Designing the Future at Newburyport High School
From the Massachusetts Science and Technology/Engineering Curriculum Framework

The Relationship Among Science, Engineering, and Technology

Science seeks to understand the natural world, and often needs new tools to help discover the answers.

Engineers use scientific discoveries to design products and processes that meet society’s needs.

Technologies (products and processes) are the result of engineered designs. They are created by technicians to solve societal needs and wants.
Massachusetts Science and Technology/Engineering Curriculum Framework
Strand 3 - Physical Science

Broad Concept: Newton's Laws of motion and gravitation describe and predict the motion of most objects.

At Newburyport High School, physics students use 3D design software when they design, build and test projects that address the concepts of motion and forces.

Examples:
- Eggcellerator Cars
- Catapult Project
- Mouse Trap Cars
Massachusetts Science and Technology/Engineering Curriculum Framework
Strand 4 - Technology Engineering

Broad Concept: Engineering Design involves practical problem solving, research, development and invention and requires designing, drawing, building, testing and redesigning.

At Newburyport High School, students use ProDESKTOP to design projects in Robotics and CAD classes.

Examples:

Hacky Sack  Robot
Escape Robot
The Engineering Design Process

Steps of the Engineering Design Process

1. Identify the Need or Problem
2. Research the Need or Problem
3. Develop Possible Solution(s)
4. Select the Best Possible Solution(s)
5. Construct a Prototype
6. Test and Evaluate the Solution(s)
7. Communicate the Solution(s)
8. Redesign
Benefits of Making Connections Between Math, Science and Technology/Engineering

- Move Technology/Engineering beyond production-based content to critical thinking and problem solving
- Design and construction activities reinforce abstract math and science concepts
- Highly visual and hands-on experiences motivate students with various learning styles
Why is 3D Design Software Important?

- Quick way for students to get ideas into a design format
- Promotes collaborative learning
- Quality of work: clean, accurate, does not require artistic talent
- Designs can be exported for use in rapid prototyping and CNC machining operations
Multidisciplinary tool enables students to quickly conceptualize, design and develop working plans for their project ideas in:

Tech/Engineering  CAD/Drafting  Art
Physics  Math
Gallery of Student Designs

Bike

Joe P.
Laptop Computer
Bus with Interior View

Matt S.
Technology/Engineering

Course: Robotics
Teacher: Steve Smith
Concepts: Engineering design process
Extrude, project, sweep, revolve, loft
Prototyping
Manufacturing (CNC)
Projects: Hacky Sack Robot
Escape Robot
Robot Car

Conor W.
Differential Gear Assembly

Bill D.
Rapid Prototyping
Students chose an existing product they felt could be improved upon. They surveyed consumers, developed a Customer Needs Statement, Established Benchmark Standards and used Pro/DESKTOP to redesign the product.

**Customer Need Statement**

*Self Dispensing Toothbrush*

**Team #5**

We are making a Self Dispensing Toothbrush that will screw on the top of a toothpaste tube and you can brush with it without putting the toothpaste on.

<table>
<thead>
<tr>
<th>Customer Needs</th>
<th>Apply</th>
<th>Design Needs</th>
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</thead>
<tbody>
<tr>
<td>1. It needs to be comfortable to hold</td>
<td>Yes</td>
<td>Rubber</td>
</tr>
<tr>
<td>2. It needs to be easy to clean</td>
<td>Yes</td>
<td>Comes with a syringe</td>
</tr>
<tr>
<td>3. It needs to be simple to use</td>
<td>Yes</td>
<td>Easy to screw on, self explanatory</td>
</tr>
<tr>
<td>4. It needs to be durable</td>
<td>Yes</td>
<td>Strong Plastic, strong design</td>
</tr>
<tr>
<td>5. It should be flexible but durable</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>6. It should be comfortable to brush with</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>7. Colorful and vibrant</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
Science

Course: Physics

Concepts:

Force and Motion
Conservation of Energy:
Exchanges between Potential and Kinetic Energy
Projectile Motion

Projects: Eggcellerator Car
Catapult
Mouse Trap Car

Teachers:
Ken Cole (Physics)
Steve Smith (Robotics)
Integrated Studies

Course: Pre-Engineering

Teachers: Ken Cole (Physics), Steve Smith (Tech / Engineering) and Mark Littlefield (Math)

Timeline: Spring 04 -- grant notification
Fall 04 – planning
Spring 05 – course implementation

- The cross-disciplinary course will be taught and developed by teachers from three disciplines
- Using the engineering design process to solve a series of problems, students will experience the connections among math, science and engineering.
Other Subjects

- Computer-Aided Design / Drafting
- Art
Training Teachers From Other Districts
Pro/DESKTOP Benefits

• It’s free!
• Students may install on home computers
• Ability to upgrade to Pro/ENGINEER for advanced students
• By teachers, for teachers
Challenges

- Commitment to change
- Teacher comfort level
- Time constraints
- Computer availability
- Common planning time
Tips for Success

- Commitment from leadership
- Commitment of colleagues
- Enlist support from outside sources
- Learn side-by-side with your students
Thank You