Introductory Seminars to Prepare Students to Participate in STEM Research

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General Outline

- Science and Technology Honors Program
- Introductory Seminar Structure
- Activities in the Seminar
- Survey Data
The Science and Technology Honors Program

- Established in 2005
- Create a curriculum that
  - Recruits and trains highly motivated science and engineering students
  - Involves students in mentored research experiences earlier in their career
  - Takes advantage of the research strengths of the university
  - Leads to continued study in the sciences and engineering
STH Curriculum

- Four-year curriculum
  In addition to courses in the major, though many courses in the major count toward the STH requirement

- 30 semester credit hours
  - Seminars
  - Courses in academic departments
  - Laboratory courses
  - Leadership training
  - Thesis proposal and preparation courses
### Total Active Students

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Total Active Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-2006</td>
<td>12</td>
</tr>
<tr>
<td>2006-2007</td>
<td>36</td>
</tr>
<tr>
<td>2007-2008</td>
<td>57</td>
</tr>
<tr>
<td>2008-2009</td>
<td>93</td>
</tr>
<tr>
<td>2009-2010</td>
<td>136</td>
</tr>
<tr>
<td>2010-2011</td>
<td>139</td>
</tr>
<tr>
<td>2011-2012</td>
<td>171</td>
</tr>
<tr>
<td>2012-2013</td>
<td>196</td>
</tr>
</tbody>
</table>

### Distribution of ACT Composite Scores 2007-2011

<table>
<thead>
<tr>
<th>Year</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
</tr>
</tbody>
</table>

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**Figure 4. Distribution of ACT Composite Scores 2007-2011**

- **BME**: 27%
- **CH**: 16%
- **BY**: 29%
- **NEUR**: 8%
- **PH**: 5%
- **CIS**: 2%
- **MA**: 2%
- **PY**: 2%
- **CE**: 1%
- **EE**: 3%
- **Other**: 5%
Freshman Seminar (STH 199)

1-Credit Course
1st Semester
Different Instructor on Monday and Wednesday

**Mondays**
- Informal Discussions
- Reading Popular Literature
- Study Tips
- Career Planning

**Wednesdays**
- More Formal Discussions
- Reading the Primary Scientific Literature
  - Interdisciplinary
  - Hoskin’s CREATE method
- Laboratory Visits with STH Liaisons
Monday Sessions

Students requested additional study sessions in Fall 2010

- Structured as active learning sessions
- Sessions related to study tips
- No outside of class assignments
- Students were expected to attend
- Discuss how to approach a research mentor
- Taking on big ideas in a safe learning environment

- Expanded to required session in Fall 2011 and 1-credit course in Fall 2012
Monday Readings and Discussion

- “Into the Air” Malcolm Gladwell
- “The Language of the Laboratory” Alan Mandell
- “Can We Know the Universe? Reflections on a Grain of Sand” Carl Sagan
- Case Studies from “The Ethical Chemist” Jeffrey Kovac
  - Laboratory Clean Up
  - A Careless Coworker
  - Undergraduate Coauthor
- What Does a Freshman’s Resume Look Like?
## Formative Survey Responses

<table>
<thead>
<tr>
<th></th>
<th>Fall 2010 N=30</th>
<th>Fall 2011 N=51</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Sessions have helped me</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. think about science in new ways</td>
<td>70</td>
<td>71</td>
</tr>
<tr>
<td>b. become more confident about choosing science as a career</td>
<td>60</td>
<td>78</td>
</tr>
<tr>
<td>c. think about how to present myself to potential mentors</td>
<td>80</td>
<td>84</td>
</tr>
<tr>
<td>d. enjoy being a member of STH</td>
<td>73</td>
<td>98</td>
</tr>
<tr>
<td><strong>2. The career/resume tips session with (Career Services) was helpful.</strong></td>
<td>77</td>
<td>66</td>
</tr>
<tr>
<td><strong>3. The readings selected were interesting.</strong></td>
<td>80</td>
<td>73</td>
</tr>
<tr>
<td><strong>4. The readings were understandable</strong></td>
<td>77</td>
<td>73</td>
</tr>
<tr>
<td><strong>5. Discussions were too brief</strong></td>
<td>37</td>
<td>38</td>
</tr>
</tbody>
</table>

