

# STEM - THE NEXT GENERATION: PREPARING STUDENTS TO ON-BOARD INTO STEM CAREERS

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## QUESTIONS

What skills will the next generation of students need?

What can educators do now to ensure that their graduates have the skills they need for their future careers?



## TO ANSWER THESE,

We need to understand the global environment we are living in.

What is more, we need to understand the global environment our kids will be graduating into.



Slides 4–16 are taken from Did You Know? Video:

<http://www.youtube.com/watch?v=fhnWKg9B2-8&feature=related>



**If you're one in a million in  
China . . .**



**There are 1,300 people just like  
you.**



**In India, there are 1,100 people  
just like you.**



**The 25% of the population in  
China with the highest IQ's . . .**





**Is greater than the total  
population of North America.**



**In India, it's the top 28%.**



**Translation for teachers:  
They have more honors kids  
than we have kids.**



**China will soon become the  
number one English speaking  
country in the world.**



**If you took every single job in  
the U.S. today and shipped it to  
China . . .**



**China would still have a labor surplus.**



**There are over 100 million  
registered users of MySpace.  
(August 2006)**



**The average MySpace page is  
visited 30 times a day.**





**If MySpace were a country, it would be the seventh largest in the world.**

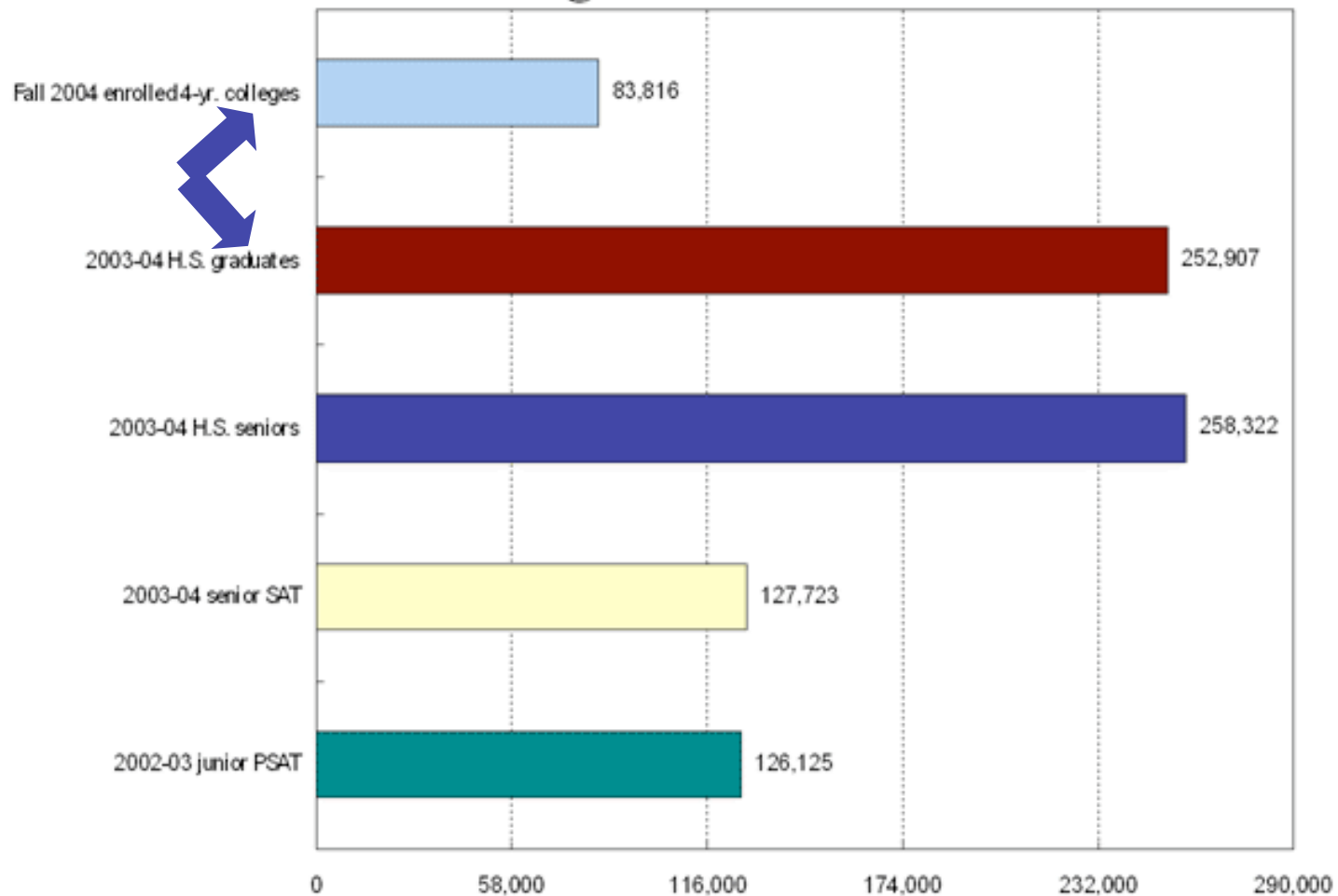


**Now let us see where we are.**

## THE CHALLENGE IN ENGINEERING

- Number of graduates from high schools in ALL of U.S. - 3,118,689
- Of these, 1,212,278 entered four-year colleges (39%)
- Freshman enrollment in all areas of engineering showed a steady decline during 2002-2004:
  - 97,817 in 2002
  - 97,170 in 2003
  - 96,978 in 2004
- Percentage of students enrolled in engineering programs in 2004 seems to be around 8% - a very narrow pipeline to meet the workforce needs.
- While the number of scientists and engineers who graduate from Indian and Chinese universities is increasing, U.S. universities are awarding fewer degrees in science and engineering every year, and many of them go to international students.

## 2004 High School Seniors: Graduation and Four-Year College Enrollment: Texas



Source: The College Board/U.S. Department of Education

## PERCEPTIONS AND REALITY CHECKS

Elected officials, corporate CEOs and education experts believe today's schools aren't as challenging as they need to be and that students just aren't learning enough.

