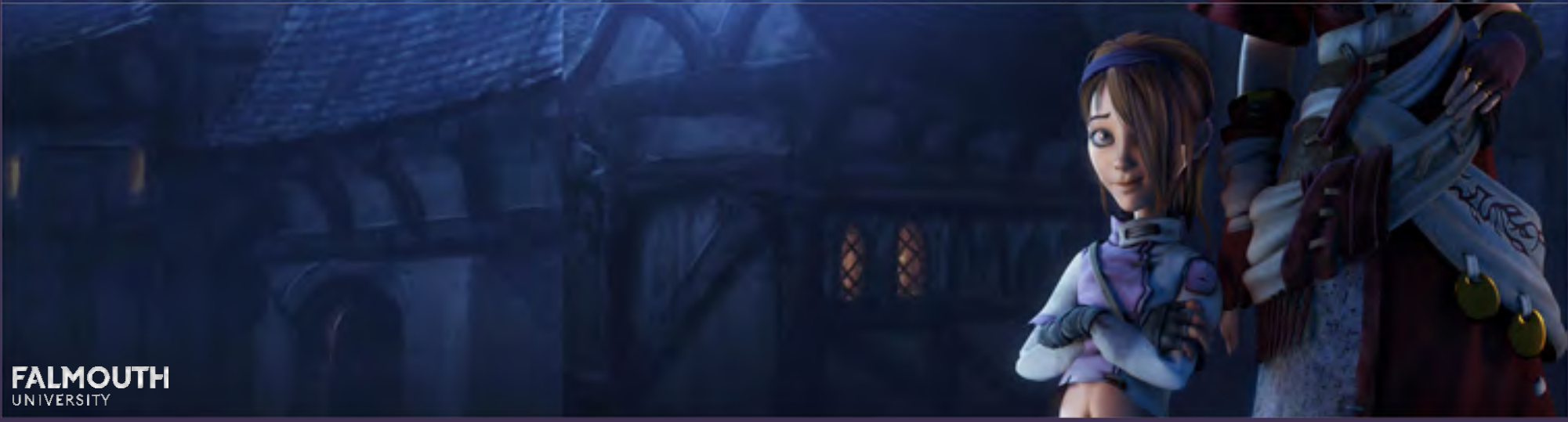


COMP320: Research Practice

1: Module Induction

Learning Outcomes

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

FALMOUTH
UNIVERSITY

Final Year Project

BCS Guidelines

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

BCS Guidelines

It is expected that within an undergraduate programme, students will undertake a **'major' individual 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

BCS Guidelines

It is expected that within an undergraduate programme, students will undertake a **'major' individual 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**

BCS Guidelines

It is expected that within an undergraduate programme, students will undertake a **'major' individual 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

BCS Guidelines

It is expected that within an undergraduate programme, students will undertake a **'major' individual 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

BCS Guidelines

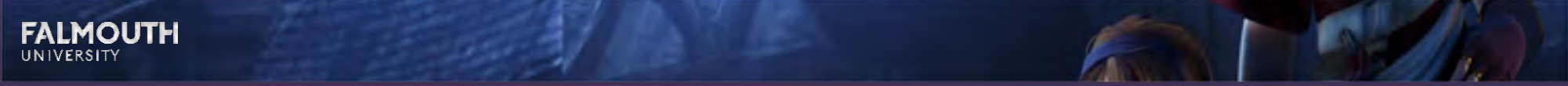
It is expected that within an undergraduate programme, students will undertake a **'major' individual computing project**, normally in their final year and normally as an individual activity, giving them the opportunity to demonstrate:

- 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

BCS Guidelines

It is expected that within an undergraduate programme, students will undertake a **'major' individual 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

Final Year Project Assignments

- The final year project is made up of **four** separate assignments

Final Year Project Assignments

- The final year project is made up of **four** separate assignments
- In COMP320 (this study block):
  - Research Proposal
  - with a Prototype Computing Artefact

Final Year Project Assignments

- The final year project is made up of **four** separate assignments
- In COMP320 (this study block):
  - Research Proposal
  - with a Prototype Computing Artefact
- In COMP360 (next study block):
  - Dissertation
  - with a Computing Artefact

