

# Core Curriculum

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Option Discussions

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February 3 & 7, 2011

# Today's Lunch

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- Update everyone on the progress in revising the core curriculum.
- Talk about process for feedback.
- Data on differences between options, student satisfaction with the core, overloading, pass/fail grading, and preparation/background of incoming students.

# Council on Undergraduate Education

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## **CUE website**

<http://www.cue.caltech.edu/core>

- Section on core curriculum
  - This presentation
  - Feedback form as an excel file
  - Documents from Core Curriculum Task Force
  - Minutes from Faculty Board and Faculty discussions on core
  - Syllabi of courses within core
- Main CUE page contains a feedback section

# Process for Core Review

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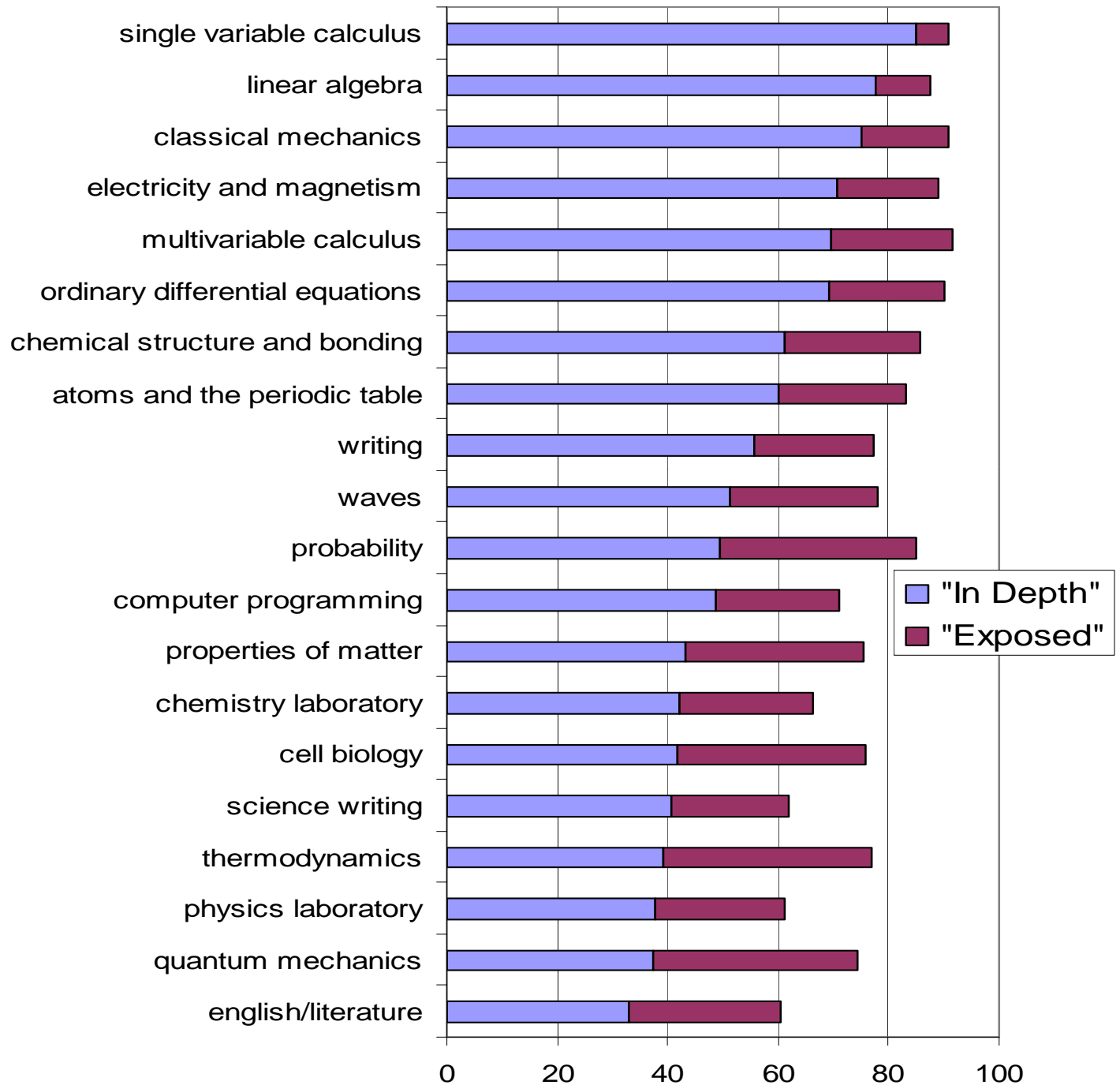
- Last major changes were in 1996
  - Reduced math and physics from 6 quarters to 5
  - Introduced biology and menu courses
  - Established Core Curriculum Steering Committee
- Review of Core was suggested in 2007 by Ad Hoc Committee on Student Experience
- Current Core Curriculum Task Force (CCTF) established in 2008; part of accreditation review
- Final recommendations of CCTF available on faculty board website

# Caltech top 20 subjects

Survey of Caltech faculty  
May, 2009

Approximately 80 topics –

- In depth
- Exposed
- Menu
- Not in core
- Not sure



# Proposed philosophical changes to core

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1. Renormalization of requirements across the key sciences
2. Choices throughout the core
3. An intensive emphasis on critical writing skills
4. Early exposure to more faculty in non-lecture settings.
5. A commitment to improved labs involving data collection & analysis and design & build
6. Exposure to new intellectual frontiers
7. A commitment to innovative courses and excellent teaching.

