THE COMPASS PROJECT
www.berkeleycompassproject.org

Berkeley
UNIVERSITY OF CALIFORNIA

Building Modeling Skills and Developing Science Identity in Physics Freshmen

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Outline

- Overview of the Compass Project
- Introduction to Modeling
- Outcomes

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Overview of the Compass Project

What is Compass?

The Compass Project is an **APS award-winning**, **student-founded** and **student-run** organization in the physical sciences at UC Berkeley, in existence since 2006.

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.

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Demographics

Student involvement:

- ~**130** current undergrads (~**30** alumni)
- ~**40** current grad students (~**10** alumni)

Among Compass undergraduates:

- **45%** are women
- **30%** are underrepresented minorities
- **20%** are first-generation college students

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Why Compass?

For undergrads:

- Retention
  (for the right reasons)
- Deeper understanding
  of science
- Self-advocacy

For grad students:

- Improved pedagogy
- Professional development
- Means of giving back

For everyone:

- Community and mutual support

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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

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Introduction to Modeling

Compass Classroom Pedagogy

- Learning focuses on challenging problems:
    - Presented in context
    - No clear solution method
    - Open-ended
    - Spurs further inquiry
- Small group discussion and experimentation + large group consensus-building
- Physical “props”: group whiteboards, jargon buzzers, consensus cards

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Compass Course Structure

- 2 hours/week, for 14 weeks, for credit
- Up to 20 students, of varying backgrounds
- Concurrent with a variety of other math and science classes
- Co-taught by 2 instructors grad students and senior undergrads

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Introduction to Modeling

Content:
Focuses on answering scientific questions through building and refining models:

- 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**
- an **identity as a scientist**
- a **growth mindset**

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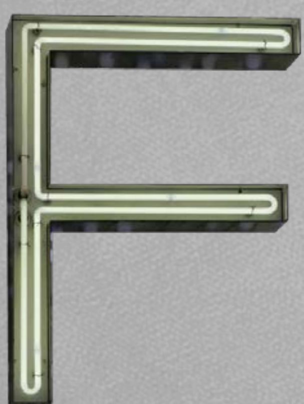
Nature of Science

Goal: Students deepen their understanding of the nature of science by engaging in the process of scientific modeling.

Ray model of light (1st half of semester):

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

 +  = ?

