Teaching Physics in Alabama

Alliance for Physics Excellence (APEX)

Physics Teaching Research Program (PTR)

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University of Alabama

Alliance for Physics Excellence

The goal of the *Alliance for Physics Excellence* (APEX) program is to integrate research-based teaching practices into Alabama physics classrooms via in-service teacher education, and evaluate the impact on physics teachers and their students in the state's school systems.

APEX
Physics Teacher Research (PTR)

APEX PTR 2013-2014
Cohorts 1 & 2 Data Collection & Analysis Team

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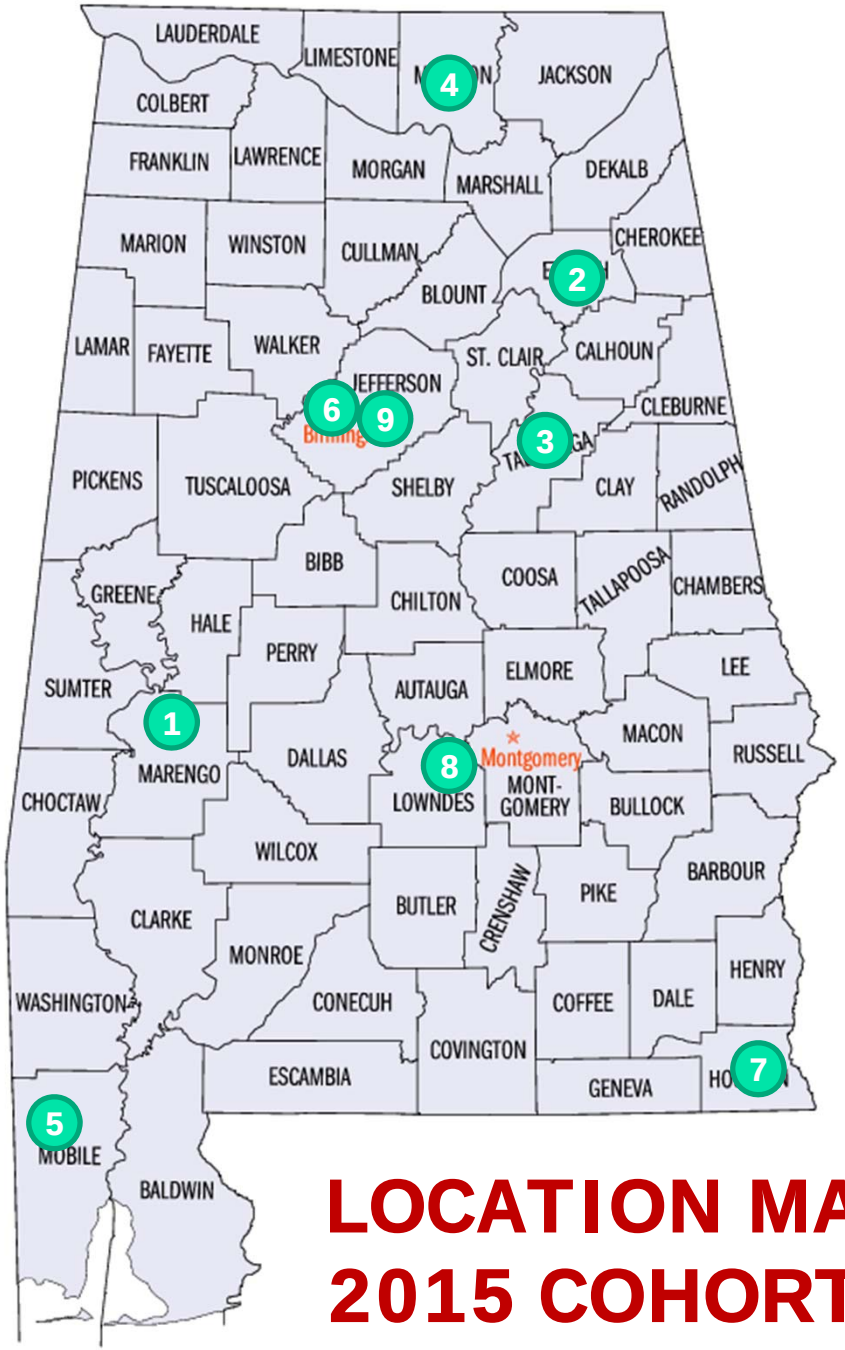
Who are Alabama Teachers of Physics?