*From Scott Fraser's presentation to the Faculty Board (12/5/10)*

# A Suggested Reformed Caltech Core

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- Freshman seminar (1 term) **NEW**
- Physics (4 terms) **REDUCED**
- Math (4 terms) **REDUCED**
- Chemistry (2 terms) **UNCHANGED**
- Chemistry Laboratory (1 term) **MORE CHOICES**
- Biology (1 term) **UNCHANGED**
- Breadth menu (1 term) **UNCHANGED**
- Programming (1 term) **NEW**
- Algorithms (1 term) **NEW**
- Design & Build Laboratory (1 term) **NEW; REPLACE FROSH LAB**
- Writing-intensive freshman humanities (2 terms; **GRADED**)
- Writing-intensive advanced HSS classes (4 terms; **GRADED**)
- HSS electives (combined with the writing intensive classes to a total of 11 terms) **REDUCED**

Current Core	
Freshman Math (Ma 1abc)	27
Sophomore Math (Ma 2ab)	18
Freshman Physics (Ph 1 abc)	27
Sophomore Physics (Ph 2 ab)	18
Freshman Chemistry (Ch 1 ab)	15
Freshman Biology (Bi 1, 1x, 8, 9)	9
Menu Course	9
Chemistry Lab (Ch 3a, 3x)	6
Additional Introductory Lab	6
Science writing	3
Humanities (2 intro & 2 adv)	36
Social Science (2 intro & 2 adv)	36
Additional HSS	36
Physical Education	9
Total	255

Oral communication  
(not officially part of the core;  
part of option units)

3 units

New Core	
Freshman Math (Ma 1abc)	27
Math menu	9
Freshman Physics (Ph 1 abc)	27
Phys menu	9
Freshman Chemistry (Ch 1 ab)	15
Freshman Bio (Bi 1, 1x, 8, 9)	9
Menu Course	9
Chemistry Lab (Ch 3a, 3x)	6
Computer Science	9
Algorithms	9
Freshman seminar	6
Design and build	9
Science communication	9
Humanities (2 intro)	18
Social Science (2 intro)	18
Additional HSS	63
Physical Education	9
Total	261



# A Minimal Caltech Core

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## Permit Options-rights

Freshman seminar (1 term) **NEW**

Physics (3 terms) **REDUCED**

Math (3 terms) **REDUCED**

Chemistry (2 terms) **SAME**

Chemistry Laboratory (1 term) **SAME**

Biology (1 term) **SAME**

Breadth menu (1 term) **SAME**

Writing-intensive freshman humanities (2 terms; **graded**)

Writing-intensive advanced HSS classes (4 terms; **graded**)

HSS electives (combined with the writing intensive classes to a total of 11 terms) **REDUCED**

# What now?

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- Council on Undergraduate (CUE) is helping to manage process.
- The Core Curriculum Steering Committee, the Curriculum Committee and the Faculty Board vote on curriculum changes (not CUE).
- Lunches for representatives of the options
- Feedback on proposed changes by end of March
- Early April, lunch with representatives of options
- Student-Faculty Conference on April 6
- Possible vote by all faculty
- Target changes for fall 2012

# Some recent progress

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- At a humanities faculty meeting on 2/1/11, the humanities faculty unanimously voted to:
  - Student cannot get advanced humanities credit for the 5<sup>th</sup> and 6<sup>th</sup> term of a foreign language;
  - Students satisfying their advanced humanities must take both courses on grades.
  - These changes will have to be approved through the Core Curriculum Steering Committee, Curriculum Committee, and Faculty Board.
- Curriculum Committee has been working on plan for freshman seminars in fall.

# Feedback forms

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## Questions for the options:

- How important are the following courses to your undergraduate program?
- Should this course be part of the core curriculum required of all students?
- Would your option require this course if it was not part of the core?

CUE would like to have feedback by the end of winter term. Second lunch at the beginning of spring term to discuss feedback. Student Faculty Conference on April 6.

