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DoD STEM Education Strategy

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Outline

- **Why DOD is involved in STEM education**
- **DoD assets**
- **Coalition model**
- **Maryland pilot project**
- **Potential partnerships**



Problem Overview

What we care about, and why...

Assure High Quality Science, Technology, Engineering and Mathematics Workforce.

***Science and Technology provides
a vital force multiplying effect &
US "battlefield" advantage***

Sustaining U.S. Leadership in S&T requires

- ***World Class Technical Talent***
- ***State-of-the-Art Infrastructure***
- ***A Dynamic Innovation System***

***If the US loses its Technology Advantage --
National and Economic Security are At Risk***



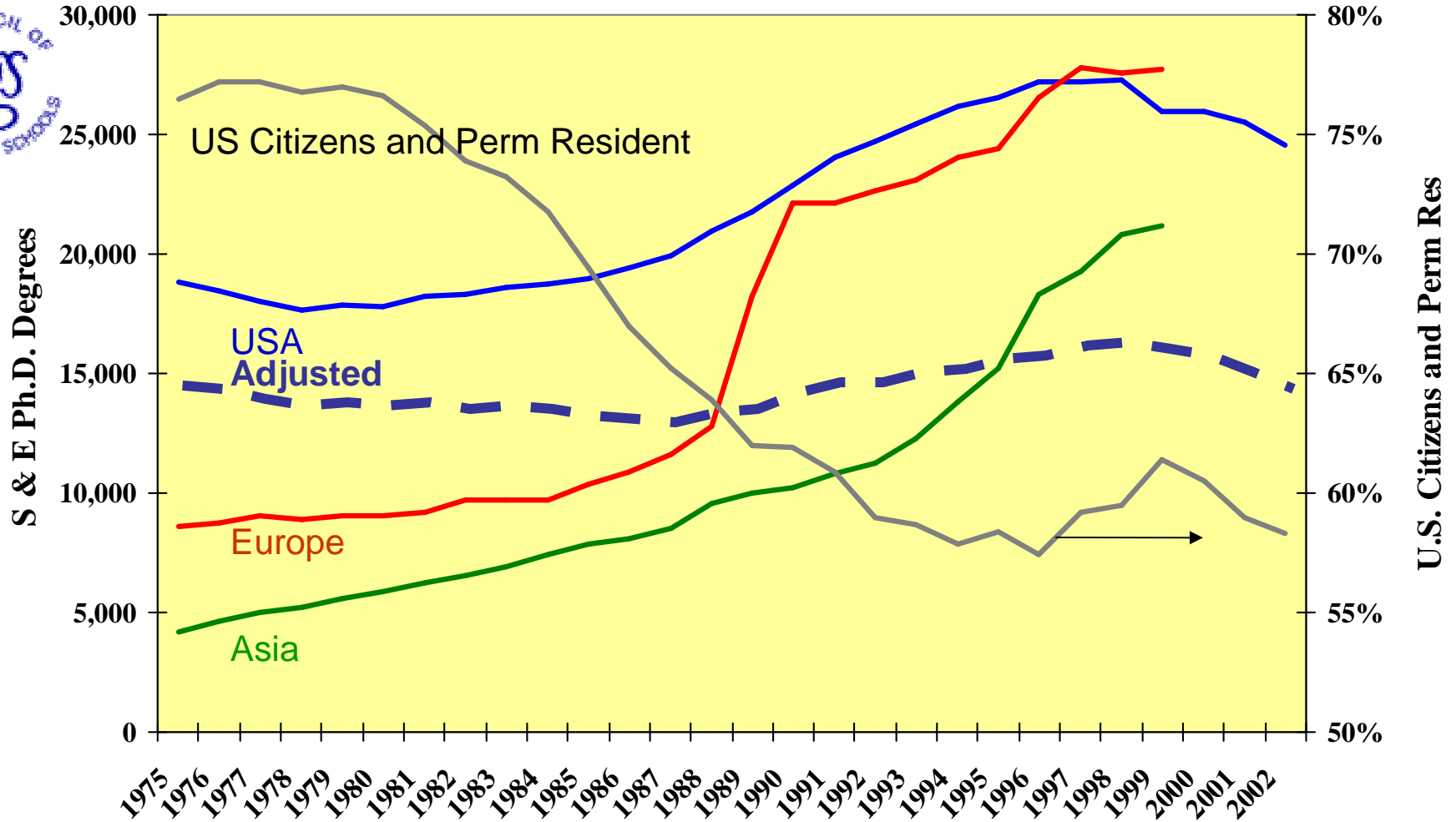
A National Issue

12 major studies (1999-2006) have pointed up key U.S. vulnerabilities in science, technology, engineering, and mathematics (STEM)

- **Under-performance of K-12 education**
- **Stimulating interest in STEM disciplines/careers**
- **Attrition in post-secondary STEM education**
- **Graying of the workforce**



