Durham University

Interactive Screen Experiments

Using Technology to Make Science Labs Less Scary

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To Cover

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  - The Barriers to Laboratory Learning
- **Interactive Screen Experiments**
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- **This Project – How its evolved since last year**
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  - Implementation & Use
  - Student Feedback
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The Foundation Centre

- **The Foundation Centre offers direct progression to all Durham University departments after a year of study for:**
  - Local Mature Students
  - International Students
- **The diversity of the cohort is a strength, but for this study each student group has its own issues**
  - Local Mature Students
    - Often little formal education in their recent experience
  - International Students
    - Learning in a second language
- **Both have somewhat of a culture shock**

Barriers to Laboratory Learning

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- **Experience as a barrier to learning**
  - Often local mature students haven't been in a laboratory since school
  - This can lead to anxiety which presents a barrier to learning
  - Some international students haven't had much lab experience either
- **Visualization as a barrier to learning**
  - Inexperience also means students can struggle to visualize a system purely from a text description
  - An issue for both groups of students
- **Language as a barrier to learning**
  - Terms like 'voltmeter', 'current', 'electrolysis' etc are alien to students and can be off-putting

Arriving at a Solution

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- **We needed something to**
  - Remove the barriers
  - Familiarize students with the kit
- **This familiarity would also relax anxiety about the tasks they are asked to complete.**
- **Constraints didn't allow them to use the lab outside of class time.**
- **The solution was to seek funding from the university to develop Interactive Screen Experiments.**

The Virtual Physics Lab

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- **Technologies have been used to reproduce experimental physics teaching in many ways**
  - Film/Video – Transmission of Information
  - Coded Simulations – Lack Connectivity
  - Interactive Video – Limited Choices
  - Remote Experiments – Asynchronicity
  - Interactive Screen Experiments

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What are They ?

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- **Inspired by ISEs developed at the Open University**

P.A.Hatherly et al, Eur.J.Phys. 30, 751--762, 2009.

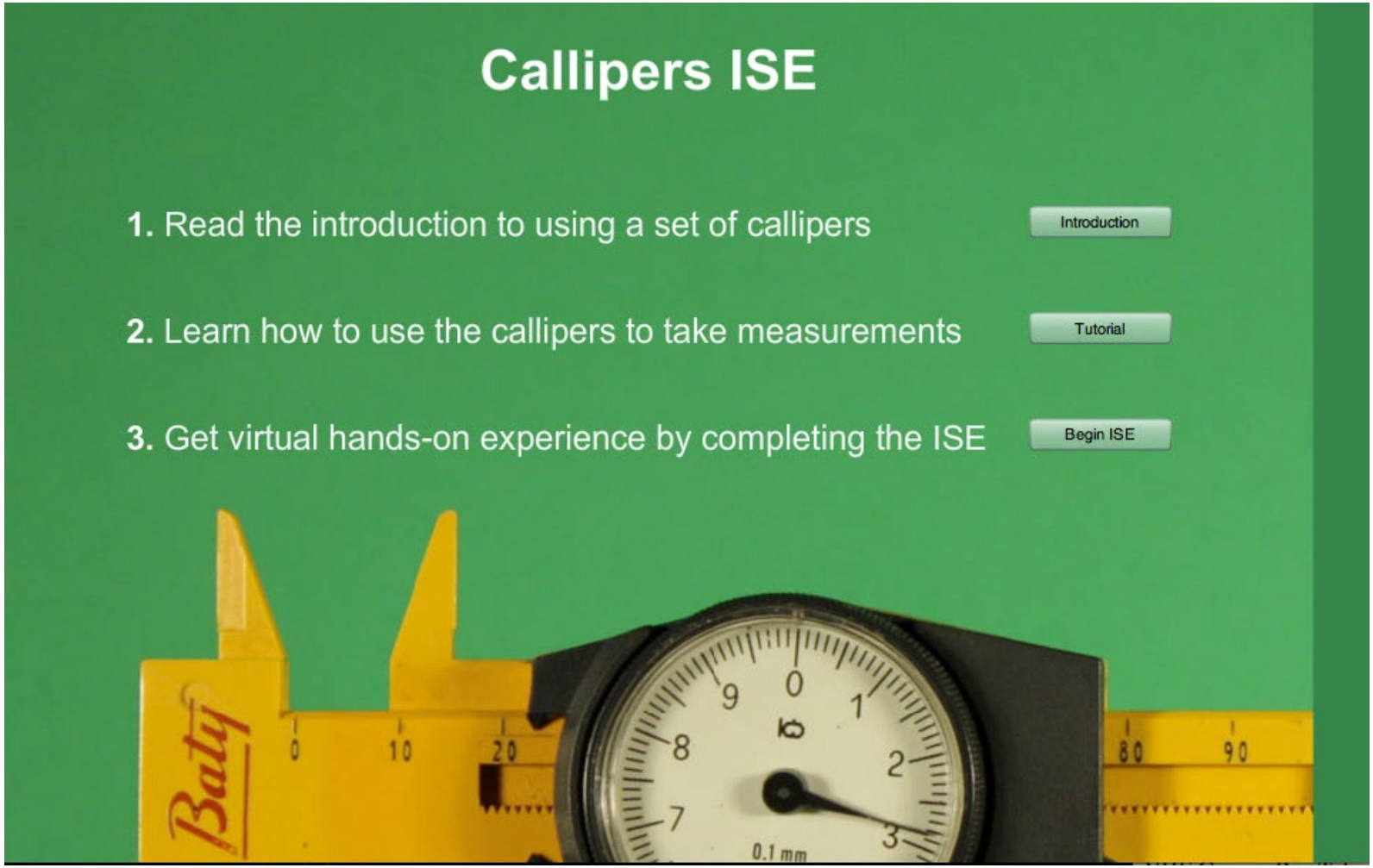
"a highly interactive movie of an experiment filmed as that experiment was being performed."