“Training the workforce of tomorrow with the high schools of today is like trying to teach kids about today’s computers on a 50-year-old mainframe. It’s the wrong tool for the times.” - Bill Gates

“Teachers of these subjects are so frightened that they transmit the fear to the children. These kids are afraid of science.” - P. Roy Vagelos, Merck CEO

“If the U.S. doesn’t get its act together, Du Pont is going to the countries that do, and so are IBM and Intel.” - Chad Holliday, Du Pont CEO

## PERCEPTIONS AND REALITY CHECKS

The number of parents who worry about whether local schools are teaching enough math and science has declined from 60% to 36% since mid-nineties.

Their perceptions:

- children will be well prepared for college or work when the time comes;
- today's schools are better than the ones they went to;
- material children are learning is more challenging and difficult than when they were in school;



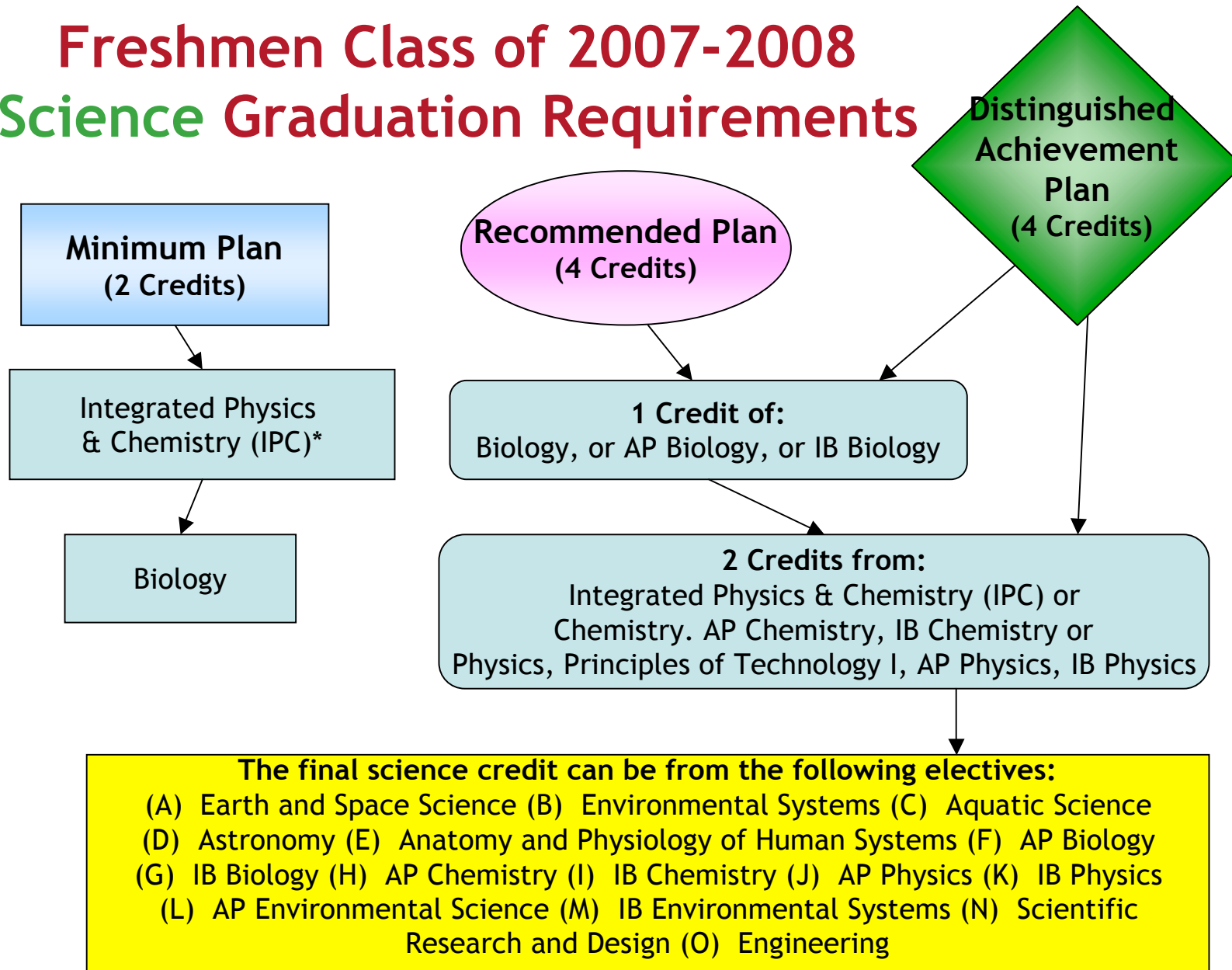
**Now let us see what we are currently doing in our schools.**

## Tenth Grade Science

Distinguished	Above Mastery	Mastery	Partial Mastery	Novice
<p>assess error in measuring energy conservation; interpret calculations and graphs of rate, force, momentum, work and time;</p> <p>suggest a simple machine to provide optimum mechanical advantage;</p> <p><b>measure calculate the spring constant and relate to its properties;</b></p>	<p>interpret calculations and/or graphs of rate, force, momentum, work and time;</p> <p>compare calculated mechanical advantage of similar simple machines;</p> <p><b>measure calculate the spring constant;</b></p>	<p>relate Newton's Laws of Motion to rate, force, momentum, work and time;</p> <p>calculate mechanical advantage of simple machines;</p> <p><b>compare the effect of different forces on vibrating systems;</b></p>	<p>define Newton's Laws of Motion, rate, force, momentum, work and time;</p> <p>calculate mechanical advantage of some simple machines;</p> <p><b>recognize vibrating systems;</b></p>	<p>state the three Laws of Motion;</p> <p>calculate mechanical advantage of a simple machine;</p> <p><b>recognize a pendulum is an example of a vibrating system;</b></p>