Doctoral S&E Degrees by World Region



Council of Graduate Schools

— USA — Europe — Asia — % US Citizens

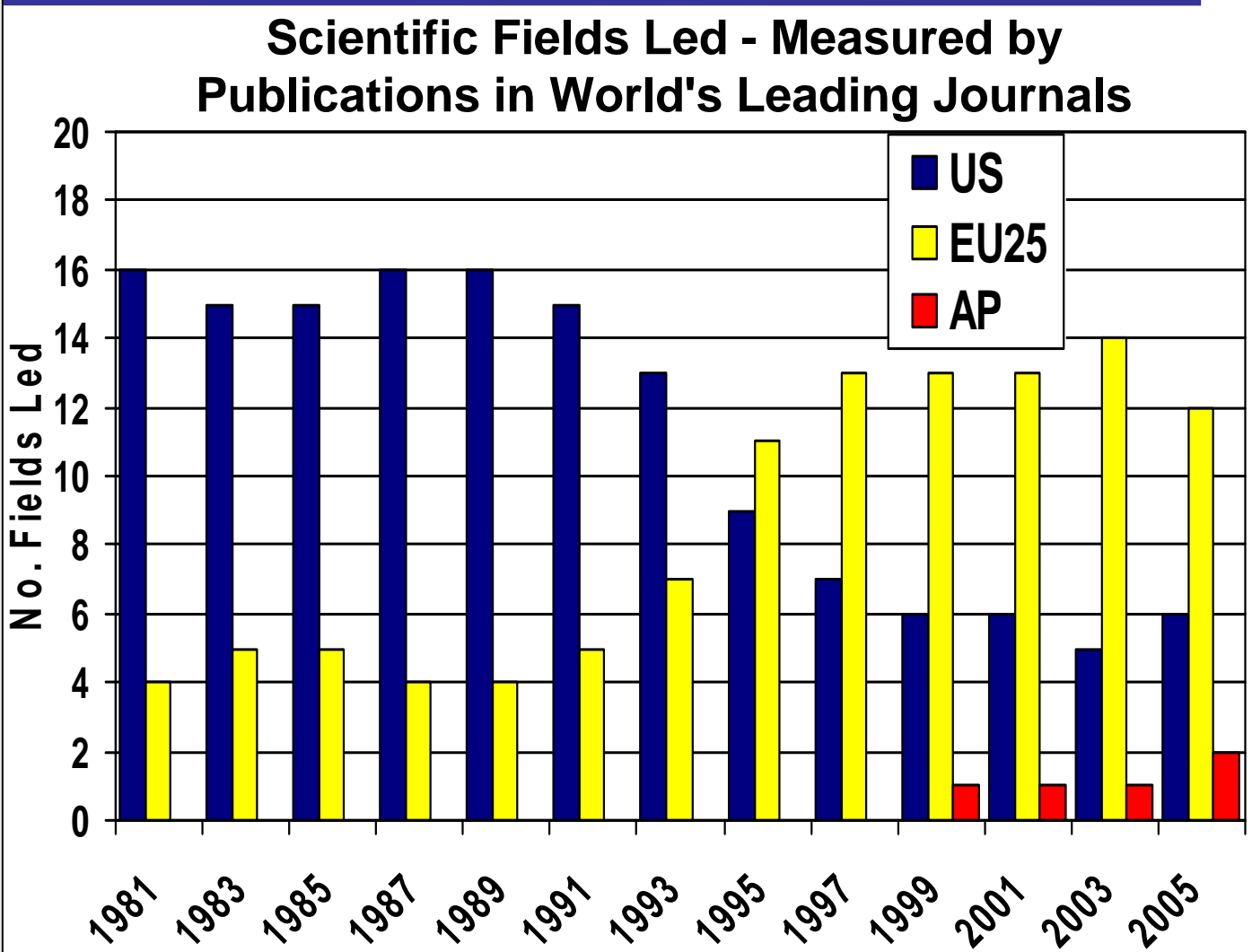
www.cgsnet.org⁵

Source: NSF Science and Engineering Indicators



World Technology Leadership

- 20 Technology Areas**
- Agricultural Science ~~-X~~
 - Biology & BioChem
 - Chemistry ~~-X~~
 - Clinical Medicine
 - Computer Science***
 - Ecology & Environment
 - Engineering ~~-X~~
 - Geoscience
 - Immunology***
 - Materials Science ~~-X~~
 - Math
 - Microbiology
 - Molecular Bio & Genetics***
 - Multidisciplinary***
 - Neuroscience***
 - Pharmacology ~~-X~~
 - Physics ~~-X~~
 - Plant & Animal Science
 - Psych & Psychiatry***
 - Space Science
- (*Led by US in 2005)
- X US is third in 3 way race**