User interacts with movie as if carrying out the experiment

ISEs at Durham

- **ISEs at Durham were developed for the department of Physics** (Nolan, S, McComb T.J.L., Szablewski M & Hughes I. – HEA New Directions, Recently Accepted
- **Here they were used to help overcome the disparity of practical physics experience they encountered amongst their cohort of freshers**
- **Talks (3 Rivers 2011, DUBBU)**
- **Results were positive**

ISE Demo



http://level1.physics.dur.ac.uk/ISE/Callipers.php

ISE Project for Foundation Science; Developments since FYNAC2011

The Grant

- **In 2011 we were awarded an Enhancing the Student Learning Experience Grant (£6.3K) by Durham University, with aims:**
  - To develop Interactive Screen Experiments (ISEs) for foundation level physics, chemistry and biology
  - To study student utilization of a repository of online mechanics simulations
  - To develop a foundation level website offering the screen experiments and a student-editable glossary of technical terms
  - To evaluate the impact on students' learning in the Foundation Centre
  - To disseminate this work both within the University and at a national level
- **This grant led to £1K from HE STEM for 'Conceptual Understanding of Physics' and a HEA funded workshop**

Developing the Virtual Laboratory

The Higher Education Academy

Durham University

19th March 2012,
St Aidans College,
Durham University, UK

An interdisciplinary 1 day HEA workshop on utilizing computer virtualizations to enhance the laboratory learning experience of new science, engineering and medicine students in the UK