# Freshmen Class of 2007-2008 Science Graduation Requirements



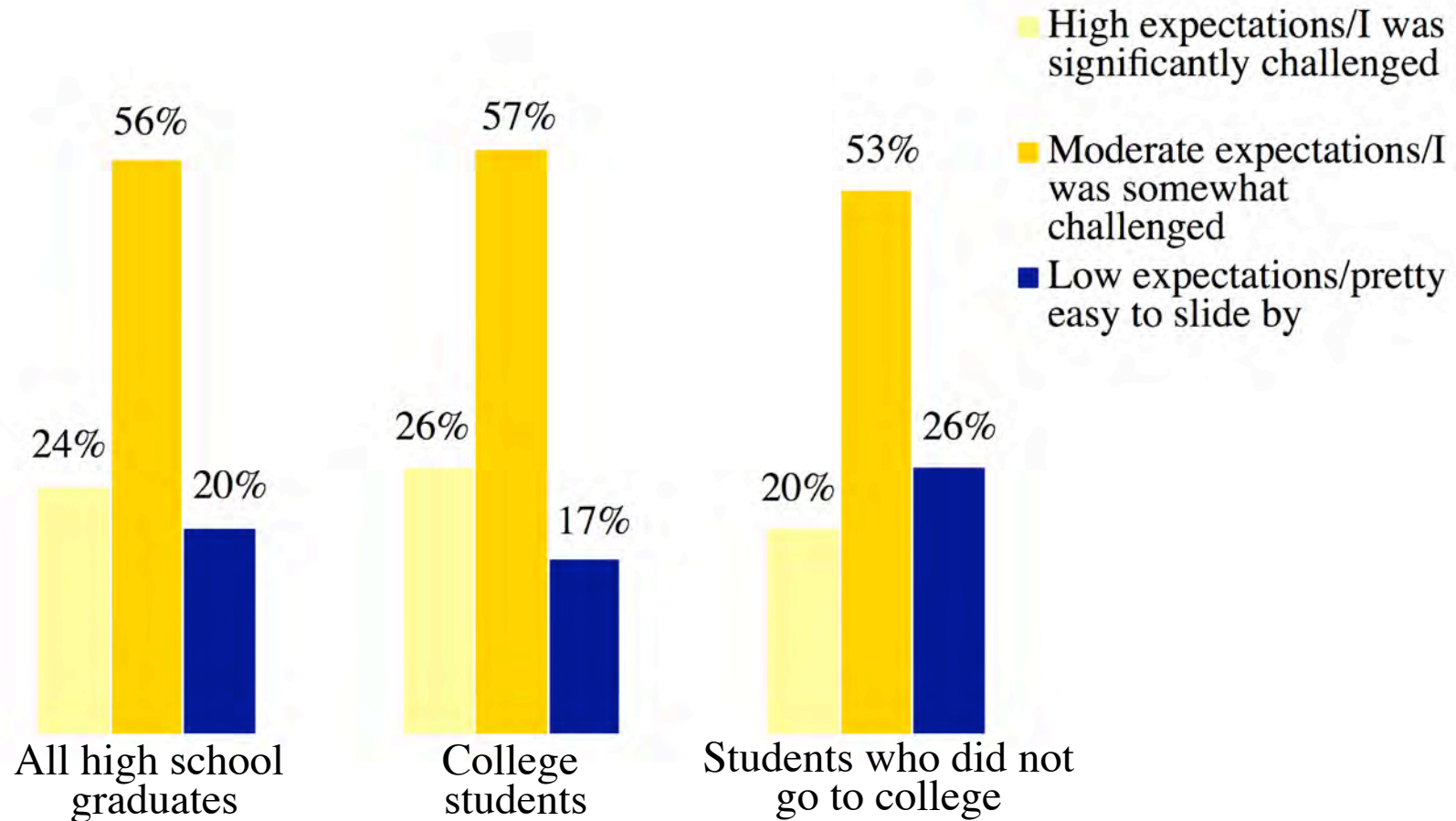
*"The core problem is that course titles don't really signal what is taught in the course and grades don't signal what a kid has learned. What we're going to end up with is the high school valedictorian who can't write three paragraphs."*

- Kati Haycock, president of the Education Trust

*"For all of our talk of the achievement gap amongst subgroups of students, a larger problem may be an instructional gap or a rigor gap. There's a disconnect between what we want and expect our 12th-grade students to know and do and what our schools are actually delivering through instruction in the classroom."*

- David W. Gordon, superintendent of Sacramento County schools in California

## MOST HIGH SCHOOL GRADUATES WERE MODERATELY CHALLENGED



Source: Peter D. Hart Research Associates/Public Opinion Strategies, *Rising to the Challenge: Are High School Graduates Prepared for College and Work?* prepared for Achieve, Inc., 2005.

## MAJORITY OF GRADUATES WOULD HAVE TAKEN HARDER COURSES

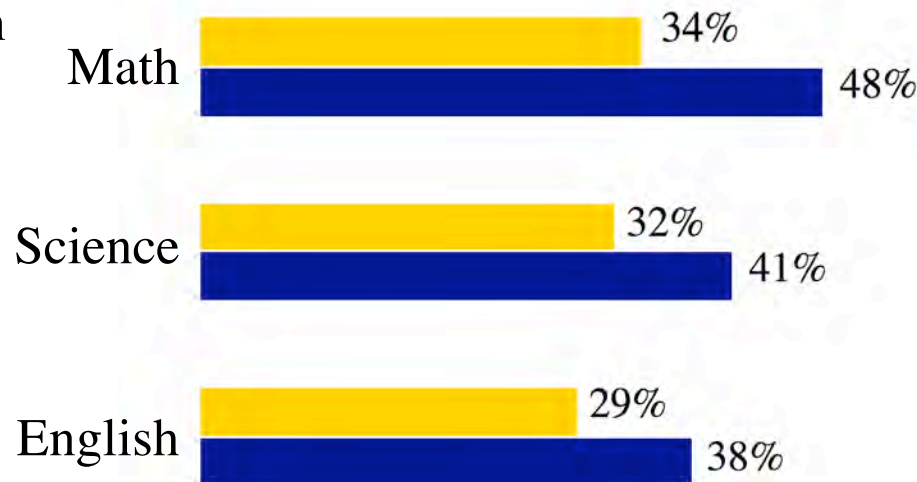
Knowing what you know today about the expectations of college/work ...

