Fort Detrick and National Interagency Confederation for Biological Research (NICBR)

Office of the Secretary of Defense

Keith Thompson

DoD STEM Education Strategy

Maryland Business Roundtable for Education

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Outline

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

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

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

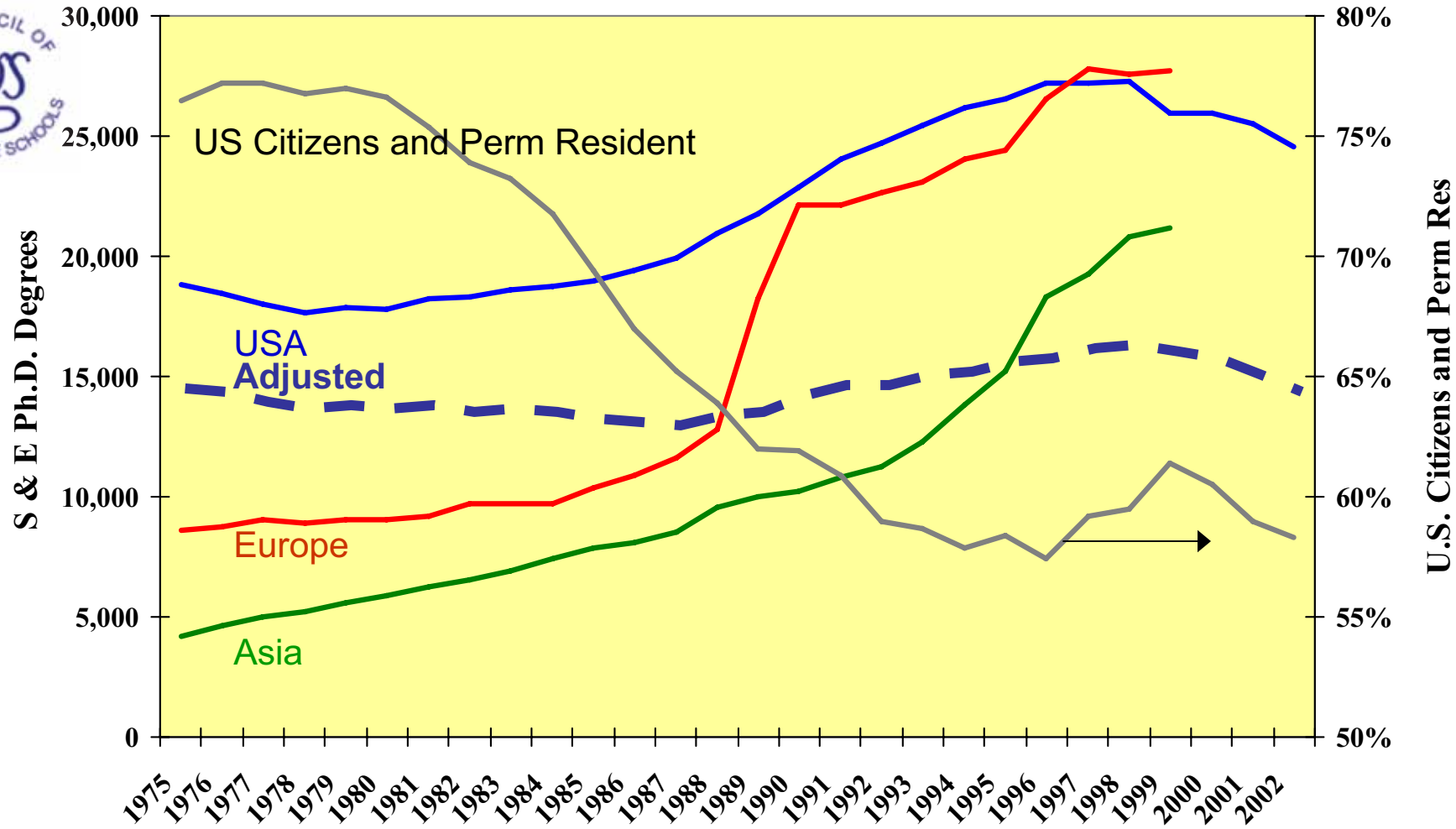
(November 2005 BLS Monthly Labor Review.)