From: R. Duane Shelton, Data Source: Thomson Scientific, National Science Indicators, ISI 2006, Copyright retained
 US= United States, EU25= European Union, AP= Asia Pacific



What DoD Brings to the Table

- Cutting edge tools, facilities and experts
- Distributed state-of-the-art research assets
- A large pool of committed STEM volunteers
- Significant industry and university relationships
- Far-reaching Congressional authorization in education and workforce development
- Many ongoing local and national programs
- High level of commitment including resources



Strategy

Recognize: Going it alone will continue to achieve marginal gain

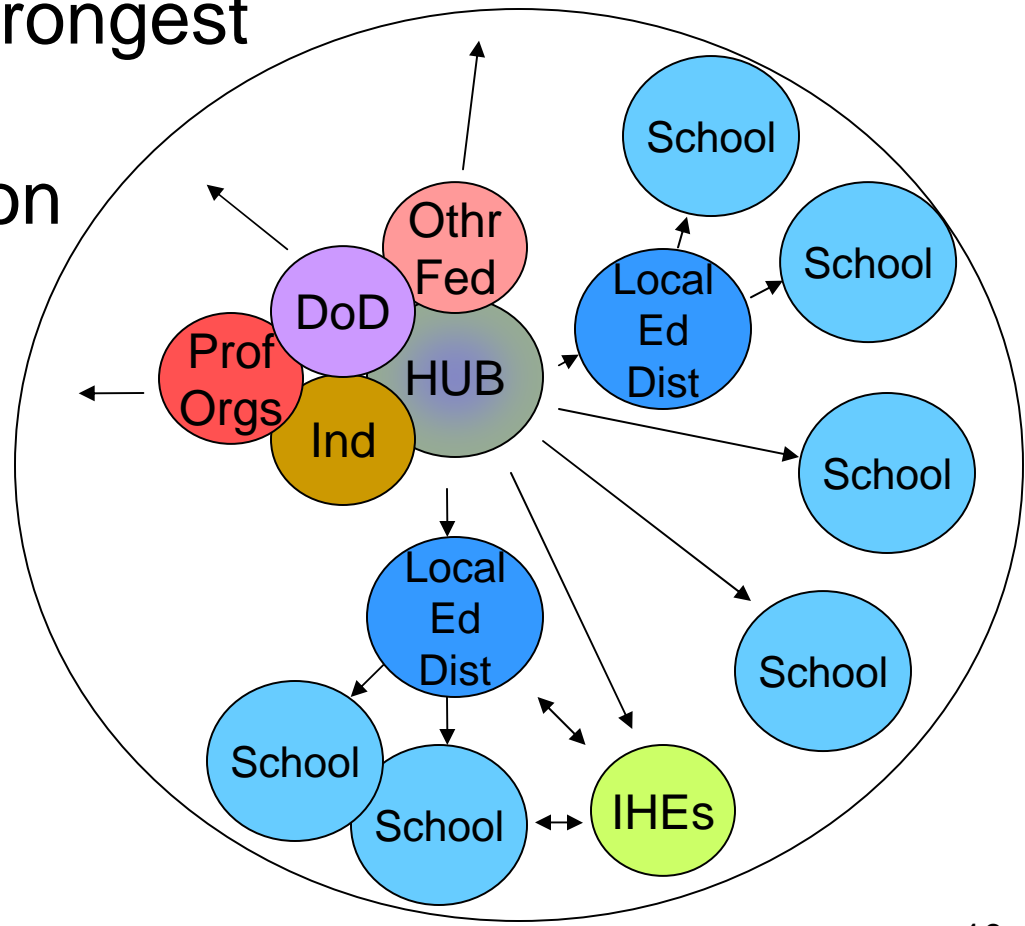
Engage – Collaboratively and Comprehensively