Would have taken more challenging courses in at least one area

College students  
 ■ Students who did not go to college



Would have taken more challenging courses in:

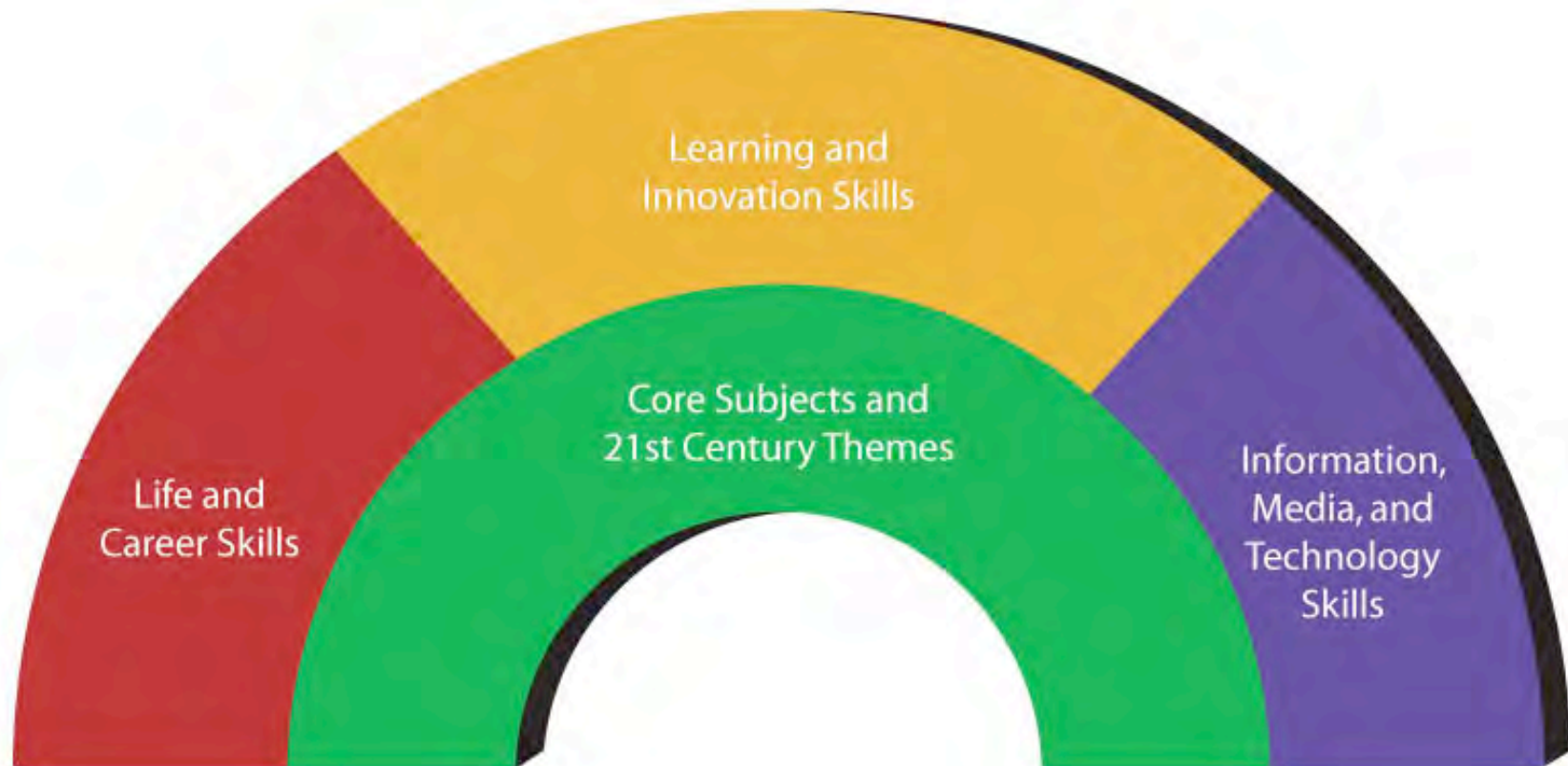


Source: Peter D. Hart Research Associates/Public Opinion Strategies, *Rising to the Challenge: Are High School Graduates Prepared for College and Work?* prepared for Achieve, Inc., 2005.

## LONG-TERM RESEARCH NEEDS - AN EXAMPLE

- Understanding the mechanisms of human pathogenesis, response, and healing
- Sensors networks
- Extraction of understanding from large quantities of data
- Human behavior and system design
- Understanding complex, adaptive systems
- Intelligent, adaptive power grid
- Replacing humans in hazardous situations
- Reliable computer code and secure computer systems

# 21<sup>st</sup> Century Skills Framework

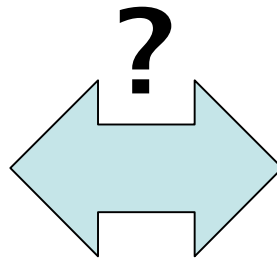


(Taken from a presentation of Ken Kay and Milton Chen at the Education Finance Summit, National Conference of State Legislatures, San Antonio, February 15-17, 2008, <http://www.ncsl.org/edfinancesummit/>)

# 21<sup>st</sup> Century Skills Framework

## Core Subjects

- Economics
- English
- Government
- Arts
- History
- Geography
- Reading or Language
- Arts
- Mathematics
- Science
- World Languages
- Civics

