COMP320: Research Practice

1: Intro to the final year project

Learning outcomes

- **Explain** the aims and expectations of the final year project
- **Select** appropriate methodologies to conduct scholarly research
- **Recall** Falmouth University's policy on research ethics and the procedure for obtaining ethics approval

Final year project

BCS guidelines

It is expected that within an undergraduate programme, students will undertake a **major computing project**, normally in their final year and normally as an individual activity, giving them the opportunity to demonstrate:

- their ability to apply **practical and analytical skills** present in the programme as a whole
- **innovation** and/or **creativity**
- **synthesis** of information, ideas and practices to provide a **quality solution** together with an **evaluation** of that solution
- that their project meets a **real need** in a wider context
- the ability to **self-manage** a significant piece of work
- **critical self-evaluation** of the process

Final year project assignments

- The final year project is made up of **four** separate assignments
- In COMP320 (this study block):
  - Prototype research artefact
  - Research review and proposal
- In COMP360 (next study block):
  - Research artefact
  - Dissertation

Deliverables

- ASAP: Research ethics approval form (including a brief project proposal)
- Week 7: Presentation (focus on literature review)
- Week 8: Research review and proposal — peer review
- Week 13 (after xmas): Presentation (focus on proposal and preliminary results)
- Formative deadlines: check MyFalmouth

Research review and proposal

- Essentially the **first half** of your **dissertation**
- Maximum **six pages**, in **IEEE Transactions** format
  - Same format as an academic journal paper
  - Page limit **excludes** figures, tables, references and appendices
  - 6 pages $\approx$ 6000 words

Research review and proposal

- Give a thorough **literature review** of your chosen topic
- Suggest and justify one or more **research questions**
- Describe your proposed **methodology**
- Present any **preliminary results** you obtain this study block

Prototype research artefact

- Some kind of **software** artefact — depends on your project
- For example:
  - A game or app that you will use to gather data from human testers
  - A testbed for computational experimentation
  - A case study for a particular design approach
  - A tool to be evaluated
- Discuss with your supervisor to decide what is appropriate

Research ethics

Research ethics

Research involving people is premised on a fundamental moral commitment to advancing human welfare, knowledge, and understanding, and to examining cultural dynamics

Research ethics: Why

- Historically, human participants have not been well-protected from researchers
- Need to protect people from dangerous and naïve research practices
- Conflicts of interest (e.g., financial gain, big business)
- Monitoring of controversial issues (e.g., gene editing with CRISPR)
- Privacy and data protection
- Promoting high quality research

Falmouth University research ethics policy

- Find and read the following documents on LearningSpace:
  - Falmouth University Research Ethics Policy
  - Research Ethics Approval Application Form

Important!

- Failure to adhere to the Research Ethics Policy is **academic misconduct**
- In particular, you **must** fill in and submit an Ethics Approval Form **before** carrying out any research
- You **must** fill the form in, even if your project does **not** involve human subjects (though in this case it will be easy to fill in)

Next steps

- You must meet your supervisor **next week** (week 2)
- You will meet at least **once every 2 weeks** thereafter
- **Email** them and set up a time
- Bring a draft of your **ethics approval form** to the meeting

What is science?

"*The most that can be expected from any model is that it can supply a useful approximation to reality. All models are wrong; some models are useful*"

George E.P. Box (1919 – 2013)
British statistician

Image: https://asq.org/about-asq/honorary-members/box

What is science?

Some common misconceptions

- Science is a collection of facts; ×
- Science is the creation of new gadgets; ×
- Scientific ideas are absolute and unchangeable; ×
- Scientific ideas are subject to change, therefore unreliable; ×
- Observations give answers directly to the scientists; ×
- Science **proves** stuff; ×
- Science can only **disprove** stuff; ×
- The scientist works to **show** that his/her theory is right; ×

Essential reading: Common Misconceptions About Science: `http://goo.gl/TN7k9B`

Image: `http://xkcd.com`

What is science?