# Issues Related to the Core

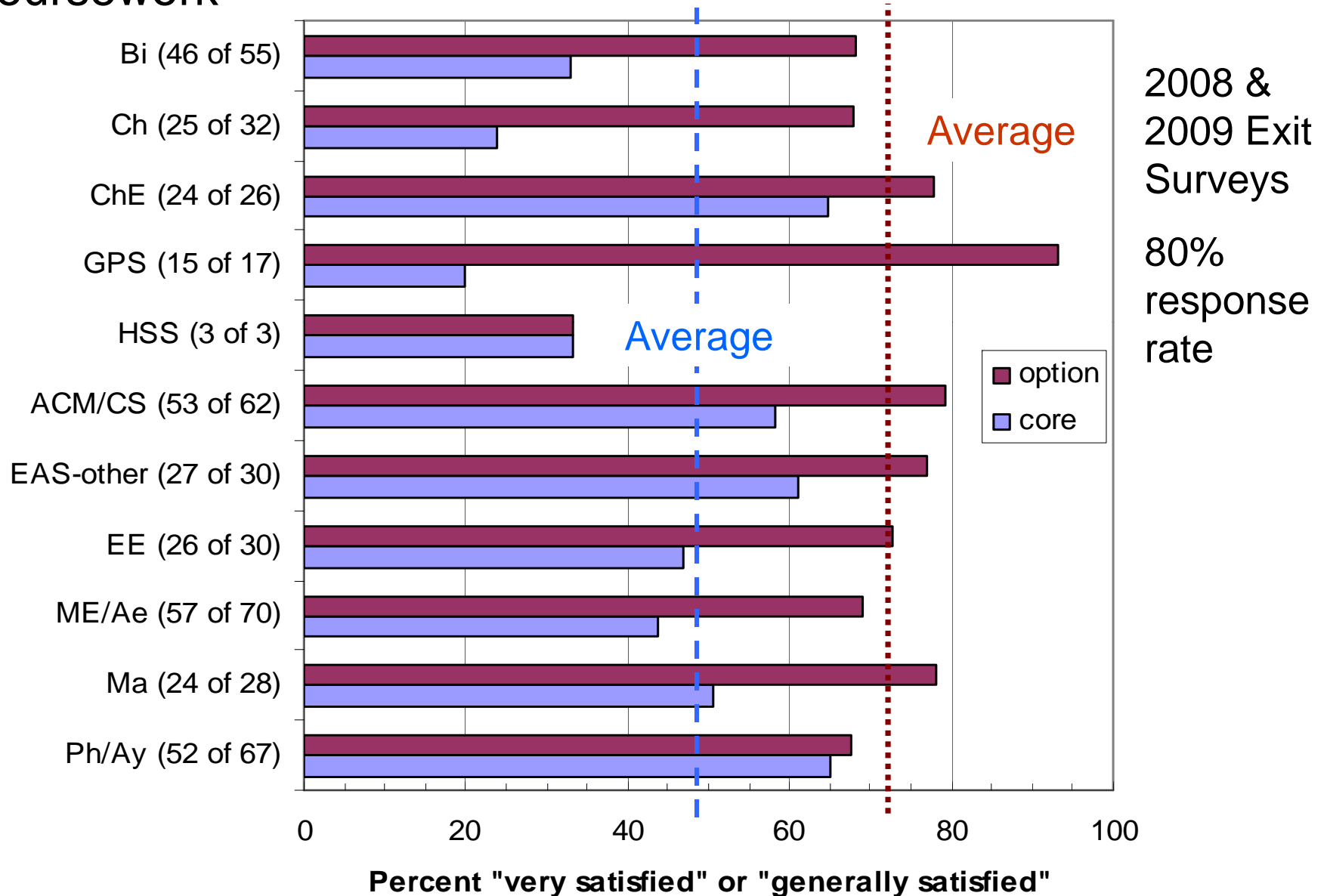
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- The effect of proposed changes will vary by option.
- Student satisfaction with core
- Overloading and option creep in freshman year
- Pass/fail grading
- Variation in preparation of incoming students
- Quality of teaching – biggest issue for students

	Students/ year <sup>1</sup>	Option Units <sup>2</sup>	2 <sup>nd</sup> Frosh Lab	Require CS 1	Require D & B
<b>Applied Comp Math</b>	11	174	N	N	N
<b>Applied Physics</b>	9	174-192	N	N	N
<b>Astrophysics</b>	4	203	Y	N	N
<b>Bioengineering</b>	15	217-220	Y	Y	Y
<b>Biology</b>	19	151-166	N	N	N
<b>Chemical Engng</b>	26	272-302	Y	N	Y
<b>Chemistry</b>	18	151-171	Y	N	N
<b>Computer Science</b>	26	195	N	Y	N
<b>Electrical Engng</b>	27	193-202	Y	N	Y
<b>EAS</b>	6	177-186	N	Y	Y/N
<b>GPS majors</b>	6	156-189	Y	N	N
<b>Mathematics</b>	15	147	N	N	N
<b>Mechanical Engng</b>	32	177-195	N	Y	Y
<b>Physics</b>	29	198-201	Y	N	N
<b>HSS first majors</b>	3	150-168	N	N	N
<b>second majors</b>	24				

<sup>1</sup>Based on current sophomores, juniors, seniors; <sup>2</sup>From registrar's website

# Satisfaction with core math and science and with option coursework



# Overloads

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- Approximately 20% of freshman overload in winter term (most popular quarter to overload; all courses on pass/fail). The most popular non-core winter courses are Bi 8 (75 frosh), CS 2 (54), CS 21 (26), APh 9b (19), CS 11 (16), and Ma 5b (12).
- Options often encourage freshman to take these courses in addition to core courses.
- For freshman an overload is more than 51 units, typically consisting of five 9-unit classes, one 6-unit lab, plus ...
- In 2010-11 catalog, “Course requirements for biology are designed to be met by students taking Bi 8 and Bi 9 starting in their second year. However, many students interested in biology elect to take these courses in their first year. Those passing Bi 8 and Bi 9 in their first year may be excused from the Institute requirement to take Bi 1.”



# Examples of freshman schedules in winter term

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## Student 1

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Ch 1b  
Ma 1b  
Ph 1b  
Hum/En 5  
Bi 8 Molecular bio  
Ph 3 Physics lab  
BE 1 Intro BioEng  
PE 87 Swim team

Total units: 55  
6 academic  
classes

## Student 2

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Ch 1b  
Ma 1b  
Ph 1b  
CS 2 Programming  
CS 21 Decidability  
& Tractability  
Ph 8 Physics lab  
APh 9b Lab

Total units: 54  
7 academic  
classes

## Student 3

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Ch 1b  
Ma 2b  
Ph 1b  
Hum/En 7  
Ch 3a  
Ma 5b Abstract  
Algebra

