Why run practical classes?

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1976-2008

Outline of my talk

• Expense of practical laboratories
• Why do we do practicals?
• Types of practicals
• Demonstrating
• What lecturers say
• Assessment
• What students say

Laboratory work is expensive...

• Equipment
• Consumables
• Space
• Demonstrating
• Technicians
• Marking

Why do practicals? (1)

• Practical skills
• Use of apparatus
• Experimental design
• Produce laboratory notebook
• Write report

Why do practicals? (2)

• Illustration of lectures
• Experimental basis of theory
• Errors/critical awareness
• Problem solving
• Motivation for research
• Independent thought

Types of practical

• Full procedure labs
• No-procedure labs
• Projects
• “Dry” practicals
  – Data analysis
  – In silico
**Full procedure labs**
- Full instructions provided
- Use of apparatus
- Experimental protocols
- Methods of data analysis

**No-procedure labs**
- Students told to measure X
- ..determine Y
- ..demonstrate relationships
- Left to plan how to do it.

**Basic equipment**
- Pipettes
- Spectrophotometers
- Centrifuges
- Microscopes
- Electrophoresis
- pH meters
- Mixers

**Basic techniques**
- Enzyme, metabolite & macromolecule assays
- Enzymes as reagents
- Use of radioactivity
- Separation of materials
- Use of biological material
- Mutagenesis
- Cell culture

**Projects**
- Students given open-ended problem
- Formulate hypothesis
- Design experiments
- Test hypothesis
- Write report

**“Dry” practicals**
- Can be used as substitute to develop certain skills:
  - Data analysis
  - Experimental design
- Come back to these later
Demonstrating

• What is its function?
• Active vs passive
• Proactive vs reactive
• Who does it?
• How are they trained?

What lecturers say……..

Working in the lab is what I like best about being an academic. I’d like to convey that feeling of engagement and enquiry to the students.

What lecturers say……..

Some of my students seem to leave their brains at the door. They plod through the labs on autopilot. Their reports show no evidence that they were ever in the lab at all.

What lecturers say……..

When I was a student labs always seemed hushed. I prefer to hear students chatting together busily, being active, even noisy… treating the place like a workshop rather than a church.

What lecturers say……..

I have a colossal amount of marking to do. I end up skimming through reports getting an overall feel for the thing and sticking a mark on it. The students don’t get much in the way of detailed comments and it shows, because they make the same mistakes over and over.

What lecturers say……..

I find I enjoy it more when students have to design an experiment or work out how to do things for themselves. I’m not convinced of the value of cook book follow-the-recipe type labs.
What and how do we assess?

- Do we assess:
  - Practical skills
  - Data analysis
  - Report writing
  - Group work
  - Communication skills

Types of report

- Full traditional write-up
- Data sheets
- Data and comprehension sheets
- Group reports
- “Paper”
- Posters
- Talks

What students say:
What makes a good practical

- Clear and easy to follow instructions
- Exciting/interesting laboratory class
- Helpful staff
- Learning new knowledge
- Learning new skills
- Related to lectures
- Well organised class, no student time wasted

What students say:
What makes a bad practical

- Mostly the opposite!
- Too long
- Repetitive write-ups
- It does not work!

Wants vs needs: mismatches

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<thead>
<tr>
<th>What students want:</th>
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<tbody>
<tr>
<td>Expts that work</td>
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<tr>
<td>Do it once</td>
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<tr>
<td>State of art</td>
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<td>Told what to so</td>
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</tbody>
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<table>
<thead>
<tr>
<th>What students need:</th>
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<tbody>
<tr>
<td>Understand problems</td>
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<tr>
<td>Repeats for stats</td>
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<tr>
<td>Basic techniques</td>
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<td>Think for themselves</td>
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Summary

- Practical work is expensive
- Need to consider carefully what you are trying to do
- Importance of demonstrating
- Consider "dry practicals"
- Assessment needs to be considered along with practical
Dry practicals

- Paper-based
  - Example to follow

- Computer-based – “in silico”
  - Simulations

On-line practicals/simulations - 1

David Bender on-line Virtual Laboratory
http://david-bender.co.uk/VirtualLab.html
or
http://www.ucl.ac.uk/~ucbcdab/simulations.htm

Biomodel
http://biomodel.uah.es/en/lab/ – in English
http://biomodel.uah.es/lat/ – in Spanish (more complete)
Contact from Education Committee: Angel Herráez
angel.herraez@uah.es

Enzyme purification – Spanish

Labster
https://www.labster.com/simulations/

On-line practicals/simulations - 2

Lucenz Simulator – enzyme kinetics
http://learnbiochem.weebly.com/enzyme-kinetics.html

AG Booth – protein purification and enzyme kinetics
http://www.agbooth.com/app/

Simenzkin – enzyme kinetics
https://www.researchgate.net/publication/319077262

Gepasi – kinetics simulations
http://www.gepasi.org/

On-line practicals/simulations - 3

Open University (UK) – OpenScience Laboratory
http://www.open.ac.uk/researchprojects/open-science/

Strathclyde Pharmacology

Pharmacology4you
http://pharmacology4you.blogspot.co.uk/p/software.html

Nuffield Foundation
http://www.nufffieldfoundation.org/practical-biology

Protopedia
http://proteopedia.org/wiki/index.php/Main_Page