- **Perspective** -- Address the whole Pipeline
 - Identify effective activities at all levels, K-graduate
- **Pathways** – Connect Learning to Life & STEM Careers
 - Link in-school and lab-based opportunities
 - Engage students as they progress through the continuum
- **Partnerships** -- Build Coalitions
 - Industry, State & Local Education Authorities, Educators, Academia, and other Government Agencies
 - Defy the Not-Invented-Here mentality



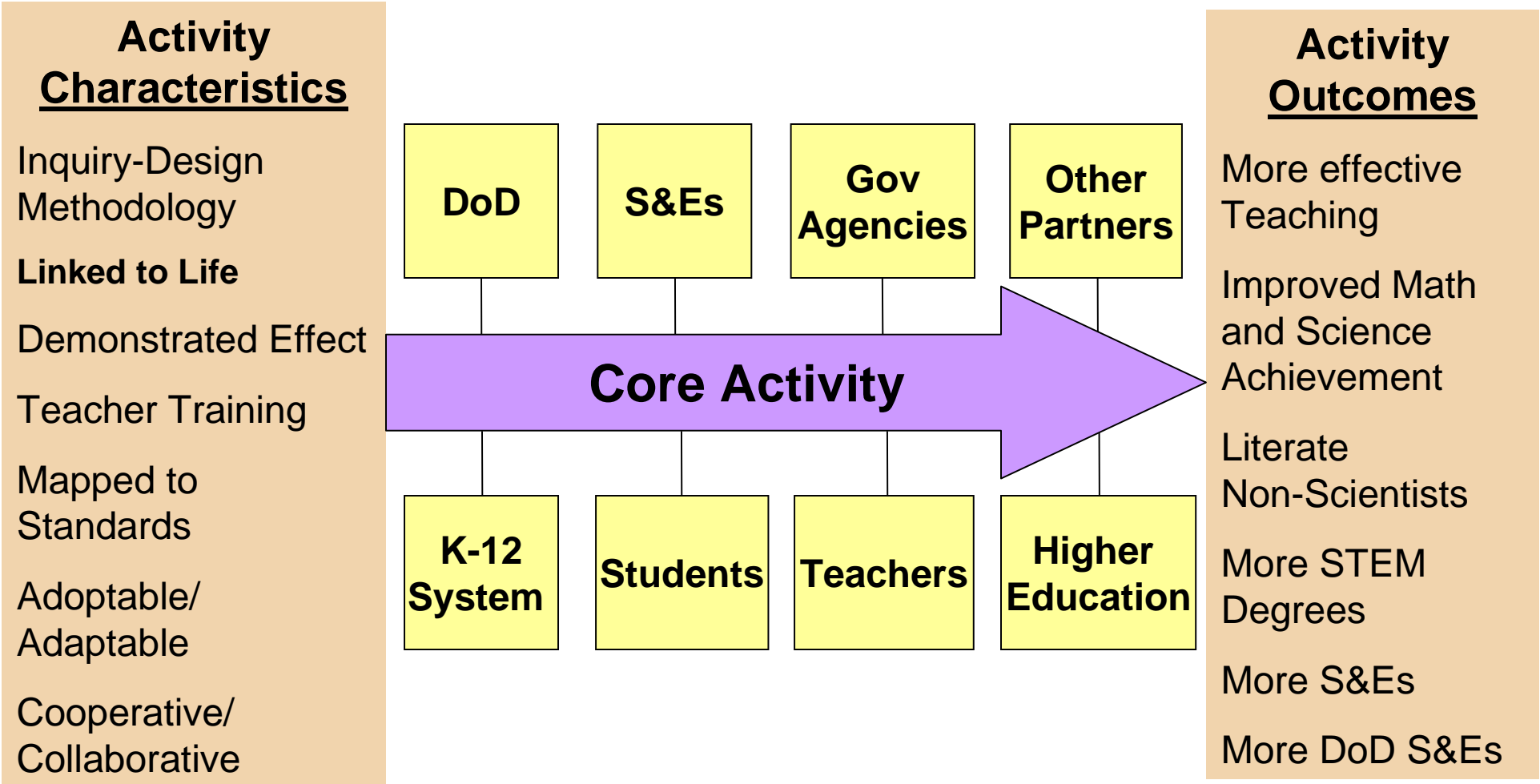
A Model for Outreach/Integration

- HUB & Spoke Interface
 - HUB should be Strongest STEM Presence
 - Easier Coordination
 - Local Meetings
- Comprehensive Delivery
- Critical Mass
- Greater Impact Training Teachers
- Improved ROI For Everybody





Coalition Model





Objectives

- Internal
 - Align assets around a coordinated strategy
 - Identify and Use effective approaches
- External
 - Create momentum around a single, specific effort
 - Foster a national culture of collaboratively engaging in STEM education improvement
 - Recognize, Adopt and Repeat:
No organization can build capacity on the scale that is required on its own – **We Must Work Together**

.....Work Together On What?



One Specific Effort

This effort meets all the criteria:

Materials World Modules

- Interdisciplinary approach to Inquiry-Design Based Instruction
 - Inquiry-Design based approach simulates the methodology used by DOD and Industry to develop technologically advanced products
- Curriculum enhancement developed and refined over 10 years by internationally recognized researcher
- Enables real-world application of textbook concepts
- Mapped to MD Standards (and others)
- Field-tested, evidence-based
- Opportunity for collaboration abounds
- MWM offers far more than just MWM – it's a rally point

