation

Scientific integrity

Integrity: “the quality of being honest and having strong moral principles” (Oxford Dictionary).

In science, a responsible conduct of research implies:

Honesty: conveying information truthfully and honouring commitments.

Accuracy: reporting findings accurately and taking care to avoid errors.

Efficiency: using resources wisely and avoiding waste.

Objectivity: letting the facts speak for themselves and avoiding bias.

Acting differently does not necessarily lead to crime or fraud, but is considered irresponsible scientific behaviour and represents scientific misconduct.

Research integrity $\Rightarrow$ Irresponsible behaviour $\Rightarrow$ Scientific fraud

Though extreme fraudulent behaviour in science is clearly identifiable, the grey area in between can be a matter of debate.

[*Ethical issues in research,* Michael Kalichman, U. of California, San Diego]

Research misconduct: the case of Hwang Woo-Suk

Dr. Hwang Woo-Suk (former professor at Seoul National University) was the first person to report that his lab extracted stem cells from cloned human embryos.

2004	Science Articles
2004	Time "People Who Mattered"
2005	Allegations of fabrication of data
2006	Apologised and admitted that he fabricated part of the data; he and 5 members of his research team were indicted for embezzlement
2009	Sentenced to 2 years of imprisonment

Consequences:

Personal: loss of position, honour and a criminal record

South Korea: loss of prestige and honour

General: loss of public trust

Research misconduct: the case of Diederik Stapel

Diederik Stapel is a former professor of social psychology at Tilburg University and, before that, at the University of Groningen.

- In 2011 Tilburg University suspended him for fabricating and manipulating data for his research publications.
- Stapel had committed fraud in at least 55 of his papers and in 10 Ph.D. dissertations written by his students.

What drove him towards fraud?

- Ambition.
- Frustration caused by experimental data, which rarely led to clear conclusions.
- Obsession with elegance and order.
- Scarcity of research resources, competition for grants.

[http://archive.nytimes.com/www.nytimes.com/2013/04/28/magazine/diederik-stapels-audacious-academic-fraud.html]

Frauds like that of Stapel are extreme cases (which might make it easier to be detected) but there are other threats to the integrity of science.

Think about examples of scientific misconduct. Write down 3 examples.

- Massaging of data (unjustified removal of outliers).
- Selective reporting of experiments.
- Stopping data collection once the results confirm a hypothesis.

These are examples of misconduct that distorts scientific knowledge.

Scientific misconduct

The are different categories of scientific misconduct:

Misconduct that distorts scientific knowledge, as a result of which society can be put at risk: falsification (incl. deliberate withholding of data); fabrication of nonexistent data.
Misconduct which misleads the scientific community: plagiarism; unjustified authorship; duplicate publication; deliberate false evaluation of projects and results.
Questionable research practices, which cast doubt on the seriousness of the research: sloppy handling of data; division of the results, with publication in several different journals solely for the purpose of increasing the list of publications.

SWISS MED WKLY 2010;140(13–14):183–186 · www.smw.ch

Does it happen a lot?

Admitted vs. observed misconduct

Percentage of researchers who admitted:		
falsification, fabrication	0.3–4.9%	**mean: 2.6%**
questionable research practices	up to 33.7%	**mean: 9.5%**
Percentage of researchers who had observed scientific misconduct by others:		
falsification, fabrication	5.2–33.3%	**mean: 16.7%**
questionable research practices	6.2–72%	**mean: 28.5%**

