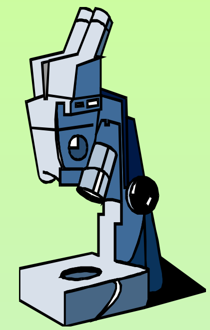

Laboratory-Industry Relationships

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ITU

OUTLINE of Presentation:

Introduction, definitions, "The Scientific Method"

What type of organisations and laboratories are involved ?

Main differences, with examples:

a. Routine vs. research labs

b. University vs. Research Institutes

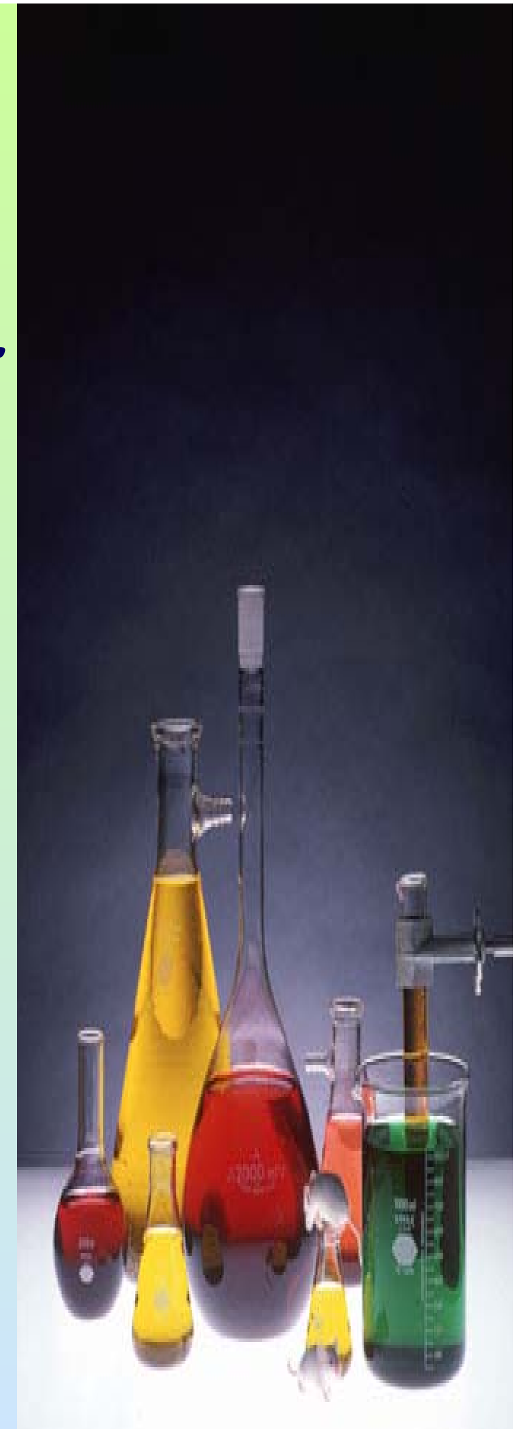
What determines the choice for a research theme in a lab ?

From where comes the money ?

How is research organised ?

How is quality of research assured ?

Scientific Integrity vs. Misconduct



Scientific laboratories

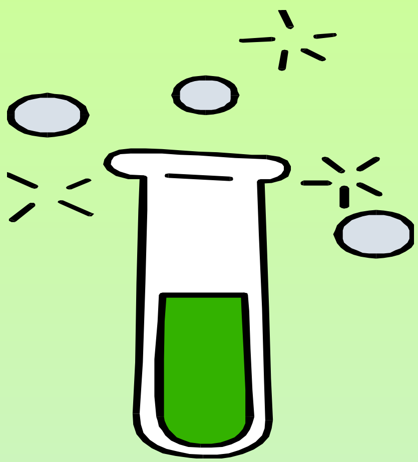
DEFINITION 1:

- The scientific laboratory is a concrete place, located in different kinds of institutions (universities, research centers, industries, military buildings, etc.), the unity of which is determined either by specific fields and subjects of research or by specific scientific methods.

Definitions 2&3..

- The scientific laboratory is where science is practiced in collaboration- between scientists, technicians, secretaries, professors, research students, engineers etc.
- In some instances, it is the place where scientists are trained and from where their *professional identity* is acquired.

  i.e. “Max Planck Institute”, “Institut Pasteur”, “TUBITAK”, ITU, METU etc.