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



USA — Europe — Asia — % US Citizens

Source: NSF Science and Engineering Indicators

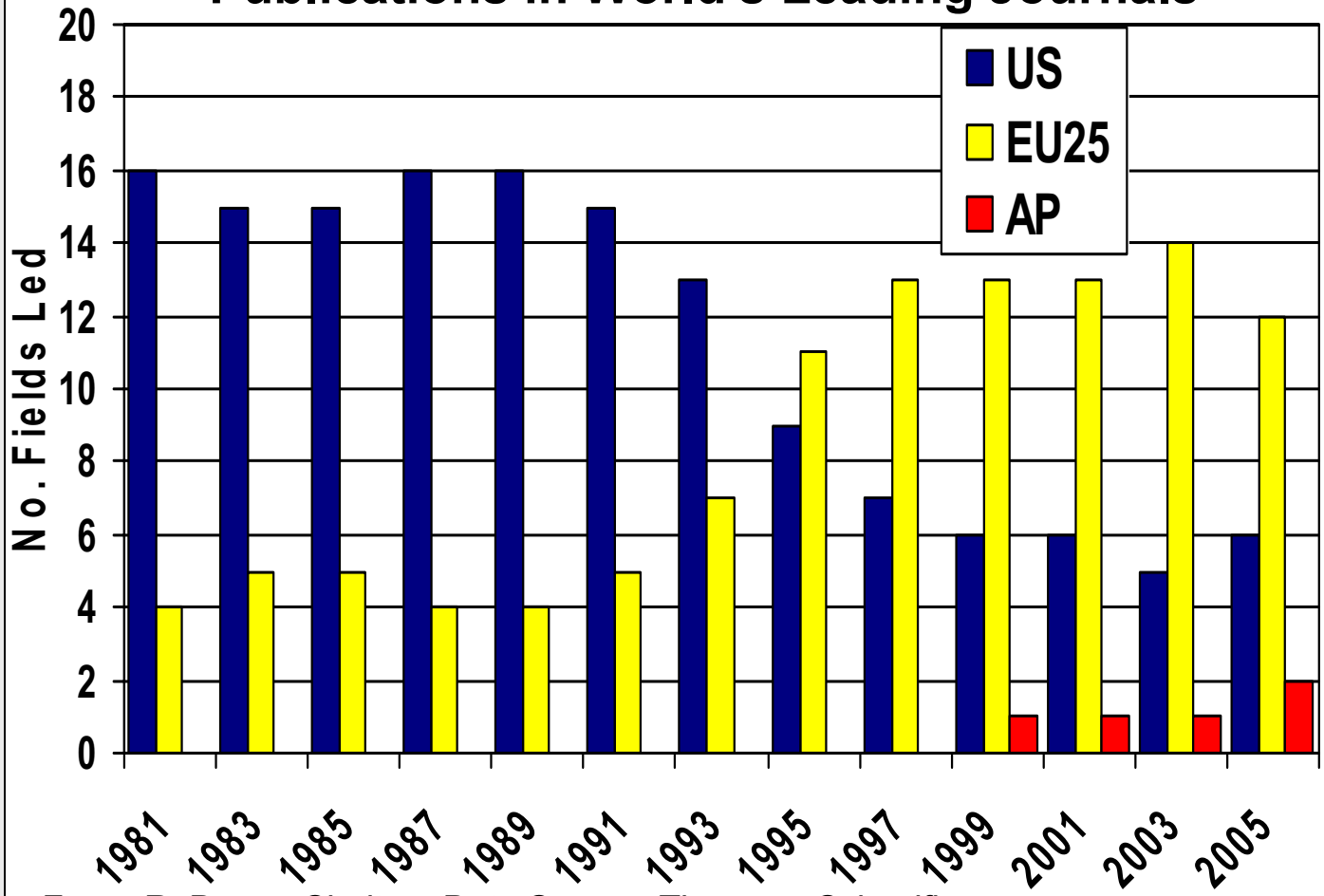
World Technology Leadership

20 Technology Areas

Agricultural Science -X
Biology & BioChem
Chemistry -X
Clinical Medicine
Computer Science*
Ecology & Enviroment
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