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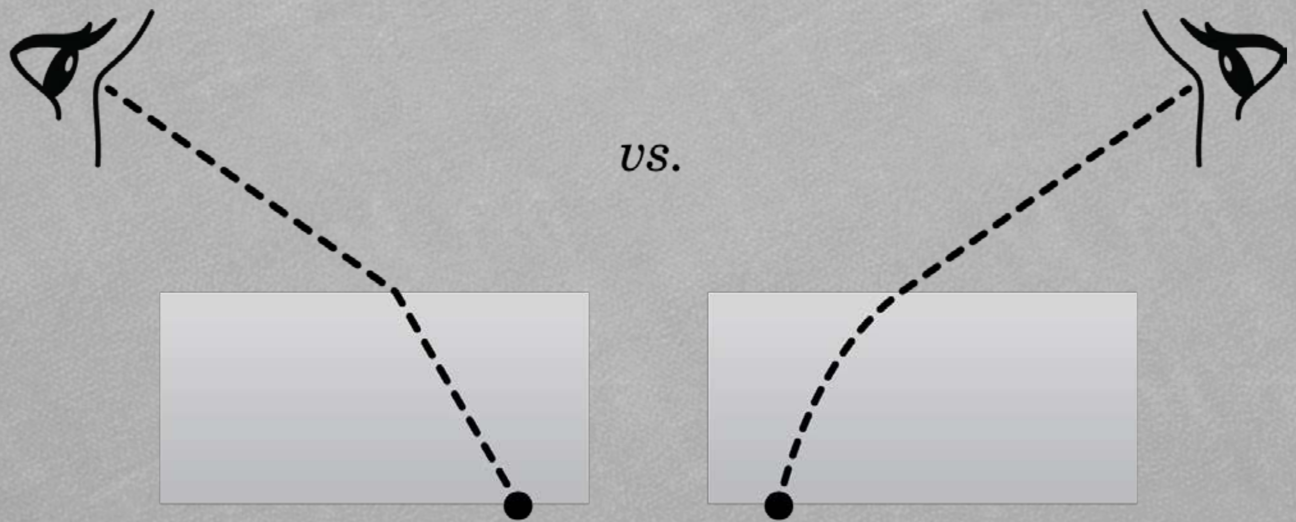
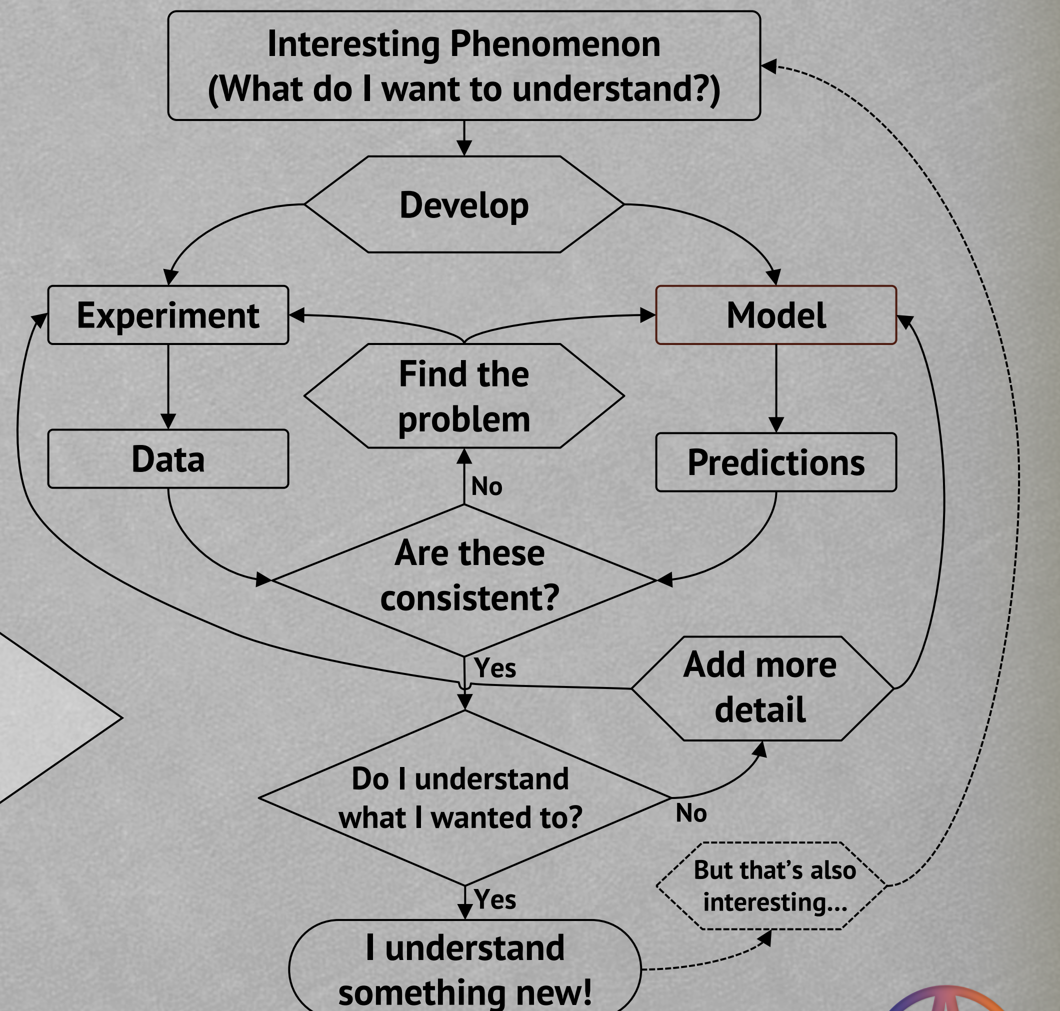
Example Activity

"Consider two different models for the interaction of light and a piece of plastic: one where the light bends all at once at the interface and one where it bends continuously in the plastic. Using plastic of different, but known, thicknesses, devise and conduct an experiment to determine which model is correct."



