

MSc/PhD module MTMG05:  
**Scientific research and  
 communication skills**

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5 week course – 9 hours contact time

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[www.met.rdg.ac.uk/cag/courses](http://www.met.rdg.ac.uk/cag/courses)

## Lecture 1: Introduction

- 1.1 Aims and structure of this module
- 1.2 Scientific research skills
- 1.3 General Framework for communication
- 1.4 Exercises

## 1.1 Aims of this module

- To develop your scientific skills
- To understand the important role of communication in science
- To enable you to communicate confidently

## Why do this module?

- To get credits – NO
- To learn about weather/climate – NO
- To enable you to get a lot more out of the programme – YES
- To help you with assessed modules in the course:
  - Field trip report and presentation (Autumn)
  - Team project (Spring)
  - Dissertation project presentation (Summer)
  - Dissertation report (Summer)
- To help you communicate in your future career

## Timetable

Week	Date	Topic	Who and where
1	6 Oct 3-4pm	Introduction	All in GU01
2	13 Oct 3-5pm	Listening, presentation and reading skills	All in GU01
3	20 Oct 3-5pm	Writing skills	All in GU01
4	27 Oct 3-5pm	Library skills Presentation practice	WCM/HDR in 103 AM/HDR in GU01
5	3 Nov 3-5pm	Library skills Presentation practice	AM/HDR in GU01 WCM/HDR in 103

Note: library skills session to be given by  
 Sue Egleton in Main Library

## Reading

- [www.met.rdg.ac.uk/cag/courses](http://www.met.rdg.ac.uk/cag/courses)
- S. Cottrell, 1999: The Study Skills Handbook, Macmillan Press Ltd
- Many books on communication skills

## Computing skills for scientific research

- (Re-)searching
  - Bibliographic databases  
(need ATHENS password from library!)
  - The World Wide Web  
(www.google.com – secondary unreviewed source)
- Word processing
  - Microsoft Word
    - Tools → Spelling and Grammar
    - Document template (use Headings to introduce structure)
- Presentations
  - Microsoft Powerpoint

For help on computing refer to

- [www.rdg.ac.uk/ITS](http://www.rdg.ac.uk/ITS) (then go into Quick Help)
- Guides in the Department library (Idiot's guides to ...)

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## 1.2 Scientific research skills

What does a scientist need to know?

- Scientific method
- How to ask good questions
- How to search for information (re-search!)
- How to critically assess information
- How to work in a team
- How to write up scientific reports
- How to make scientific presentations
- Other?
  - Communicate with media, policy makers etc.

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## Scientists as rebels

- Galileo Galilei 1564-1642 (The Renaissance)
- *"About the year 1645, while I lived in London (at a time when, by our civil wars, academical studies were much interrupted in both our Universities), ... I had the opportunity of being acquainted with divers worthy persons, **inquisitive natural philosophy**, and other parts of human learning; and particularly of what hath been called the **New Philosophy** or **Experimental Philosophy**. We did by agreements, divers of us, meet weekly in London on a certain day and hour, under a certain penalty, and a weekly contribution for the charge of **experiments**, with certain rules agreed amongst us, to treat and discourse of such affairs..."* – John Wallis
- Royal Society founded 1660: motto: "nullius in verba"
- Jenny Uglow, 2002: The Lunar Men: The Friends who Made the Future 1730-1810, Faber and Faber, 501 pages.

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## Royal Society motto: "nullius in verba"

It looks like it means "Words do not matter" or "Do not pay any attention to words," since *nullius* means "nothing" and *verba* is "word." So most people think it means that words mean nothing and you have to do the experiment.

But *nullius* is genitive singular; it can't mean that. It means "of nothing" or "of no one." I knew what the motto meant. I knew that it was a fragment of a statement from Horace – a famous quotation from a poem, in which he says, "**I am not bound to swear allegiance to the dogmas of any master.**" *Nullius addictus jurare in verba magister*. It's "Nullius in verba," or "In the words of no (master)." It's just a fragment from a larger line.

"That's all I'm doing," I said. "I'm saying that we are not bound to swear allegiance to the dogmas of any master; I'm here to present an alternative viewpoint that's consistent with your own society. How can you castigate me?"