Scientific Fields Led - Measured by Publications in World's Leading Journals



From: R. Duane Shelton, Data Source: Thomson Scientific, National Science Indicators, ISI 2006, Copyright retained

US= United States, EU25= European Union, AP= Asia Pacific

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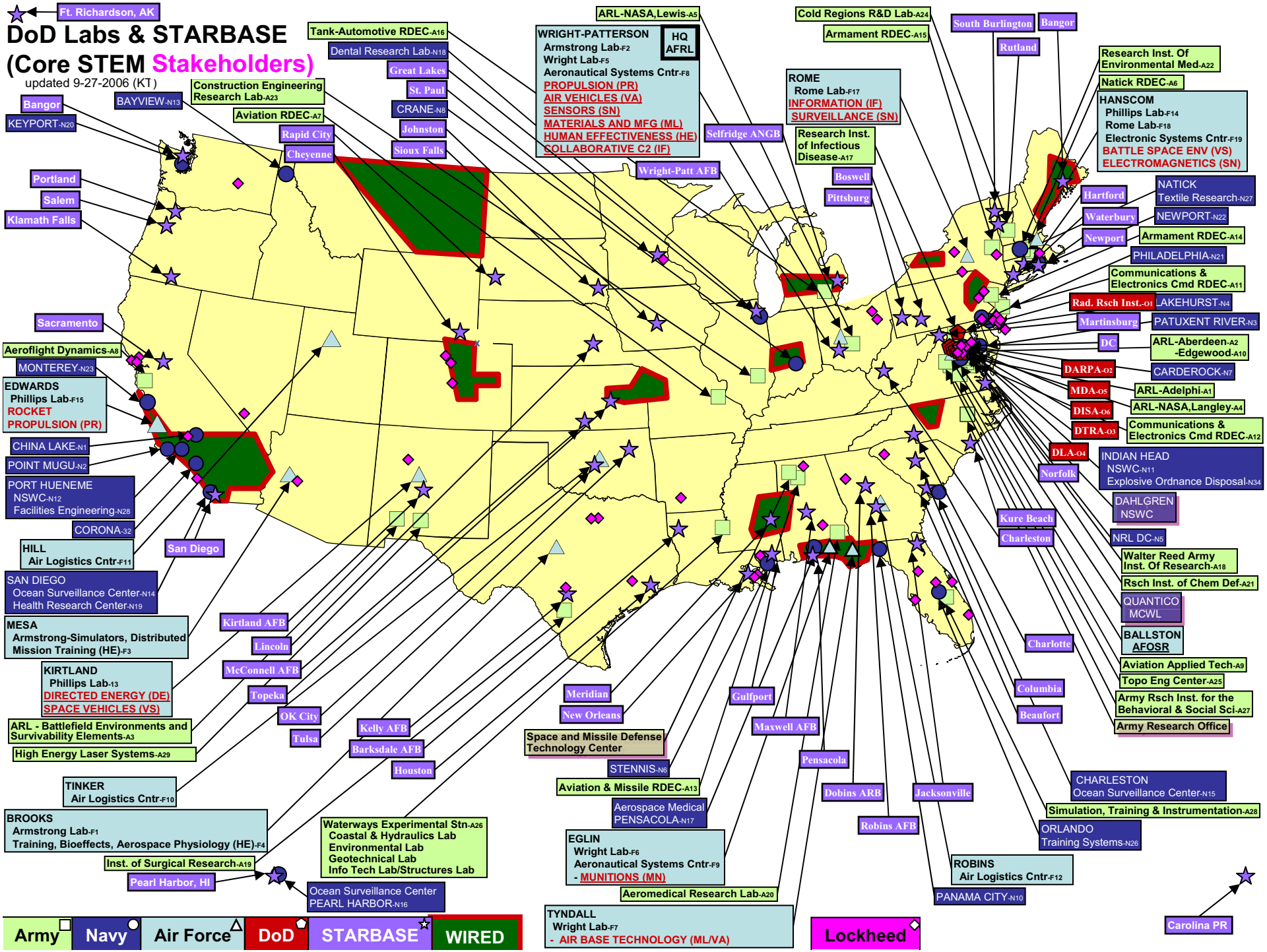
What DoD Brings to the Table