Representing the Scientific Process

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



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Science Identity

Goal: Students begin to self-identify as scientists through practicing the methods that professional scientists use to conduct and communicate their work.

Independent research project (2^{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?) via model-building and experiments.
- Present results through a paper and a poster session

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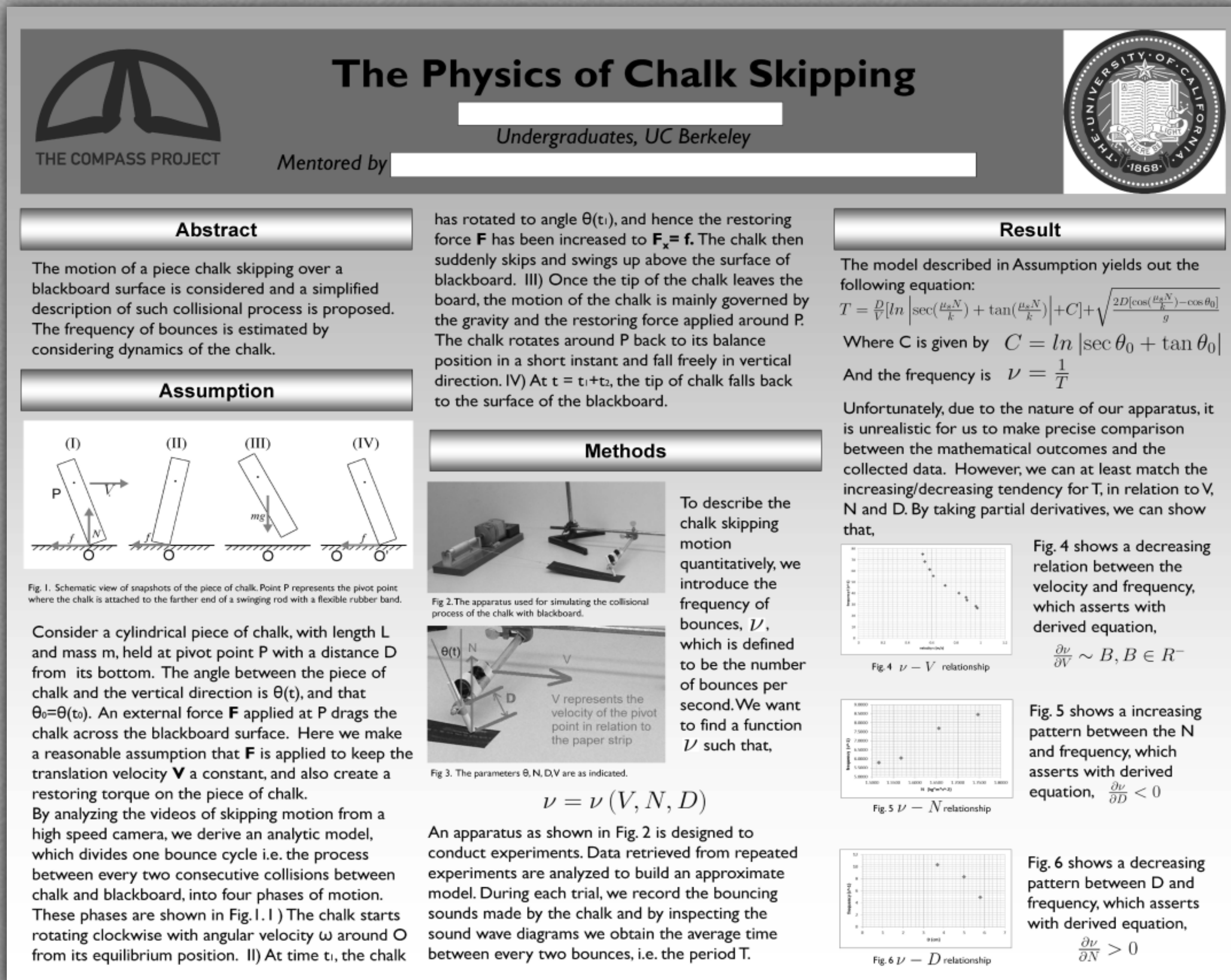
Example Poster



