Building Modeling Skills and Developing Science Identity in Physics Freshmen

Joel C. Corbo
What is Compass?

The Compass Project is an APS award-winning, student-founded and student-run organization in the physical sciences at UC Berkeley.

Its goal is to support and retain students (especially those traditionally underrepresented) by creating a unique, diverse environment that blends teaching, learning, mentoring, leading, and community building.

Among Compass undergrads, 45% are women, 30% are URM, and 20% are first-generation college students. 90% have graduated with or declared a STEM major.
Components of Compass

- Freshman course sequence
  - Summer Program
  - *Introduction to Modeling* (Fall)
  - Introduction to Measurement (Spring)
- Transitioning to Berkeley Physical Science (for transfer students)
- Frontiers of Physics (for upper-division students)
- Mentoring Program
- Research Lecture Series
- Office Hours
- Leadership in Compass
Introduction to Modeling

Structure:
One 2-hour class/week for 14 weeks, 16-20 freshmen, 2 instructors.
Course content includes:
- a unit on model-building via the ray model of light
- an independent research project
- weekly self-evaluations and related discussions

Goals:
Remove barriers to persisting in STEM & build research skills by developing:
- an understanding of the nature of science
- a science identity as a member of a community of practice
- a growth mindset
Nature of Science

Ray model of light:

- Through small-group discussion, experimentation, and class-wide consensus-building, students develop a model for light propagation.

- Students reformulate their ideas about the “scientific method” based on their experiences studying light.

- This process helps students understand what models, how to construct them, and how to use them to answer questions.
Independent research project (2\textsuperscript{nd} half of semester):

- Students form 2-3 person teams supported by a graduate student research advisor.

- Choose and answer a question (e.g., how does chalk skip on a blackboard) with model-building and experiments.

- Present results through a paper and a poster.
Growth Mindset

Two components:

- Readings and discussions on the nature of intelligence, failure, and success
- Weekly self-evaluations based on rubric (example below), with written instructor responses

<table>
<thead>
<tr>
<th>Skill</th>
<th>Questions to ask yourself</th>
<th>Beginning</th>
<th>Developing</th>
<th>Succeeding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Persistence</strong></td>
<td>• What do you do when you’re frustrated?</td>
<td>I tend to try one or two things. I give up more easily than I should.</td>
<td>I try to stick with things, but I sometimes feel unsuccessful. Sometimes I seek new approaches to help.</td>
<td>I look for new ways to think about the problem. I find a way to persist when appropriate.</td>
</tr>
<tr>
<td></td>
<td>• Do you independently pursue understanding?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Self-compassion</strong></td>
<td>• When you’re having difficulty with something, how do you feel about yourself?</td>
<td>I have trouble with feeling like a failure, and these feelings often make me feel like giving up. I’m my own worst critic.</td>
<td>I am sometimes overly critical of myself. I tend to ignore feelings of failure rather than using them to improve.</td>
<td>I acknowledge my difficulty, but I don’t let it define how I feel about myself. I act kindly towards myself and view failure as an opportunity for self-improvement.</td>
</tr>
<tr>
<td></td>
<td>• Do you make productive use of failure?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This rubric is adapted from work by Jon Bender and is licensed under the Creative Commons Attribution-ShareAlike 3.0 Unported License (http://creativecommons.org/licenses/by-sa/3.0/)
Thanks!

More questions? Come see me at my poster at the PERC poster session.
### Demographics & Retention

<table>
<thead>
<tr>
<th>Category</th>
<th>Compass (%)</th>
<th>Physics Dept (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>45</td>
<td>16</td>
</tr>
<tr>
<td>Chicano/Latino</td>
<td>26</td>
<td>7</td>
</tr>
<tr>
<td>African American</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Native American</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>First Generation</td>
<td>19</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Graduates (90% STEM)**
- STEM (62%)
- Non-STEM (8%)
- Undeclared (30%)

**Non-Graduates (of declared, 87% STEM)**