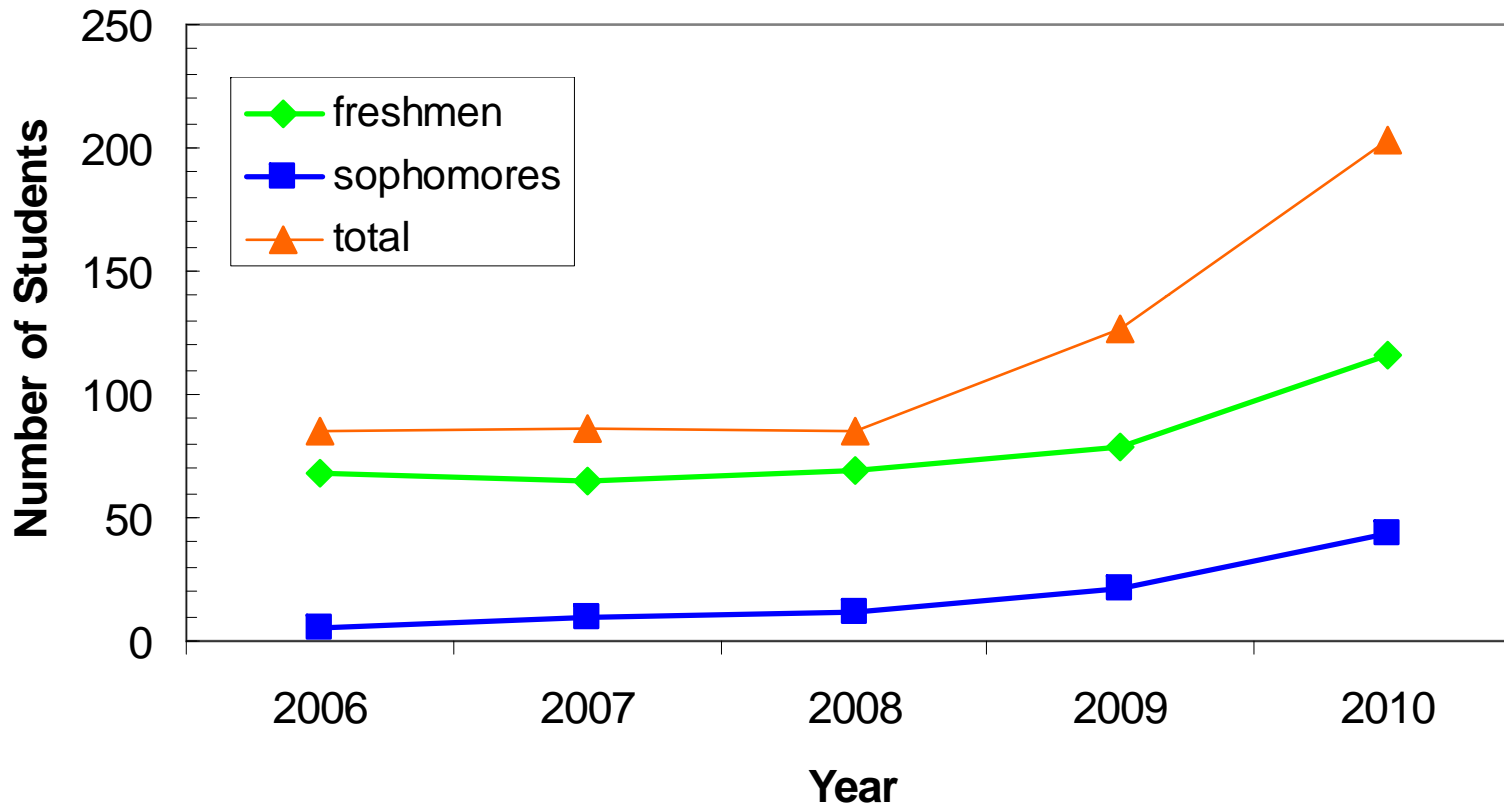
Total units: 51  
6 academic  
classes

# More on overloading

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- In general, students who overload tend to have higher GPAs in third term. But does overloading lead to burn-out?
- Do these options want students to take these courses as freshman on pass-fail?
- EE used to encourage students to take EE 51 and 52 in freshman year, but they have changed their policy.

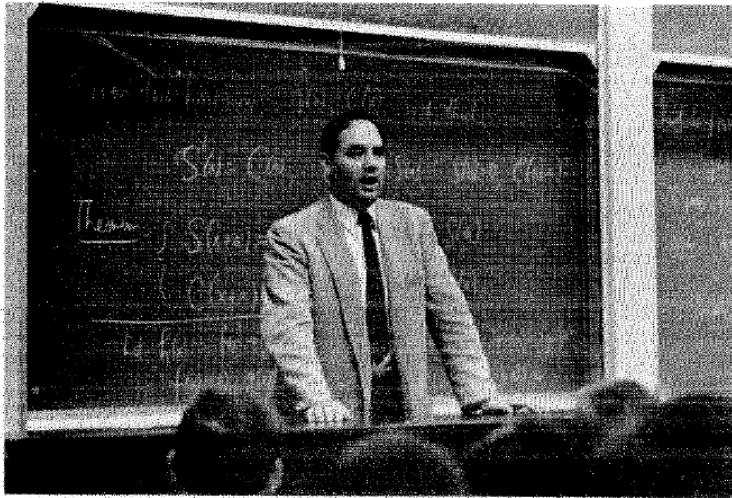
# Enrollment in CS 1



About half of the freshman class was enrolled in Introduction to Computer Programming, CS 1, in fall 2010.