- Kind of like a planning day for the week. It was a good way to prepare.
- I really enjoyed this class; it helped me zone out of immediate concerns and remember that science is awesome. Reading stuff from other scientists is empowering.
Wednesday Sessions

Goals

• Prepare students for mentored research
• Want students to be intellectual participants in research

Challenges

• Unfamiliar with the scientific literature
• Unaware of faculty expectations in the research environment
Wednesday Sessions

- Reading the Primary Scientific Literature
  - Interdisciplinary
  - Hoskin’s CREATE method

  Consider
  Read
  Elucidate hypotheses
  Analyze data
  Think of the next Experiment

- Laboratory Visits with STH Liaisons
  - Literature
  - Videos
  - Presentations

Challenges for implementing CREATE

CREATE (Hoskins et al.)
• CREATE conceived as 400 level, 3 hr, semester-long cell biology course
• “less is more” philosophy
• Examine series of 4 papers from single lab during semester
• Emphasis on students constructing their knowledge

Sci Tech application
• Freshman 1 hour honors Introductory Seminar
• Students in all science/engineering majors
• Baseline scientific knowledge variable
STH Introductory Seminar Course Plan

Visit UAB Lab with STH Liaison
- Topic
- Key terms
- 3 minute video

D2D Paper “training” paper
- Map intro
- Cartoon method
- Annotate figure

UAB Lab Research Paper
- Select key figure
- Map intro
- Cartoon method
- Annotate figure

Poster
Example Concept Maps
Pre/Post Assessments

- IRB Approved
- 27-item survey
- Ask students to rate their confidence in scientific skills including
  - Analysis
  - Experimental design
  - Communication
  - Understanding the literature
  - Career choices
Example Results – Areas with Significant Improvement

Course goals

- Understand research process
- Readiness for demanding research
- Understand how scientists think
- Discuss scientific research
- Read and interpret scientific literature within major

Graph showing improvements for different course goals.
Example Results – No Improvement

- Ability to analyze data
- Become part of learning community
- Clarification of career path
- Believe interdisciplinary approach is beneficial

Suggest honest student evaluation
Other Measures

- 95% of the F2010 cohort retained into the SO year
  - Two prior years retention rate for STH students was 81%
  - UAB rate for same cohort is 79%

- 100% of the F2010 cohort participated in mentored research in 2011-2012 academic year
  - F2010 cohort yielded 3 National Scholarship Award winners

- ~33% of the F2011 cohort participated in mentored research in Spring 2012
Conclusions
• Sessions have been popular
• Create sense of community/identity
• Increased confidence related to participating in scientific research
• Improved retention rates

Further studies
• Collect student generated questions for complexity and understanding
• Survey faculty attitudes about STH student performance in the research environment

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Applying CREATE Skills to Lab Paper

- Paper from UAB research lab (3 student teams)
  - Concept map of Introduction
  - Cartoon of Methods for key figure
  - Annotate key figure
    - Broadened impact
    - Communication challenge
  - Prepare Poster – motivation to revise

- Student groups needed individual coaching to reason through the data in the key figure and decipher the relevant methods
Suggestions for Improvement

• Readings
  • More
  • A semester-long book
• Outside speakers
  • Career development
  • Research overviews
• Study tips
Adapting CREATE for Sci Tech Freshmen

- **Introductory Seminar course goals**
  - Understand “What is research” by exploring UAB labs
  - Link lab research to overall scientific questions
  - Develop skills needed for comprehensive reading of scientific papers
- **Teamwork and presentation skills**
  - PowerPoint
  - Video
  - Poster
Engaging Students