Why we need labs?

“Scientific facts” are not given by nature.
Nor are they usually "discovered" by scientists in any simple sense of the word.

Their construction results from complex processes involving heterogeneous networks of scientists, machines, techniques, institutions, engineers, politicians, skills, information, knowledge, strategies, choices, patents, ethical conflicts, controversies, innovations, etc.

THE SCIENTIFIC PROCESS

- 1.Discipline
- 2.Language
- 3.Method

1.A discipline

is a system of techniques to solve problems.
The "disciples" should possess:

- Dedication to reality and truth
- Willingness to balance theory, observation, and uncertainty
- Assumption of responsibility, accountability

2.The Language of Science

- Hypothesis: A testable statement that links the “known” to the “unknown”
- Theory: Hypotheses linked to one another by formal rules
- Law: Theories (or axioms) that have been extensively tested and never rejected

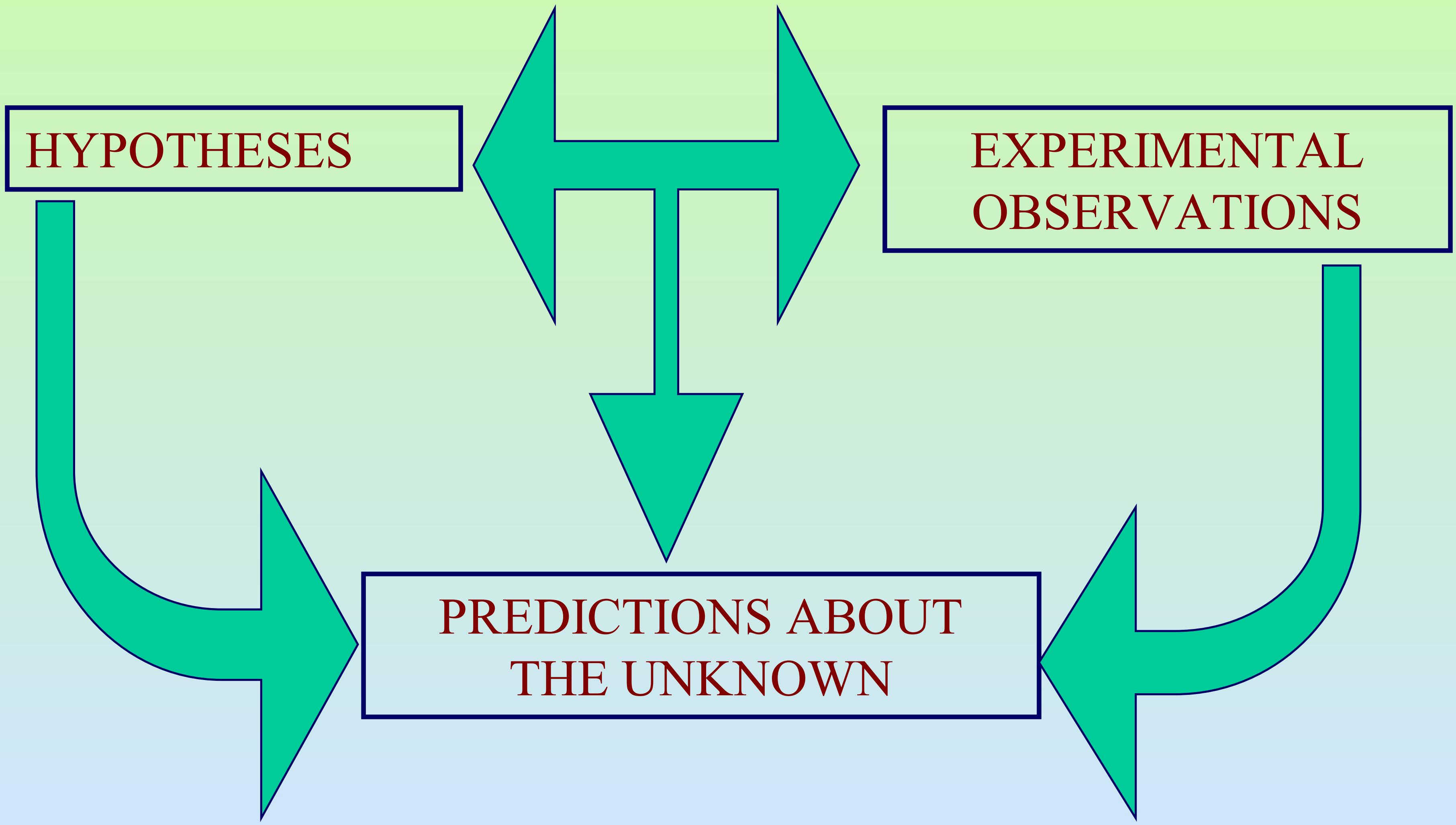
The Language of Science

- *Inductive* reasoning: approaching a problem from specific observations and subsequently developing general rules
- *Deductive* reasoning: approaching a problem from a general, rule-based point of view and focusing one's attention on specific cases
- *Validity*: The best available approximation to the truth of a given proposition, inference, or conclusion

3.The Scientific Method

- Identify a problem or question that might be answered and that is relevant to our expertise
- Formulate a hypothesis
- Make experimental observations
- Deduce or induce predictions

The Scientific Method