Selected Samples

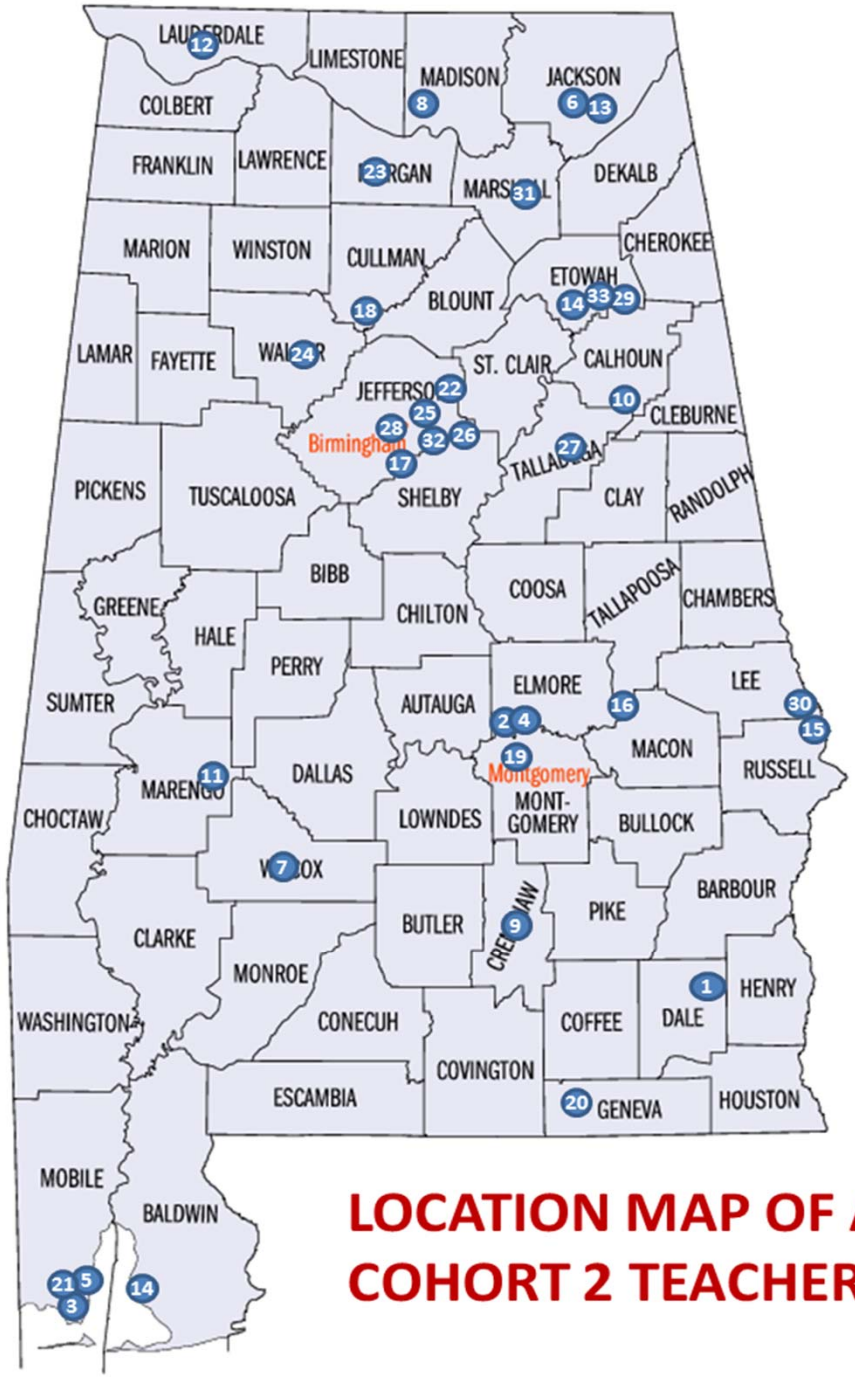
APEX Cohort 1 Yr2

Plus Cohorts *1 Yr0* and (2)



Teacher
1 C. Phillips
2 C. Caldwell
3 D. Hall
4 M. Maddox
6 A. McLeod
7 A. Olguin
8 R. Williams
9 M. Johnson

LOCATION MAP OF APEX
2015 COHORT 1 TEACHERS



LOCATION MAP OF APEX COHORT 2 TEACHERS

Background

APEX Cohorts 1 (2) School Characteristics

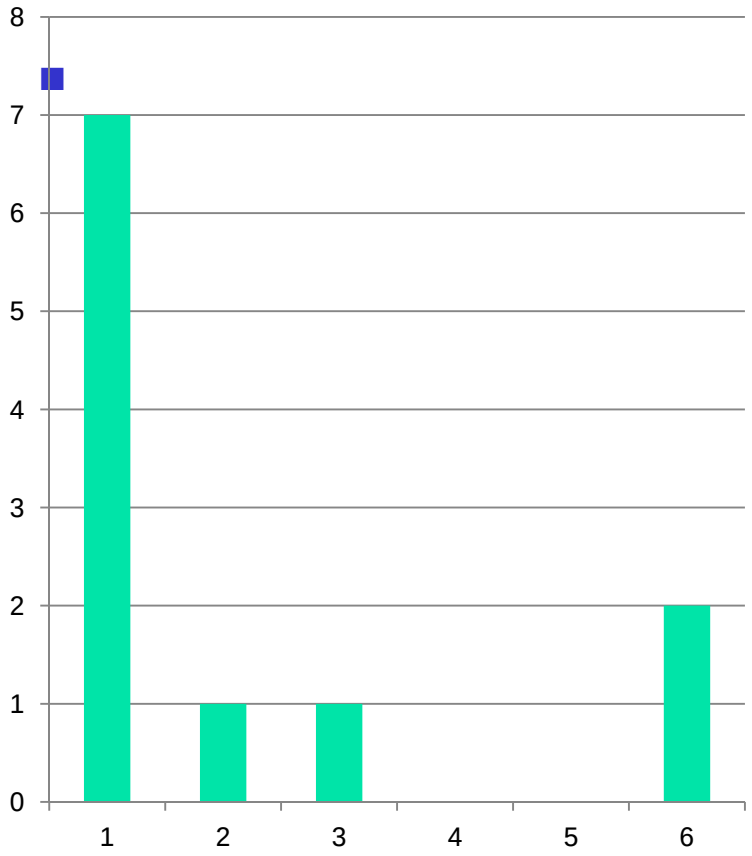
- 45% (38%) under-represented minorities (AL=42%)
- 56% (52%) free lunch (SES) (AL=47%, US=39%)
- 70% (83%) graduation rate (AL=72%)
- 17.6% (17) Student/Teacher ratio (AL=14.3, US =14.2)
- Average school size = 1010 (1058) students
- Average school type = grades 9-12, most common

