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science for a changing world

# Linking AP Courses and Earth Science Literacy with Departmental Sustainability Webinar

**January 26, 2010**

***Two Committees and the National Literacy Initiative: A Promise of Geoscience Departmental Sustainability***

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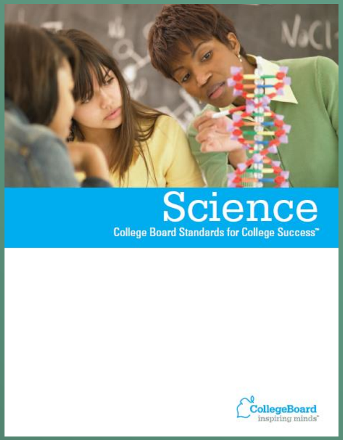
CollegeBoard




**Reform of A.P. Science Courses &**
**Science Standards for College Success**

Earth Science Literacy Initiative

**www.earthscienceliteracy.org/**

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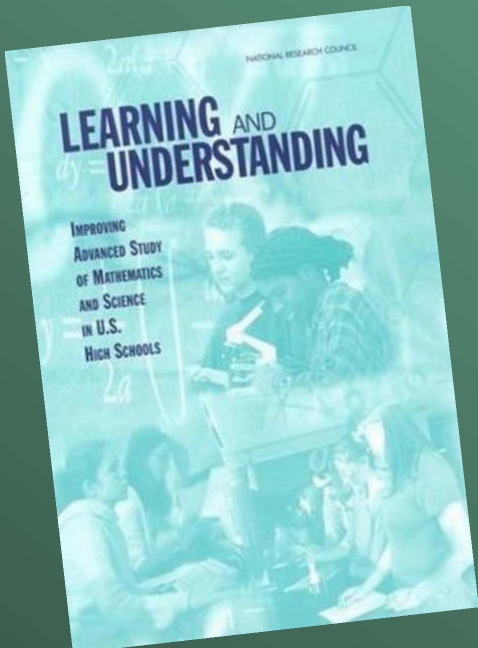


"Students can study topics in depth and develop conceptual understanding only if curricula do not present excessive numbers of topics. Currently, AP and IB programs are inconsistent with this precept."

"Curricula for advanced study should emphasize depth of understanding over exhaustive coverage of content."

"Instruction in advanced courses should **engage** students in **inquiry** by providing opportunities to **experiment, analyze** information critically, **make conjectures** and argue about their validity, and **solve problems** both individually and in groups."

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# AP Science Redesign

Discipline-specific expertise is provided by Redesign Commissions whose membership includes secondary and postsecondary educators and practicing scientists:

-- AP Biology Redesign Commission
-- AP Chemistry Redesign Commission
-- AP Environmental Science Redesign Commission
-- AP Physics B Redesign Commission

7 environmental scientists, 5 geoscientists

# AP Science Redesign
# Curriculum Model: Environmental Science

**Integrated Learning**

| Unifying Concepts | Big Ideas of the Essential Content | Scientific Inquiry and Reasoning |
|---|---|---|
| • Models<br>• Systems<br>• Continuity and Change<br>• Scale<br>• Structure/Function<br>• Science Explains the Real World | • Energy conversions underlie all Earth processes.<br>• The Earth is composed of interdependent and interacting systems.<br>• Matter on Earth is finite and moves through various biogeochemical cycles.<br>• Human actions impact the environment.<br>• Human beings depend on ecosystem services. | • The initiation of knowledge creation is usually careful observations that evoke informed questions.<br>• Experiments are designed to answer a particular question. The quality of the answer is determined by the thoughtfulness of the design of the experiment and the tenacity of the experimenter.<br>• Science and technology operate in a social context. Science and technology can serve national interests. But nationalism can impede solutions to transnational problems.<br>• The capacity to reason scientifically requires an understanding of cause and effect, the difference between argument and explanation, and the uncertainty that arises from the use of models and measurement.<br>• Situations that require the interpretation of graphical, symbolic, and numerical information and the application of judgment in the evaluation of the quality of that information support skill in analysis.<br>• Communication is an essential element of the creation of scientific knowledge. Both the individual and the community have a role in the critical evaluation of information or ideas.<br>• Skill in the numerical and symbolic representation of information and relationships increases the power of expression and the clarity of thought. |

# So why should I care about all this ?

? ? ? ? ?