What type of organisations are involved with laboratories ?

Organisations that drive laboratories:

- **Governments(i.e.TUBITAK)**
- **Universities(i.e. ITU)**
- **Hospitals, public and private(i.e.ÇAPA and Pakize Tarzi)**
- **Specific Industries(i.e.IOOC:International Olive Oil Council Laboratories)**
- **Private companies (i.e. ARCELİK)**

Main differences:
University Labs vs. Research Institutes

- University labs work more on "pure science": projects are mostly for dissertations –theses.
- Research Institutes work more on applied and technological subjects.
- Example: TUBITAK's motto:

  "**Production for development, technology for production, science for technology**"

National Research Laboratories: i.e. TUBITAK

(Turkish Scientific and Industrial Research Institute)

Expected Functions of TUBITAK :

- Motivate, formulate and develop research projects
- Coordinate national research teams
- Develop scientific policies, advise governments
- Organise scientific meetings for communication of research results

Types of Projects carried out at TUBITAK labs

- **In-house projects:on research priority areas determined by government, financed solely by TUBITAK**

- **Contracted projects: >%60 of finances through supporting institution**
  - **-Local: industrial or governmental supports**
  - **-International(NATO, EU etc)**

- **Industrial services: short term technical support in the form of pilot-scale production of "prototypes" or laboratory analyses on products or consultancy or tailor-made trainings etc.**

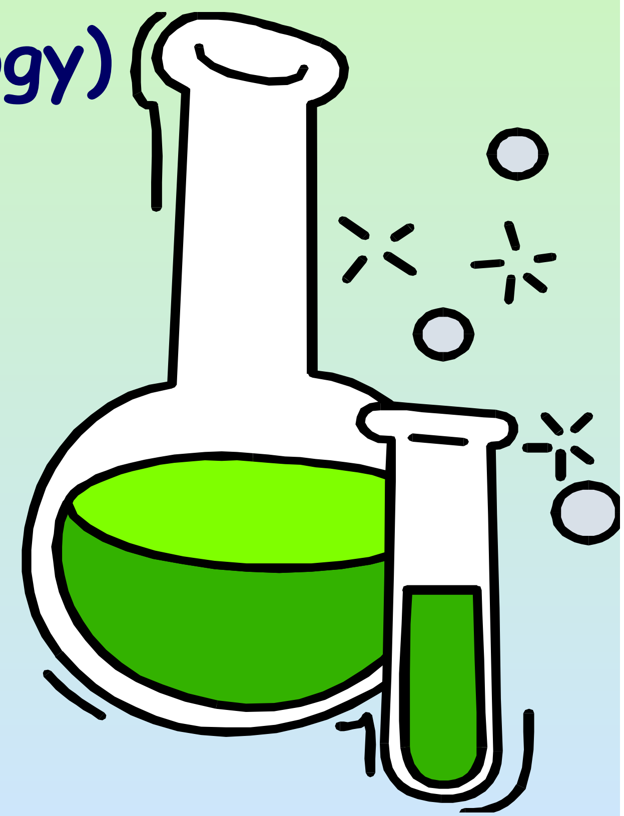
Main differences:Routine and research labs:

	Routine laboratories	Research laboratories
Character:	Quality control Service delivery Diagnosis	R & D: Mostly application but also some fundamental research
Input:	External	Mainly internal
Questions:	Similar, few types	Mixed, many types
Assignments:	Mainly standard	Highly variable
Procedures:	SOP's	Literature + experience
Output:	External	Internal

Main differences:Routine and research labs in a hospital

Routine laboratories in a hospital
(driven by doctors' fields of expertise,patients' needs, and "profitability" issues):

Clinical chemistry (chemical pathology)
Microbiology
Haematology
Surgical and diagnostic pathology
Clinical genetics
Pathology



Research laboratories in a medical faculty (driven by both the doctors' fields of expertise and by contemporary medical issues):

Biochemistry / molecular biology
Physiology
Cell biology
Immunology
Pathology
Psychology

What determines the choice for a research theme in a lab ?

<u>Internal factors</u>:

History of the lab

Fields of expertise of the researchers

Personal or group interest

Scientific discipline of department or group

Leadership and policy of the group

<u>External factors</u>:

Department or faculty policy

Division and/or Institute policy

Scientific developments

Cooperation and collaboration potential with other research groups

Money flows (national or international funding)

MONEY FLOWS:

Example: From where comes the money to University Labs?

1st type of money flow

Direct funding of universities by the government:

Bag of money for the university without any specific label (model).

Universities / faculties / research institutes / departments decide on internal distribution.

Meets barely the basic needs of lab.

2nd type of money flow

Indirect funding of research by government, through national science foundations (TUBITAK, DPT, TTGV):

Grants for individuals and programs (thematic collaborations) for specified periods.

Policy-driven: for specific themes and talents.

Researchers have to apply for grants.

3rd type of money flow

Direct funding by international non-profit organisations(NATO; EU 6th framework program etc):

Researchers have to apply for grants.

Mainly individual applicants, but also institutes.

4th type of money flow

Direct funding by concerned industries and commercial companies:

Driven by commercial interest and specific applications of science for technology development

Researchers and institutes are assessed.

5th type of money flow

Researchers start and run their own commercial business (i.e. recent earthquake and geologists-civil enginers of ITU)

How is research organised ?

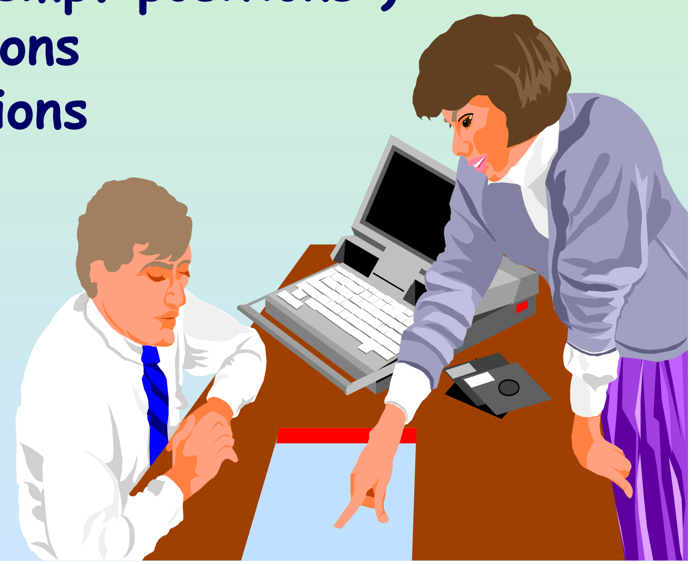
The "size" of labs may vary from small units to big research centers, depending on the number of researchers and of research projects handled.
Each project involve a specific "project research group".

"Project research group"s are made up of an average of 4-8 people:

Project leader or director(s):	1-2* staff(full or associate professors)
Senior researchers:	1-3 staff(assoc.and assist. professors)
Senior technicians :	1-2 staff
Post docs :	1-4 (might be temp. positions)
PhD students:	2-5 temp. positions
Junior technicians:	2-5 temp. positions
Students:	2-3

*Co-Director

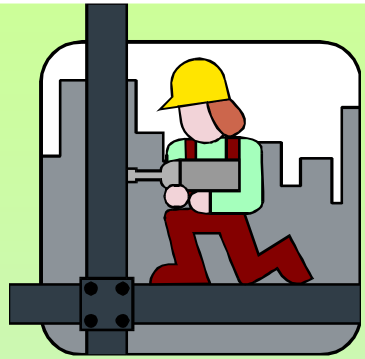
A time-schedule(monthly-annual) has to be prepared in advance and it sholud be adhered to with only acceptable minor deviations.