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

DoD Labs & STARBASE (Core STEM Stakeholders)

updated 9-27-2006 (KT)



Strategy

Recognize: Going it alone will continue to achieve marginal gains

Engage – Collaboratively and Comprehensively

- **Perspective** -- Address the 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

Coalition Model

Activity Characteristics

Inquiry-Design Methodology

Linked to Life

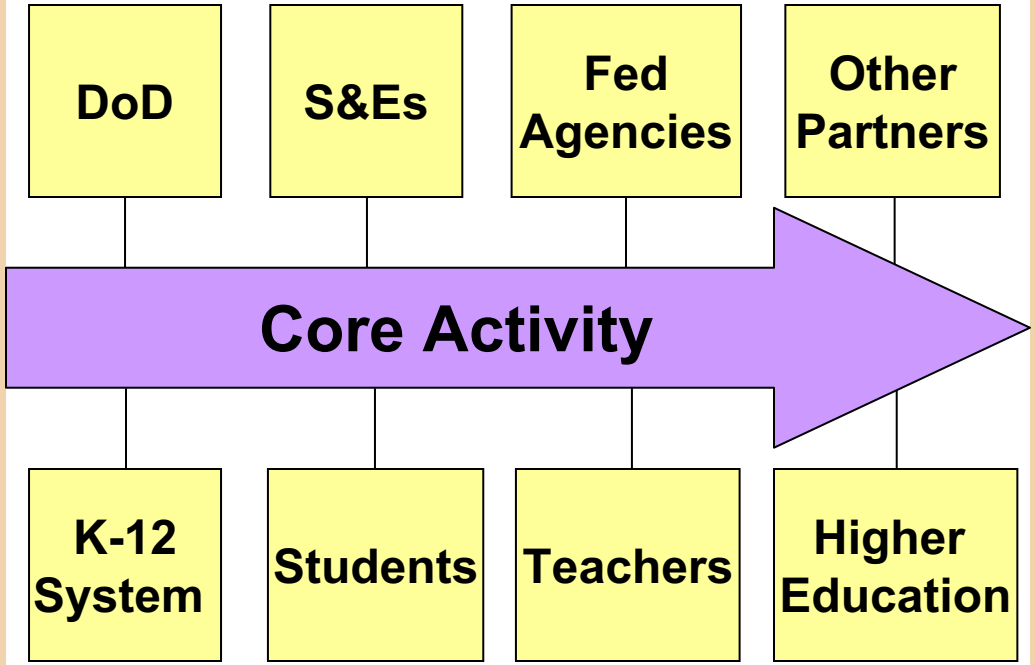
Demonstrated Effect

Teacher Training

Mapped to Standards

Adoptable/ Adaptable

Cooperative/ Collaborative



Activity Outcomes

More effective Teachers

Improved Math and Science Achievement

Literate Non-Scientists

More STEM Degrees

More S&Es

More DoD S&Es

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 collaboration in STEM education
  - 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-Based Learning
  - Inquiry-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

