

National Academy of Sciences Symposium April 28, 2004



Carl Truxel

Technology Education Department

Dulaney High School

Baltimore County, Maryland

National vs. Maryland Technology Standards

- Baltimore County courses
- Dulaney High School courses
- Engineering Tech/Physics Evolution
- Advanced Technology Options
- Staff Development
- Community Support
- Was it worth it?
- 2004/2005 Registration

Dulaney High School

Baltimore County, MD

- Student Enrollment: 1952
- Standard, Honors, G & T
- Concurrent college enrollment

Dulaney High School

Baltimore County, MD

- **Class of 2004**
 - 7 National Merit Finalists
 - 30 National Commended Students
 - 60 Maryland Distinguished Scholars
- **Class of 2003**
 - 7 National Merit Finalists
 - 26 National Commended Students
 - 51 Maryland Distinguished Scholars

Dulaney High School Baltimore County, MD

- 80% Caucasian
- 12% Asian
- 7% African American
- 1% Hispanic

Dulaney High School

Baltimore County, MD

Pathways - Schools within a School

- Health and Biological Sciences
- Engineering and Technology
- Communications and Fine Arts
- Business
- Combined Studies
- Law, International Studies and Public Affairs

National Standards

Students will develop an understanding of:

- Technology (3)
- Effects on Society (4)
- Design (3)
- Abilities for a Technological World (3)
- The Designed World (7)

Maryland Standards

Acquire skills and knowledge of:

- The nature of technology
- The impact of technology
- Engineering Design

(continued)

Maryland Standards (cont'd)

- CORE Technologies

Biological

Mechanical

Electrical

Optical

Electronic

Structural

Fluid

Thermal

Materials

(continued)

Maryland Standards (cont'd)

- The Designed Worlds of:

Agricultural &
Biological

Medicine

Construction

Manufacturing

Energy & Power

Transportation

Information &
Communications

County-wide Technology Education Offerings

Animal Behavior	Environmental Science
Aquatic Science	Foundations of Technology
Architecture	Introduction to Technology Systems
Communications	Manufacturing
Computer Networking	Paramedical Biology
Digital & Analog Electronics	Power, Energy & Transportation
Drafting/CAD	Radio & Television
Engineering 101	Research & Experimentation
Engineering Tech/Physics	

Dulaney HS Selections

* indicates Basic

** indicates Advanced

Animal Behavior	**Environmental Science
Aquatic Science	*Foundations of Technology
**Architecture	Introduction to Technology Systems
**Communications	Manufacturing
**Computer Networking	*Paramedical Biology
Digital & Analog Electronics	Power, Energy & Transportation
*Drafting/CAD	**Radio & Television
**Engineering 101	**Research & Experimentation
*Engineering Tech/Physics	

Interdisciplinary Connections

Fluids – Boat Hull Design

■ Theory

- Corpus immerses in umore a vi qui ascendit pare ponderi copiae umoris summati afficitur
- Un cuerpo sumergido en un fluido es actuado por una fuerza hacia arriba iguala al peso del volumen de fluido desplazado

Interdisciplinary Connections

Fluids – Boat Hull Design (cont'd)

■ Concepts

Displacement	Laminar flow
Buoyancy	Eddy
Viscosity	Symmetry
Density	Balance
Specific gravity	Torque
Streamline	Ballast
Turbulence	Acceleration with constant force

Interdisciplinary Connections

Fluids – Boat Hull Design (cont'd)

■ Mathematics

Ratios

Proportions

Fractions

Equations

Decimals

Volume

Linear Measurements

Interdisciplinary Connections

Mechanics- Mouse Trap

Powered Vehicle

- Theory

- Energy storage and conversion

- Concepts

Torsion

Coil Spring Theory

Hooke's Law

Potential & kinetic energy

Friction

Momentum

Mechanical advantage

Vectors

Velocity

Acceleration

Summation of forces & moments

(cont'd)

Interdisciplinary Connections

Mechanics- Mouse Trap

Powered Vehicle (cont'd)

■ Mathematics

Ratios

Fractions

Decimals

Linear measurements

Perpendicularity

Parallelism

Formulas

Trigonometric functions

Angular measurements

Interdisciplinary Connections

Structures & Static Mechanics- Bridges & Towers

■ Theory

- Maximize the live load to dead load efficiency

■ Concepts

Compression

Bending

Shear

Forces

Live load

Reactions torsion

Moments of inertia

Tension

Deflection

Elastic limit

Vectors

Dead load

Neutral axis

Materials

Interdisciplinary Connections

Structures & Static Mechanics- Bridges & Towers (cont'd)

■ Mathematics

Geometric shapes

Symmetry

Linear measurements

Trigonometric functions

Fractional parts

Vectors

Formulas

Linear equations

Interdisciplinary Connections

Projectile Motion (Types I, II, or III)