In “big” laboratories, there might be some overlapping of fields of expertise. In that case, usually there exists extensive cooperation on basis of complementary expertise and mutual interests, involving the formation of a **“Matrix management”** among divisions on research themes, or multidisciplinary research institutes:

Examples: Institute of Energy Research at ITU: Researchers from Ch.Eng., Faculty of Mines, Faculty of Mech. Eng.,Faculty of Sciences.

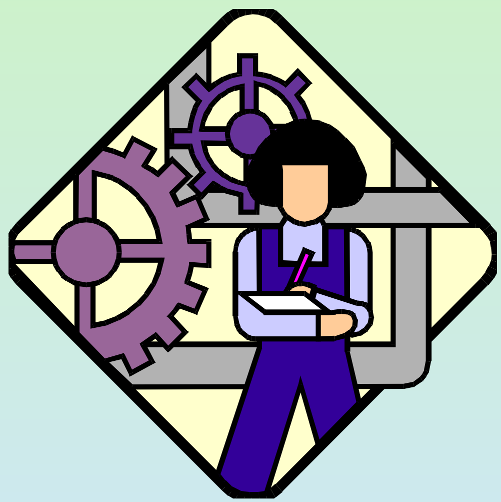
Faculty departments	Institute divisions			
	Theme 1	Theme 2	Theme 3	Theme 4
Biochemistry	☐	☐		
Cell biology		☐	☐	
Epidemiology				☐
Physiology		☐	☐	
Immunology				☐
Molecular biology	☐	☐	☐	
Pathology		☐	☐	
Statistics			☐	



RESEARCH PROGRAM GOALS

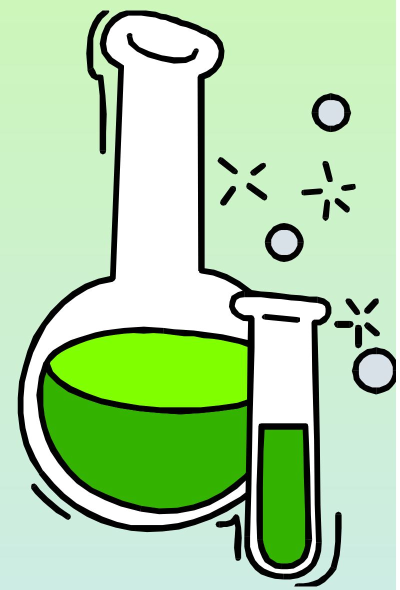
- The research has to be useful -to someone.
- The minimum *goal*: it should produce consistent, reliable, and accurate results
- "Highest attainable *quality" should be* the ultimate goal for all research programs
- The research group has to set up standards and procedures as measurement criteria for its success
- Success in research should be considered "everyone's responsibility"

QUALITY ASSURANCE AND QUALITY CONTROL in Laboratories



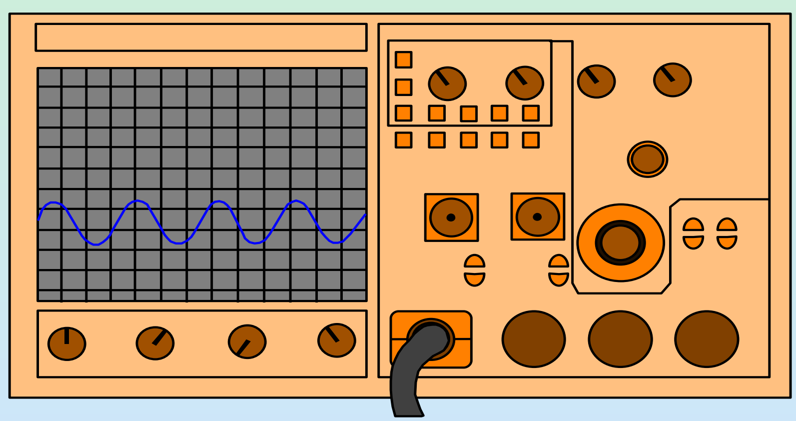
Standard Laboratory Practices

- Instrumentation
- Reagents and standards
- Analytical procedures
- Standard operating procedures(SOP's)
- Sample handling before and in the laboratory



Instrumentation

- Is it appropriate for the task?
- Is it calibrated?
- Is it maintained?
- Is it clean before and after use?