- Lots of opportunity for collaboration
- MWM offers far more than just MWM – it's a rally point

DoD Approach to MWM Scale-Up

- Invest ~ $15 million over (3-5) years to establish a sustainable program
- Leverage community college network to disseminate program and train teachers
- Demonstrate that <u>collaboration</u> <u>at scale</u> can occur through regional consortia
- Measure program effectiveness through rigorous evaluation

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 applied around the country
- Produce outcomes that capture national attention

Partnership Opportunities

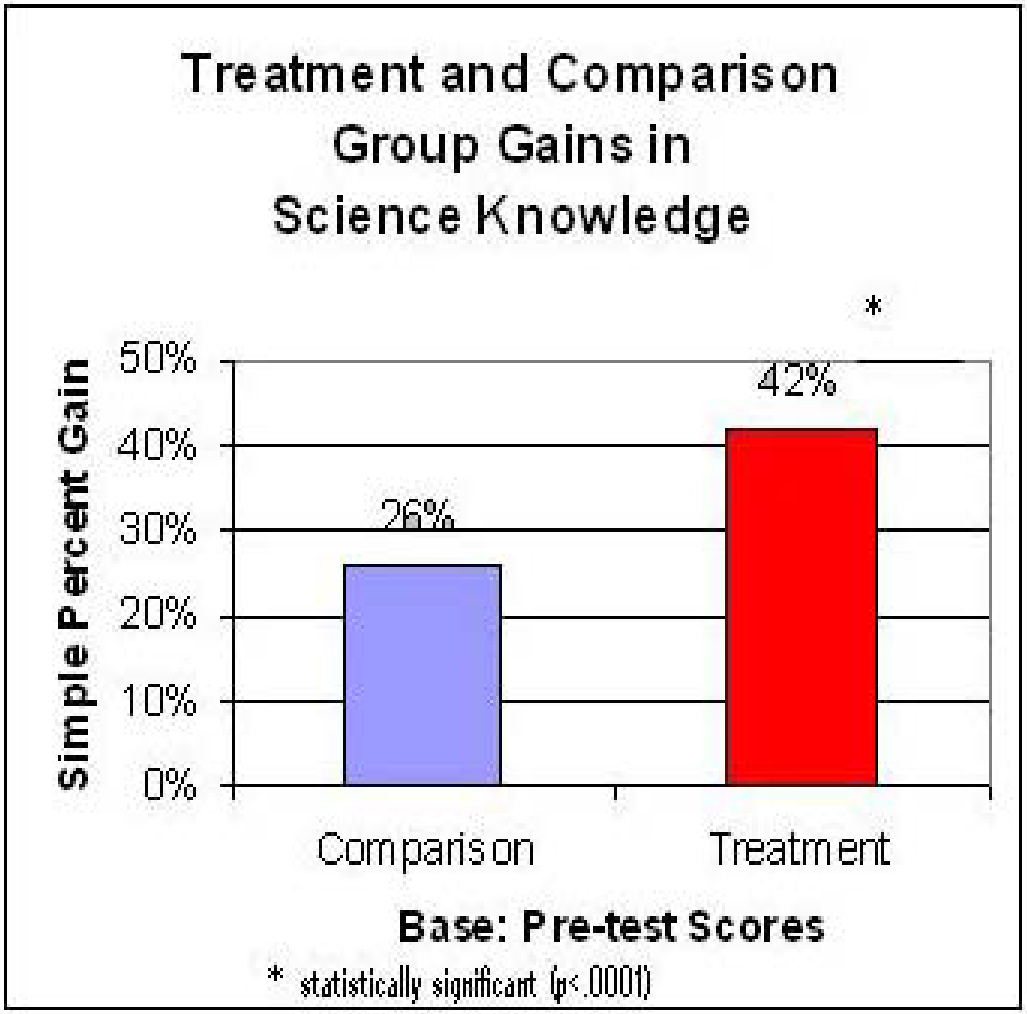
- Leadership
  - take the lead near your facility