SWISS MED WKLY 2010;140(13–14):183–186 · www.smw.ch

Causes of scientific misconduct

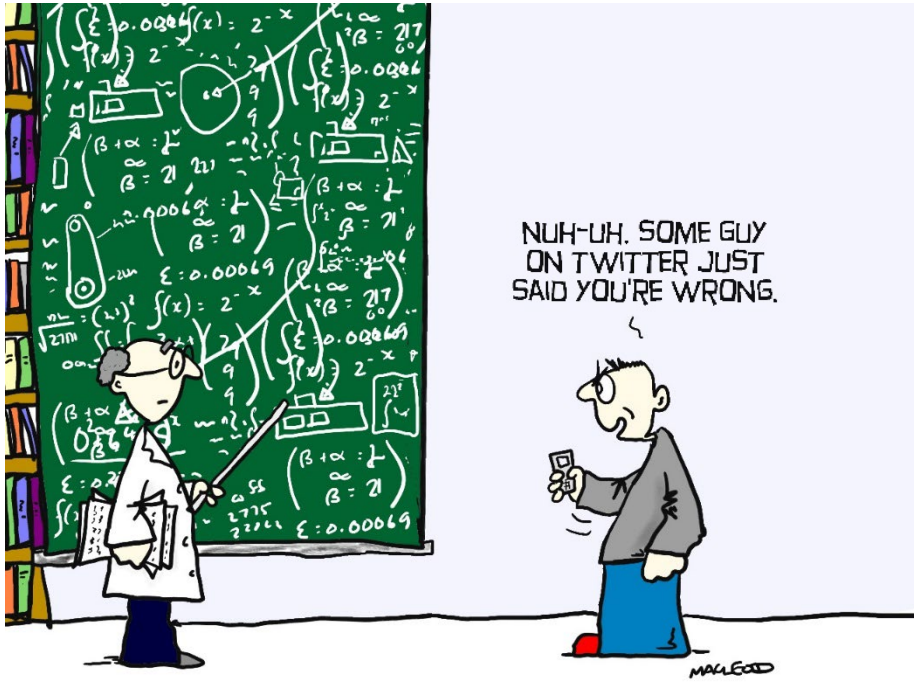
What causes researchers to misbehave?

- Career pressure (publish or perish) $\Rightarrow$ excessive competition.
- A bias (personal or from a supervisor) towards confirming a starting hypothesis.
- A feeling of justification (I worked hard and thus I deserve a good result).
- Frustration caused by unsuccessful experiments and unsatisfactory results.
- Feeling of being treated unfairly by the organisation/system (*e.g.* grant rejection).
- Cultural differences (*e.g.* fear of losing face, inability to share difficulties).
- Insufficient attention to safety in the lab ("I know my research is not going to harm anyone, so why waste my time getting the safety permission?").
- …..

Don't let these situations force you into non-ethical behaviour.

Why is it important to avoid it?

- Personal loss of reputation and position.
- Loss of reputation and of trust in scientific output.
- Acceptance of public towards *e.g.* innovations will be reduced.
- Societal willingness to fund research will be threatened.



How to avoid scientific misconduct?

The risks of scientific misconduct can be minimised by:

- Training and education (like this short module)
- Setting up good practices

There are several suitable sets of good practices. For example:

The Netherlands Code of Conduct for Scientific Practice

Ethics in research

Ethics in research should be taken into account when:

1) Planning research
2) Conducting research & data management
3) Reporting research

[*Ethical issues in research,* Michael Kalichman, U. of California, San Diego]

[The Netherlands Code of Conduct for Scientific Practice]

Planning research

- Safety
  - Minimise the risk of accidents, use hazardous substances properly.
  - Be aware of the internal regulations regarding safety

- Laboratory Animals: follow regulations for animals used in research

- Personal or intellectual conflicts
  - Researchers should be objective. Avoid making judgments or presenting conclusions not based on scientific evidence, even if in a non-scientific context (*e.g.* TV, social media).
  - Researchers should defend a certain viewpoint only based on scientific grounds. Competing viewpoints must be mentioned and explained.
  - Researchers should not accept duties for which they lack the necessary expertise. If necessary, actively indicate the limits of your competence.
  - Researchers should not serve as reviewers for grants and publications submitted by close colleagues.

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Ownership

Researchers generally do not own the data they produce.

⇒ Your data (electronic, lab journals) and samples should be delivered to your supervisor at end of your PhD.

Data collection

Safe, accurate and tidy data collection is crucial in research:

- To grant reliability of your findings
- To allow others to re-analyse/verify

Data storage

Data collection should be accompanied by suitable data storage:

- Accurate, complete, reliable, authentic and provided with metadata (⇒ traceable)
- Stored for at least 10 years after collection (all data!)
- Available and understandable for verification and further research by others after completion of the research and/or departure of the researcher.
- Lab journals should be stored in a safe place (at university)
- Electronic files should be backed up regularly (Cloud drive)
- Samples should be clearly labelled and properly stored in the lab.