Deliverables

Deliverables

- Week 2: Brief Project Proposal

Deliverables

- Week 2: Brief Project Proposal
- Week 5-6: Hypotheses and Ethics Review

Deliverables

- Week 2: Brief Project Proposal
- Week 5-6: Hypotheses and Ethics Review
- Week 7: Practice Presentation on Literature Review abd Research Design

Deliverables

- Week 2: Brief Project Proposal
- Week 5-6: Hypotheses and Ethics Review
- Week 7: Practice Presentation on Literature Review abd Research Design
- Week 8: Peer Review of Work-in-Progress

Deliverables

- Week 2: Brief Project Proposal
- Week 5-6: Hypotheses and Ethics Review
- Week 7: Practice Presentation on Literature Review abd Research Design
- Week 8: Peer Review of Work-in-Progress
- Week 11: Presentation of Proposal, including justification of methods and demonstraton of statistics

Deliverables

- Week 2: Brief Project Proposal
- Week 5-6: Hypotheses and Ethics Review
- Week 7: Practice Presentation on Literature Review abd Research Design
- Week 8: Peer Review of Work-in-Progress
- Week 11: Presentation of Proposal, including justification of methods and demonstraton of statistics
- Week 12: Peer-Review of Proposal, including justification of methods and demonstraton of statistics

Deliverables

- Week 2: Brief Project Proposal
- Week 5-6: Hypotheses and Ethics Review
- Week 7: Practice Presentation on Literature Review abd Research Design
- Week 8: Peer Review of Work-in-Progress
- Week 11: Presentation of Proposal, including justification of methods and demonstraton of statistics
- Week 12: Peer-Review of Proposal, including justification of methods and demonstraton of statistics
- Week 13 (after xmas): Presentation on Proposal, Prototype, and Preliminary Results

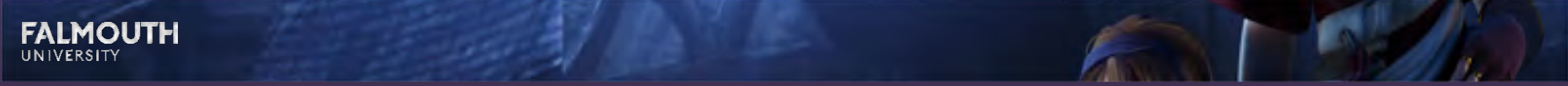
Note on Presentations

The submission of the literature review and proposal is worth roughly 70% of the available marks. Or, 11.6% of the overall degree classification. Please do not neglect it!

It will require considerable effort to read the literature, refine your question, and propose a sound research design!

Note on Presentations

Presentations will be delivered to `non-domain' experts. These are research-active staff who will be outside of your field. Present your materials as-if writing for a competent computing professional who is unfamiliar with your specific field.



Research Review and Proposal

Research Review and Proposal

- Essentially the **first half** of your **dissertation**

Research Review and Proposal

- Essentially the **first half** of your **dissertation**
- Maximum **six pages**, in **IEEE Transactions** format

Research Review and Proposal

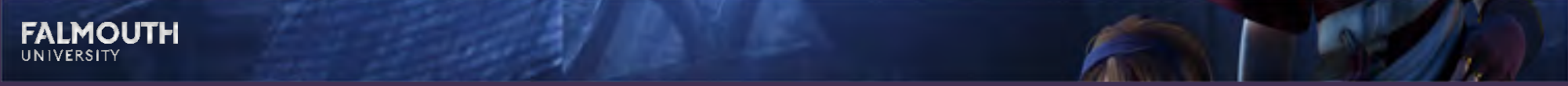
- Essentially the **first half** of your **dissertation**
- Maximum **six pages**, in **IEEE Transactions** format
  - Same format as an academic journal paper

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

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 Proposal

Research Proposal

- Give a thorough ad comprehensive **literature review** of your chosen topic

Research Proposal

- Give a thorough ad comprehensive **literature review** of your chosen topic
- Suggest and justify one or more **research questions**

Research Proposal

- Give a thorough ad comprehensive **literature review** of your chosen topic
- Suggest and justify one or more **research questions**
- Describe your proposed **methodology**