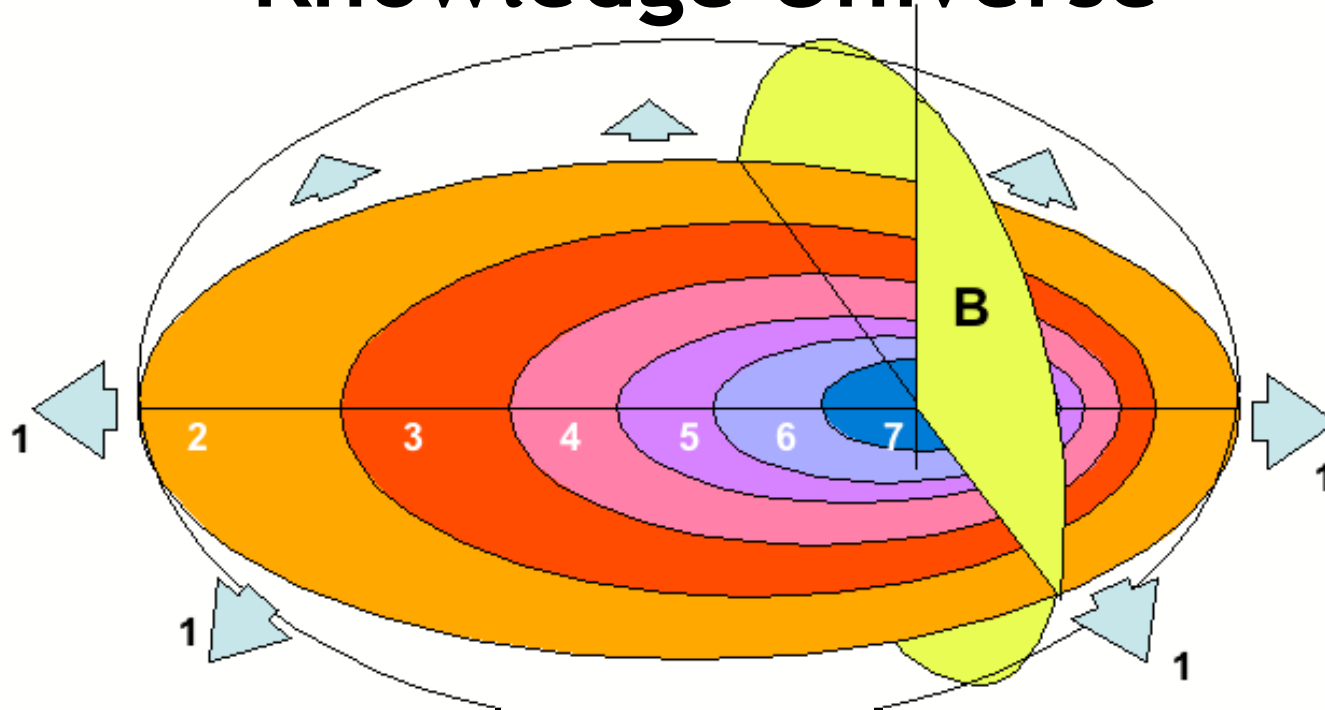


## 21<sup>st</sup> Century Themes

- Global Awareness
- Financial, Economic, Business & Entrepreneurship Literacy
- Civic Literacy
- Health Literacy

(Taken from a presentation of Ken Kay and Milton Chen at the Education Finance Summit, National Conference of State Legislatures, San Antonio, February 15-17, 2008, <http://www.ncsl.org/edfinancesummit/>)

# Knowledge Universe



1. All that could be known and will be known
2. All that is known
3. Technical knowledge of all industry
4. Technical knowledge of your industry
5. Technical knowledge of your company
6. Design Team knowledge
7. Individual knowledge

Knowledge Crosscuts

A. Arts & Sciences

B. Engineering & Technology



# SEEING EDUCATION ANEW

The traditional science education needs to be re-thought in light of changes in student expectations.

Teachers have to be able to promote the students` problem solving skills, autonomy and ability to reflect, conceptual thinking.

It is important to to create new teaching and learning styles supported by new media and technology.

Teachers need to see their roles more as consultants a la Peter Drucker than information conveyors.

That is, schools should help students identify their potential, develop that potential and determine their potential directions of growth.

“Teaching People To Teach” is not a meaningful concept.



*What is Prairie View A&M  
University Doing  
To Meet These Challenges?*



## PROACTIVE LINKAGE COMPONENTS OF OUR APPROACH

- Curricular Alignments
- Interactive Learning Environment - Science Education Center
- Student projects - relevant to learning and real world
- Teacher-Faculty collaboration - Teacher In Residence, Faculty In Residence, continual feedback and assessment
- Involvement of parents and community leaders in student development
- Sustainability via throughout-the-year mentoring, periodic interaction with university and industry personnel, and building communities of practice.
- Emphasis of inter-relationships between disciplines

## STUDENT AWARENESS TO LIFE IN COLLEGE AND THE WORKFORCE



- Exposure to different careers - taken from the Bureau of Labor Statistics Handbook and other such documents;
- Presentations by professionals from colleges, universities and industry;
- Workshop on the development of individual career plans (relevance established through self-discovery as opposed to being directed);
- Workshop on “translating” available job requirements into required minimal preparations;
- “What if” scenario laboratories, where each student will explore possible evolutions of their careers starting with specific beginnings.

## TEACHER TRAINING, ESPECIALLY IN MATHEMATICS AND SCIENCE



### Levels of training:

- Advanced training for teachers with science and mathematics educational experience.
- Hands-on training emphasizing exposure to science and mathematics for teachers who are teaching out of their disciplines. The objective is to reduce the apprehension of these teachers so that they can be more effective in their classrooms.
- Opportunities for professional development - continuing education, and master's and doctoral degrees.