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Growth Mindset

Goal: Students develop a growth mindset—the belief that abilities can be developed through hard work and dedication—by charting their own growth and critically discussing growth with their peers.

Two components:

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

Sample Rubric

Skill	Questions to ask yourself	Beginning	Developing	Succeeding
Persistence	• What do you do when you're frustrated? • Do you independently pursue understanding?	I tend to try one or two things. I give up more easily than I should.	I try to stick with things, but I sometimes feel unsuccessful. Sometimes I seek new approaches to help.	I look for new ways to think about the problem. I find a way to persist when appropriate.
Organization	• Do you keep accurate, thorough, and consistent records of work? • Do you submit materials in a timely manner? • Do you refer to your records to support conclusions?	There are significant gaps in my records, and/or I consistently forget to complete assignments on time.	I don't complete all assignments on time or I have no record of some of my work/activities. When I neglect to do something, I forget about it because it's too late.	I am timely and thorough with work and record-keeping. When I've neglected something, I correct my oversight quickly. My records are a valuable resource.
Connections	• Do you try to make connections with new people who might be able to help you in the future? • Do you make use of your connections when you need help?	I tend to go it alone.	I sometimes get help from other people, but only when I really need it. My network of supporters could be better developed.	I have a strong network of people who I go to regularly for help and support.
Self-compassion	• When you're having difficulty with something, how do you feel about yourself? • Do you make productive use of failure?	I have trouble with feeling like a failure, and these feelings often make me feel like giving up. I'm my own worst critic.	I am sometimes overly critical of myself. I tend to ignore feelings of failure rather than using them to improve.	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.

Self-Evaluation Quotes

First Week

"I have decided to work on [courage] mainly because I do not respond well to uncertainty or the feeling of being overwhelmed. I have a tendency to avoid or stress about anything that I feel uncertain about. Usually this means that I won't speak up when I'm not sure that what I want to say will be well received… I think that not having the courage to engage my peers is probably the worst problem for me in physics class."

End of semester

"One positive example of growth due to the difficult coursework is that I ended up doing more homework in groups. I was really able to engage in solid collaboration with very talented students, which is something that I have avoided in the past. I really enjoyed the opportunities to discuss hard problems. In fact, I was actually more comfortable in such situations than I thought I would be."