Research Proposal

- Give a thorough ad comprehensive **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 Computing Artefact

Prototype Computing Artefact

- Some kind of **computing** artefact — depends on your project

Prototype Computing Artefact

- Some kind of **computing** artefact — depends on your project
- For example:

Prototype Computing Artefact

- Some kind of **computing** artefact — depends on your project
- For example:
  - A game or app that you will use to gather data from human testers

Prototype Computing Artefact

- Some kind of **computing** 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

Prototype Computing Artefact

- Some kind of **computing** 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

Prototype Computing Artefact

- Some kind of **computing** 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

Prototype Computing Artefact

- Some kind of **computing** 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

FALMOUTH
UNIVERSITY

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

Research Ethics: Why

- Historically, human participants have not been well-protected from researchers

Research Ethics: Why

- Historically, human participants have not been well-protected from researchers
- Need to protect people from dangerous and naïve research practices

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)

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)

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

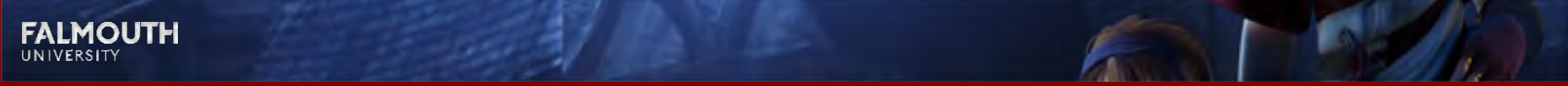
Research Ethics: Why

- 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

Falmouth University research ethics policy

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



Important!

FALMOUTH
UNIVERSITY

Important!

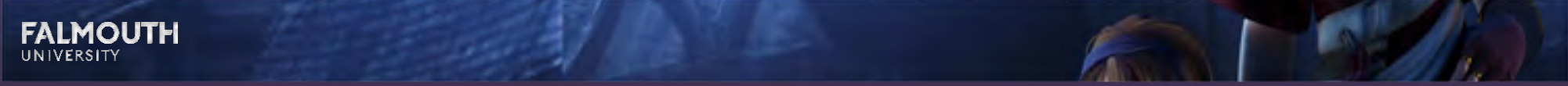
- Failure to adhere to the Research Ethics Policy is **academic misconduct**

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

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

Next steps

- You must meet your supervisor **next week** (week 2)

Next steps

- You must meet your supervisor **next week** (week 2)
- You will meet at least **once per week** thereafter

Next steps

- You must meet your supervisor **next week** (week 2)
- You will meet at least **once per week** thereafter
- **Mandatory** to attend

Next steps

- You must meet your supervisor **next week** (week 2)
- You will meet at least **once per week** thereafter
- **Mandatory** to attend
- Bring a draft of your application for **ethics approval** to the meeting in Week 6

Next steps

- You must meet your supervisor **next week** (week 2)
- You will meet at least **once per week** thereafter
- **Mandatory** to attend
- Bring a draft of your application for **ethics approval** to the meeting in Week 6
- Note: the university has a new policy, so supervisors may need to submit on your behalf...

FALMOUTH
UNIVERSITY

What is science?

"*Science and everyday life cannot and should not be separated.*"

Rosalind Franklin (1920 – 1958)
English Chemist and X-ray crystallographer

Image: https://commons.wikimedia.org/wiki/File:Rosalind_Franklin_CC-BY-SA.png

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; ×

- Facts *vs* hypotheses *vs* theories *vs* laws;

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

Image: `http://xkcd.com`

What is science?