Background

APEX Cohorts 1yr2, *1yr0* (2) Physics Teachers

- Years teaching science
  - Sample total = 115, *106*(332) years
  - Average = 12.8, *11.8* (11.5) years
  - Range = 8-18, *7-17* (2-34) years
- Years teaching physics of total
  - Sample total = 77, *68* (182) years
  - Average 8.6, *7.6* (6.5) years
  - Range = 4-16, *3-15* (1-28) years
- Physics teachers %
  - 67, *67* (68) Female
  - 33, *33* (32)% Male

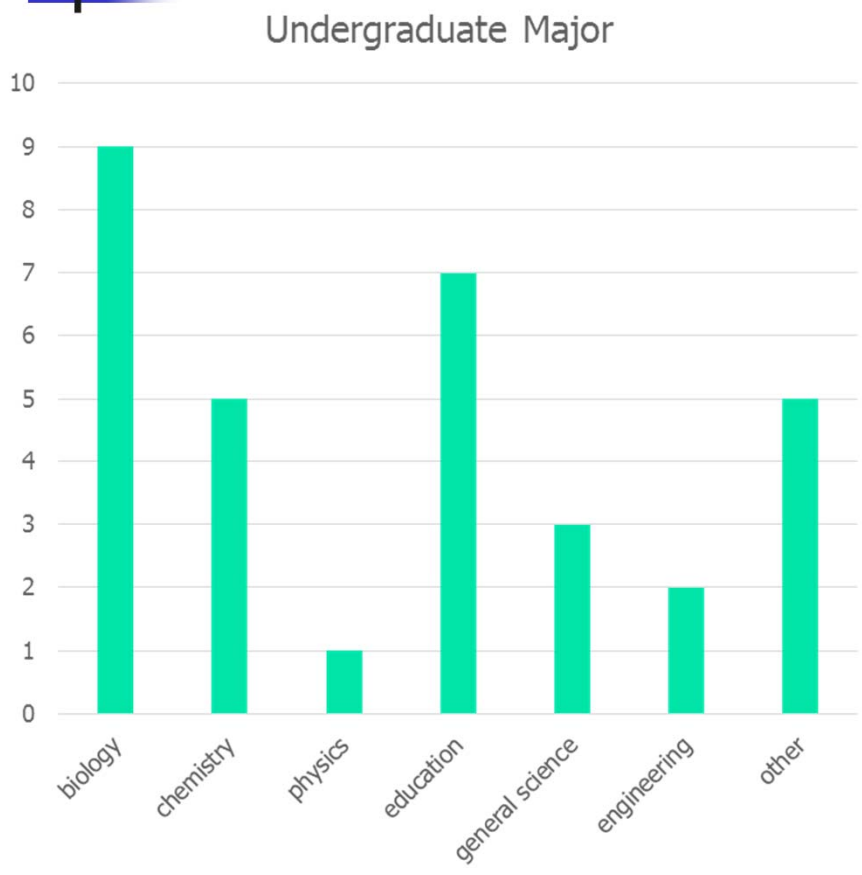
APEX Cohort 1 Physics Teachers



Undergraduate College Major

1. Biology = 64%
2. Chemistry = 9%
3. Physics = 9%
4. General Science = 0%
5. Engineering = 0%
6. Other = 18%

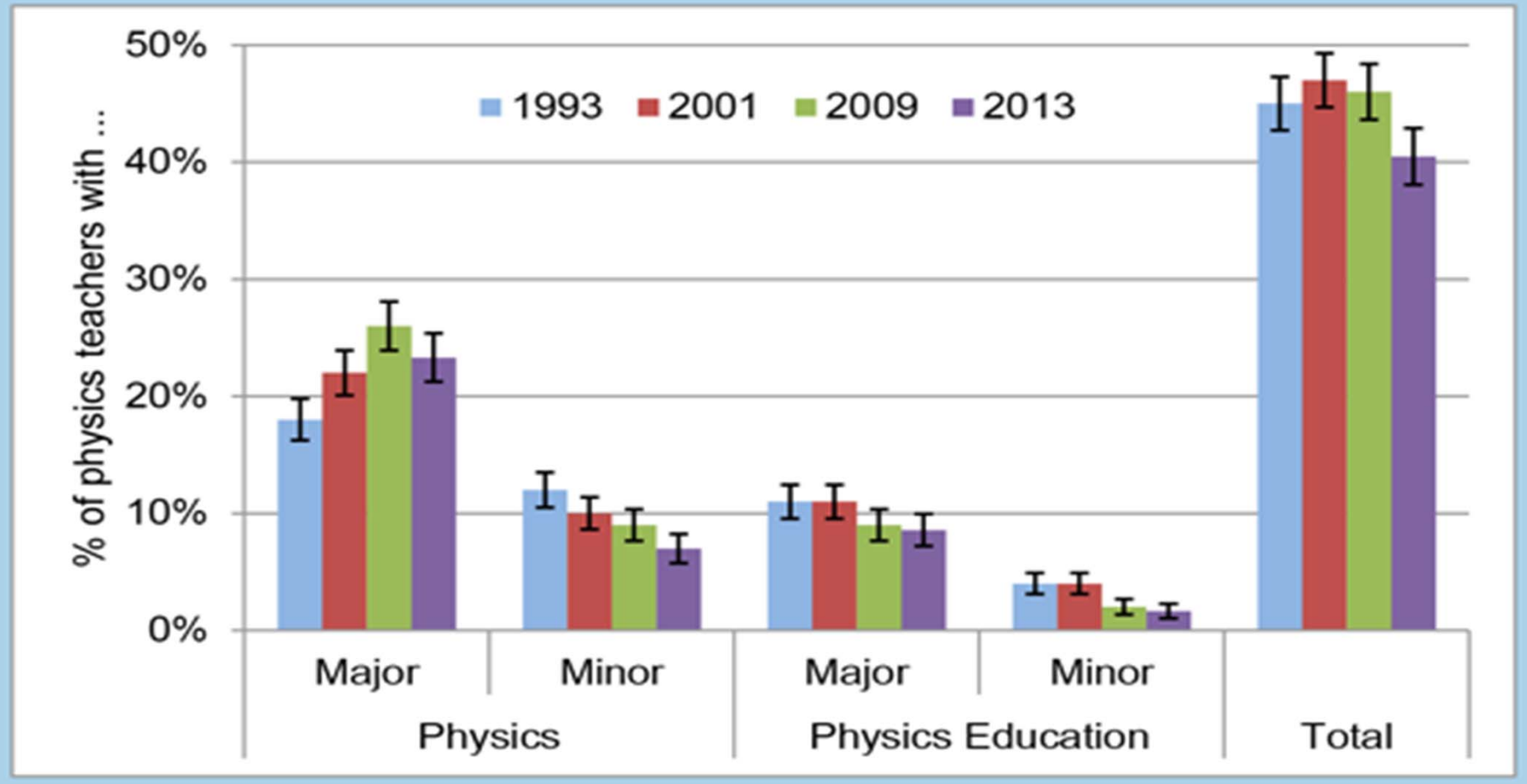
APEX Cohort 2 Physics Teachers



Undergraduate College Major

- Biology = 28%
- Chemistry = 16%
- Physics = 3%
- Education (Biology with general science)= 22%
- General Science = 9%
- Engineering = 6%
- Other = 16%

Percent of Physics Teachers with a Physics Degree*



* Teachers are counted only once, so a teacher with both a physics major and a physics education minor counts here only as a physics major. The hierarchy for counting is physics major, physics education major, physics minor, and physics education minor.

The error bars represent a 95% confidence interval for the proportion.