- critical national need
- critical discipline need
- expanded view of the professoriate
- better integration of education and research

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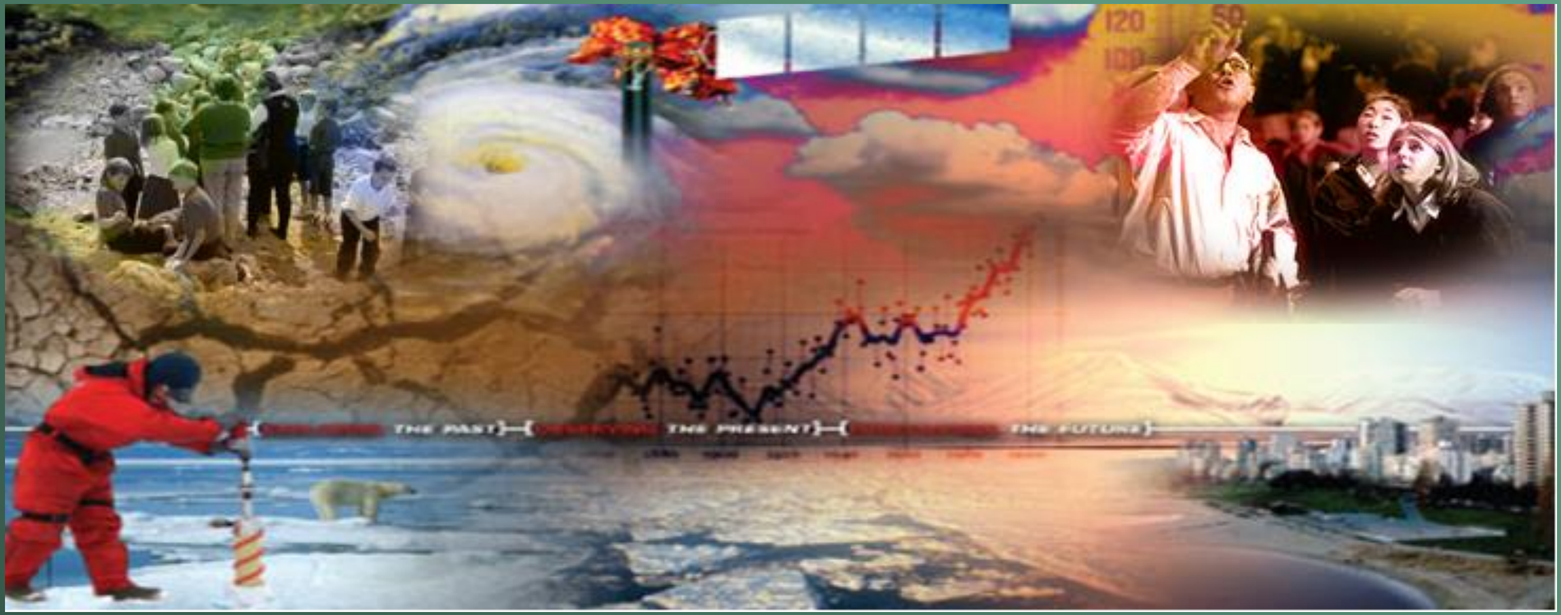
**The Central Premise:** Education and research are always in the social service; both are inextricably bound at all levels.

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# Constraints driven by:

- the student pool from which we draw and upon which we are ultimately dependent

- expectations and opportunities associated with national and global priorities

- demographic and workforce issues

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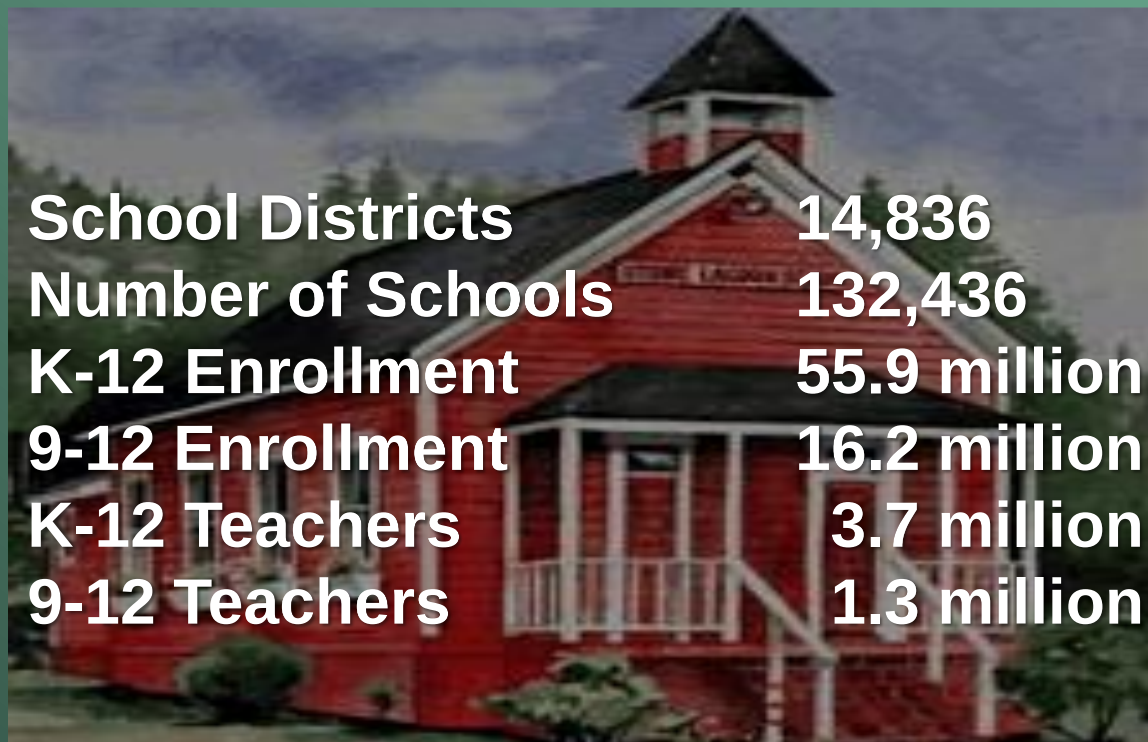
# Provide Student Opportunities: The K-12 “Consumer” Market



| | |
|---|---|
| School Districts | 14,836 |
| Number of Schools | 132,436 |
| K-12 Enrollment | 55.9 million |
| 9-12 Enrollment | 16.2 million |
| K-12 Teachers | 3.7 million |
| 9-12 Teachers | 1.3 million |

Source: NCES Digest of Education Statistics

Table 299: **Degrees conferred in biology, micro, and zoology 1970-01 to '2006-07**

| year | Biology B | Biology M | Biology D | Microbiology B | Microbiology M | Microbiology D | Zoology B | Zoology M | Zoology D |
|---|---|---|---|---|---|---|---|---|---|
| **70-71** | 26294 | 2665 | 536 | 1475 | 456 | 365 | 5721 | 1027 | 878 |
| **75-76** | 40163 | 3177 | 624 | 2927 | 585 | 364 | 6077 | 976 | 645 |
| **80-81** | 31323 | 2598 | 734 | 2414 | 482 | 370 | 3873 | 881 | 613 |
| **85-86** | 27618 | 2173 | 574 | 2257 | 392 | 362 | 2894 | 618 | 548 |
| **90-91** | 29285 | 1956 | 632 | 1788 | 343 | 443 | 2641 | 551 | 516 |
| **95-96** | 44818 | 2606 | 768 | 2200 | 364 | 606 | 3463 | 677 | 501 |
| **00-01** | 42310 | 2582 | 780 | 2779 | 334 | 553 | 3045 | 560 | 380 |
| **06-07** | 52527 | 2679 | 788 | 2347 | 369 | 667 | 2223 | 416 | 263 |