A good operational definition

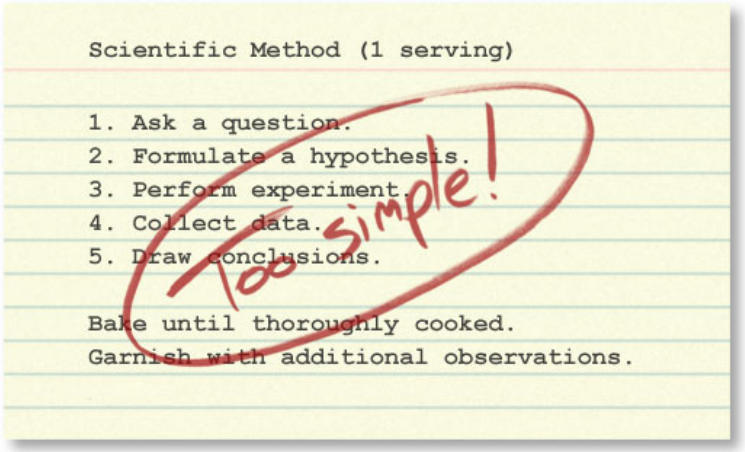
> *"What do you think science is?*
> *There's nothing magical about science.*
> *It is simply a systematic way for carefully*
> *and thoroughly observing nature and*
> *using consistent logic to evaluate results."*
>
> – Steven P. Novella

Image: `http://www.relativelyinteresting.com/definition-science-steven-novella/`

What is science?

The scientific process

- Normally shown as a flowchart or a sequence of steps;
- Oversimplification of a complex and iterative process;
- Suggests an “end” to the process.