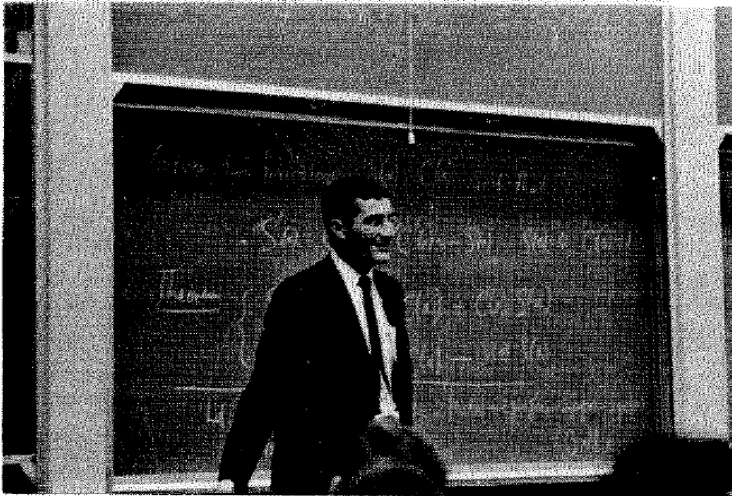
# Pass/Fail *Engineering & Science (1964)*

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*Robert Huttenback, Master of Student Houses*

It's  
Official —

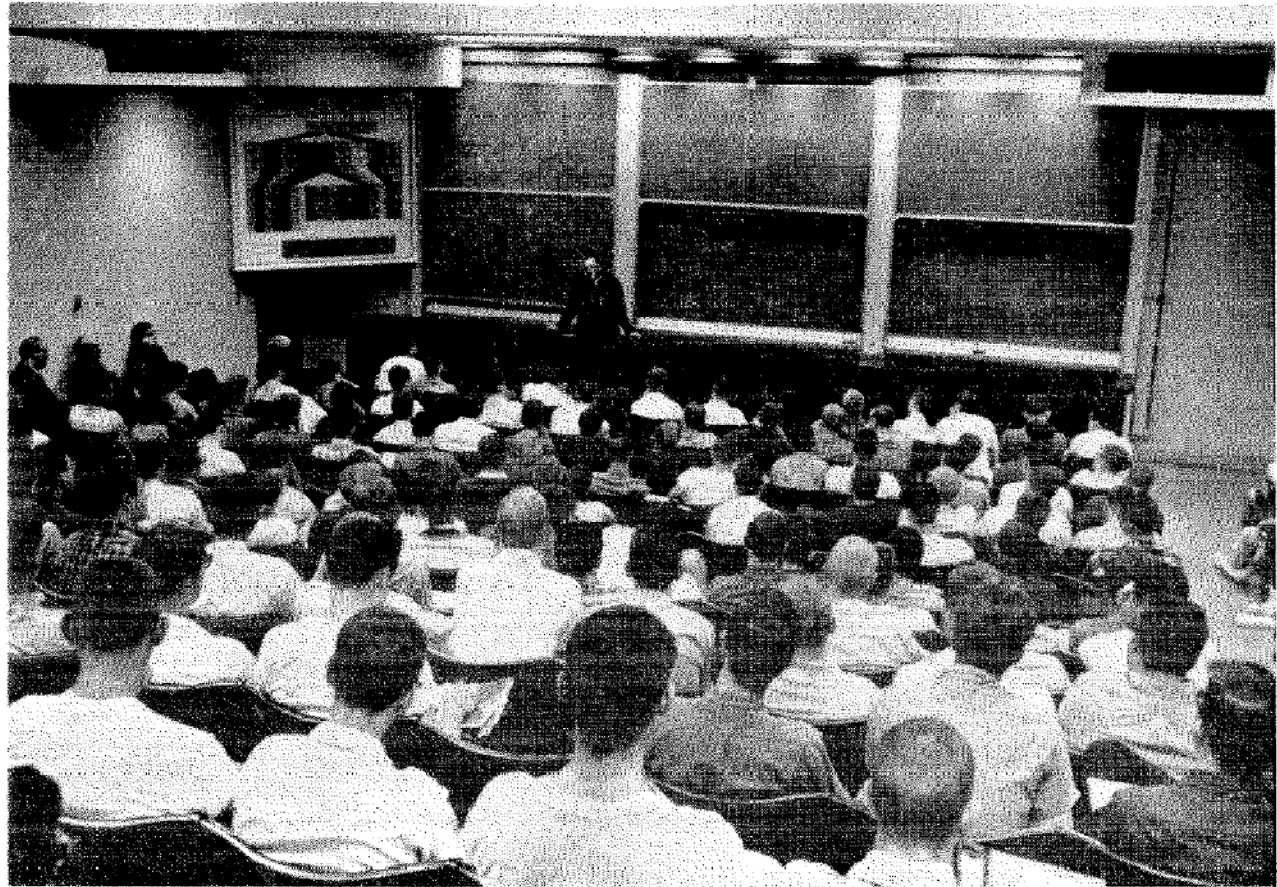


*Tom Apostol, professor of mathematics*



*Rochus Vogt, assistant professor of physics*

— No  
More  
Freshman  
Grades



# Rationale for P/F

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At a special meeting of the freshman class on November 5, faculty representatives officially announced the decision to eliminate all freshman grades at Caltech for a period of two years. The move, which has been under consideration for some time, substitutes a pass-or-fail system for the usual letter grades. The faculty hopes that, under the new system, **students will learn earlier to substitute more mature and substantial motives for work than the threat of low GPA or the status of a high one.**