## ALIGNMENT OF CURRICULA BETWEEN HIGH SCHOOLS AND COLLEGES/UNIVERSITIES

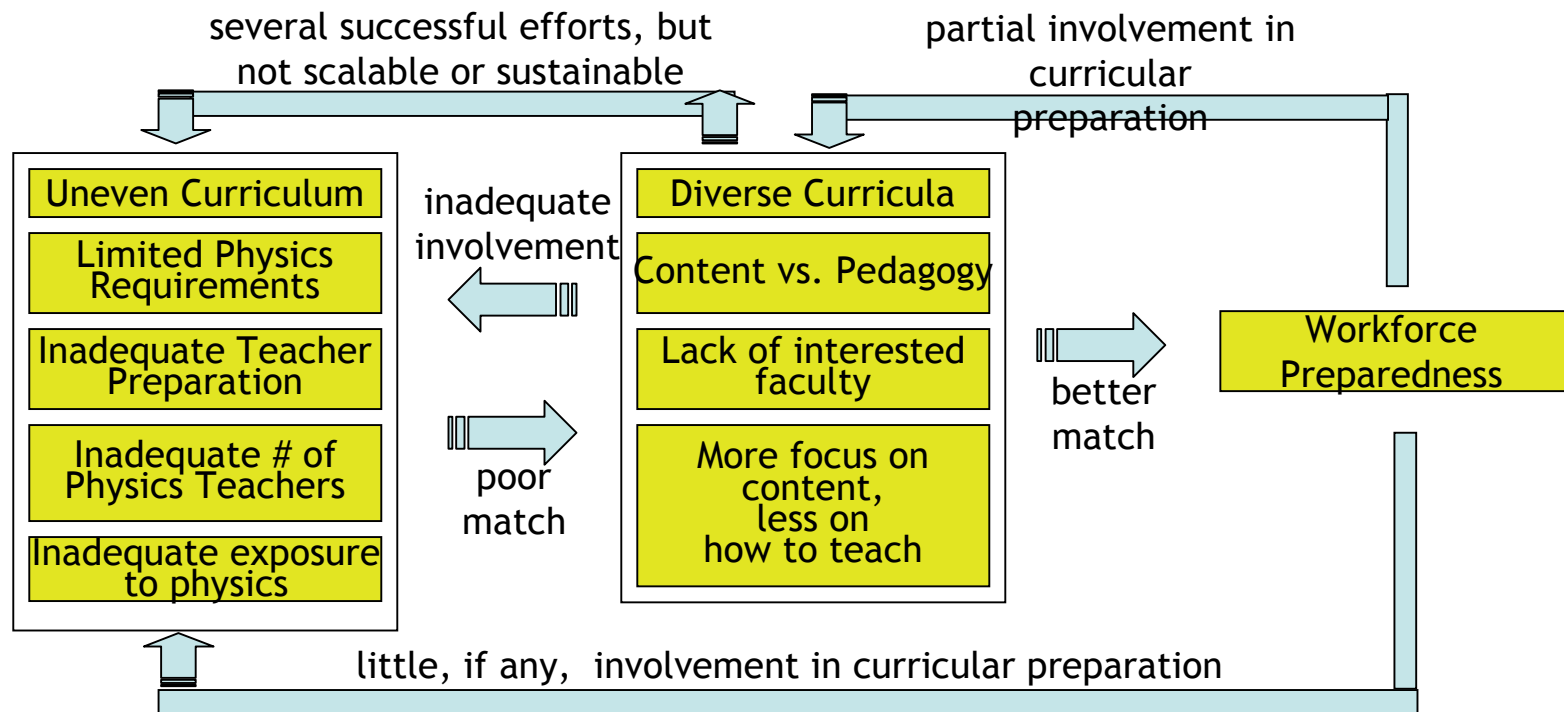
- Incompatibility in graduation requirements and college preparation requirements.
- For instance, the requirements for school graduation are based mainly on a standardized test while the requirements for entry into a university (especially into engineering and related fields) are generally a lot higher (over 30% of students entering college require remedial courses).
- Identify gaps in the coverage of science and mathematics materials, and design a curriculum that provides for a seamless transition to college.

# CURRICULAR ALIGNMENTS!

Alignment is A Good Starting Point But More is Needed!



## A MORE REALISTIC PICTURE





## COMPLETE SET OF COURSES FOR SCIENCE TEACHERS

1. PHSC 1123 – Physical Science I
2. PHSC 2123 – Physical Science II
3. PHSC 3083 – Science of Everyday Life
4. PHSC 3183 – Modern Physics for Science Teachers
5. PHSC 3223 – Introduction to Atmospheric Science.
6. PHSC 4011 – Earth Science Laboratory
7. PHSC 4013 – Earth Science
8. PHSC 4024 – Astronomy and Geology
9. PHSC 4163 – Special Topics in Physical Science
10. PHYS 4173 – Research Project (Capstone Course)



## DEVELOPMENT OF SUPPLEMENTARY MATERIALS

- Demonstrate the integration of multiple disciplines to reinforce the concepts from one subject to applications in other subjects.
- Most engineering and technology departments present concepts and techniques in fragmented courses - topics engineers “need to know,” leading to the feeling that an engineering education is simply a collection of courses.
- The result is fewer students motivated to pursue engineering careers, and even those with a limited perspective.
- Supplementary courses - modified courses and “bridging courses” - can provide an important element of synergy.



ROYAL HIGH  
SCHOOL

## A SPECIFIC IMPLEMENTATION SCENARIO - ROYAL HIGH SCHOOL

1. Assist Royal High School in redesigning the instructional and learning environment for teaching and learning success, by integrating technology tools to improve the academic success of all RHS students;
2. Improve all RHS students' state assessment (TAKS) and ACT/SAT scores;
3. Formulate a teacher preparation system that closely reflects the teaching conditions in tomorrow's schools and the learning needs of tomorrow's students; and
4. Continue to support the professional development and career growth for in-service teachers.