These procedures represent your Research Data Management Plan (some university have specific forms for this purpose. For an example: RDMP@ENTEG)

Metadata is "data about data", *e.g.* description of how other data are collected or labelled

Data sharing

- Do not release data that have not been carefully validated.
- Do not release data before you have informed all the people involved in the research.
- Researchers can withhold data until they have had time to establish the priority for their work (*e.g.* patenting vs. publication).
- Once patented, all the information should be freely available for other researchers to check and use.

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Authorship and Publication

Researchers have responsibilities when they share results with others through informal communications, oral presentations, publications:

- Whatever format is used, research results should be shared honestly and without bias, but also efficiently.
- Distinguish when a conclusion is based on an unequivocal interpretation of your data or is a working hypothesis that is still rather speculative.
- Inefficiency (publishing similar results several times or incremental progress) wastes public funds and the valuable time of reviewers and journal editors. This is a typical example of non-fraudulent but irresponsible behaviour.
- Who should be an author? $\Rightarrow$ People who made a significant contribution to the work (grey area?).

Last but not least: Plagiarism

Plagiarism means citing or paraphrasing the words or ideas of someone else and presenting them as your own.

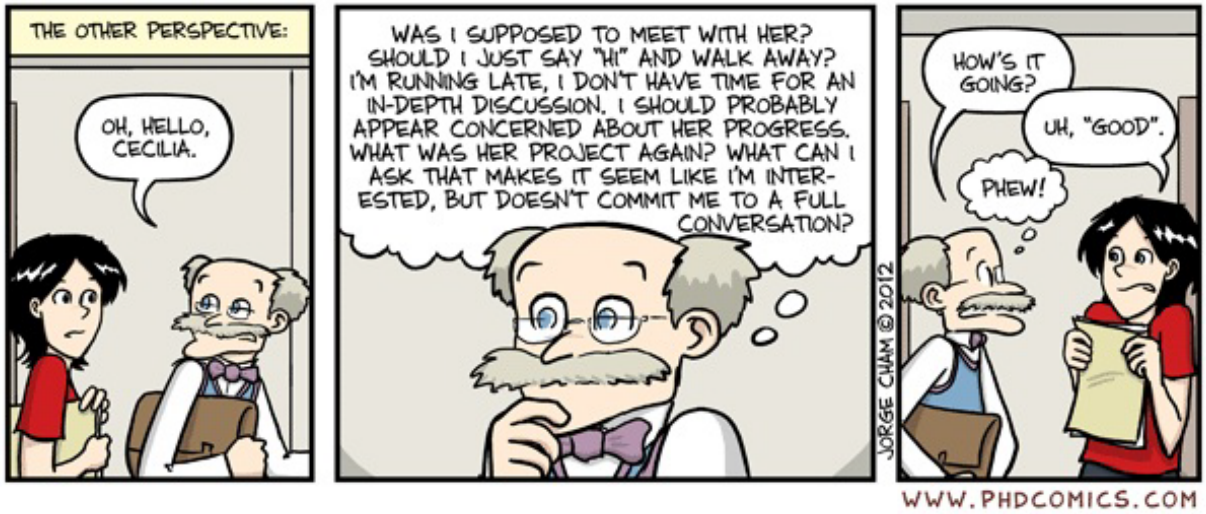
Plagiarism is not necessarily deliberate; it can also arise from ignorance or carelessness.

- No Copy & Paste (also of your own work and/or experimental sections). More than 5 consecutive words from another text may already be considered plagiarism. If you want to quote somebody's else statement, use quotation marks and cite the source.
- Make sure you always provide proper source references so that others can see which ideas are not your own but found in publications by other authors. To be done also if you are describing something in your own words.
- Generally-known facts do not have to be referenced. For example: "At 1 atm of external pressure, water boils at 100 °C".

⇒ Plagiarism can be checked internally (specific software) and/or by journals.

Supervisor-PhD student relationship

When in doubt, talk to your supervisor(s)…



Scientific Integrity issue: what to do?

If you think that the academic integrity has been violated by someone within the university, you can make a complaint.

1) Consult the confidential advisor (if available at the institution where you are doing your PhD).