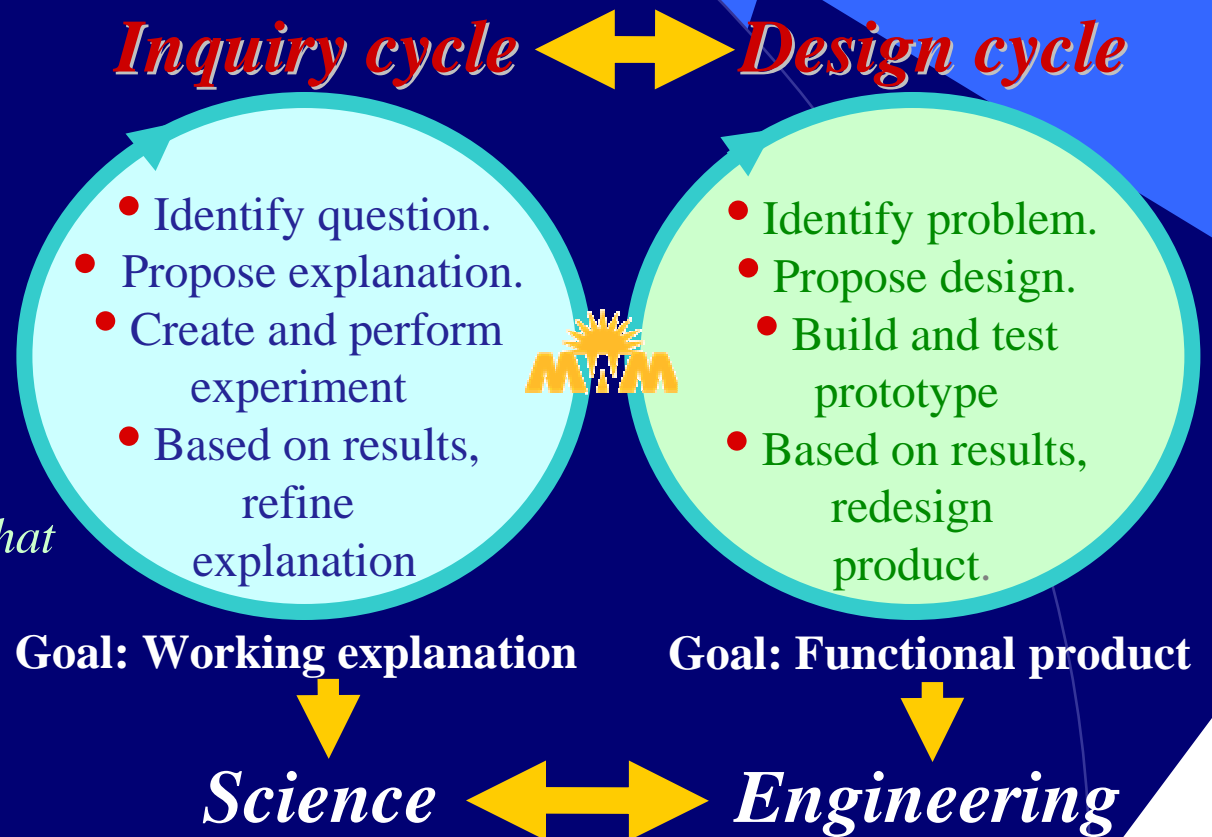


Materials World Modules

Northwestern University Materials World Modules (MWM)

- Secondary School Curriculum
- Pedagogy integrates Inquiry and Design

- Students complete a series of hands-on, *inquiry-based activities* in each module
- Each module culminates in *design challenges*
- Students simulate the work of *scientists* (through activities that foster inquiry) and *engineers* (through activities that emphasize design)





DoD Approach to MWM Scale-Up

- Invest over (3-5) years to establish a sustainable program
- Leverage community college network to disseminate program and train teachers
- Demonstrate that collaboration at scale can occur through regional consortia
- Measure program effectiveness through rigorous evaluation



National Defense Education Program

PE: 0601120D8Z	FY06	FY07	FY08	FY09	FY10	FY11	07-11
PR-07 Request	10.1	19.5	26.1	31.7	52.9	74.4	204.6

- National Defense Education Program (NDEP)
 - Addresses identified needs and stimulates holistic approach to improving STEM education (i.e., the entire pipeline)
 - Base program: SMART – comprehensive education and training program offers scholarship/fellowship and employment
- 2007 NDEP Highlights
 - Expansion of SMART scholarship/fellowship awards (~\$14.5M)
 - Expansion of Pre-College enhancement & coordination (~\$5M)
 - Inquiry-Design Based Instruction
 - Materials World Modules



SMART/NDEP Program

National Defense Education Program (NDEP)

Science Mathematics and Research for Transformation (SMART)

- Defense critical disciplines
- Security clearable
- Have & maintain a minimum GPA 3.0 on 4.0 scale
- Civil Service payback required (set at 1 to 1 by policy)
- Scholarship/Fellowship (Associate through Ph.D.)
- Employee status while enrolled
- Comprehensive education and training = shaped workforce
- Post degree follow-up
- ~40 awards in FY06 (30 in FY05)