*Engineering & Science (1964)*

# Other reasons given for P/F

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- Reduce stress on students entering college
- Allow students with weaker backgrounds to come up to speed
- Allow students to “experiment” as they think about possible majors

# Shadow Grades: Cumulative Percentages

Shadow (S) and Letter (L) for Fall 2007-Spring 2010

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Grades	All courses with shadow and grades		All Ma (except Ma 2b)		Ma 2b		Ma 5b	
	S	L	S	L	S	L	S	L
A	40	53	45	67	49	39	53	56
B	81	87	81	91	80	82	92	89
C	96	98	94	97	98	97	100	96
D, E, I, F	100	100	100	100	100	100	100	100
N	4000	4684	1001	147	55	823	53	73



# Shadow Grades: Cumulative Percentages

Shadow (S) and Letter (L) for Fall 2007-Spring 2010

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	All courses with shadow and grades		Hum/English 5, 6, 7		Hum/History 2, 3, 4		Hum/Philos 8, 9	
Grades	S	L	S	L	S	L	S	L
A	40	53	48	71	44	50	51	63
B	81	87	95	97	95	91	93	97
C	96	98	99	100	98	92	97	100
D, E, I, F	100	100	100	100	100	100	100	100
N	4000	4684	168	58	158	66	103	32

# Recommendation of the CCTF

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- All classes in fall term will be P/F
- All core courses in winter term will be P/F
- Courses substitute for core requirements will not be P/F automatically
- Any writing-intensive class taken in any term will be taken on letter grades

# Ph and Ma Diagnostic Exams

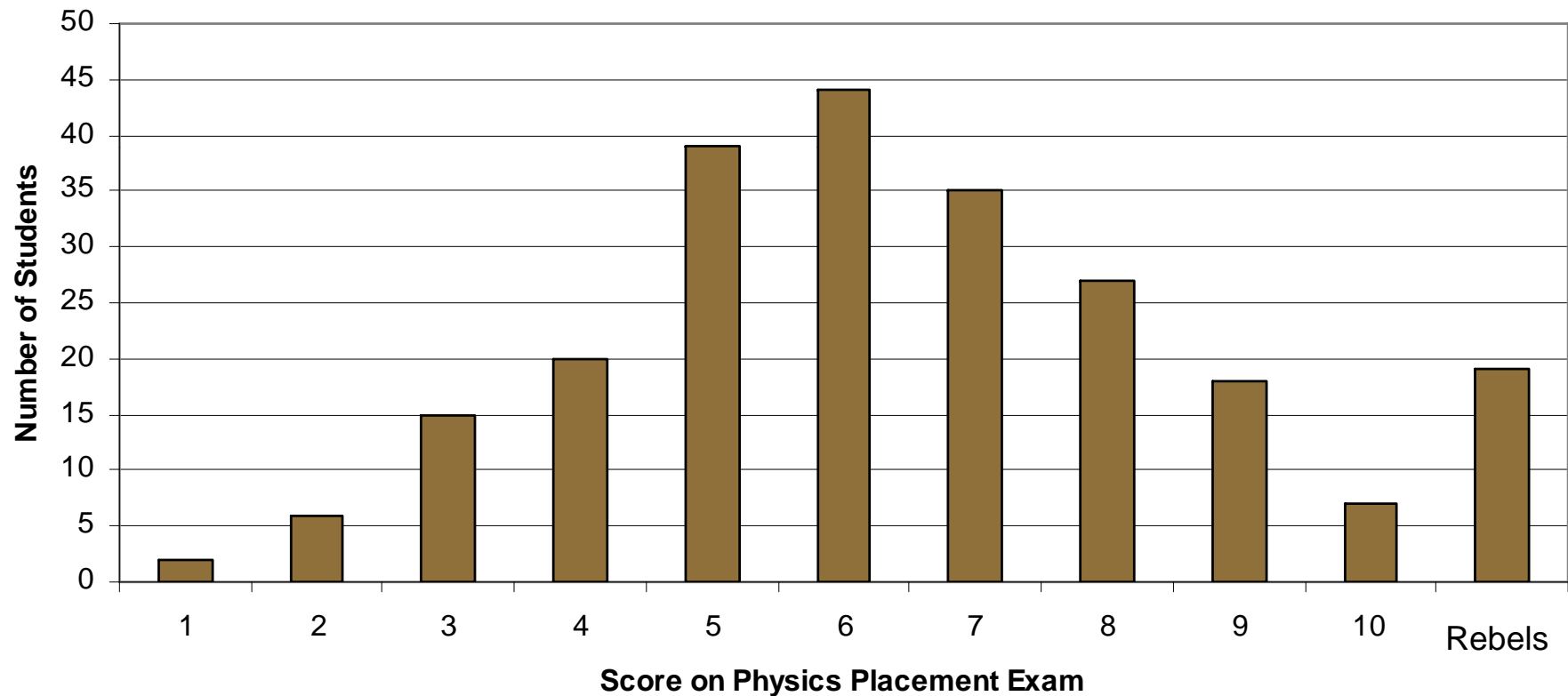
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- Tests are taken in the summer prior to arrival on campus.
- Physics – weakest students placed in lowest sections of Ph 1.
- Math – lowest scorers are placed in Ma 1 section 1 for 12 units and take Ma 1d for 5 units in winter; the next lowest group of students are recommended (but not required) to take Problem Solving in Calculus (Ma 8) for 3 units in fall term.