www.aip.org/statistics

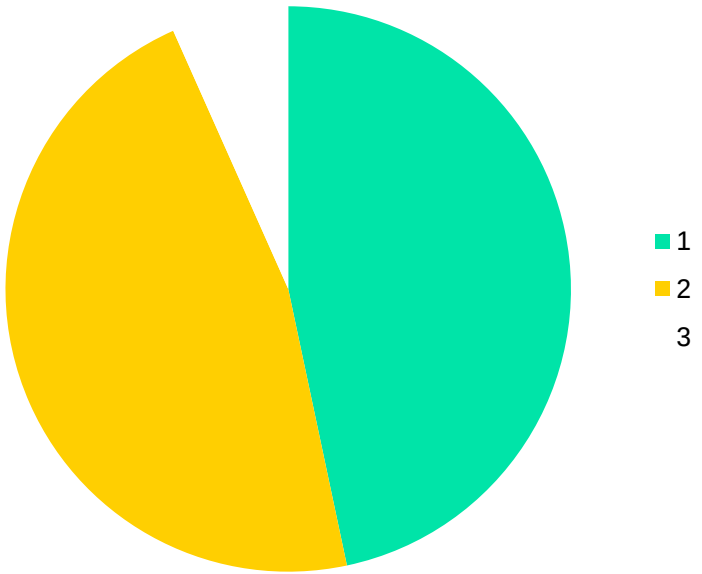
Background

- **Teacher certification**

APEX Cohorts 1 (2)

- 1. 78 (94)% Biology, General science
- 2. 11 (6)% Physics & Mathematics
- 3. 11 (0)% Other

All areas of certification represented by percentage



Background

APEX Cohorts 1 (2)

College / University degree

- Bachelors = 0 (45)%
- Masters = 100 (48)%
- Ph.D. = 0 (3)%
- Other = 0 (3)%

Professional development experience

- Science =100%

High School Physics Teacher* Demographics

	2013	2005	1997	1987
Estimated Number of Teachers	27,000	23,000	19,000	17,900
Median age (years)	46	46	44	41
AAPT membership (%)	24	23	25	24
Highest Degree Earned				
% with Bachelor's as highest	31	34	42	37
% with Master's as highest	63	60	54	59
% with Doctorate as highest	6	6	4	4
Physics or Physics Ed Major (%)	32	33	33	26
… in Physics(%)	24	23	22	—
… in Physics Education (but not Physics (%)	8	10	11	—
Self-described physics specialist (%)	56	57	48	—
% Women	37	30	25	23

* We call anyone teaching at least one physics class a physics teacher; for many teachers, a majority of their classes are in other subjects.

— These data were not collected in the 1987 survey.

www.aip.org/statistics

What Happens in our Alabama Physics Classrooms?