Launching Device Theory-Predictable Trajectories

- Theory
 - Predictable trajectories

- Concepts

Power

Velocity

Inclination angle

Altitude

Turbulence

Azimuth

Potential and Kinetic energy

Mass

Acceleration

Trajectory

Apex

Range

Accuracy

Repeatability

(cont'd)

Interdisciplinary Connections

Projectile Motion (Types I, II, or III)

Launching Device Theory-Predictable Trajectories

■ Mathematics

Fractions

Decimals

Linear measurements

Vectors

Linear equations

2nd order equations

Angular
measurements

Trigonometric
functions

Interdisciplinary Connections

Problems & Assessments

- Activities are based on applied science theory
- Product specifications define the challenge
- Documentation and performance requirements resources defined
- “Point value” established, i.e. 100-350
- Assessments for theory and practical skills
- Scoring rubric
 - Design
 - Documentation
 - Performance

Engineering Technology/ Physics Program

- Trial run
 - 7 Seniors from Power & Energy class
- Physics/Tech Ed curriculum presentation sequences
- Number of women participants

(cont'd)

Engineering Technology/ Physics Program (cont'd)

- Scheduling changes proposed:
 - Students taking Physics and Chemistry in 11th grade would NOT take Technology Education in 9th or 10th grades
 - Engineering Tech/Physics taught concurrently with higher level mathematics and Language Arts courses
 - Classes would be scheduled to allow 4 class periods per week in each area plus a double laboratory period

Transition Period Statistics

	1996	1997
Standard Physics Classes	2	3
Honors Physics classes	4	6
G & T Physics students	35	50
Advanced Placement students	12	25
Engineering Technology classes	9	12
Female representation	25%	42%

Research and Experimentation

- Structured portion
 - Research methodologies - JHU RET program
 - Scientific Method - Science curriculum, history
 - Scheduling & Estimating - PE resource
 - Engineering Graphics - VectorWorks
 - Data Collection & Analysis - Laboratory procedure(s)
 - Ethics Issues - PE Code, case studies

(cont'd)

Research and Experimentation (cont'd)

■ Research Areas 2003/2004

- Fluid systems - Cargo ship design
- Electro-mechanical - microprocessor controlled tractor
- Acoustics - High quality output from ported enclosures
- Solar Energy - Incorporation in hybrid vehicle design
- Magnetics - Systems for transportation use
- Structures - Quake-proof bridges and towers
- Aerodynamics - $1/10$ scale gas turbine amplifiers
- Electronics - Plasma circuits in audio amplifiers
- Robotics - Basic/C++ controlled multi-sensory devices

Engineering 101 Content

- Applications software – Microsoft Office
- Engineering Graphics – VectorWorks
- Programming – Java, C++
- Data Collection – Project dependent
- Properties of materials – ferrous, non-ferrous, synthetic
- Static Mechanics – Structural analysis, beams, trusses, cables
- Thermal Technology – Heat transfer

Staff Development

- 1994 SCI/TECH Committee established
- One Science and one Technology teacher per high school
- Build solid working relationship, understand both contents
- Review commercially available resources
- Create theory-specific activities
- Supervisors blessed and SUPPORTED program

Community Support

- Baltimore Museum of Industry
- Technology Education Association of Maryland
- International Technology Education Association
- University of Maryland
- Johns Hopkins University ERC
- National Aeronautics and Space Administration
- American Institute of Aeronautics and Astronautics
- American Society of Chemical Engineers
- American Society of Civil Engineers
- American Society of Mechanical Engineers
- American Society of Highway Engineers
- Institute of Electrical, Electronic Engineers
- Maryland Society of Professional Engineers

Was It Worth the Effort?

- 93% of R & E and Engineering 101 students were accepted in four-year Engineering programs
- During 2002/2003, 367 students took 843 AP exams
- 86% of ALL AP test takers scored 3 or better
- 60% of all seniors and 34% of all juniors are enrolled in at least 1 AP course
- 23 AP courses are offered, 10 in Mathematics and Science

Was It Worth the Effort?

(cont'd)

- Percentages of ALL tested students scoring 3 or better in Mathematics and Science tests:

AP Calculus (2 courses)	96%
AP Chemistry	90%
AP Computer Science	100%
AP Physics E & M	100%
AP Physics Mechanics	100%
Statistics	85%

Was It Worth the Effort?

(cont'd)

- Engineering Tech/Physics programs

2000/2001	Perry Hall, Carver, Catonsville, Woodlawn
2001/2002	Franklin, Loch Raven, Overlea, Randallstown
2002/2003	Pikesville, Towson
2003/2004	Sparrows Point, Chesapeake, Hereford, Parkville
2004/2005 (planned)	Dundalk, Kenwood

Dulaney's Fall 2004 Registration

- 345 students in 15 sections of Engineering Tech/Physics
 - 98% of registrants are juniors
- 285 students in seven other courses
- 630 (total) students to be served 2004/2005

**Found another way to
NAIL YOUR JELLO
TO THE TREE?**