A good operational definition

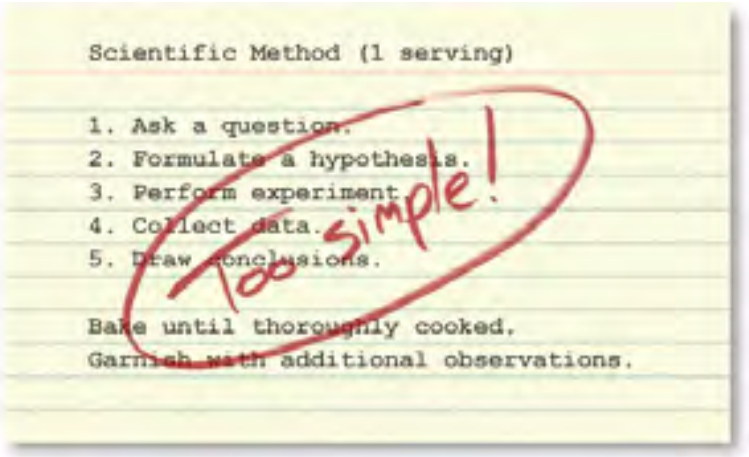
> *"What do you think science is?*
> *There's nothing magical about science.*
> *It is simply a systematic way for carefully*
> *and thoroughly observing nature and*
> *using consistent logic to evaluate results."*
>
> – Steven P. Novella