<http://www.asee.org/smart/>



Partnership Opportunities

- **Leadership**
 - Take the lead near your facility
- **People**
 - Scientists and engineers
 - Partner with and Support classroom teachers
 - Support for after-school efforts
 - Coordination requires a Coordinator
- **Resources**
 - Funding
 - Facilities

**Beginning or Joining such an effort
will bring other collaborative opportunities into view**



Backup



DoD STEM Education Efforts

DoD is engaged in education enrichment activities at every level: K- 20 and Professional Development

Level of Support

Elementary

High School

Undergraduate

Graduate

Post-doctoral

Faculty

Continuing Education

Type of Support

Apprenticeship-Employment

Coop/ Work Study

Equipment Donation

Grants/Stipends

Mentoring/Tutoring

Release Time

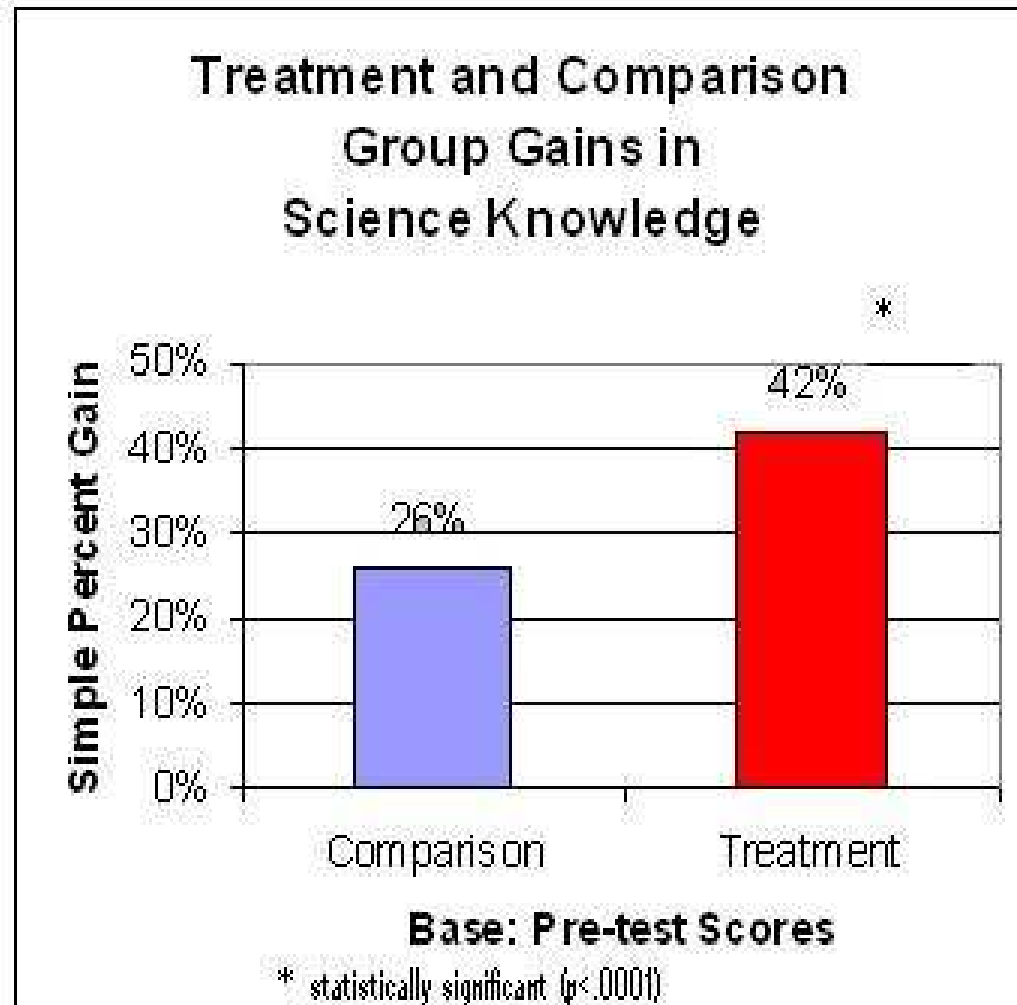
Scholarships/Fellowships

Tuition Assistance



Results of 2006 Summer Institute