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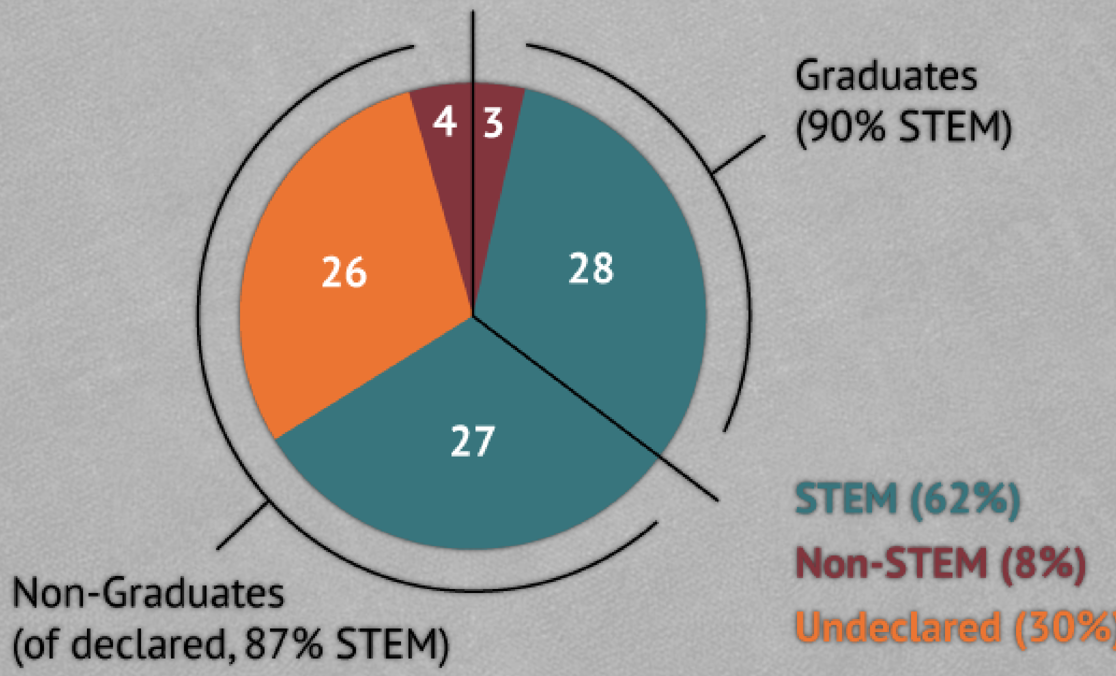
Outcomes

Retention

Among 2007-2012 summer program students



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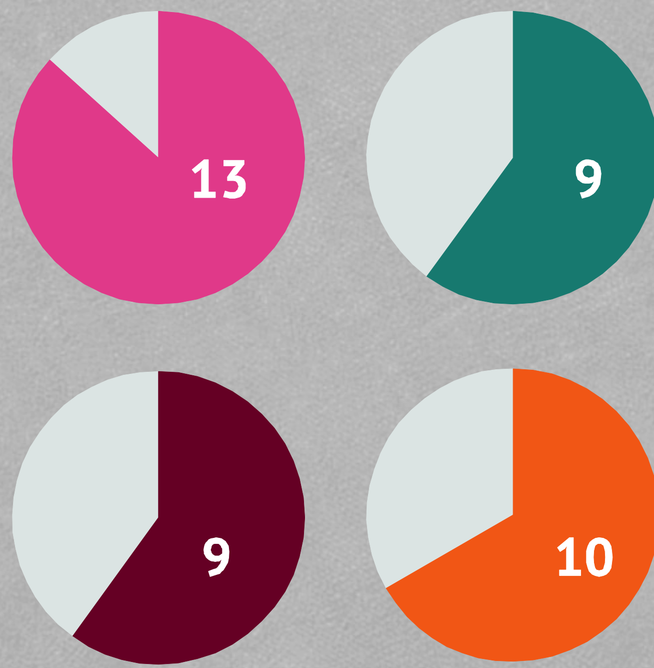
Community

From survey of 2010 summer program students after their first year of college:



See other Compass students at least once per week

Live with or plan to live with other Compass students

See other Compass students daily

Study with other Compass students

Out of **15** total respondents

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Quotes from Survey

After your first year as a Cal and Compass student, what (if anything) is important for you about Compass?

“The skills you learn . . . Compass puts you in an environment where you really have to learn how to think with a science-y brain. Also the friends you make. Almost every single one of my friends at Cal I met through Compass."

"Helps me know that I am not the only person who finds difficulties with the physics and (more generally) undergraduate education at Berkeley. It gives me confidence that I can face the challenges in a physics education."

"I love the sense of community and belonging Compass offers. I always feel included in any activity and the people are very approachable. Compass has become a family for me and a support system I can count on for guidance and help."

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Questions?

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Organizational Structure

Courses

Summer program

Semester courses

Teacher training

Programs

Mentoring

Lecture series

Office hours

Community outreach

Support

Technology & social media

Publicity & design

Social events

External

Budgeting & fundraising

Program evaluation

Alumni association

Student-run, with departmental support (administrative, financial, office space, faculty advisor)

Consensus-based decision making

Continuous influx of new leadership

Still a challenge: financial stability

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