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Source: NCES, Digest of Educational Statistics: 2008

ies NATIONAL CENTER FOR EDUCATION STATISTICS

Table 313: **Degrees conferred in chemistry, geology, and physics 1970-01 to ’2006-07**

| year | Chemistry B | Chemistry M | Chemistry D | Geoscience B | Geoscience M | Geoscience D | Physics B | Physics M | Physics D |
|---|---|---|---|---|---|---|---|---|---|
| 70-71 | 11061 | 2244 | 2093 | 3312 | 1074 | 408 | 5071 | 2188 | 1482 |
| 75-76 | 11015 | 1745 | 1578 | 4677 | 1384 | 445 | 3544 | 1700 | 997 |
| 80-81 | 12682 | 1862 | 1649 | 6332 | 1702 | 404 | 3441 | 1294 | 866 |
| 85-86 | 10110 | 1712 | 1878 | 5760 | 2036 | 395 | 4180 | 1501 | 1010 |
| 90-91 | 8311 | 1637 | 2196 | 2367 | 1336 | 600 | 4236 | 1725 | 1209 |
| 95-96 | 10395 | 2214 | 2228 | 4019 | 1288 | 555 | 3679 | 1678 | 1462 |
| 00-01 | 9466 | 1952 | 2056 | 3495 | 1220 | 472 | 3418 | 1365 | 11699 |
| 06-07 | 10994 | 2097 | 2514 | 3319 | 1437 | 640 | 4843 | 1777 | 1442 |

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Source: NCES, Digest of Educational Statistics: 2008

ies NATIONAL CENTER FOR EDUCATION STATISTICS

Table 186: **Total Fall Enrollments, 1970 - 2006**

| | |
|---|---|
| 1970 | 8,580,887 |
| 1975 | 11,184,859 |
| 1980 | 12,096,895 |
| 1985 | 12,247,055 |
| 1990 | 13,818,637 |
| 1995 | 14,261,781 |
| 2000 | 15,312,289 |
| 2006 | 18,205,474 |

Source: NCES, Digest of Educational Statistics: 2008

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Source: IPEDS Completions Survey; Year 2007

| | African-American | Native-American | Hispanic-American | All Bachelors |
|---|---|---|---|---|
| Psychology | 9,729 | 612 | 8,506 | 90,498 |
| Business & Management | 34,688 | 2,085 | 27,967 | 337,157 |
| Education | 8,205 | 1,000 | 9,900 | 126,531 |
| Chemistry | 852 | 90 | 748 | 11,250 |
| Biological Sciences | 5,857 | 531 | 5,453 | 79,348 |
| Computer Science | 4,588 | 249 | 2,970 | 42,596 |
| Engineering | 4,630 | 445 | 6,114 | 84,336 |
| Mathematics & Statistics | 832 | 63 | 946 | 15,551 |
| Physics | 163 | 22 | 246 | 4,877 |
| Geosciences | 79 | 26 | 135 | 4,077 |
| Total All Fields | 137,566 | 10,751 | 124,787 | 1,541,704 |

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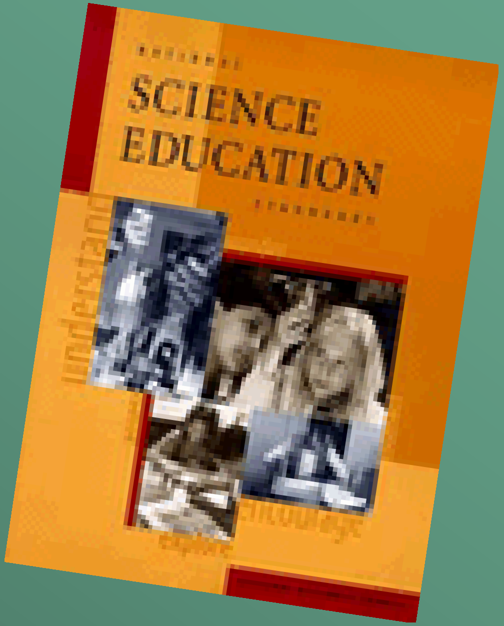
**National Academy of Sciences**
**National Research Council**

“Now, for the first time in our nation’s history, we have a call to action, a dramatic call for change, and one that specifically states that all students, at all grade levels, should receive earth science instruction.” NCES 1996




