

# Convincing first years that biology is a quantitative subject

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# The set up

10 years ago

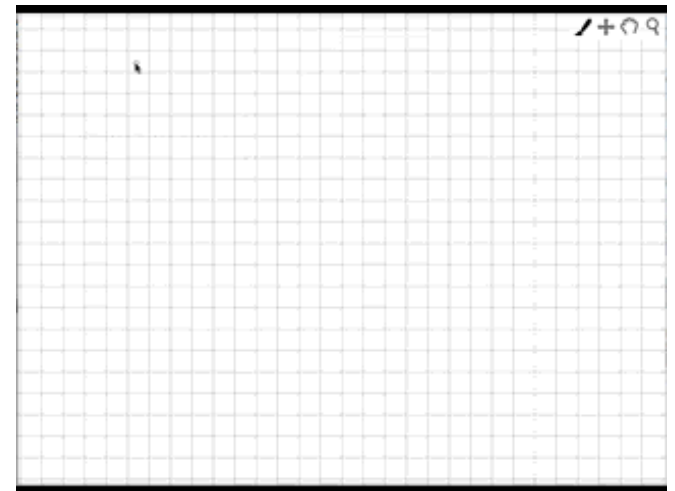
- Harmonisation of Life Sciences Teaching
- Very flexible system – many routes through >10 programmes
  - Pharmacology to Evolutionary Psychology
- Thought about core skills – skills mapping very difficult
- Decided on explicit skills modules – Quantitative skills, and Key Skills
- Quantitative Biology 1 (up to 350 students)
  - QB2 – Level 2 - Statistics
  - QB3 – Level 3/M - Modelling

# Wide level of initial skills

- A2 Maths – 35 %
  - A lot of knowledge, but need to see application to Biology
- GCSE Maths – 35 %
- Most of the rest in-between
- Mature students/Access courses
  - Need a lot of help, particularly with confidence

# What do we provide?

- Diagnostic test
  - On-line, self-evaluation, formative only
- Lectures
  - Scene setting, at most
- Workshops
  - 6 x 3h, with demonstrators. Work through workbook
- Generic catch up tutorials
  - Lectures with 'requests'
- Revision workshops
  - With demonstrators
- Small group tutorials – sign up
- Workbook/Textbook
- On-line resources
  - Questions, videos, links



# What do we cover?

Based on asking all our staff

Basic operations, fractions, ratios, percentages, estimation

Tables, charts, graphs with legends

Measurement, units, dimensions, conversions

Algebra

Powers/scientific notation

Accuracy, precision, significant figures

Concentration, moles, molarity

Polynomial and exponential functions

Logs and exponentials

Probability

Basic statistics, SD, SEM, confidence intervals

Calculus (hardly any!)

# How do we cover it?

Extended workshop examples that try to put things in biological context:

## ***Application 1. Long DNA molecules***

The largest of the 23 human chromosomes is chromosome-1, which is currently estimated to consist of 279 Mbp (bp = base pairs) of DNA in a single linear molecule. The distance between successive base pairs is 0.34 nm. If bp is an SI unit:

- (1) Express 279 Mbp in SI units, using scientific notation:
- (2) Express 0.34 nm in SI units, using scientific notation:
- (3) What is the length of the chromosome-1 DNA molecule? Quote the correct number of significant figures and use scientific notation.
- (4) Quote the value using a sensible prefix notation:
- (5) If the DNA could be replicated by a single replication complex at  $50.0 \text{ bp s}^{-1}$  (bp per second), how long would that complex take to replicate chromosome-1?
- (6) Express this in more familiar units: a. hours b. minutes c. seconds

# How do we cover it?

Series of MCQs on each topic:

Water ( $\text{H}_2\text{O}$ ) has  $M_r = 18$ . What is the molar concentration of pure water?

- a. 18 M
- b. 56 M
- c.  $1.8 \times 10^{-2}$  M
- d. 1000 M

# Assessment

- Small mark for diagnostic test and workshop attendance (but may stay only as long as required to check answers)
- Four exams – MCQs plus worked examples, like in the workshops
- Have a very formative function, marked fast, and students can check on answers in workshops/tutorials



# Built on elsewhere

Explicit cross talk between:

Quantitative Biology

Key Skills 1 and 2

Practical Modules, including Experimental design and analysis

QB2 Statistics

We could do this better

# Evaluation

2009-10

<b>Largely/Very helpful</b>	
Workbook	72 %
Workshops	71 %
Demonstrators	73 %
Lectures	36 %
<b>Many/Very many</b>	
New Skills	56 %
<b>Largely/very largely</b>	
Biology a quantitative science?	65 % (92 %)

# Evaluation

## Quotes

The workshop sessions were the most beneficial to me, as the demonstrators would explain everything very clearly

Workshops allowed 1 on 1 guidance when stuck

Fantastic demonstrators in workshops helped with a lot of things I'd never met before (logs, exponentials)

Great to bring non-mathematical biologist up to speed

The module is useful for people who have not done maths to a high level/for a long time. It is also a good review for people who have done maths recently. It was also good in how it applied maths to biology

# Evaluation

## Quotes

The lectures were not very useful – I found it hard to understand learning that way, better in workshops

Make it optional, most of it was a tedious repetition of A level maths

Putting extra modules such as QB1 and Key Skills just adds more stress in an area that people doing BIOLOGY are just not interested in. Otherwise we would do maths

The material covered in the lectures is really simple and basic, while in the workshop/exam, we have to deal with much harder questions

# Strengths/Weaknesses

## From colleagues

It's compulsory! Forces a focus on quantitative skills from day 1 – can't hide from it.

The students really appreciate the graded levels of help they can get.

Teaches the demonstrators QB too!

Puts the maths in a biological context. Quantitative Biology, not Maths for Biologists

It would be good if everything arose organically out of the biology, but...

Quite intensive and expensive

# Does it work?

...at least now they're embarrassed that they can't do it, and they go away and work it out

# Acknowledgements

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