Selected Samples

APEX Cohort 1 Yr2

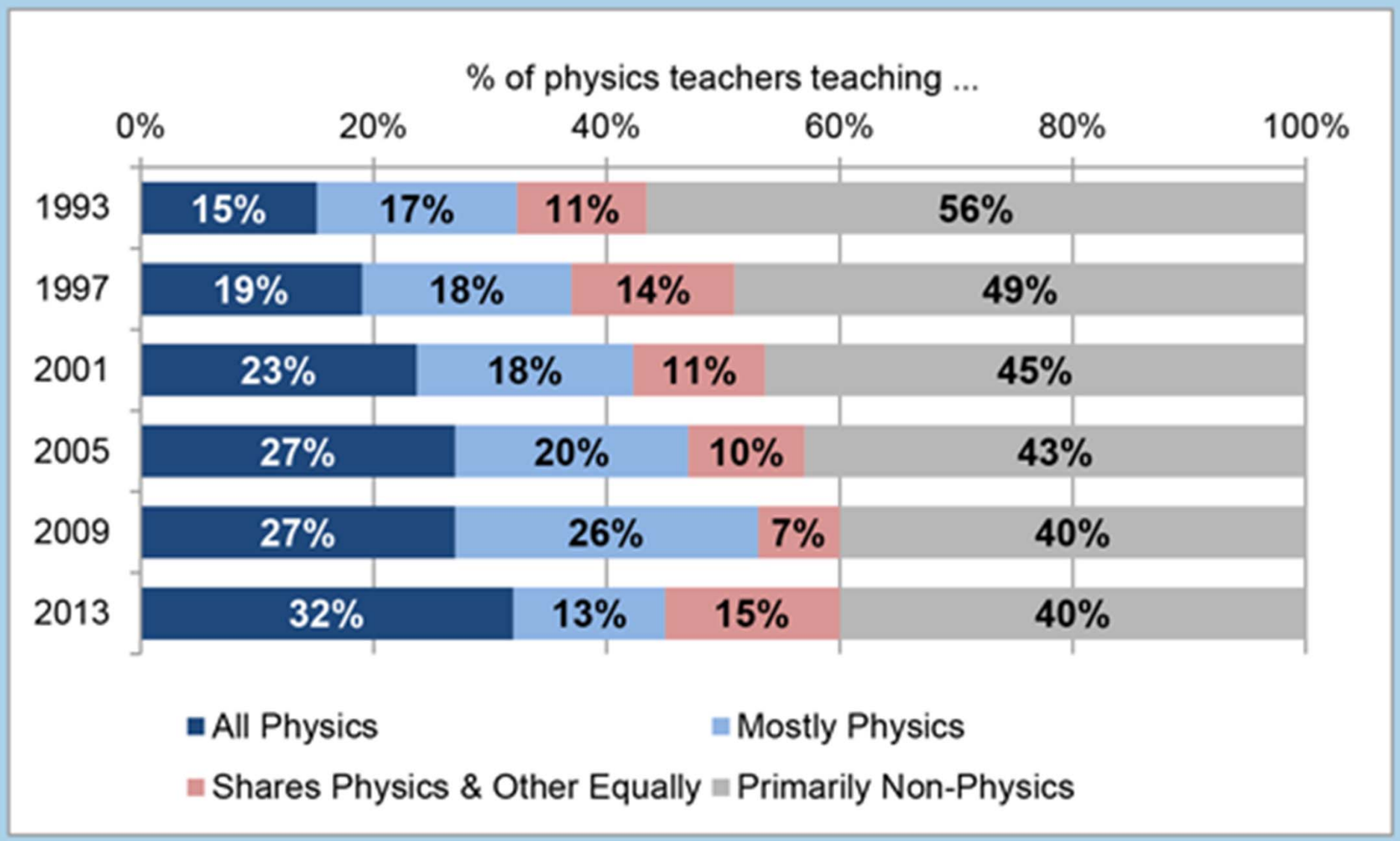
Plus Cohorts *1 Yr0* and (2)

Benchmark Indicators

The Sample of Alabama physics classes- APEX Cohorts *1* (2)

- Types of physics courses represented
  - *63* (47)% “General” Physics
  - *38* (45)% AP Physics
  - *25* (8)% Honors physics