# Physics Placement Scores

Typical Distribution

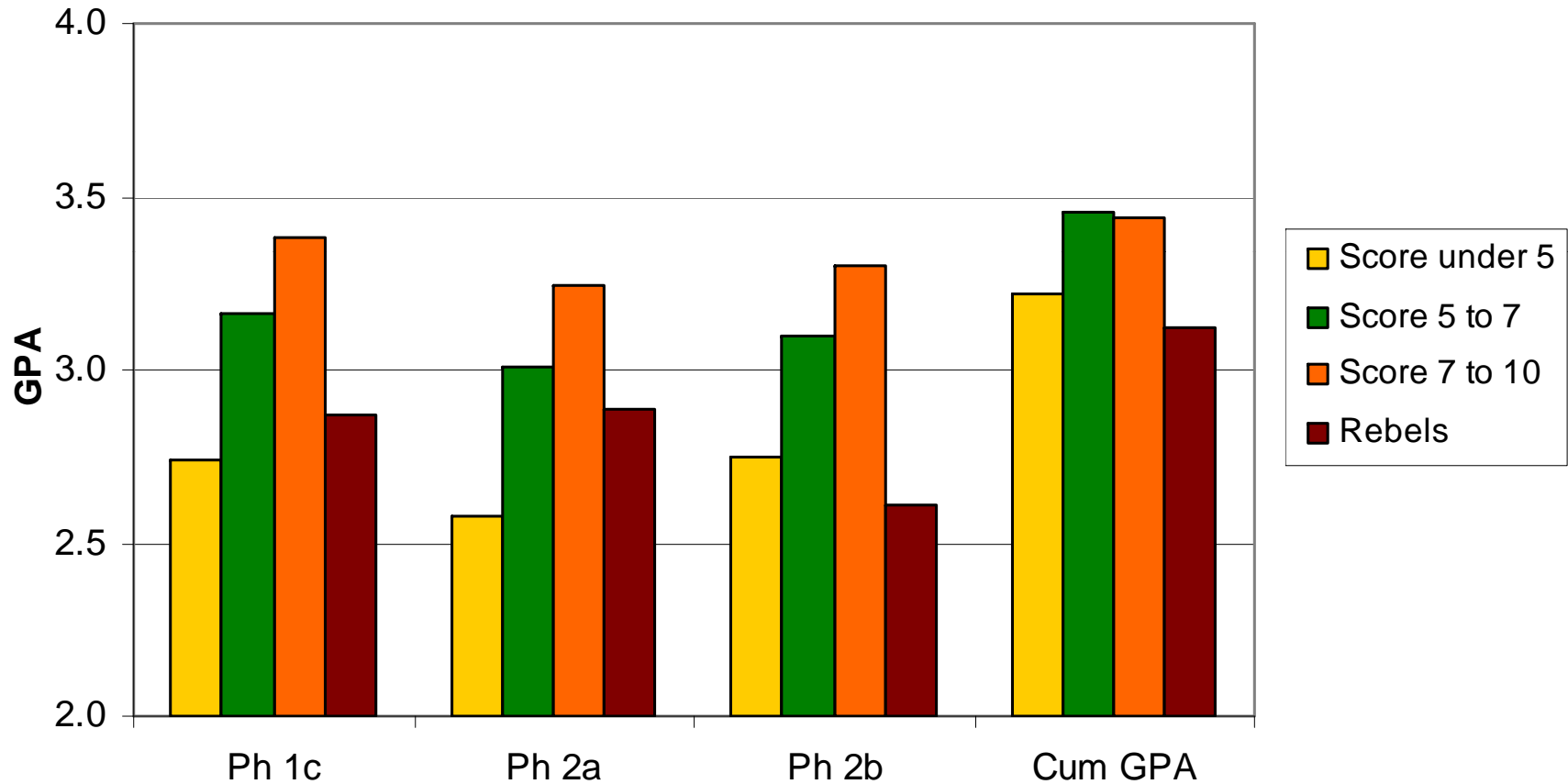
Students Entering in 2005



213 student took test; 19 students (the “rebels”) did not. Average score 6.4

# How do they do in later courses?

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Data from students entering in 2004-06; 147 students with scores less than 5; 226 students with scores between 5 and 7; 232 students from 7 to 10; and 44 rebels.