2) Consult me as D-Carbonize reference person for Scientific Integrity.

All these situations will be handled carefully, with confidentiality whenever appropriate.

In conclusion

These slides include contributions by:

- Prof. dr. ir. Erik Heeres
- Prof. dr. Tamalika Banerjee
- Prof. dr. Beatriz Noheda

Main sources:

- ‘Ethical issues in research’, Michael Kalichman, U. of California, San Diego
- ‘Introduction to the Responsible Conduct of Research’ (ORI-US Federal Office of Research Integrity).
- The Netherlands Code of Conduct for Scientific Practice.

The Netherlands Code of Conduct for Scientific Practice

Principles and good practices:

1) Scrupulousness: scientific activities are performed scrupulously, unaffected by mounting pressure to achieve.

2) Reliability: each scientific practitioner is reliable in performing her/his research, in the reporting and in the transfer of knowledge through publications and teaching.

3) Verifiability: whenever research results are presented, it is made clear what the data and the conclusions are based on, where they were derived from and how they can be verified.

4) Impartiality: in their scientific activities, the scientific practitioners pursues no other interest than the scientific interest.

5) Independence: scientific practitioners operate in a context of academic liberty and independence. If restrictions of that liberty are inevitable, these are clearly stated.

I. Scrupulousness

Principle

Scientific activities are performed scrupulously, unaffected by mounting pressure to achieve.

- Accurate source references serve to ensure that credit is awarded where credit is deserved. This also applies to information gathered via the Internet.
- Authorship is acknowledged. Rules common to the scientific discipline are observed.
- Good mentorship is essential: a student and junior staff member are in a position of dependency. The responsibilities of persons involved in teaching and research are clearly defined and observed at all times.
- A scientific practitioner avoids personal relationships that may give rise to reasonable doubt concerning the objectivity of his decisions, or that may result in any form of coercion or exploitation of a hierarchically subordinate person.
- A scientific practitioner ensures that he maintains the level of expertise required to exercise his duties. He does not accept duties for which he lacks the necessary expertise. If necessary, he actively indicates the limits of his competence.
- Damages as a result of errors or negligence are repaired to the best of one's ability.

II. Reliability

Principle

Science's reputation of reliability is confirmed and enhanced through the conduct of every scientific practitioner. A scientific practitioner is reliable in the performance of his research and in the reporting, and equally in the transfer of knowledge through teaching and publication.

Best Practice

- The selective omission of research results is reported and justified. The data has indeed been collected. The statistical methods employed are pertinent to the acquired data.
- Speculation spurred by results of scientific research is recognizably presented as such. This does not include conclusions on the basis of the presented results. Suggestions for follow-up research may rest on speculation, in the form of an interpretation of the acquired results.
- The system of peer review can only function on the assumption that intellectual property is recognized and respected.
- A scientific practitioner provides a complete and honest overview of his skills whenever a decision concerning his career or duties is pending.
- In transferring information in education, a selective representation of available knowledge is either avoided or justified. A clear distinction is made between transferred knowledge and personal opinion or related speculation.

III. Verifiability

Principle

Presented information is verifiable. Whenever research results are publicized, it is made clear what the data and the conclu-sions are based on, where they were derived from and how they can be verified.

Best Practice

III.1 Research must be replicable in order to verify its accuracy. The choice of research question, the research set-up, the choice of method and the reference to sources studied is accurately documented.

III.2 The quality of data collection, data input, data storage and data processing is guarded closely. All steps taken must be properly reported and their execution must be properly monitored (lab journals, progress reports, documentation of arrangements and decisions, etc.).

III.3 Raw research data are stored for at least five years. These data are made available to other scientific practitioners at request.

III.4 Raw research data are archived in such a way that they can be consulted at a minimum expense of time and effort.

III.5 The source of all educational material, including oral information transfer, is stated.

IV. Impartiality

Principle

In his scientific activities, the scientific practitioner heeds no other interest than the scientific interest. In this respect, he is always prepared to account for his actions.

Best Practice

IV.1 Scientific practitioners give others room to take their own intellectual stance. This applies particularly in case of a hierarchical relation, like the relation between a teacher and a student or a tutor and a PhD student.