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

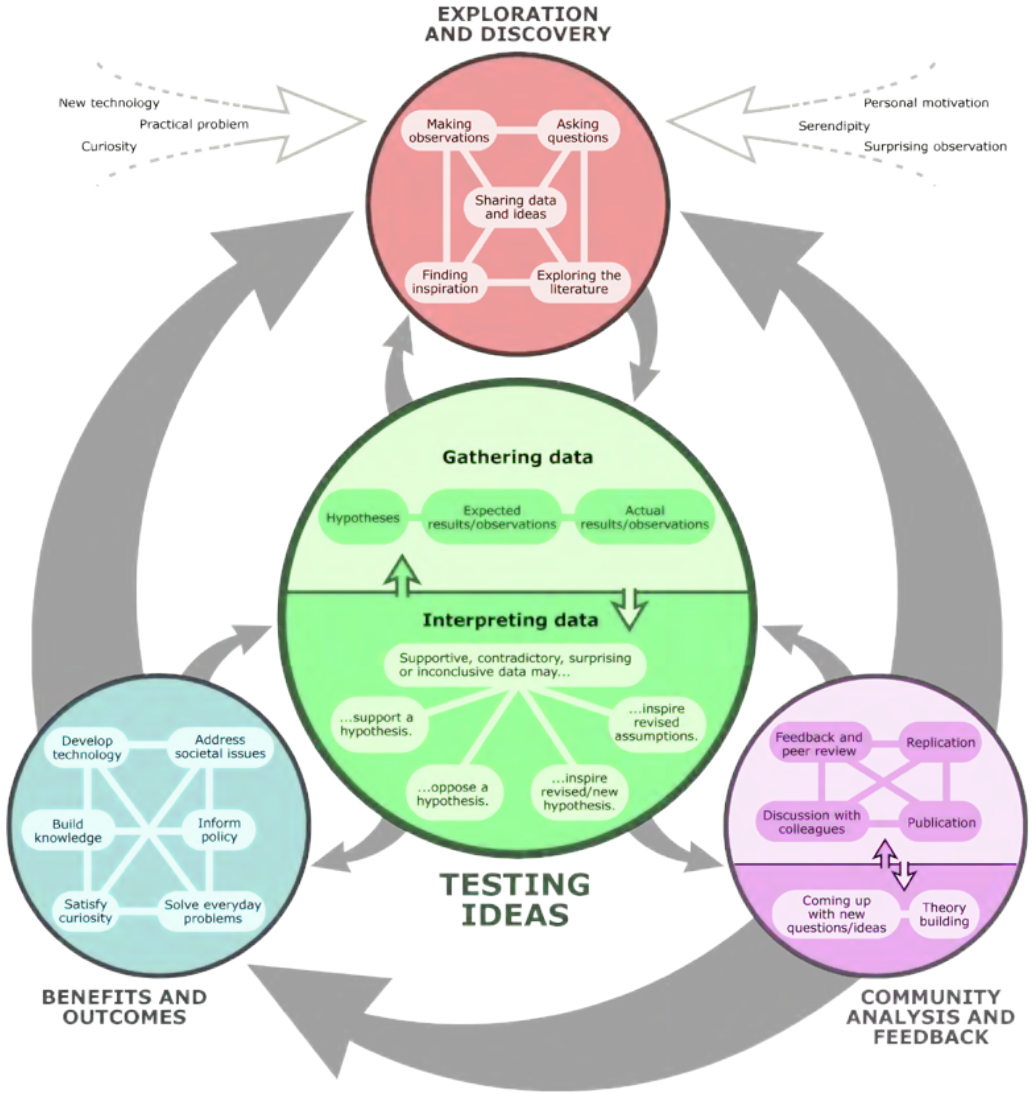


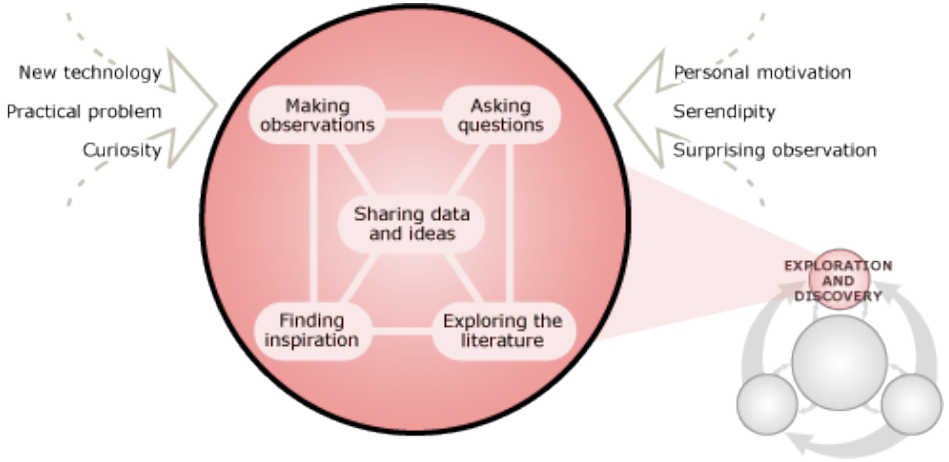
Image: `http://goo.gl/VglXc5` - (c) Understanding Science, 2015. Used with permission.

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?

