Principles of scientific work

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Goal:
To learn the principles of thinking, working and communicating the results at a scientific level

Plan:

- About science and scientific activity
- The scientific method
- Dissemination of scientific work
  (Article, PPT, poster, theses)
- Collecting data - databases
- Mathematics i.e. statistics
- Language
- Evaluating scientific work (and it's author)
- Ethics

Antoine de Saint-Exupéry

Course recquirements:

Evaluation (grading):

1. Activity and participation in the course of the course ☺ – ⅓
2. Seminar – ⅓
3. Exam – ⅓

    1. A&P – Dialogue and discussion during classes
       Homework

Evaluation (grading):

2. Seminar
    a) Teamwork (¼ credit)
    b) Two pages of text (½ credit)
    c) Peer review (¼ credit)

ALL THE ELEMENTS OF THE SEMINAR ARE PREREQUISITE FOR THE EXAM

2. a) Teamwork:
Give an abstract and keywords to the paper you will get during 3rd class

Deadline: 11.11.
Turn in via e-mail +
name the file:
One-letter code of the paper + SURNAMES of teammembers

e.g. 'H – Jones, Smith, Whatever'

Evaluation (grading):
2. Seminar

2. b) Two pages of text

Conforming to the academic/scientific criteria
Impecable grammar and syntax and spelling
Reasonable, understandable, clear,
concise, unambiguous, straightforward

Deadline: 2.12.

Turn in via e-mail
name the file: SURNAME

Advice:
the simplest way is to correct an existing text in accordance with the lessons learned in this course

Evaluation (grading):
2. Seminar

2. c) Peer review

Review the text by using the '*Track changes*' tool
Use the '*New comment*' tool to explain why the correction was suggested

I'll provide the text subsequent to finishing a) and b)
Deadline: 13.1.

3. Exam – in stead of the last lecture;

85-100% - 5
75-85% - 4
60-75% - 3
50-60% - 2

Literature:

Silobrčić, V. (2008.) Kako sastaviti, objaviti i ocijeniti znanstveno djelo. 6. izdanje, Medicinska naklada, Zagreb.

(for math)
Zar, J.H. (1996): Biostatistical analysis. Prentice Hall, Upper Saddle River, New Jersey, 662 pp.

(english)

Wilson E. B. (1998): An Introduction to Scientific Research. Dover Publications

Clements F.E. (2011): Research methods in ecology. University of Toronto Libraries.

Carey S.S. (2011): A Beginner's Guide to Scientific Method. Wadsworth Publishing.

Hairston, N. G. (1989): Ecological experiments: purpose, design and execution. Cambridge University Press.

Cohen M. F. (2008): An Introduction To Logic And Scientific Method. Hughes Press.

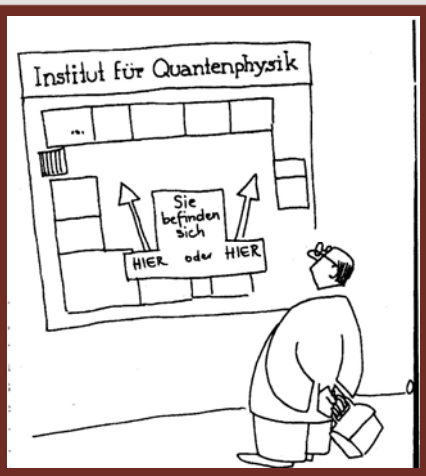
Descartes R. (1637): Discourse on the Method of Rightly Conducting One's Reason and of Seeking Truth in the Sciences.

Classification and grading of scientific research in Croatia

National Council for Science, Higher Education and Technological Development:
Regulations on scientific and artistic areas
fields
and
branches

Scientific and artistic areas:

1. Natural sciences
2. Technical sciences
3. Biomedicine and health
4. Biotechnical science
5. Social sciences
6. Humanistic sciences
7. Arts
8. Interdisciplinary areas of sciences
9. Interdisciplinary areas of arts



Fields of natural sciences:

1.01. Mathematics

1.02. Physics

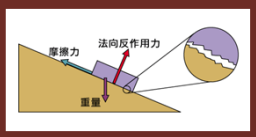
1.03. Geology

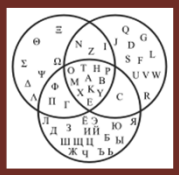
1.04. Chemistry

1.05. Biology

1.06. Geophysics

1.07. Interdisciplinary natural sciences





Branches:

Biology

1.05.01 biochemistry and molecular biology
1.05.02 botany
1.05.03 microbiology
1.05.04 zoology
1.05.05 ecology
1.05.06 genetics, evolution i phylogeny
1.05.07 general biology

