POGIL in the Biochemistry classroom

Linette M Watkins
Texas State University
San Marcos, TX 78666

Texas State University
San Marcos

Primarily undergraduate
~27k students
97% from Texas
20:1 student:teacher
1072 average SAT

Demographics at Texas State

<table>
<thead>
<tr>
<th></th>
<th>% Women</th>
<th>% Hispanic</th>
<th>% African American</th>
<th>% Native American</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>50</td>
<td>32</td>
<td>12</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>TxState</td>
<td>56</td>
<td>18</td>
<td>5</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>College of Science</td>
<td>39</td>
<td>21</td>
<td>5</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>Dept of Chem &amp; Biochem</td>
<td>46</td>
<td>27</td>
<td>7</td>
<td>&lt; 1</td>
</tr>
</tbody>
</table>

References: US census bureau, 2000 Census of population; TxState Office of Institutional Research, Oct 2005

Biochemistry major

Number of majors 2001-2005
Principles of Biochemistry

- First offered in 2003
- Only junior biochemistry minors and majors
- Prerequisite for ALL other Biochem courses
- 15-60 students per Fall semester
- POGIL used in Fall 2004
- Self-selected groups of 3-4

Principles POGIL exercises

- Hydrogen bonding
- Bond properties
- Acid-base reaction
- Nucleophilicity
- Polarity
- Beer’s Law
- Hypochromism
- Amino Acids
- Amino acid interactions
- pI
- Protein purification
- Protein characterization
- DNA sequencing
- Restriction mapping
- Enzyme kinetics
- Enzyme mechanism
- Enzyme regulation
- Carbohydrates

Student performance

<table>
<thead>
<tr>
<th>Semester</th>
<th>DFW rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>FALL02</td>
<td>10%</td>
</tr>
<tr>
<td>FALL03</td>
<td>40%</td>
</tr>
<tr>
<td>FALL04</td>
<td>25%</td>
</tr>
<tr>
<td>FALL05</td>
<td>64%</td>
</tr>
</tbody>
</table>

Metabolism

- Offered since before 1997
- Mixed classes
  - Junior biochem/chem minors
  - Senior biochem majors
  - Masters levels students
- 40-60 students per semester
- POGIL started in Spring 2005
- Mixed groups of 3-4
**Metabolism exercises**

**POGIL exercises**
- Thermodynamics
- Glycolysis
- Gluconeogenesis
- Oxidative phosphorylation
- Fatty acid metabolism

**Other group exercises**
- Signal transduction
- Gluconeogenesis
- Citric acid cycle
- Photosynthesis
- Glycogen metabolism
- Amino acid metabolism

**Student performance**

<table>
<thead>
<tr>
<th>Semester</th>
<th>DFW rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP99</td>
<td>44%</td>
</tr>
<tr>
<td>SP00</td>
<td>38%</td>
</tr>
<tr>
<td>SP01</td>
<td>33%</td>
</tr>
<tr>
<td>SP02</td>
<td>32%</td>
</tr>
<tr>
<td>SP03</td>
<td>26%</td>
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<tr>
<td>SP04</td>
<td>30%</td>
</tr>
<tr>
<td>SP05</td>
<td>16%</td>
</tr>
<tr>
<td>SP06</td>
<td>15%</td>
</tr>
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</table>

**Student attitudes**

- Very strong resistance in first year
  - Complaints to chair
  - Begging to go back to lecture
- Now it is expected, less resistance
- No change in student evaluation scores
- Lessons
  - Spend as much time as possible on buy-in
  - Make sure that you have administrative support

**Faculty attitudes**

- Happy for me to be the guinea pig
- More than half have moved from all lecture
- Five have attended POGIL workshops
- One is authoring POGIL exercises
- Two are using POGIL in Gen Chem SI sessions
- Three submitted a CCLI proposal for using POGIL in all Gen Chem and Org SI sessions
- All have some concerns, but see the need for change
Student performance in subsequent classes

- Students that did well in group exercises did not do as well in subsequent all lecture classes
- All students graduated within 1 semester of expected graduation time
- Lessons
  - Need to emphasize writing skills more
  - Need to emphasize test taking skills more

Performance on ACS exam

<table>
<thead>
<tr>
<th>Year</th>
<th>Average score</th>
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</thead>
<tbody>
<tr>
<td>2004 no POGIL</td>
<td>30±6 (n=9)</td>
</tr>
<tr>
<td>2005 1 semester POGIL</td>
<td>35±9 (n=18)</td>
</tr>
<tr>
<td>2006 2 semesters POGIL</td>
<td>27±2 (n=21)</td>
</tr>
</tbody>
</table>

Acknowledgements

Texas State Faculty
- Jim Irvin
- Rachell Booth
- Wendi David
- Debra Feakes
- Chad Booth
- Ben Martin

POGIL support
- Dave Hanson
- SUNY-Stonybrook
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- Southwestern University
- Vicki Minderhout
- Jennifer Loertscher
- University of Seattle