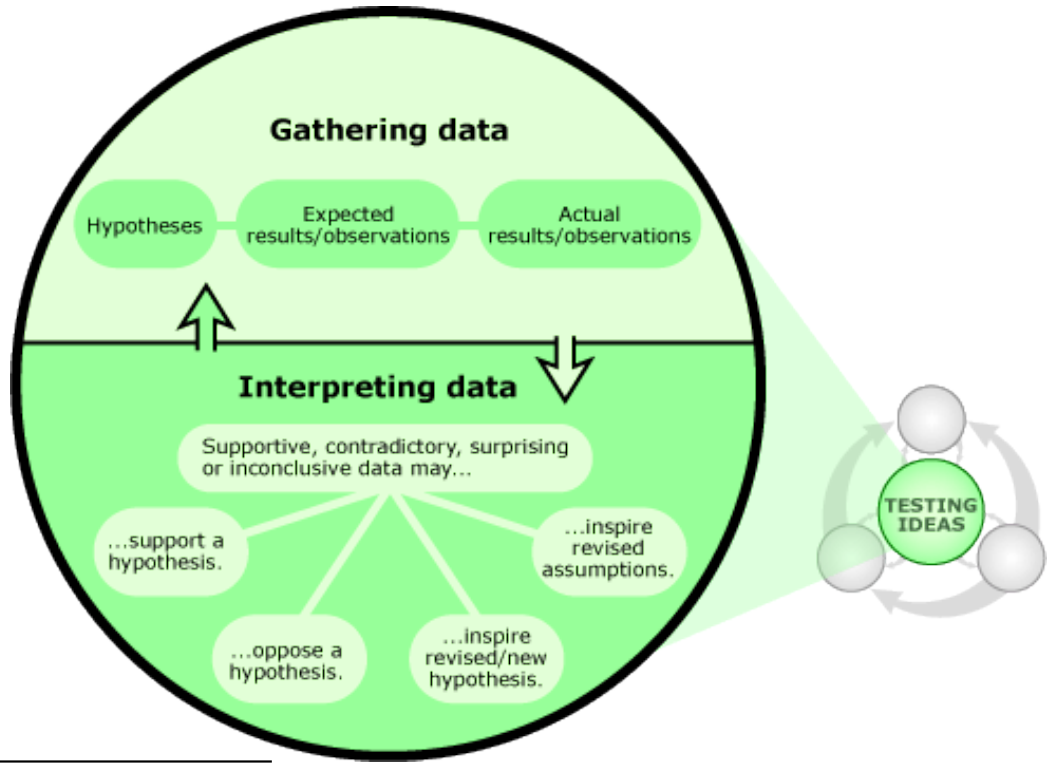


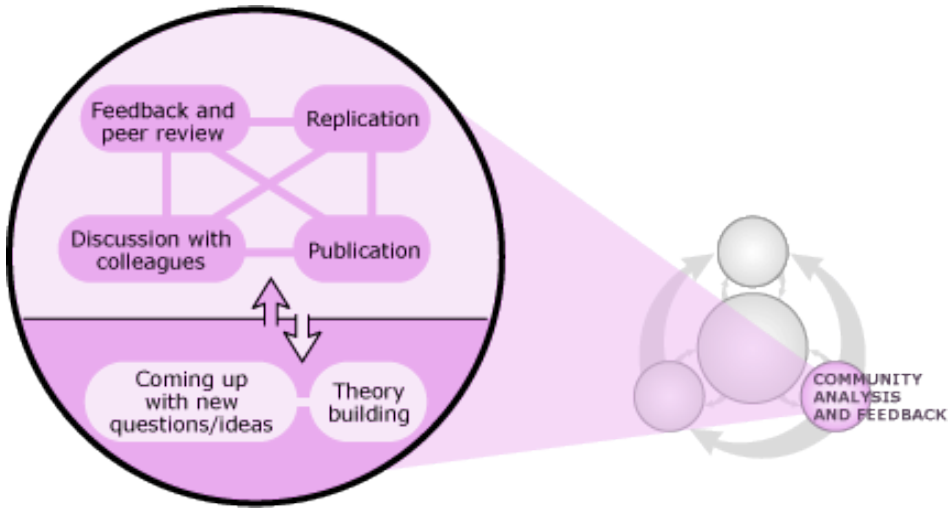
Image: `http://goo.gl/aOgSqT` - (c) Understanding Science, 2015. Used with permission.

What is science?

The scientific process

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

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



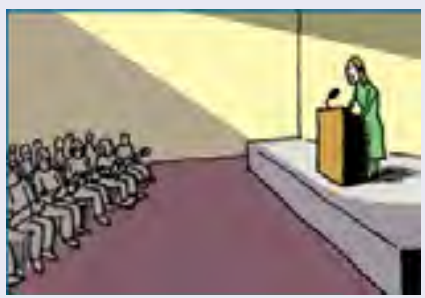
This interaction plays essential roles for the progress of research:

Criticism

Inspiration

Vigilance

Motivation

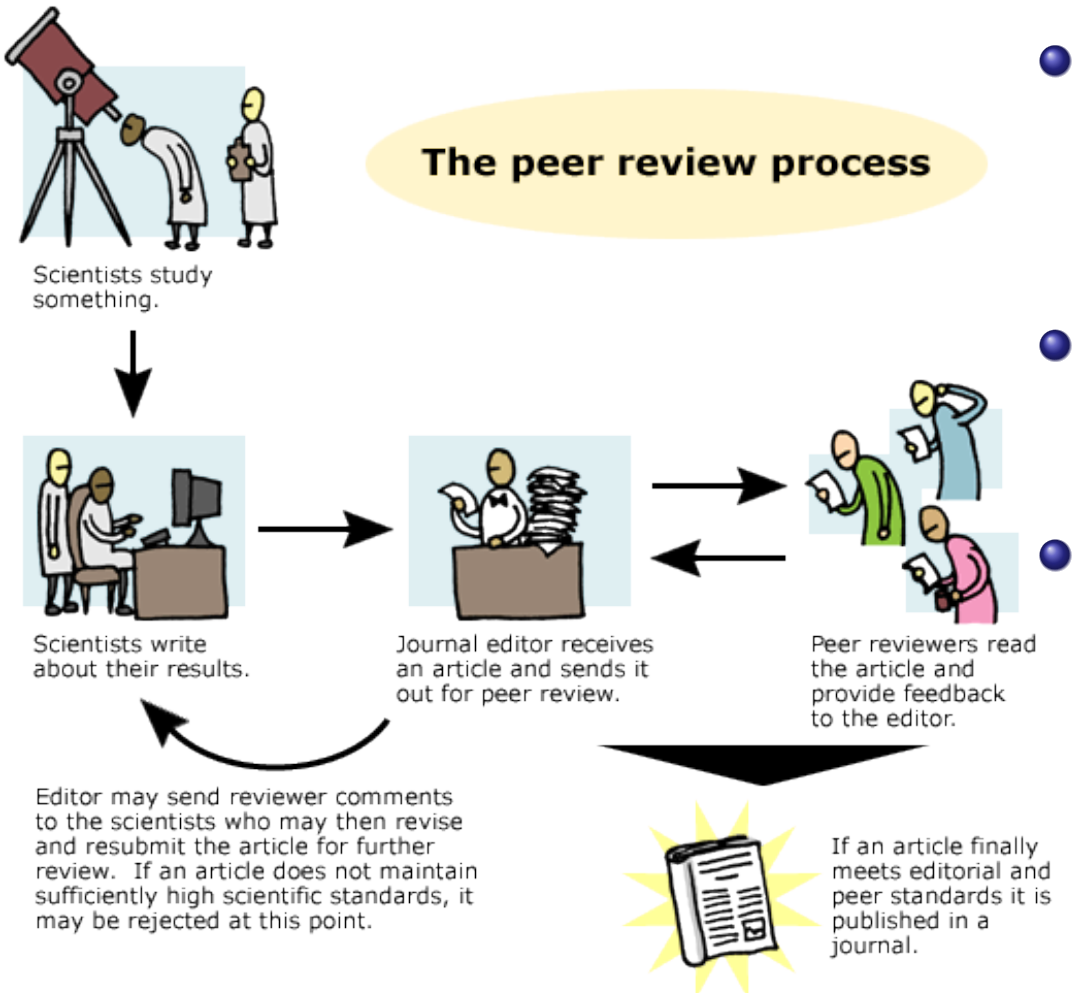


All images: `http://goo.gl/9pSCTG` - (c) Understanding Science, 2015. Used with permission.

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.

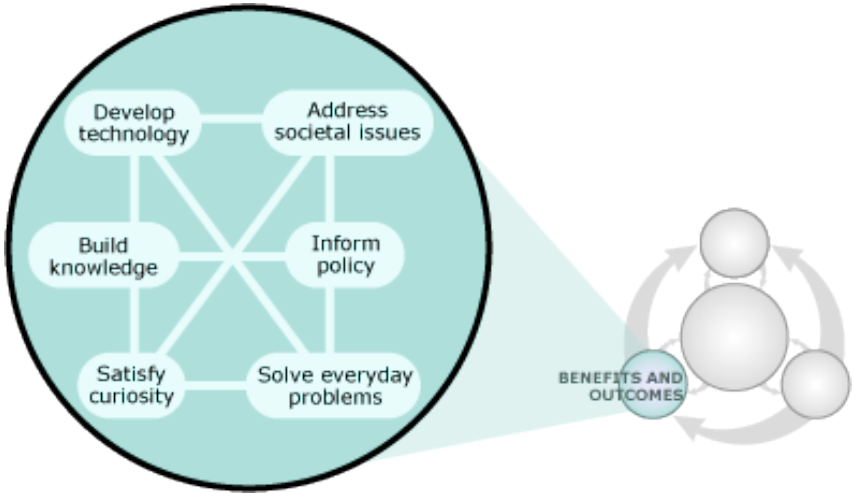
Image: `http://goo.gl/VWCVkK` - (c) Understanding Science, 2015. Used with permission.