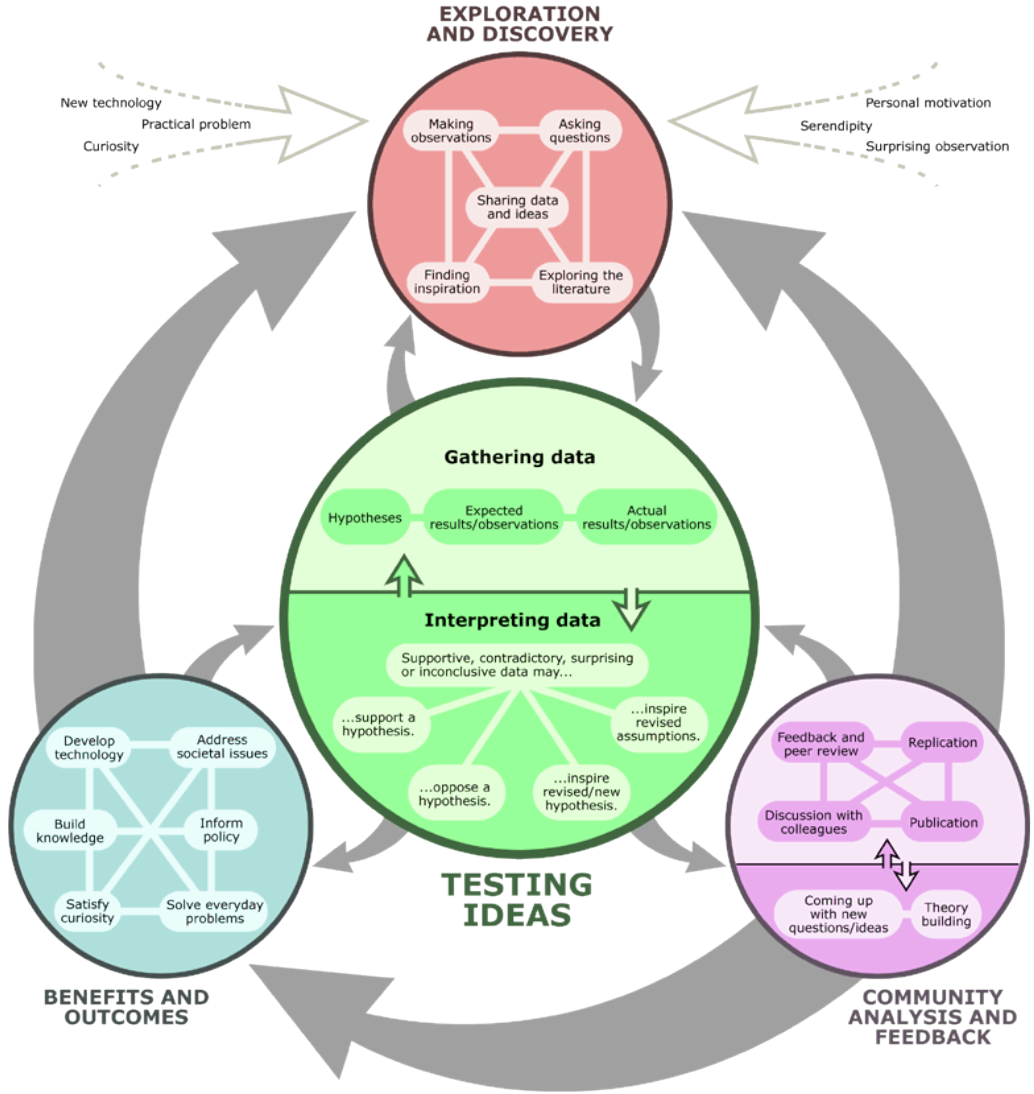


- Actually includes:
  - Several activities, performed at different stages;
  - Interaction with the scientific community;
  - Creative, “outside the box” thinking;
  - Preliminary conclusions, subject to revision as new and better data become available;
  - Learning from failures as much as from successes.

Image: `http://goo.gl/7cCGaz` - (c) Understanding Science, 2015. Used with permission.

What is science?

The scientific process



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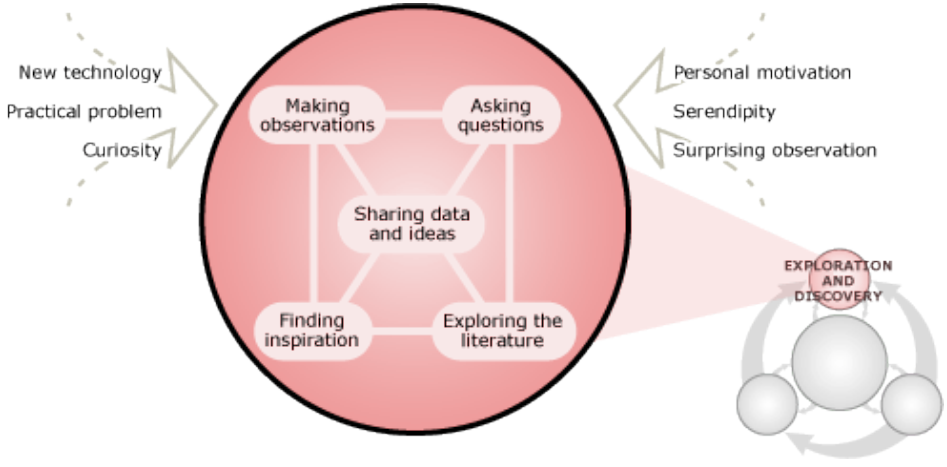
What is science?

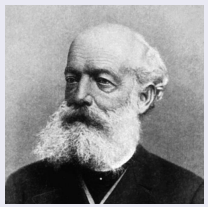
The scientific process

"*Dans les champs de l'observation le hasard ne favorise que les esprits préparés.*" – **Louis Pasteur** (Univ. Lille, France, 1854).

- Observations $\rightarrow$ **questions**;
- Exploratory experimentation;
- Preparation + serendipity.