Confirmed Guest Speakers:
- Prof N Braithwaite & Dr P Hatherly, The Open University
- Dr S Haase, Freie Universität Berlin
- Prof Ray Land, Durham University

http://tinyurl.com/6w58bj7 for further details

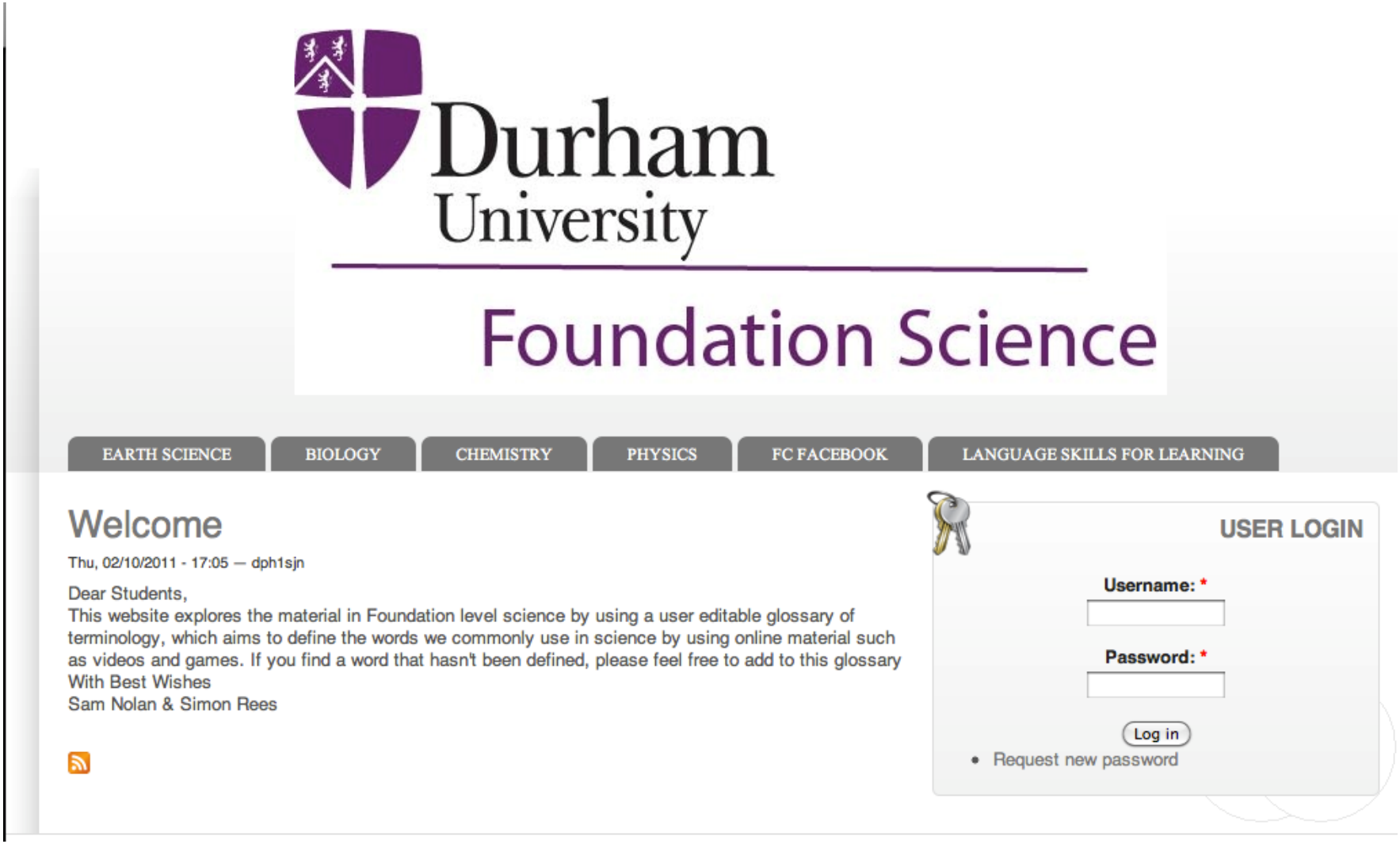
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- **Recent HEA Durham Led UK Meeting of ISE Community**
- **Over 30 Participants from 10 Universities**
- **Presentations at** http://tinyurl.com/89rtdum