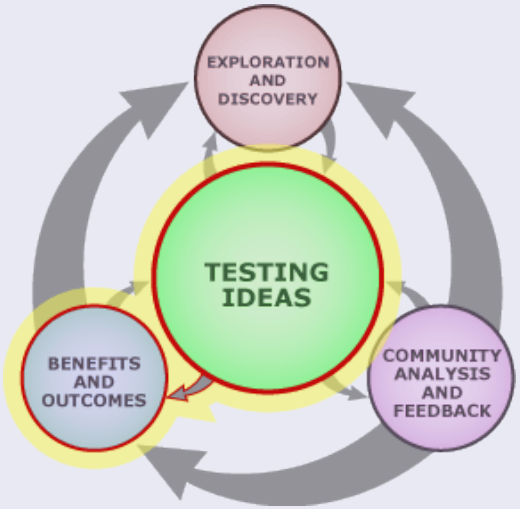
What is science?

The scientific process

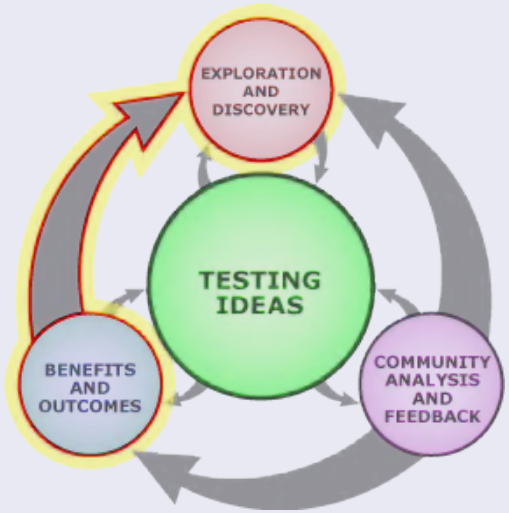
The scientific process is a way of building knowledge:

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

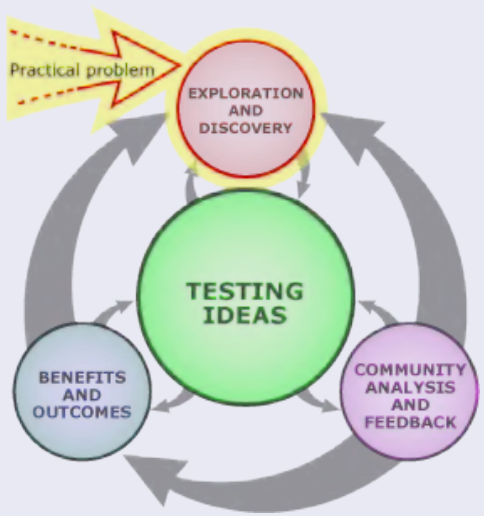




Knowledge→Applications



Technologies→Discovery



Applications→Investigation

All images: `http://goo.gl/IBRSoQ` - (c) Understanding Science, 2015. Used with permission.

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

This work is licensed under the Creative Commons CC BY-NC-SA 4.0 license (Attribution Non-Commercial Share Alike International License version 4.0).

http://creativecommons.org/licenses/by-nc-sa/4.0/

Please reference this work as:

Felipe Campelo (2018), *Lecture Notes on Design and Analysis of Experiments*.
Online: https://github.com/fcampelo/Design-and-Analysis-of-Experiments
Version 2.12. Creative Commons BY-NC-SA 4.0.

```
@Misc{Campelo2018,
  title={Lecture Notes on Design and Analysis of Experiments},
  author={Felipe Campelo},
  howPublished={\url{https://github.com/fcampelo/Design-and-Analysis-of-Experiments}},
  year={2018},
  note={Version 2.12. Creative Commons BY-NC-SA 4.0.},
}
```

Next Week

- **Locate and read** at least **TEN** academic papers from your research area (using ACM DL and IEEE eXplore)
- **Search** for potential gaps in the literature which you think your work could fill—try to articulate it explicitly
- **Devise** a research question that strives to be clear and succinct
- **Fork** the IEEE-style document on BitBucket, and email the link to your supervisor
- **Fork** the computing artefact repo on BitBucket, and email the link to your supervisor
- **Prepare** a draft proposal of 250-or-so words to take to the workshop next week, and push it into your repo