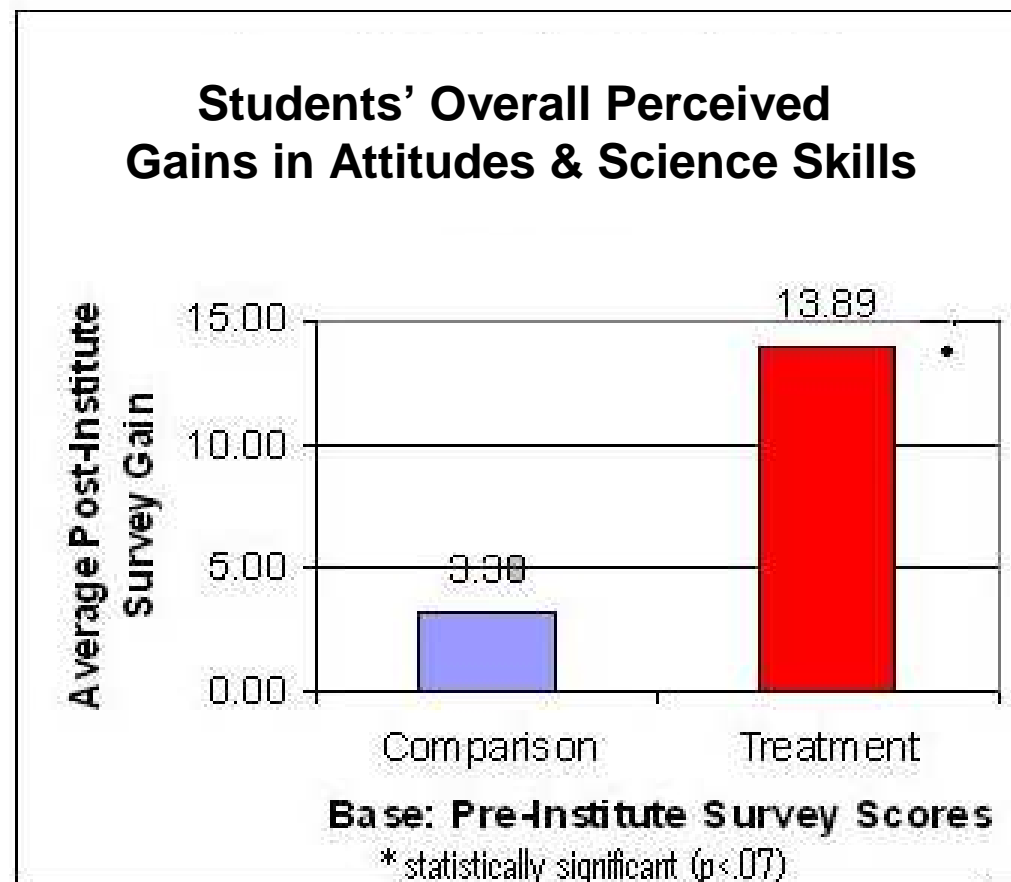
Impressive Gain (62%) over Control in Science Knowledge





More results

High Attitudinal shift





DoD S&E Challenges

- Attrition in DoD labs
- Unfilled needs in critical technologies
- Thinning supply of clearable students acquiring defense-related skills
- Increased competition for the best and brightest

Projected U.S. demand for:

Scientists will be up 17% and

Engineers will be up by 22% by 2014

(November 2005 BLS Monthly Labor Review.)



Rationale For Maryland Pilot

- High concentration of research labs including DoD, NASA, NIH, NIST
- Progressive force in STEM education
- Diverse economy and student population
- Many science and technology-based employment opportunities
- If we can't do it in Maryland...



Goals in Maryland

- Develop an implementation model that can be replicated
- Develop lessons learned that can be applied around the country
- Produce outcomes that capture national attention