The Grant

- **We used the Durham University funding:**
  - To employ a summer student (A. del Castillo Dubuc) over two summers
  - Equipment
  - Focus groups
  - Dissemination
- **Andy's time was spent:**
  - Setting up the optical equipment
  - Taking many photographs
  - Developing Flash code to link the photographs together
  - Turning the code into a teaching tool
  - Redesigning the website
- **Andy is currently looking at HTML5 as an alternative to Flash**

The Hard Work



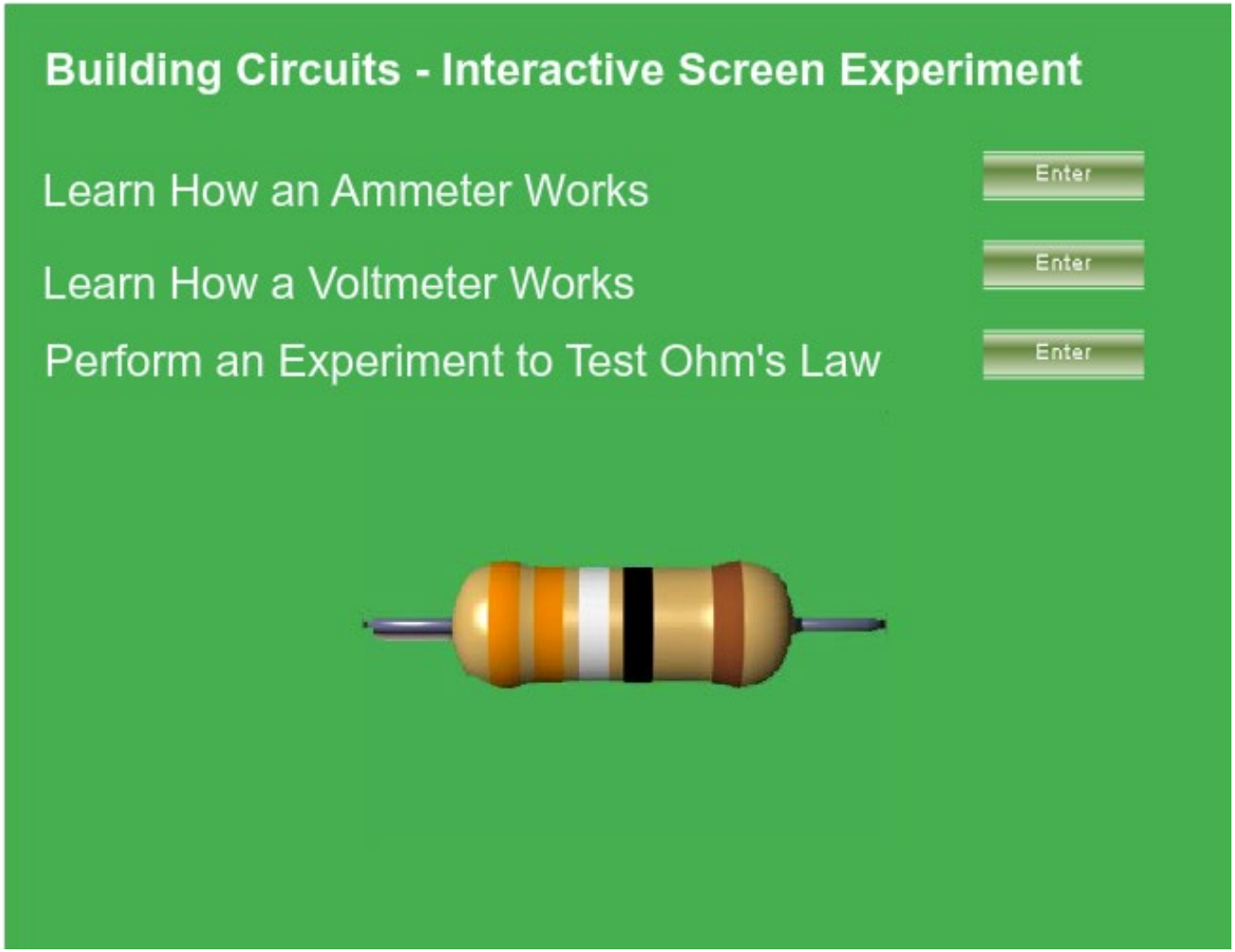
http://www.dur.ac.uk/foundation.science

ISEs

- **We created two new ISEs targeted at subjects students have a particular issue with:**
  - Circuit Building & Ohm's Law
    - Concepts such as current, voltage etc. are known to be hard for students to grasp
    - Circuit building is an acquired skill
  - Making Aspirin
    - This is the students' first experience of using a distillation apparatus

