DeVry University

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A Simple LED Light Source for Multiple Online Experiments

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Online Physics Courses

- In 2011 a survey showed that 31% of all students in higher education have enrolled in at least one online class.
  

- In 2010 a poll of 398 two and four year degree granting institutions offering introductory physics courses.
  - 9.5% offer at least one introductory physics course online.
  - 3.8% offer lab in an online format.

- In 2012 a poll of 311 accredited degree-granting two-year colleges
  - 11% offer at least one section of introductory physics online
  - 6.8% offer at least one section of an introductory physics laboratory.

Advantages to non-traditional students:
- No commute.
- Course is asynchronous It can fit into their schedule.
An online physics course should have a physical laboratory component.

- Accreditation
- Transfer credit
- “Hands On” learners
- Simply isn’t science without experiments or observations
Some Issues with online labs should be no surprise.

- Online physics students will work on the labs at the last minute.
  - May not be just procrastination.
- Online students will misread the laboratory instructions.
  - No matter how simple you think the instructions are
- Help is asynchronous.
Supplies and equipment for off-site labs should be:
  - Complete
  - Inexpensive
  - Easy to use

In addition
  - Off-site lab experiments should be similar to on-site labs.
  - For technical students labs should be computer-based.
Controlling cost to the students should be a major effort.
One method to control cost is to use the same equipment for multiple experiments.
The LED Experiment Board is an adaptation of the standard experiment for measuring Planck’s Constant using LEDs


- Easy to use
- Compact PC board
- Uses 9 volt battery
- LEDs mounted asymmetrically
- Capacitor switched in or out of circuit
- Multiple LEDs can be lit at a time.
LED Experiment Board

• Board can be used for:
  • Planck’s Constant experiment
  • Physical Optics experiments
  • Geometric Optics experiments
  • Others
Circuit
PC board

- expresspcb.com
PC board
## Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>unit cost</th>
<th>units</th>
<th>total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC board</td>
<td>$20.90</td>
<td>1</td>
<td>$20.90</td>
</tr>
<tr>
<td>SPDT slide switch</td>
<td>$0.56</td>
<td>2</td>
<td>$1.12</td>
</tr>
<tr>
<td>10 pos socket</td>
<td>$1.40</td>
<td>1</td>
<td>$1.40</td>
</tr>
<tr>
<td>Terminal block</td>
<td>$0.41</td>
<td>1</td>
<td>$0.41</td>
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<tr>
<td>1000 uF Capacitor</td>
<td>$0.74</td>
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<tr>
<td>resistor 280 ohm</td>
<td>$0.09</td>
<td>8</td>
<td>$0.72</td>
</tr>
<tr>
<td>8 pos DIP switch</td>
<td>$1.14</td>
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<td>$1.14</td>
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<tr>
<td>LED infrared</td>
<td>$0.52</td>
<td>1</td>
<td>$0.52</td>
</tr>
<tr>
<td>LED red</td>
<td>$0.64</td>
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<td>$0.64</td>
</tr>
<tr>
<td>LED orange</td>
<td>$0.38</td>
<td>1</td>
<td>$0.38</td>
</tr>
<tr>
<td>LED yellow</td>
<td>$0.95</td>
<td>1</td>
<td>$0.95</td>
</tr>
<tr>
<td>LED yellow-green</td>
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<tr>
<td>LED green</td>
<td>$1.69</td>
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<tr>
<td>LED blue</td>
<td>$1.50</td>
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<tr>
<td>LED white</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
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<td><strong>$34.92</strong></td>
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</table>
Planck’s Constant Experiment

Equipment
- LED experiment board
- PASCO Current Voltage Sensor
- PASCO USB Link
- Datastudio
- DMM (optional)
Planck’s Constant Experiment

$h(\text{exp}) = 6.08 \times 10^{-34} \text{ J} \cdot \text{s}$
Diffraction Grating Experiment

- **Equipment**
  - LED experiment board
  - Diffraction grating
  - Lens holders
  - Tape measure
  - Index card
Diffraction Grating Experiment

\[
L = 13.4 \text{ cm} \\
y_1 = 3.65 \text{ cm} \\
y_2 = 3.60 \text{ cm} \\
\theta = \tan^{-1}\left(\frac{y}{L}\right) \\
\lambda = \left(\frac{1}{500}\right) \sin \theta \\
\lambda_{exp} = 522 \text{ nm} \\
\lambda_{nom} = 523 \text{ nm}
\]
Geometric Optics Experiment

- **Equipment**
  - LED experiment board
  - Concave mirror
  - Convex lens
  - Lens holders
  - Tape measure
  - Index card
Geometric Optics Experiment

$$f_{\text{exp}} = 197 \text{ mm}$$

$$f_{\text{nom}} = 200 \text{ mm}$$
The LED Experiment board is a low cost way to provide online students with equipment to complete several at-home experiments that are of the same type and quality as experiments done in an on-site physics lab.

Questions?