Stephen Jay Gould

The Pattern of Life's History

[http://www.edge.org/3rd\\_culture/gould/gould\\_p3.html](http://www.edge.org/3rd_culture/gould/gould_p3.html)

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## The Scientific Method

- Make a **careful observation** of the world
- Ask a **question** based on what has been seen
- Propose some **tentative answers** (*hypotheses*)
- Use the hypotheses to make **predictions** about **new** as yet unobserved data/phenomena
- **Test the predictions** by making **repeated** observations of the new data/phenomena
- **Reject hypotheses** that fail to predict the new observations

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## Key ideas

- Testable **predictions** that can be **falsified** by **observation** of the real world (minimises biases caused by personal prejudice/faith)
- Needs to be **repeatable** and so methods and data have to be made **openly available** to the whole community
- **Inductive reasoning** (use a fact to make a more general hypothesis) followed by **deductive reasoning** (use a hypothesis to predict a new fact)
- **Hypothesis** = assumption to be tested
- **Model** = hypothesis with limited validity
- **Theory** = well-tested hypothesis that explains a lot
- **Parsimony principle (Ockham's razor)**: use the simplest model that explains the known facts (to get the most predictive power)

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## Common mistakes

- To selectively use data that is known not to disagree with the hypothesis
- To use unrepeatable methodology
- To use data that is not openly available
- To accept rather than reject hypotheses
- To underestimate experimental or prediction uncertainties and thereby falsely reject hypotheses
- To overestimate experimental or prediction uncertainties and thereby miss rejecting hypotheses
- To fail to formulate clear testable hypotheses BEFORE new data is observed
- To publish only successful results

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## Critical thinking

a **persistent** effort to examine any belief or source of knowledge in the light of **evidence** that supports it and the **conclusions** it draws. (E. Glaser 1941)

Critical evaluation of the **evidence, line of reasoning,** and **conclusions.**

*If you would be a real seeker after truth, it is necessary that at least once in your life you doubt, as far as possible, all things.*

Rene Descartes (1596-1650)



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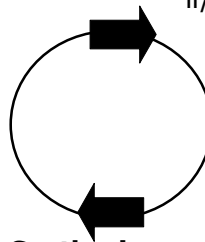
## Analytical thinking

- Standing back from the information given
- Examining it in detail from many angles
- Checking closely whether it is accurate
- Checking whether each statement follows logically
- Looking for possible flaws in the reasoning, evidence, or the way conclusions are drawn
- Comparing the issue from other points of view
- Checking all the assumptions
- Searching for any contradictions

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## Analysis and Synthesis

**Analysis** - breaking things down to see if/how all the parts work.



**Synthesis** - putting all the parts back together again to make a consistent message.

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## 1.3 General framework for communication

- **Aim** - what message do you want to convey?
- **Audience** - who are they? what do they know?
- **Medium** - written report, presentation, web,...
- **Content** - what should be included?
- **Structure** - logical framework for content
- **Style** - scientific and linguistic conventions
- **Feedback** - did the message get through?

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## The signal transmission model

**transmitter** → **message** → **receiver**  
signal (message) + noise (clutter)

Note:

- Understanding affected by receiver's background, attitudes, beliefs, excitement
- Feedback - if you haven't received it, then you haven't communicated!
- Communication is also often GENERATIVE - it helps generate/clarify ideas
- Audience=set of DIFFERENT receivers!

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## General principle

### K.I.S.S. – Keep It Short and Simple

Signal = message

All the rest is noise!  
(less is more)

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## 1.4 Exercises

- Visit the links on the module web site:  
[www.met.rdg.ac.uk/courses](http://www.met.rdg.ac.uk/courses)
- Prepare an oral presentation topic:
  - Title
  - Brief abstract (1 paragraph summary)
- Fill out ATHENS form at main library
- Learn how to use WORD, POWERPOINT, INTERNET EXPLORER

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## Examples of presentation titles

- A subject from one of the lectures
- A topic you find interesting:
  - Atlantic hurricanes
  - Tornadoes
  - Heat waves and climate change
- A scientific project you did in the past

Duration of presentation: 7 minutes

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