Reagents and Standards

- Purity
- Preparation
- Standardization
- Labeling
- Shelf life
- Disposal

Standard Operating Procedures

- Detailed instructions
- Specific for a given lab
- Hazards are known, understood, and respected
- Regular maintenance and updating or review
- Promote uniformity of procedure to minimize random variations and maximize comparability of data

QUALITY ASSESSMENT TECHNIQUES

- Replicates
- Random duplicates
- Samples spiked with standard analytes
- Interlaboratory comparisons
- Control charts

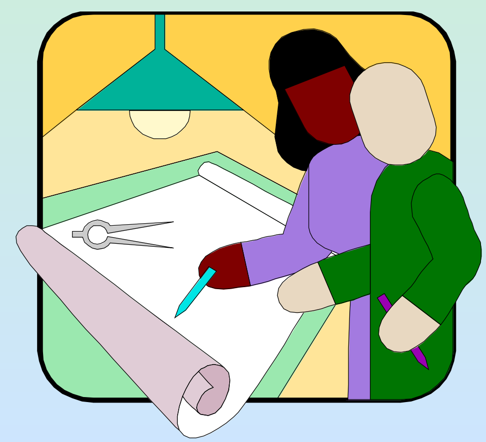
Example Technique: Spiked Samples

- Add known amount of **standard analyte*** to a real sample
- Measure spiked sample and unspiked samples
- Compute % recovery
- Helps to account for matrix effects
- Helps to assess both accuracy and precision

***Pure materials to be used regularly for calibrating instrumentation and for assessment of accuracy**

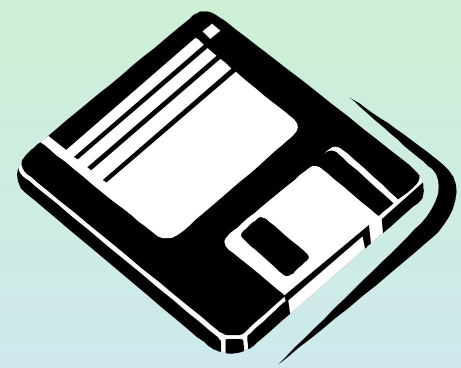
Record-Keeping and Data Processing

- *Keep all original notes on experimental studies*
- *Computer processing of research data for true interpretation of results*



Example Technique: Computer Processing

- Save raw data and intermediate steps
- Save programs (to retrace steps)
- Document data files, programs, macros, etc.
- Back-up frequently
- Store data in at least two places



How is quality of research assured ?

External and internal audits(monitoring):

<u>Internal</u>

Group reports and discussions (weekly, oral or written)
Individual reports and discussions (weekly – monthly)
Function evaluation reports(yearly)

<u>External</u>

Produce publications (Impact Factor:how many times it has been cited in prestigious journals)
Get further grant approvals
Present results at scientific symposia
Members act on Boards of journals, or are Referees of scientific papers
Open to audit visitations by experts (national/international)
No problems with “peer reviews” or ethics committees.

VALUES IN SCIENCE

- Honesty
- Responsibility
- Accountability
- Independence

  Collaboration

  Recognition of contribution

ISSUES IN SCIENTIFIC INTEGRITY

- Proper supervision of personnel and data
- Emphasis on quality of research
- Avoidance of conflicts of interest
- Compliance with regulatory requirements
- Maintenance of accurate records of procedures and results
- Suitable assignment of credit and responsibility
- Open publication and discussion of research methods and results
- Observance of confidentiality in peer reviews

SCIENTIFIC MISCONDUCT

- Deliberate fabrication, falsification, or misrepresentation of data
- Plagiarism
- Repeated errors and negligence

Engineering Ethics

Code of Ethics for Engineers (excerpt of NSPE-National Society of Professional Enginers-USA)

Fundamental Canons

Engineers, in the fulfillment of their professional duties, shall:

- Hold paramount the safety, health and welfare of the public in the performance of their professional duties.
- Perform services only in areas of their competence.
- Issue public statements only in an objective and truthful manner.
- Act in professional matters for each employer or client as faithful agents or trustees.
- Avoid deceptive acts in the solicitation of professional employment