- People
  - Scientists and engineers
  - Support for classroom teachers
  - Support for after-school efforts
  - Coordination requires a Coordinator
- Resources
  - Funding
  - Facilities

Joining the effort will bring other opportunities into view

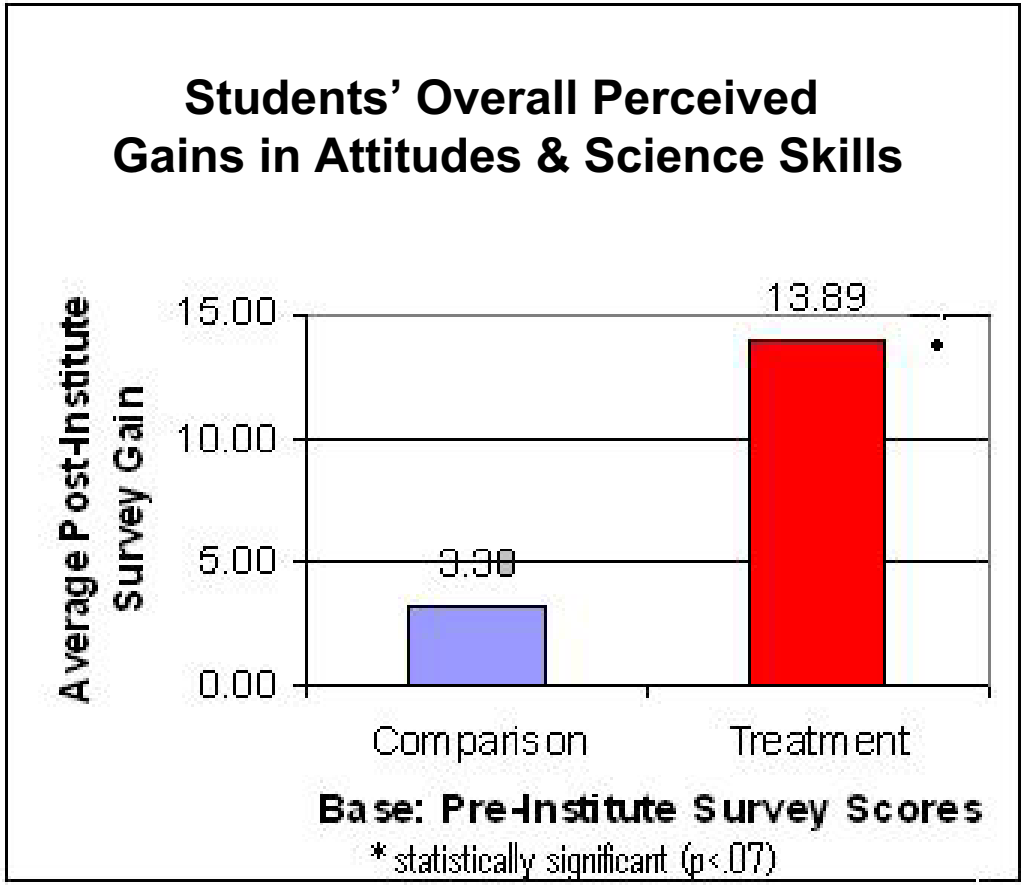
Results of 2006 Summer Institute

Impressive Gain (62%) over Control in Science Knowledge



More results

High Attitudinal shift



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)*

Inquiry cycle ⟷ ***Design cycle***

- Identify question.
- Propose explanation.
- Create and perform experiment
- Based on results, refine explanation

- Identify problem.
- Propose design.
- Build and test prototype
- Based on results, redesign product.

Goal: Working explanation ↓ ***Science***

Goal: Functional product ↓ ***Engineering***