Interdisciplinary areas of natural sciences

1.07.01 metodics of teaching courses in natural sciences
1.07.02 oceanology
1.07.03 environmental sciences
1.07.04 radiation science

Long-term strategic research directions in the RC are:

1. Fundamental research for the acquisition of new knowledge
2. Environmental protection and environmental management, development of the karst area, Adriatic sea, coast and islands
3. Agriculture, biotechnology, food
4. Health
5. ICT (Information-communication technology)
6. Nanoscience, new materials, construction and manufacturing processes
7. Energy, alternative and renewable sources, transport, security
8. Social sciences, humanities and Croatian identity
9. Social integration, education, lifelong learning

Short-term strategic research directions in the RC are:

1) Environment; 2) Health; 3) Energy and materials; 4) Croatian identity

Science is…

Systematic enterprise that builds and organizes knowledge about the universe in form of testable explanations and predictions.

System of knowledge about general truths or operation of general laws especially as obtained and tested through scientific method

Knowledge or study dealing with a body of facts or truths systematically arranged and showing the operation of general laws of the physical or material world gained through observation and experimentation

Tested and systematically arranged knowledge about something, achieved by methodical, careful and thorough research and consideration

Science is that activity which aims to further our understanding of why things happen as they do in the natural world. It accomplishes this goal by application of scientific method - the process of observing nature, isolating a facet that is not well understood and then proposing and testing possible explanations.

S.S. Carey

Traits of Science:

Social character
- Interest of society and advance of mankind, humane goals
- Integral part of the culture (human or regional)

Uniqueness and creativity
- No (local / national) boundaries and or barriers
- Dynamic

Teamwork
- Inter and multi-disciplinarity (conscious teamwork)

Interplay of scientific fields

Ubiquitous availability of results ($)

Conscientiousness, morality and ethics

Cheating is a hell of a lot worse than being stupid.

Plagiarism is an academic crime. It is punishable by academic death.

Scientific method

Set of techniques and procedures for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge.

Must be based on empirical and measurable evidence subject to specific principles of reasoning.

At some stage all branches of science must become quantitative.
Norman W.H. Cheetham

Scientific method

Fundamental steps:

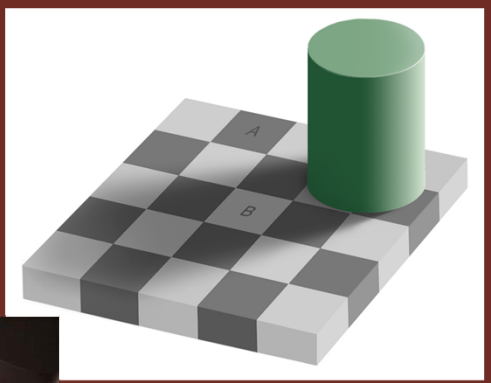
Observing and forming question(s)
determine the characteristics of the object of research

Offering a hypothesis
offering testable explanations based on previous knowledge in a form of (general) statement or mathematical model

Verifying the hypothesis / experimenting (measuring)
make prediction (according to the hypotesis)
using logical reasoning predict the outcome of the experiment or an event *in situ*

Does the behavior of 'real world' conform to the predicted outcome (according to the hypothesis)?

- Scientific method
  - Fundamental steps:
    - Observation
      - Extraordinary events (Anomalous phenomena)
    - Beware:
      - Inattentional blindness
      - Confirmation bias



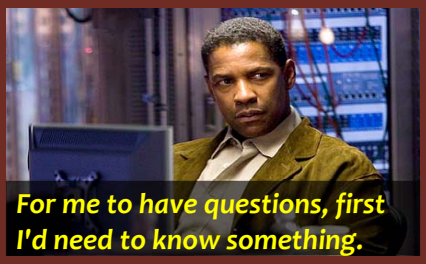
It is impossible to test a scientific hypothesis in isolation

Duhem-Quine

Scientific method

Fundamental steps:

Observing and posing questions



The scientist is not a person who gives the right answers, he's one who asks the right questions.

Claude Lévi-Strauss

Loaded (biased) questions

Why do lemmings commit mass suicide?

Scientific method - Additional guidelines

Repeatability and reproducibility

Peer review

Data recording and exchange

When submitting a manuscript online, authors must provide a Data Availability Statement describing compliance with PLOS's policy. If the article is accepted for publication, the data availability statement will be published as part of the final article. Refusal to share data and related metadata and methods in accordance with this policy will be grounds for rejection.

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