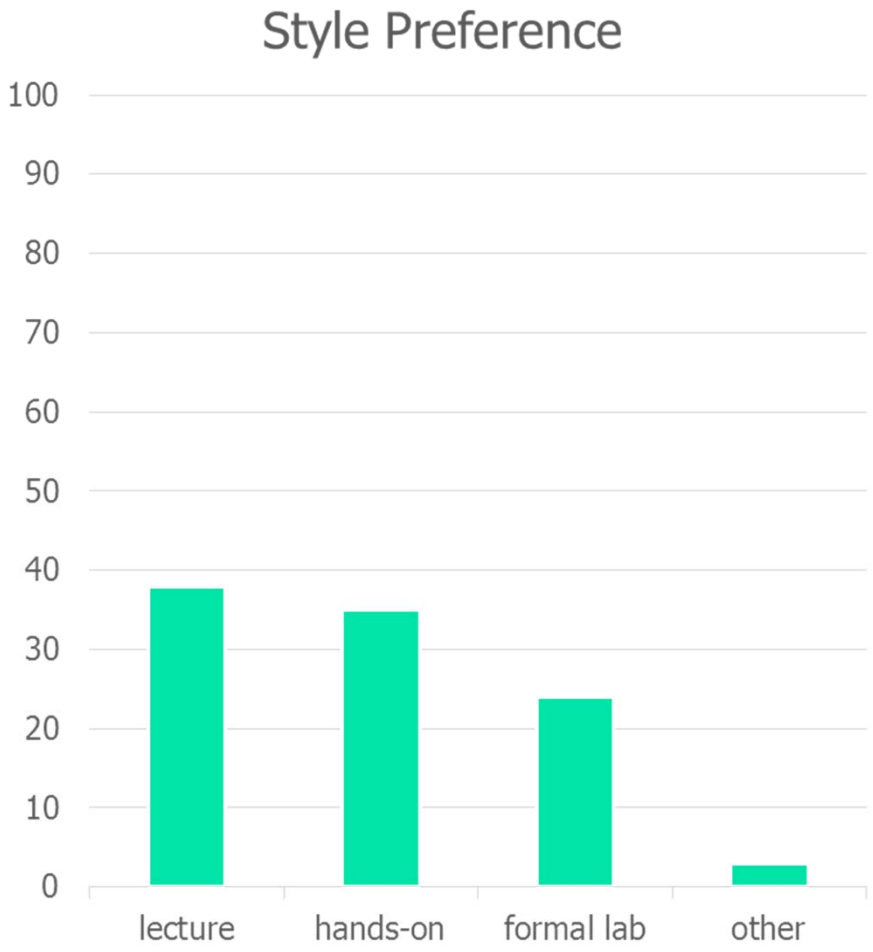
Place of Physics in Current Teaching Assignment 1987 – 2013



www.aip.org/statistics

Benchmark Indicators

- **Physics teacher preferences** (priority order) (from APEX application) Cohorts 2 (1)
  - *31* (38)% lecture
  - *17* (24)% formal lab
  - *31* (35)% hands-on activity
  - *21* (3)% other (individual work & problems)

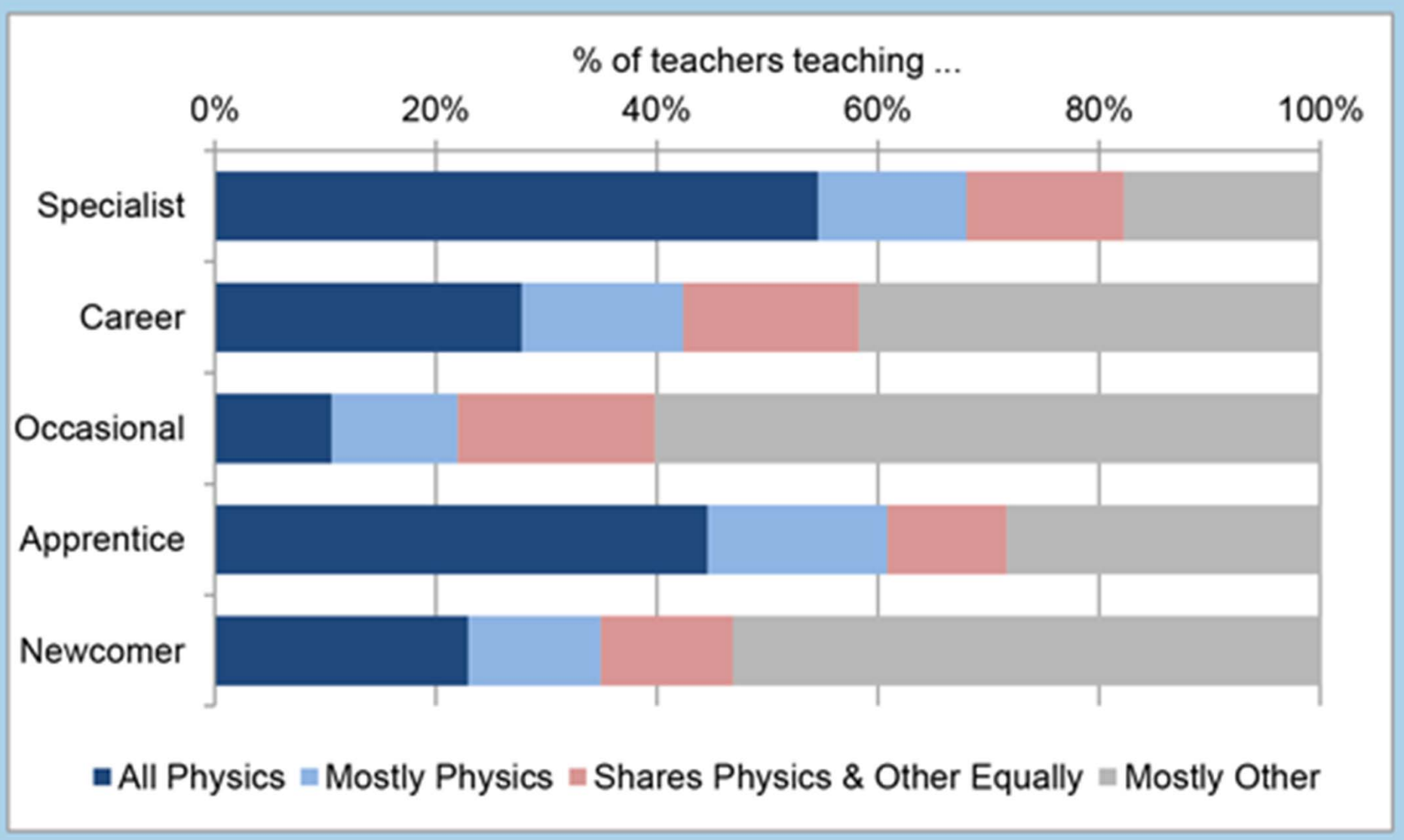


- **Physics teacher preferences** (priority order)(from Application)
- Cohort *1Yr0 Classwork*
  1. *Formal labs*
  2. *Lecture*
- Cohort (2)
  1. (Lecture)
  2. (Classwork)
  3. (Formal labs)