IV.2 The choice of methods and criteria is guided solely by the goal of truth-finding, and not by external goals such as commercial success or political influence.

IV.3 A reviewer consults his conscience as to whether he can offer an impartial assessment of a manuscript, for instance when it concerns a competing research group.

IV.4 In assessing the performance of others (peer review in education, re-search and manuscripts), a scientific practitioner heeds arguments of scientific substance. He refrains from assessing a manuscript if he is in any way involved in the education or research concerned.

IV.5 A scientific practitioner only defends a certain scientific viewpoint if that viewpoint is based on sufficient scientific grounds. Competing viewpoints must be mentioned and explained.

IV.6 Exclusively assigning one's own study books in education is avoided, in any case at undergraduate level.

IV.7 In its annual report, every university reports on its registration of side-line activities by its staff.

IV.8 Every scientific practitioner allied with a university publishes an actual and complete list of his sideline activities on, or accessible through, the website of the university.

V. Independence

Principle

Scientific practitioners operate in a context of academic liberty and independence. Insofar as restrictions of that liberty are inevitable, these are clearly stated.

Best Practice

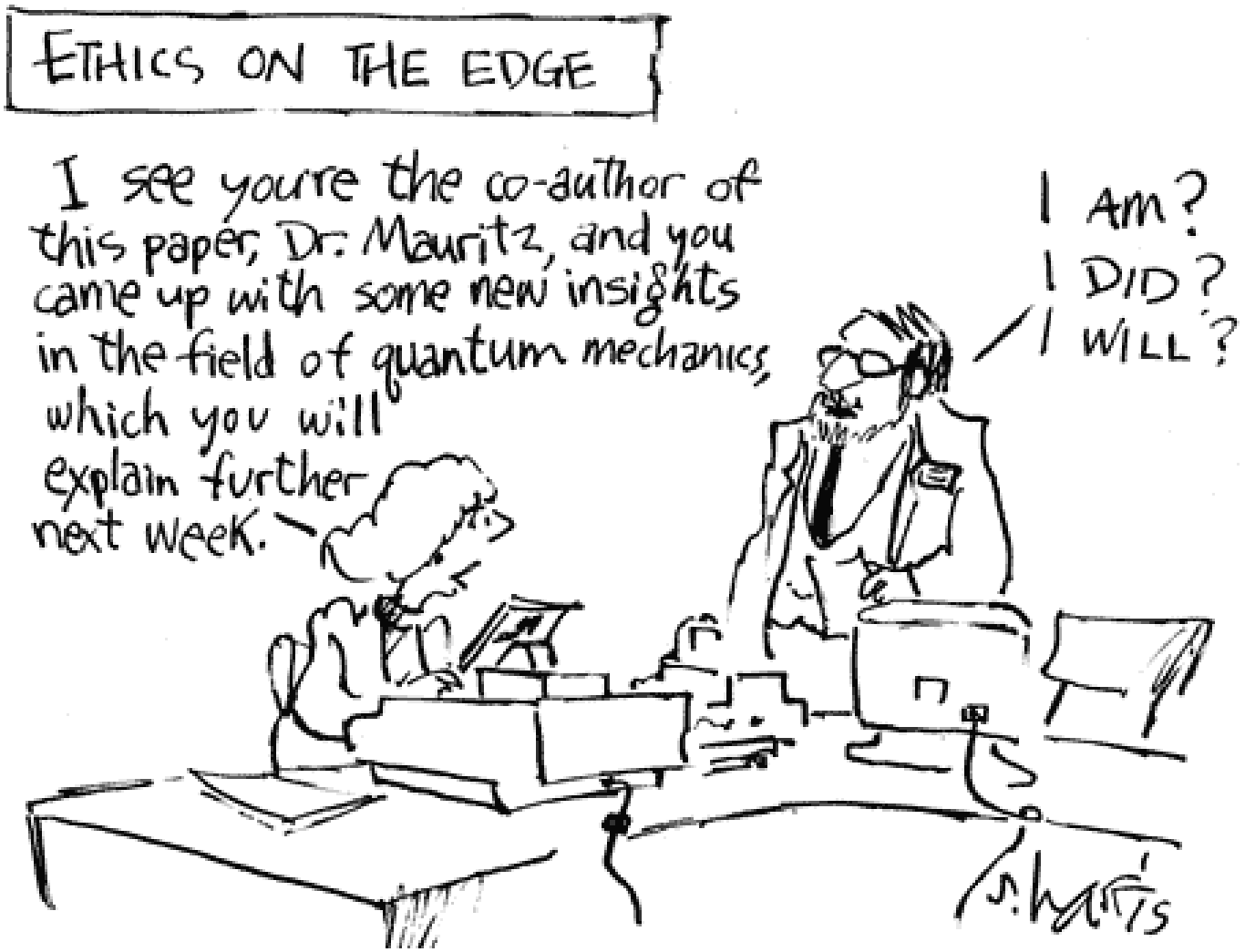
V.1 Whenever a scientific practitioner is commissioned to provide instruction or conduct research, he is allowed – once the parameters have been defined – to execute the assignment without interference by the commissioning party. The research question is of interest to science, aside from the commissioning party's particular concern. The method employed is scientifically valid. The commissioning party has no influence on the research results.