# Project XLR8 (Accelerate)



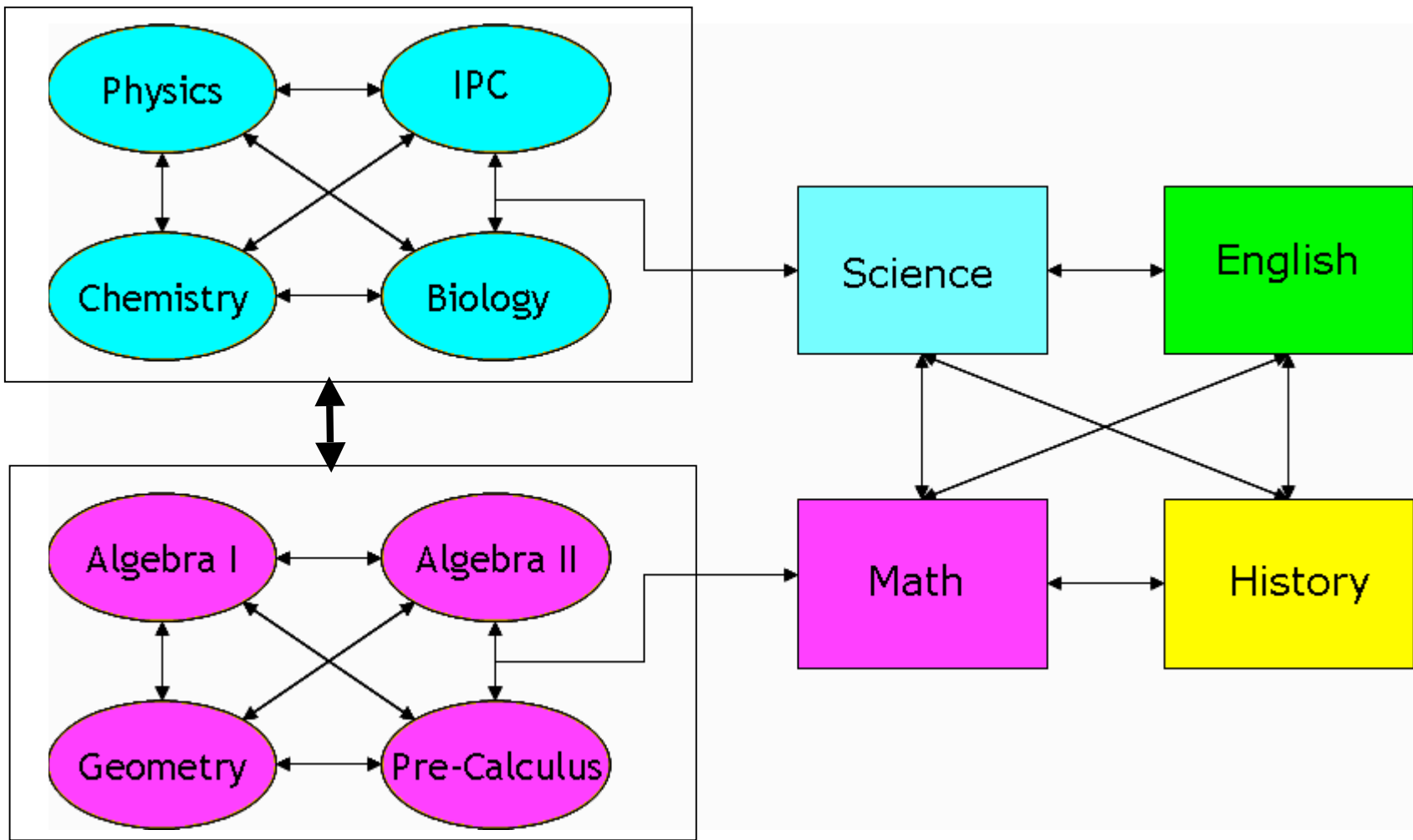
A Partnership Between  
Royal High School & Prairie View A&M University  
Funded by  
Thurgood Marshall College Fund  
With support from  
The Bill & Melinda Gates Foundation