Cohorts 1Yr2, *1Yr0* (2)

- **Number of <u>physics classes per day</u> per teacher**
  - Average = 2.3, *2* (1.82)
  - Range = 1-5,*1-6* (1-6) classes

Place of Physics in Current Teaching Assignment by Type of Teacher, 2013



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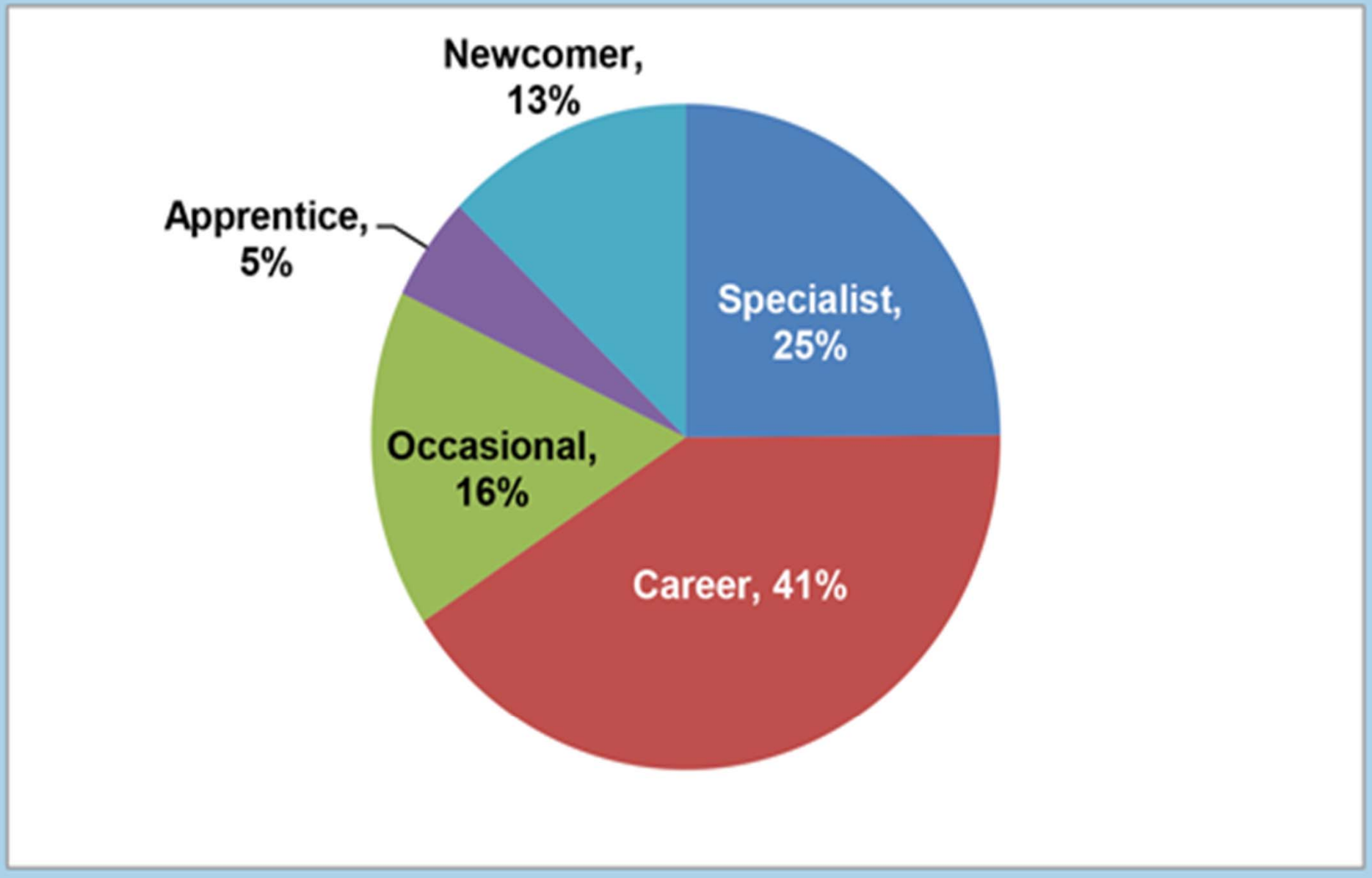
Type of Teacher Teaching High School Physics, 2013



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Benchmark Indicators (from interviews) *Cohort1Yr0*

- **Goal in teaching physics** (priority order)
  1. *Gain basic content for college*
  2. *Understanding of how the world works*
  3. *Problem solving skills*
  4. *Critical thinking skills*

- **Important content in physics to cover**
  - *Newton's Laws*
  - *ALCOS physics topics*

Benchmark Indicators (from interviews) *Cohort1Yr0*

Best way to teach physics

- *All referred to different descriptions of "hands-on approaches" =*
  - *Activities*
  - *Labs*
  - *Problem solving*
  - *Inquiry*
  - *Experience*
  - *Discovery*
  - *Hands-on*

Benchmark Indicators (from *cohort 1Yr0* teacher interviews)

- **Challenges to teaching physics**
  - *Lack of time for planning hands-on lessons (inquiry) and grading by providing feedback in a meaningful way*
  - *Lack of knowledge of physics concepts*
  - *Lack of mathematics knowledge*

What do the interview results mean to you as a member of a collaborative group of physics teachers?