Benzene (1865)

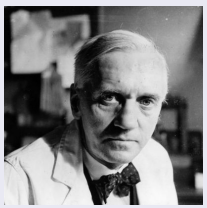


Kekule

Radioactivity (1896)

Becquerel

Penicillin (1928)



Fleming

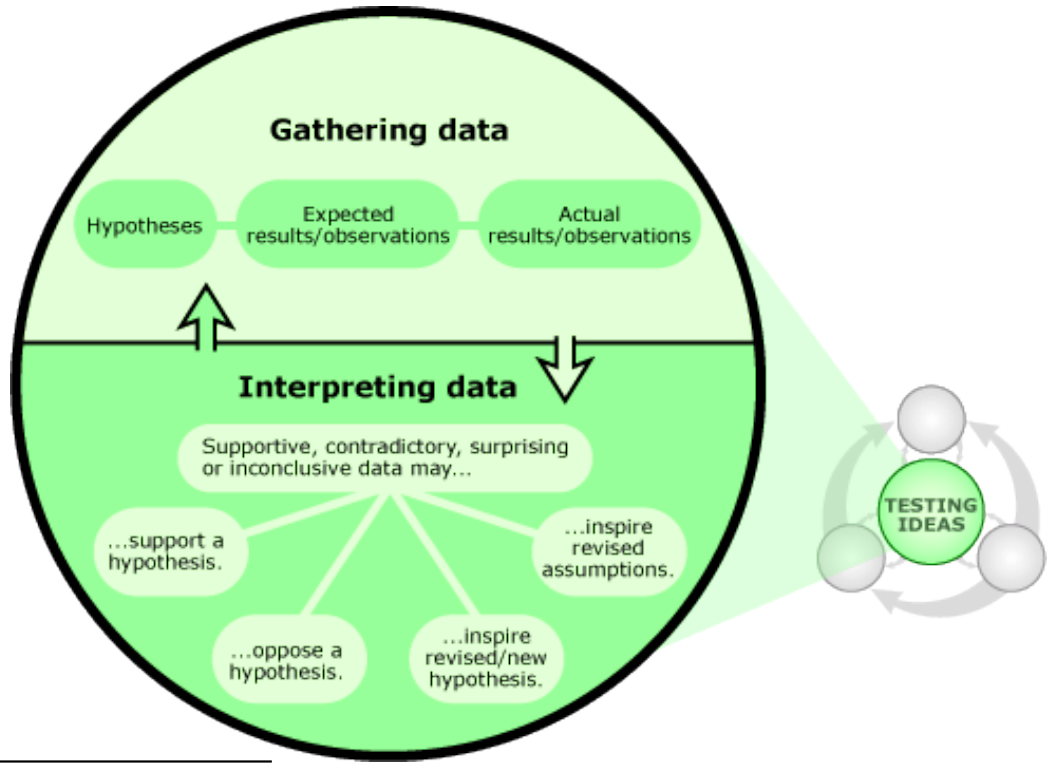
Top image: `http://goo.gl/fy8Glh` - (c) Understanding Science, 2015. Used with permission.

Scientists: `http://goo.gl/SG6sgp` | `http://goo.gl/rhLC9C` | `http://goo.gl/CFj8Ml`

What is science?

The scientific process

- Drawing and testing hypotheses;
- Comparing alternative explanations;
- Accepting / rejecting ideas based on **evidence**;
- **Predictions** *versus* **observation**: corroboration or refutation?



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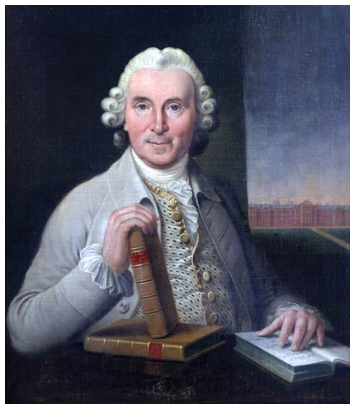
What is science?