***Earth Science***

***Physical Science*** ***Life Science***

# Number of Earth Science Teachers 9-12

| 1990 | 1998 | 2006 |
|---|---|---|
| 13,425 | 18,242 | 16,211 |

by comparison

| Chemistry | 29,522 |
|---|---|
| Biology | 59,163 |
| Physics | 22,056 |

# of Physics teachers in 2000 = 15,583

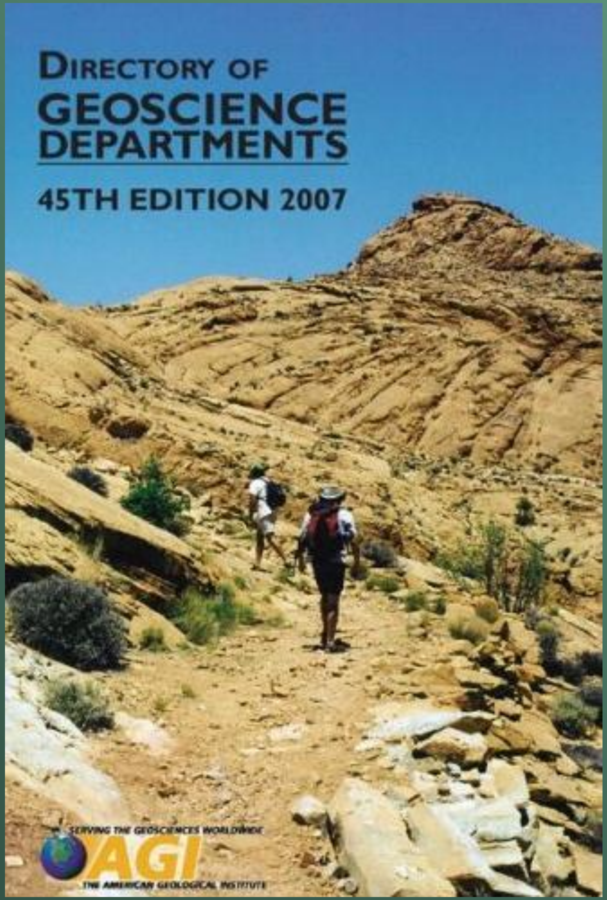
Number of Teachers=Assigned to teach course/subject one or more periods. Source: *State Indicators of Science and Mathematics Education 2007*, Council of Chief State School Officers, Washington, DC, 2007.

**State Indicators of Science and Mathematics Education**
**2007**

## High School Science

**Table 1.3** shows the percentage of high school students in each reporting state that took a first-year course in Chemistry, Physics, Biology, and Earth Science by graduation. State data on science courses show that **in most states almost all high school students take Biology**, while a**cross the states, enrollment in Earth Science at the high school is extremely varied**.

# College and University Faculty in Geoscience




| | |
|---|---|
| Professor | 6168 |
| Assoc. Professor | 2707 |
| Asst. Professor | 3145 |
| Total | 12,020 |

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*"Geoscientists Defend Earth Science in Texas"*

**And From California…**

*"Implementation guidelines failed to live up to standards' treatment of earth science."*

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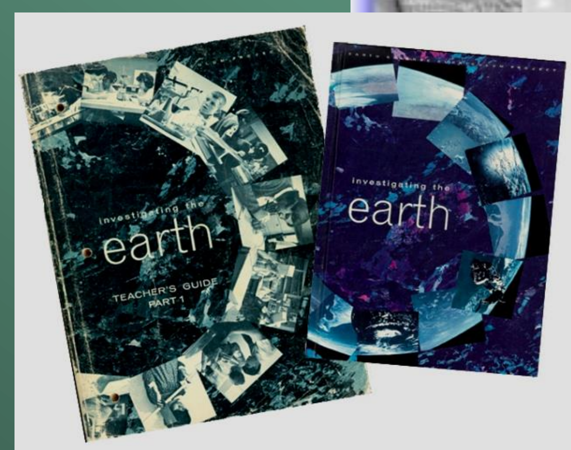
# Standards, Benchmarks, Science Anchors and literacy documents are only good intentions unless they immediately degenerate into hard work!

**Worth rediscovering what was successful in the past, e.g., the Earth Science Curriculum Project**

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# and finally, something to think about …


1967-68 level in the seven states that haven't yet responded, there would be an additional 82,023 students enrolled in earth science. This gives an estimated total secondary earth science enrollment of 841,422. An estimate of the total public school 9th grade enrollment by the USOE is 3,218,000 making the earth science enrollment nationally about 26.2%. This estimated percentage is based on 9th grade population simply for the sake of comparison, recognizing that many of these students take earth science at other grade levels and in non-public schools.

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