Benchmark Indicators (from *cohort 1 Yr0* student group interviews)

APEX Cohort 1

Physics Students

- Number of students in PTR observed classes
  - *Total=267*
  - *Class average=18*
  - *Range =12-28*

Benchmark Indicators (from *cohort 1 Yr0* student group interviews)

Interest in Physics (priority order)

1. *Interest in physics related to college career goals and success in college*
2. *Interested in physics (no reason)*
3. *Not interested in physics (no reason)*
4. *Attracted (enjoyed) to laboratory experiences in physics*
5. *Interested (appreciated) in real world applications*

Benchmark Indicators (from *cohort 1 Yr0* student group interviews)

Definition of science (physics) (priority order)

- *Concept of physics not changed due to course*
- *Physics more complex*

Attitude toward science (physics) (priority order)

- *Felt worse – anxiety or more challenging than expected*
- *Felt the same- however more curious, now easier (met the challenge); both related to hands-on, lab, & project experiences*

Benchmark Indicators (from *cohort 1 Yr0* student group interviews)

Career plans (priority order)

- *Most interested in college STEM fields*
- *chemistry, engineering, medicine*

Source of career interest

- *Early school experiences, parents*
- *Specific experiences – health in family, TV shows, museum visits*
- *Physics course – science less boring, more relevant*

What do the student results mean to you as a member of a collaborative group of physics teachers?

Benchmark Indicators (from classroom site visits)

Cohorts 1Yr2,*1Yr0* (2) with Reformed **Lesson Observation** Protocol

- Maximum rating possible = 100
- Average rating= 70.7, *54.5* (47.9)
- Range = 52-93,*12-84* (13-87)

65 = moderate level of classroom innovation with NSES/NGSS

50 = presence of some reform characteristics

20= low level of reform, traditional teaching

MacIsaac & Falconer, 2002

What do the results mean to you as a member of a collaborative group of physics teachers?

Benchmark Indicators (from classroom site visits)

Cohort 1 **Observation Sub-score** rating. 1 Yr2 (*1Yr0* +2) average with maximum =20

- 13.4 *(9.1*) -Lesson Design & Implementation
- 14.8 (*12.3*) -Propositional Knowledge
- 13.6 *(9.6)* -Procedural Knowledge
- 14.3 *(8.2*) -Communicative Interactions
- 14.6 *(12.6)* -Student/Teacher Relationships

What do the results mean to you as a member of a collaborative group of physics teachers?

Benchmark Indicators (from classroom site visits)

- **Teacher reported classroom learning environment** (Context) Cohorts 1Yr2, *1Yr0* (2)
  - Total rating = 37, *93* (56) (maximum = 125)
- **Student reported classroom learning environment** (Context) Cohorts *1Yr0* (2)
  - Total rating = *86* (86) (maximum = 125)

No difference between gender of teacher or students

What do the results mean to you as a member of a collaborative group of physics teachers?

Benchmark Indicators (from classroom site visits)

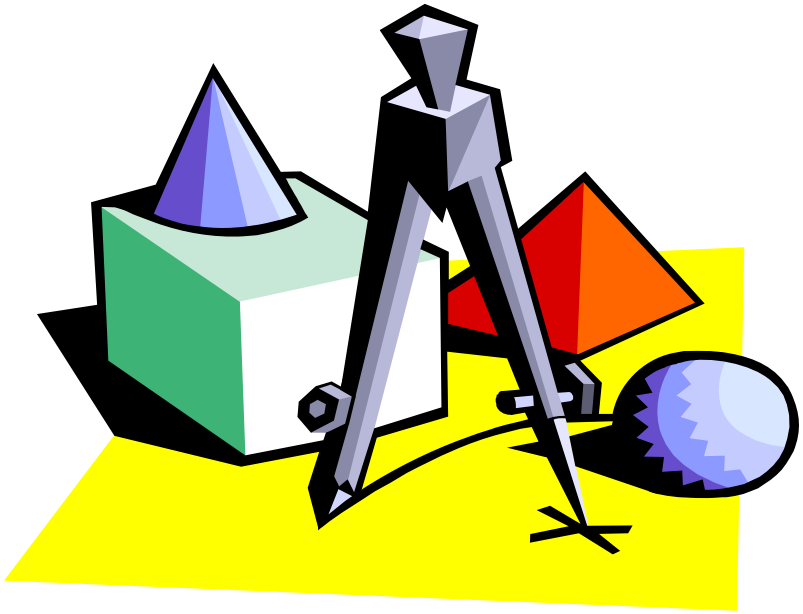
Cohorts 1Yr2, *1Yr0* (2)

Learning Environment Sub-score

T – S (Maximum =25) *Significant difference p<.05

- 5-?, *20-18* (11-18)* - Learning about the world
- 8-?, *18-18* (13-17)* - Learning about science
- 10-?, *19-17* (12-18)* - Learning to speak out
- 9-?, *17-12* (12-11) - Learning to learn
- 6-?, *22-20* (09-20)* - Learning to communicate

What do the results mean to you as a member of a collaborative group of physics teachers?



- **What do the benchmark measures mean to you as a member of a collaborative group of physics teachers?**

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