V.2 Commissioned assignments demonstrably contribute to scientific teaching or research.

V.3 There is no unclarity as to the identity of the commissioning party of a certain scientific activity, the relation between the commissioning party and the executing party, the existence of consultancy relations or other connections, etc.

V.4 The publication of scientific research results is guaranteed. Arrangements with an external financier always stipulate that the scientific practitioner is at liberty to publish the results within a specified, reasonable period.

V.5 External financiers of executed projects are identified by name. For research this means that their names are stated in the publication; for education this means that they are referred to in the course announcement and teaching material.


ETHICS ON THE EDGE
I see you're the co-author of this paper, Dr. Mauritz, and you came up with some new insights in the field of quantum mechanics, which you will explain further next week.
I AM?
I DID?
I WILL?

Scientific integrity

- Integrity = “the quality of being honest and having strong moral principles” (Oxford Dictionaries)

- Integrity in science:
  - Moral attitude
  - Ethical reflection, self criticism and self discipline

- Difficult to define, better look at misconduct

"Excuses" to misbehave:

:

- I already have enough information to know what the results will be, so there is no need to run checks again, even though they did not give me the expected results the first time.
- If my bosses read my research papers rather than counting them, I wouldn't have to publish the same research twice or chop it up into small, insignificant pieces.
- Given the competition in my field, I will be damaging myself if I shared my methods and information with colleagues too freely.
- They will cut off my funds if I report these results, so for the good of my laboratory and staff I should sit on them for a while longer.
- I know my research is not going to harm anyone, so why waste my time getting the safety permission.

Don't let these situations force you into non-ethical behaviour

Ethical issues in research, Michael Kalichman, U of California, San Diego

Data collection

Safe, accurate and tidy data collection is crucial in research

- To confirm findings
- To establish priority (patents!!)
- To allow others to re-analyse/verify

Hard-copy evidence should be entered into a numbered, bound notebook. Also include the date!
- *no loose leafs!*
- *do not edit entries without date and motivation*

Raw electronic data should be dated and stored as read-only

Data storage (1/3)

Requirements:

- accurate, complete, reliable, authentic and provided with metadata*
- safely must be stored for at least 10 years (all data!!)
- be available *and understandable* for review and further study *by others* after completion of the research and/or departure of the researcher

** **metadata** is "data about data". These can be descriptions of the design of data structures file nomenclature etc.*

Data storage (2/3)

During Research:

- Lab notebooks should be stored in a safe place
  - *in the research institute, not at home*
    they are property of the university!

- Computer files should be backed up regularly in a secure place far from the original data

- If possible samples should be kept in such a way so that they will not degrade

Data storage (3/3)

Upon completion of the research:

- Data collected in the context of research project should be deposited by the student at the time of submission of the final version of the report.

- Coming soon: online research data management plan

A grade will only be awarded for the project when all data are properly stored and lab journals are handed over to the supervisor!

Basic responsibilities

Supervisors need to know that the student will:

- do assigned work conscientiously and responsibly
- respect the authority of others working in the research setting
- follow research regulations and research protocols
- live by agreements established for authorship and ownership

Basic idea: Supervisors invest time and resources in students. Students should use time resources responsibly.