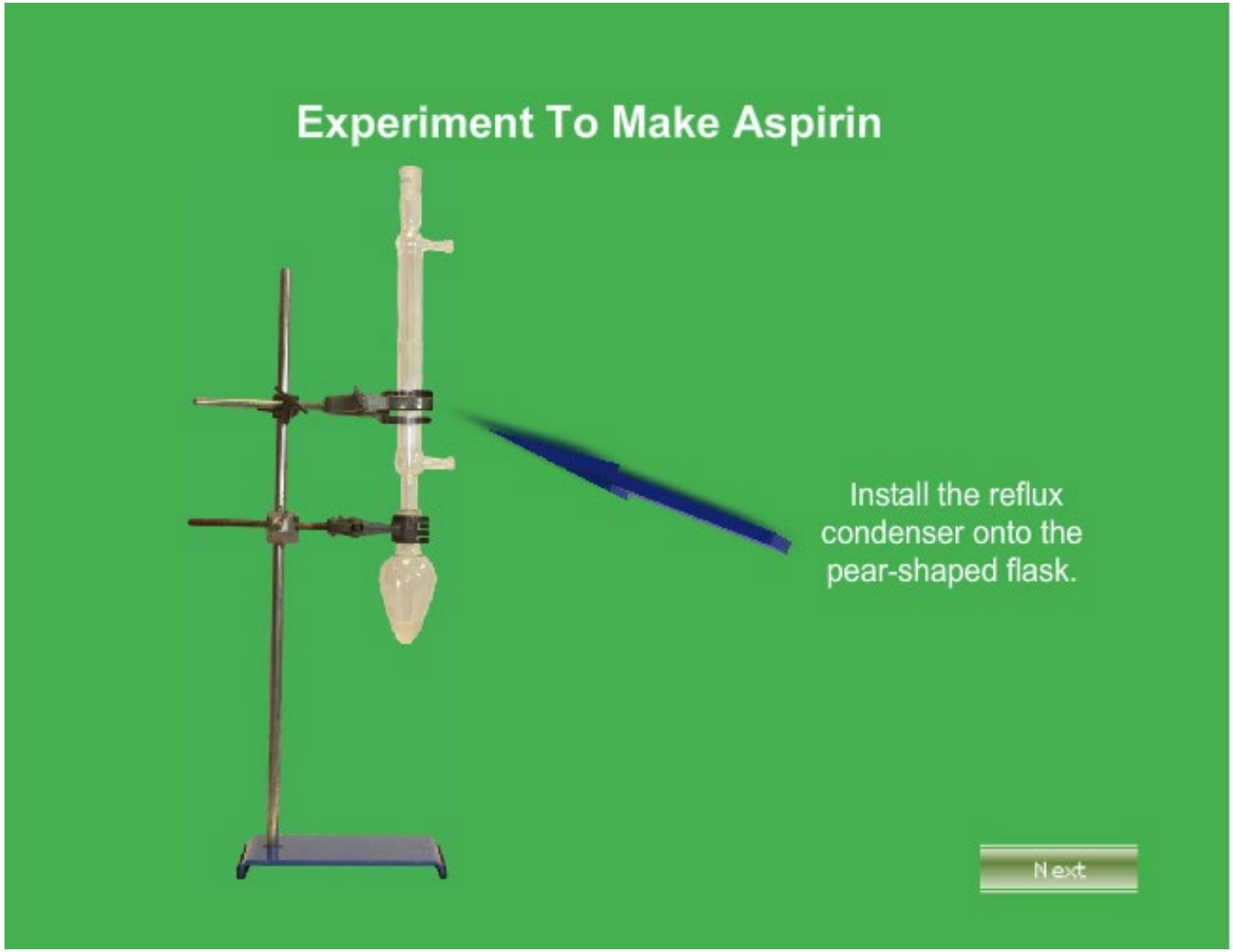
Ohm's Law

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http://www.dur.ac.uk/foundation.science/?q=node/475