# Did they graduate?

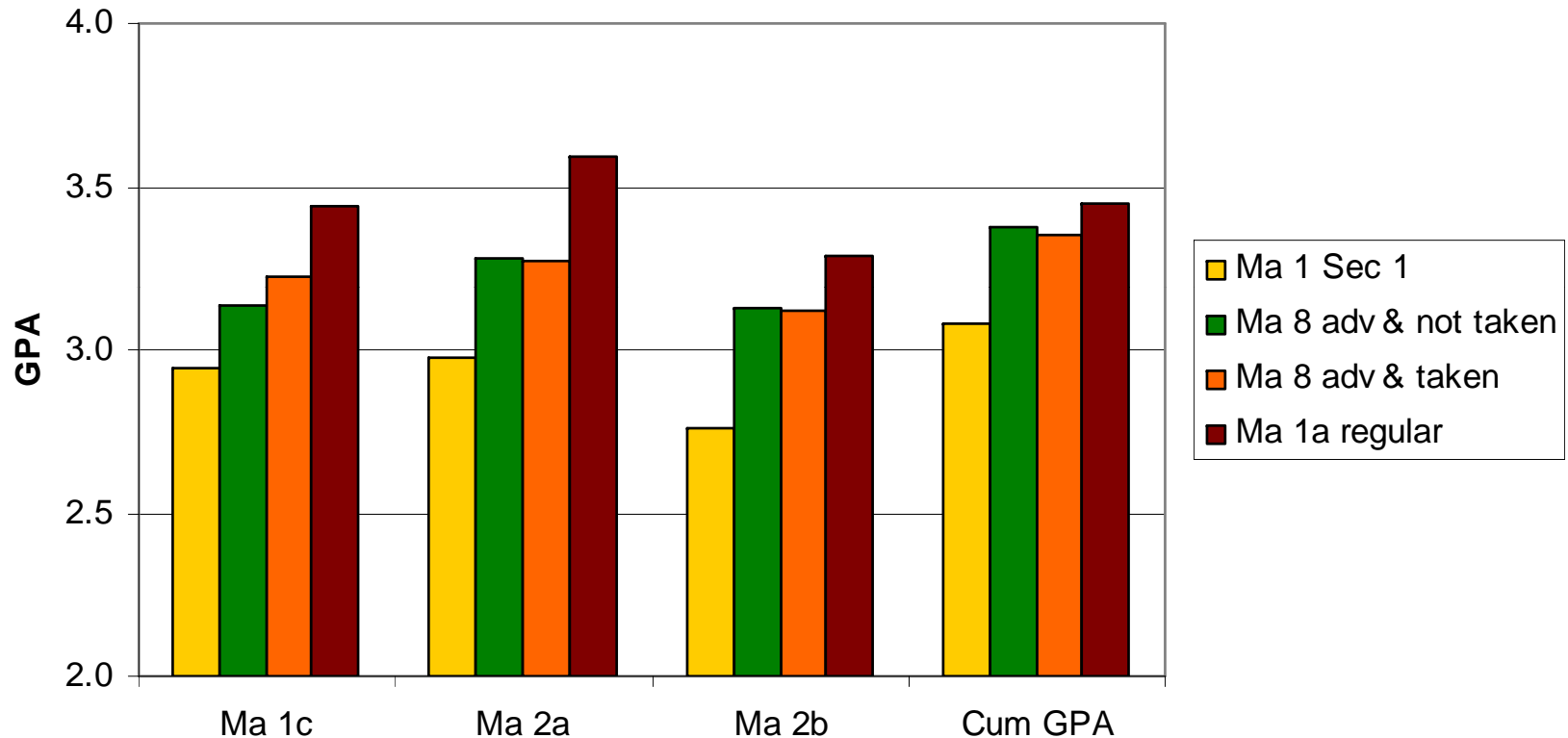
2004-06 entering cohorts

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Physics scores	Students 2004-06	First year retention	4-year grad rate	5-year grad rate and N (2004-05)		6-year grad rate and N (2004)	
Under 5	147	97.3%	75.5%	87.5%	104	93.1%	58
From 5 to 7	226	98.2%	85.4%	89.7%	156	90.5%	74
Greater than 7	232	96.1%	77.2%	85.6%	153	88.1%	67
Rebels	44	100%	61.4%	69.2%	26	87.5%	8

For Caltech, four year graduation rates are typically from 75-80%; 5-year are 86-88%; 6-year are 88-90%.

# How do they do in math?



Data from students entering in 2004-06; 92 students in Ma 1a sec 1; 68 students were advised to take Ma 8 but chose not to take it; 123 students advised to take Ma 8 and took it; 366 students took Ma 1a; students who received advanced placement in math are not included in the data above.

# Did they graduate?

2005 and 2006 entering cohorts

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Math levels	N	First year retention	4-year grad rate	5-year grad rate and N (2005)	
Ma 1a sec 1	38	100%	63%	76.5%	17
Advised Ma 8; not taken	33	91%	75.8%	70.6%	17
Advised Ma 8; taken	73	97.2%	82.2%	85.7%	42
Ma 1a regular	298	97.3%	78.5%	84.6%	156



# Did they graduate?

2004 entering cohort

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Math levels	Students	First year retention	4-year grad rate	5-year grad rate	6-year grad rate
Ma 1a sec 1	54	100%	75.9	88.9%	88.9%
Advised Ma 8; not taken	35	97.1%	80.0%	91.4%	91.4%
Advised Ma 8; taken	50	100%	84.0%	94.0%	94.0%
Ma 1a regular	68	95.6%	82.4%	88.2%	88.2%

The 2004-05 cohort was usual because of the large number of students placed in Ma 1a sec 1 (more than twice the typical number); overall 6-year graduation rate is 90.3% -- highest ever.

# Summary on Ma & Ph Placement Tests

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- All students enter Caltech top grades and top test scores; however, there is a wide distribution of scores on Ma & Ph placement tests.
- Students with lower scores in the placement tests will probably have lower grades in subsequent Ma & Ph classes as compared with students with higher scores.
- Students who avoid the physics placement test graduate at a lower rate; students with the lowest math scores also appear to graduate at a lower rate (with the exception of the unusual class in 2004).
- Ma 8 appears to help students in Ma 1c.
- Students with low Ma and Ph scores do not major in Ma and Ph, but major in Ch, Bi, CS, ME, Geo, ChE ....
- Caltech could develop better support for students with lower Ma & Ph scores, such as tutoring through the Dean's office, ...

# Thanks

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- Core Curriculum Task Force for all of their hard work;
- Mary Morley and Debi Tuttle in Registrar's Office;
- Steve Frautschi for the physics placement scores and Barry Simon for math scores;
- Ray Gonzales and Tina Zelaya in Provost's Office.