The scientific process

James Lind (1747):



- Observation: scurvy in sailors;
- Conjecture: Caused by the body rottenning;
- Idea: attempt to avoid/reverse effects with acidic substances;

Separation of a group of 12 affected sailors in six groups with identical diets, except for the addition of a supplement:

Group 1
Cider.

Group 2
Vitriol.

Group 3
Vinegar.

Group 4
Sea water.

Group 5
Oranges and lemons.

Group 6
Tea.

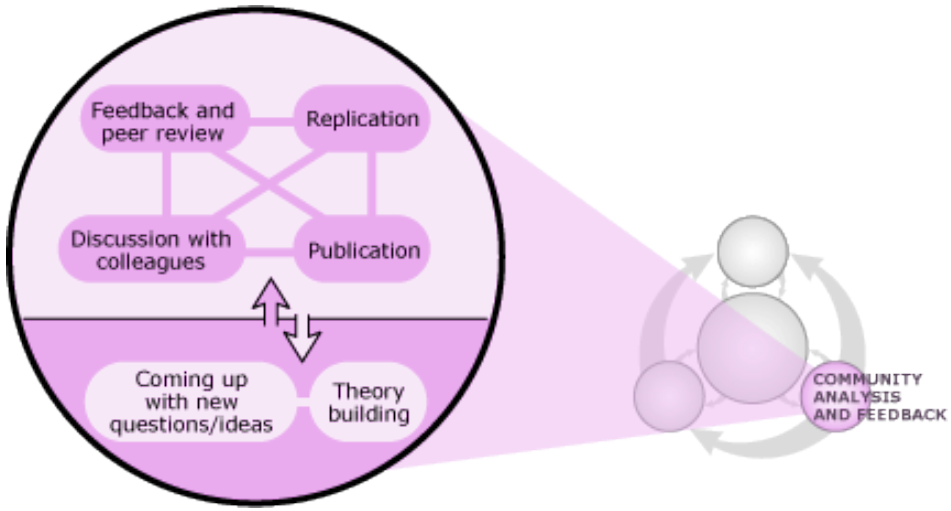
Image: `http://commons.wikimedia.org/wiki/File:James_Lind_by_Chalmers.jpg`

What is science?

The scientific process

Interaction with the scientific community is **fundamental**:

- Colleagues;
- Collaborators;
- Reviewers;
- Rivals;

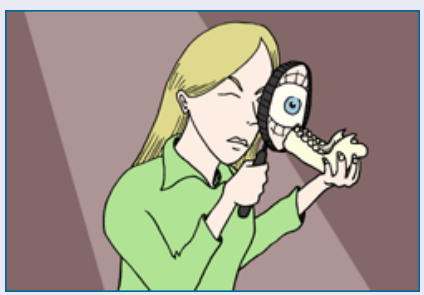


This interaction plays essential roles for the progress of research:

Criticism

Inspiration

Vigilance



Motivation

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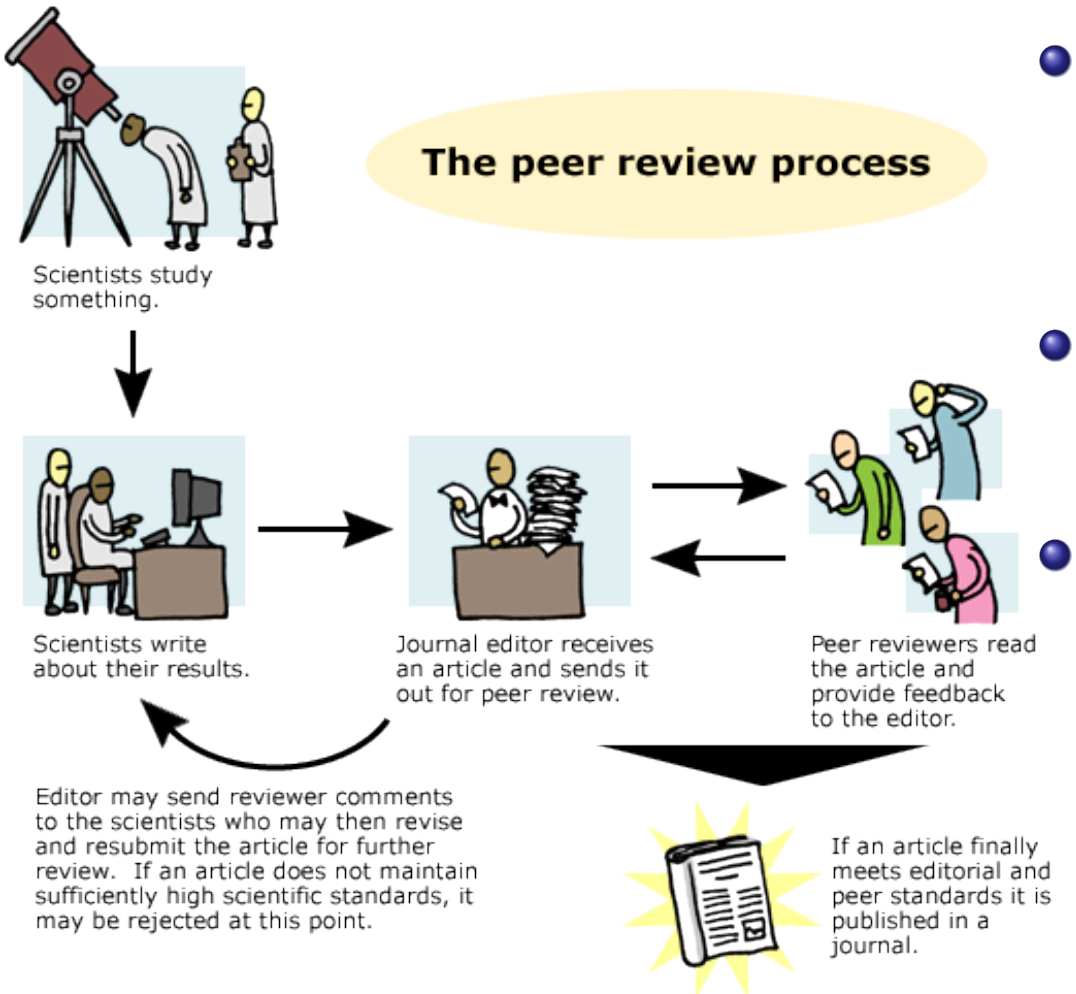
What is science?

The scientific process

Publication and peer review.



- Additionally, *post-publication review* by the wider scientific community;
- **Replication** and verification of results;
- **Reproducibility** is essential.

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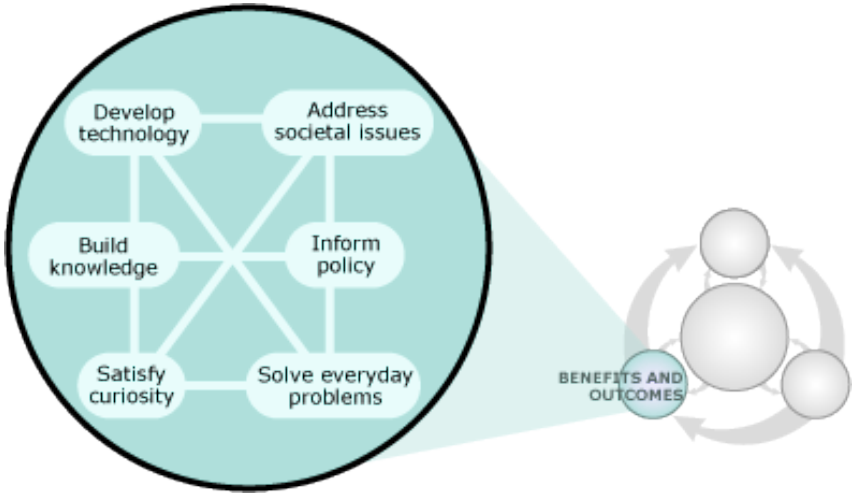
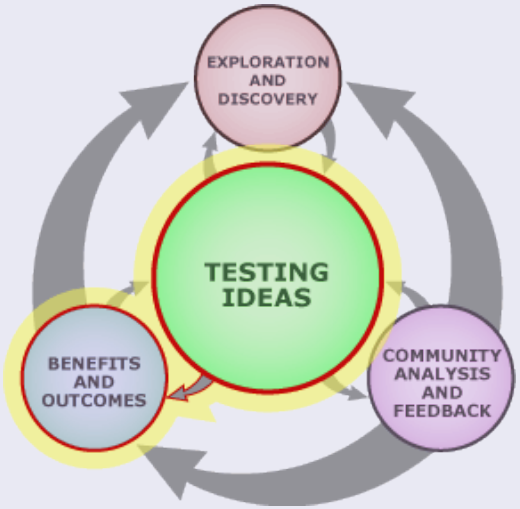
What is science?