Making Aspirin



http://www.dur.ac.uk/foundation.science/?q=node/481

Deploying the ISEs

How to Deploy

- The Foundation Physics ISE was deployed prior to student arrival in Durham.
- Students were emailed to say that this could be used to prepare them for their first practical physics class.
- According to Blackboard tracking, around 1/3 of the students used the ISE within 2 days of getting the email.
- Another 1/3 used the ISE within 2 weeks.

Student Views: Results from Focus Groups

Focus Groups

- **2 Focus Groups of up to 7 students were held (1 Queens Campus, 1 Durham City)**
- **Each group consisted of mature local students and younger international students.**
- **Students discussed their use of ISEs in terms of:**
  - Experience of Practical Science prior to arrival at Durham
  - How often they used the ISEs
  - Whether they found them useful
  - Whether they felt more prepared after using them
  - When they used them

The Good

- 'I used the experiment as soon as you sent it out, before the class, after the class and when I was writing the report. I haven't done practicals in Brazil and really appreciated this.'
- 'As it looked the same as the apparatus we were using I felt more confident doing the real experiment.'
- 'I wish we could have had more of these sent out earlier to give us something to do over the summer.'

The Bad

- 'For me it’s all about books, you can’t learn off the web'
- 'This experiment was easy I didn’t need any help'
- 'I found the layout a little confusing, too much information'

The Surprising

- **The level of recent practical experience amongst mature local students was known to be low.**
- **The level of recent practical experience amongst younger international students was thought to be high.**
- **Actually, from the small sample of 18 year old International students (Chinese, Greek, Brazilian) many still commented physics and chemistry were taught with an emphasis on the theoretical in their home countries.**

The Surprising

- **Every student (local and international) wanted more contact pre-arrival**
- **They wanted:**
  - More information about their classes
  - Reading materials
  - Logisitical information about Durham
  - ISEs to learn about the experiments they'd be doing
- **An "interest group" of the Foundation Year Network formed around the use of ISEs in 2011 (Durham, Sheffield, Keele, Hull)**

Addressing Student Concerns

- **To address issues raised in the focus groups we've:**
  - Introduced screencasts on how to use ISEs
  - Secured funding from the University to develop pre-arrival materials
- **In addition we've**
  - Secured funding from the University to develop augmented reality systems which allow students to interact with more theoretical constructs in a visual manner, e.g.
    - Add onto a movie a layer of animation which allows the students to see the physical/chemical processes at work, e.g. electrons moving in circuits or chemical reactions, forces acting on someone riding a bike etc

Bottom Line: Do ISEs help ?

- **Qualitatively - Yes**
  - Most students commented on the helpful nature of the ISEs and wished more experiments could have them
  - Staff found students more at ease with the equipment
- **Quantitatively - ?**
  - No mechanism currently exists for quantifying whether they have a positive effect here

Conclusions

- **ISEs have been deployed at Durham to aid in teaching Foundation Physics and Chemistry**
- **Student reception has been generally positive**
- **Students request more ISEs to use over the summer pre-arrival**
- **A network of interest has formed at Foundation Centres in the Foundation Year Network**

- **Future Work:**
  - Improve and adapt ISEs
  - Extend to Biology
  - Seeking funding to develop pre-arrival ISEs

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- Dr Helga Bartels-Hardege
- Dr Willy Kitchen
- Prof Peter Haycock

If you're interested in being involved

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