# Integration Plans

Phase I

Phase II

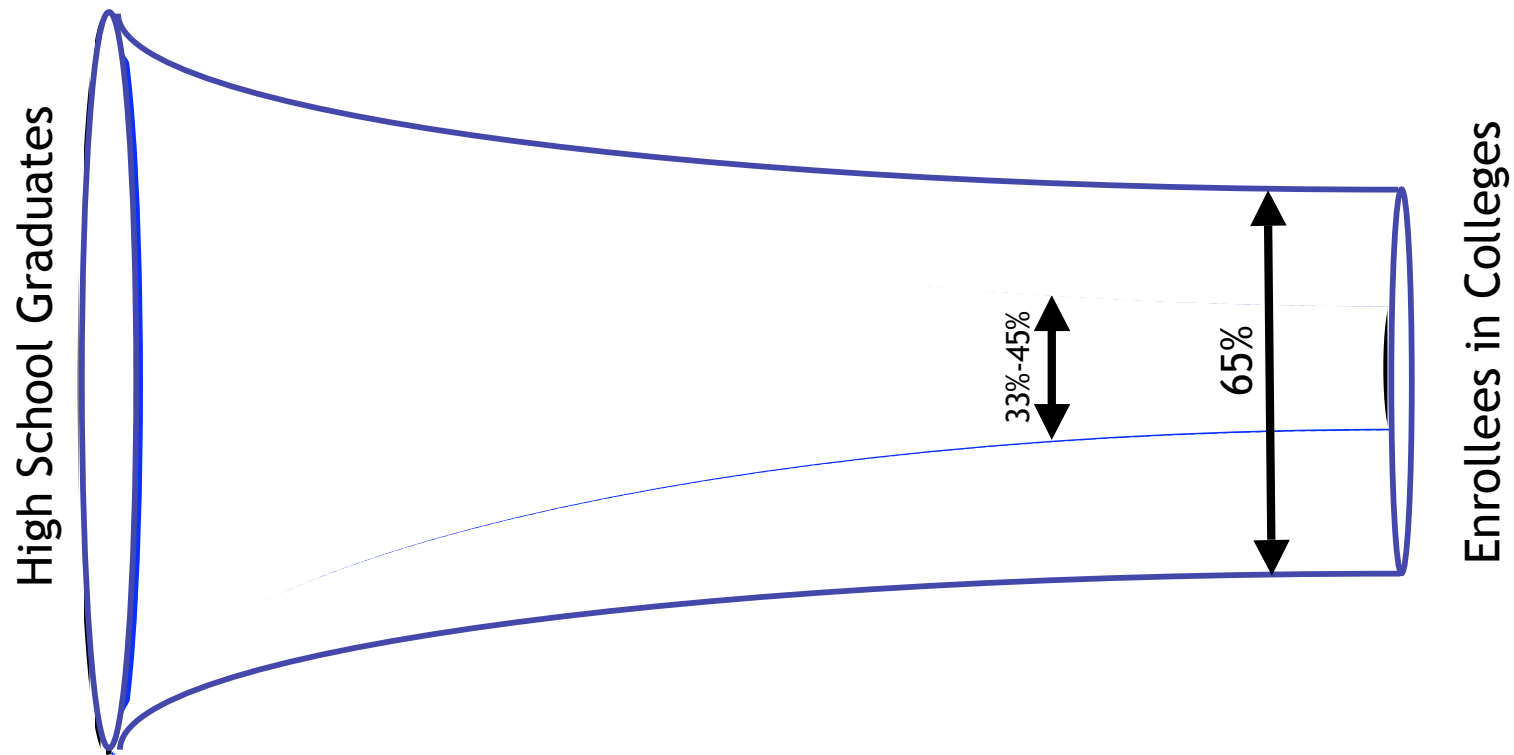




## MAJOR ELEMENTS OF THE REDESIGN

- New Leadership
- Professional Development of RHS Teachers
- Curricular Alignment
- Professional Development of University and High School Faculty
- Layered Mentoring
- Awareness for College Experience and Careers
- Technology Incorporation Into Learning
- Access to Additional Technology Resources
- Participation of All Stakeholders
- Dissemination of Project Processes and Results

## ANTICIPATED RESULT - ENHANCED PIPELINE





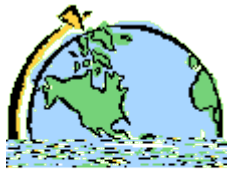
**We are currently preparing students for  
jobs that don't yet exist,  
using technologies that haven't been  
invented,  
in order to solve problems we don't even  
know are problems yet.**

(From the video "Did You Know?")

## QUESTIONS TO ASK

Are our students ready for the 21<sup>st</sup> Century?

Are our students critical thinkers and problem solvers?



Are our students globally aware?

Are our students self-directed?



Are our students good collaborators?

(Taken from a presentation of Ken Kay and Milton Chen at the Education Finance Summit, National Conference of State Legislatures, San Antonio, February 15-17, 2008, <http://www.ncsl.org/edfinancesummit/>)



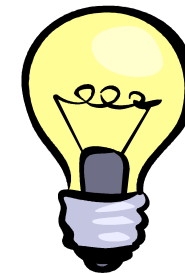
# QUESTIONS TO ASK

Are our students information and technology literate?



Are our students flexible and adaptable?

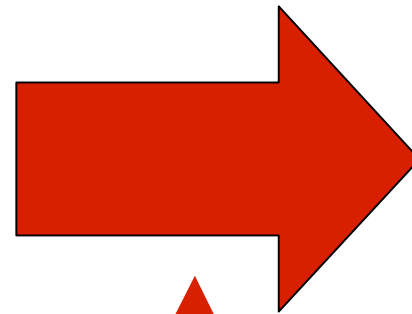
Are our students innovative?



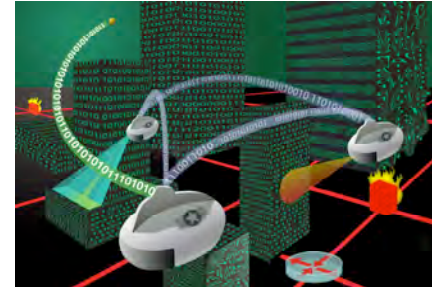
Are our students effective communicators?

(Taken from a presentation of Ken Kay and Milton Chen at the Education Finance Summit, National Conference of State Legislatures, San Antonio, February 15-17, 2008, <http://www.ncsl.org/edfinancesummit/>)

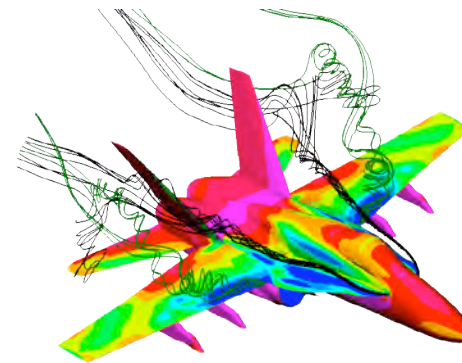
**Our Current  
Preparation  
in Science,  
Technology,  
Engineering  
and  
Mathematics  
(STEM)**



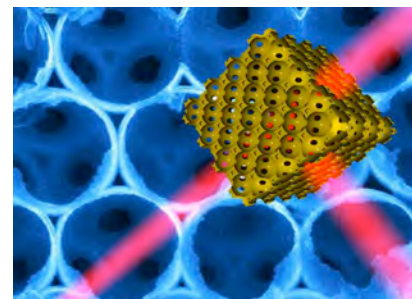
Strong  
connection  
needs to be  
made



***Mathematics,  
Information &  
Life Sciences***



***Aerospace,  
Chemical &  
Materials  
Sciences***



***Physics &  
Electronics***



## LINKS TO VISIT

<http://www.youtube.com/watch?v=pMcfrLYDm2U>

<http://www.youtube.com/watch?v=fhnWKg9B2-8&feature=related>

<http://www.youtube.com/watch?v=Tr1qee-bTZI&feature=related>

<http://www.youtube.com/watch?v=tx5KDyvlG3Q&feature=related>

<http://www.youtube.com/watch?v=Ooa8nHKPZ5k&feature=related>

<http://www.youtube.com/watch?v=7WMi5TUJDso>

<http://www.pvamu.edu/marshallgates>



**ANY  
QUESTIONS?**