The scientific process

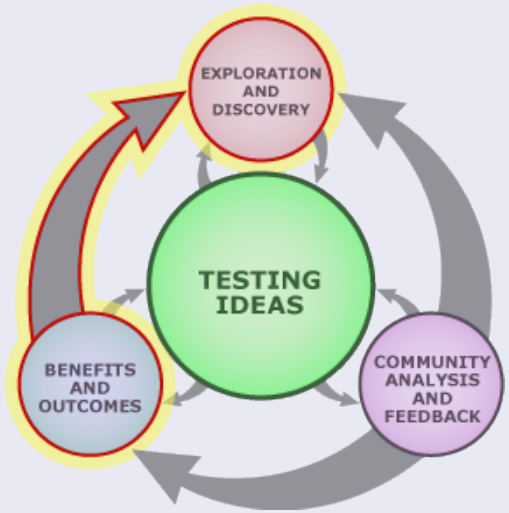
The scientific process is a way of building knowledge:

- Generate and test new ideas about how the world works;
- Iteratively increasing the reliability of the knowledge;

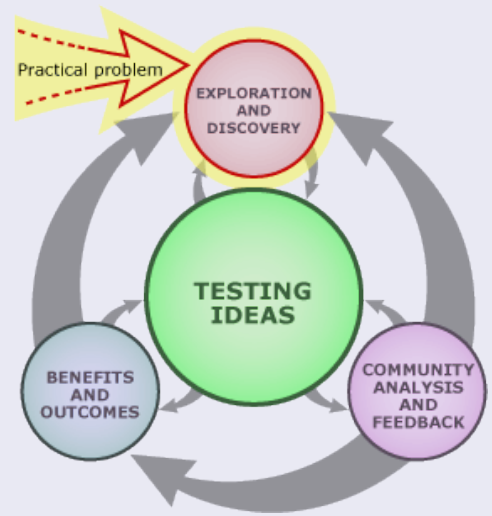




Knowledge→Applications



Technologies→Discovery



Applications→Investigation

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What is science?

To wrap it up

> "*It is important to be literate in the scientific method, not only for the sake of your own research. We are also agents of change in the population and, as such, we need to be aware of good and bad science, and able to point the difference to the society.*"
>
> – Claus C. Aranha

Image: `http://lattes.cnpq.br/2897895256340893`

Bibliography

Required reading

1. *Understanding Science*. 2014. University of California Museum of Paleontology. 3 January 2014. - `http://www.understandingscience.org`
2. F.L.H. Wolfs, *APPENDIX E: Introduction to the Scientific Method*. - `http://goo.gl/osGpU`

Recommended reading

1. Carl Sagan,*The demon-haunted world: science as a candle in the dark*, Random House, 1996.
2. The Skeptics Guide to the Universe. - `http://www.theskepticsguide.org`

About this material

Conditions of use and referencing

Please reference this work as:

Felipe Campelo (2015), *Lecture Notes on Design and Analysis of Experiments*.
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