



# PROBLEM BASED LEARNING FOR ADVANCED MANUFACTURING:

STEM SMART: PATHWAYS TO MIDDLE-SKILL  
OCCUPATIONS AND BEYOND

Olin College of Engineering  
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NEW ENGLAND  
BOARD OF  
HIGHER EDUCATION

# Presentation Agenda

- Who is NEBHE?
- What is Problem Based Learning (PBL)?
- What are the PBL Projects?
- What is a Challenge?
- Work with Whiteboards
- Questions/Comments



# Who is NEBHE?

- The New England Board of Higher Education (NEBHE) represents **260 colleges in New England**
- Mission – to promote **greater educational opportunities** and services for residents of New England

NEW ENGLAND  
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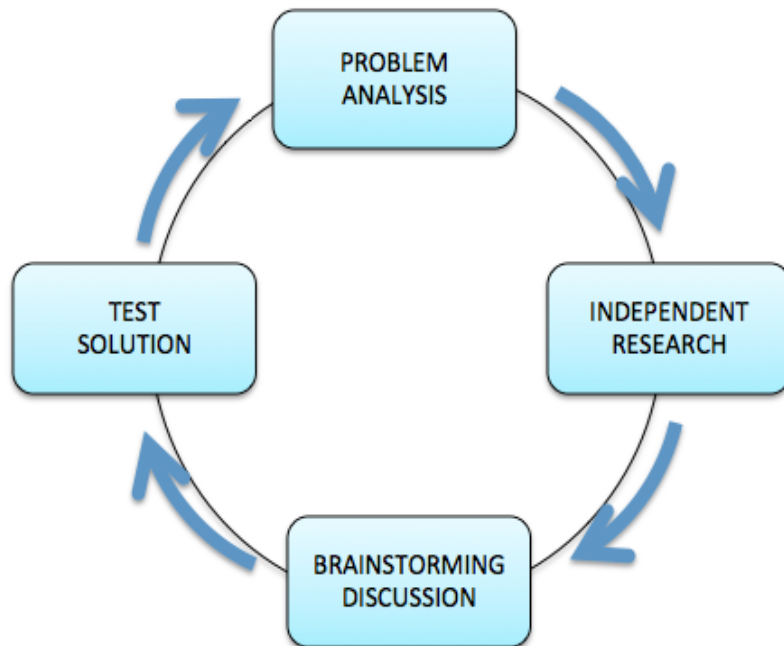
# Who is NEBHE?

## NEBHE accomplishments:

- Education **policies** of regional significance
- Efficient use and **sharing** of educational resources
- **Collaboration** between higher education and the economic well-being of New England



# What is Problem Based Learning?



- PBL teaches students *both content and problem solving skills* through engagement with authentic real-world problems.
- Originally developed for medical school education in the 1970s.
- Student-centered learning

# What is Problem Based Learning?

## CHARACTERISTICS OF PBL:

- Problems are presented **before** any formal preparation has occurred - the problem itself drives the learning
- Students work collaboratively in **teams** to frame the problem and identify learning objectives
- New information is acquired through **self-directed learning**
- Instructor is a **facilitator** who provides focused instruction and guidance on an “**as needed**” basis
- Unlike *project based learning* **no equipment is required.**

# What are the Benefits of PBL?

Research shows that PBL...

- Improves students' understanding and retention of content
- Promotes a “deep approach” to learning
- Improves critical thinking and problem solving skills
- Improves student motivation and self-efficacy for learning
- Improves students' ability to transfer problem solving skills to different disciplines
- Improves students' ability to work in teams

# Student Engagement



***“There were real-world issues there...the whole breaking down of the problem...what needs to be done...what I need to learn...it definitely helped because I know how to problem solve now.”***

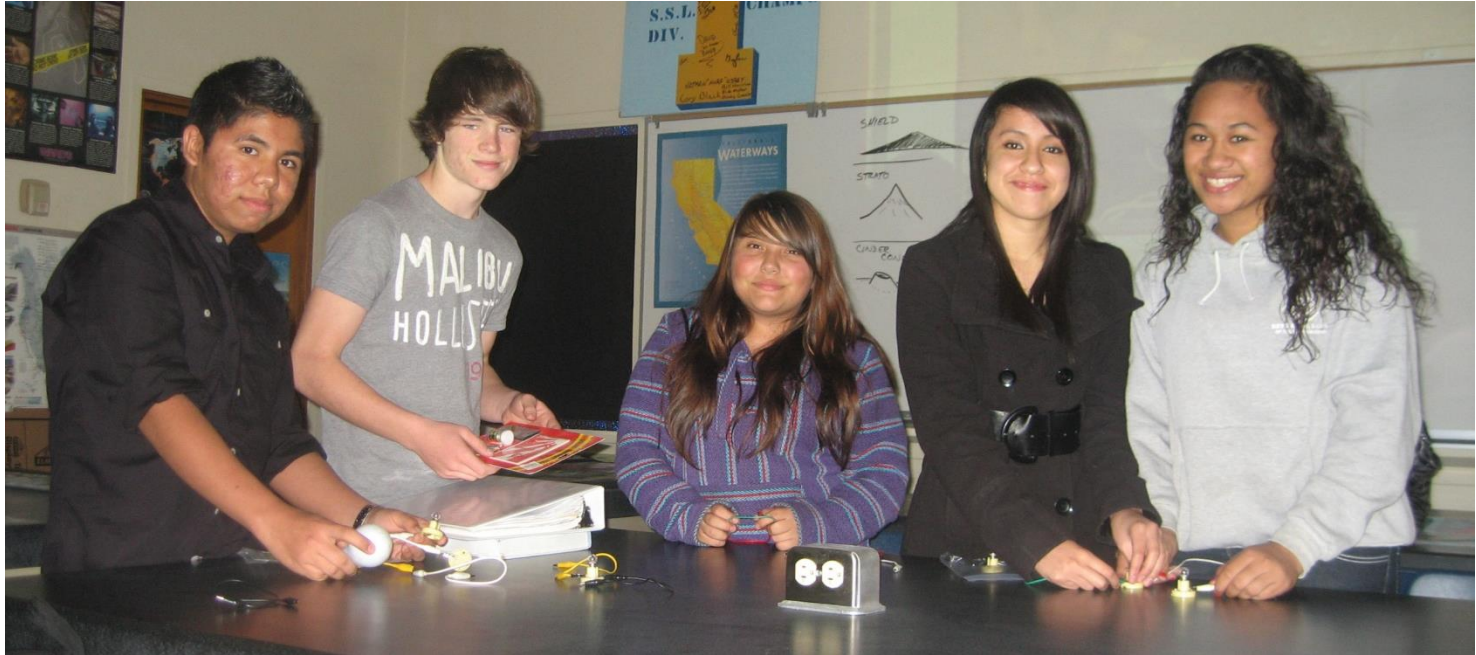


# Student Engagement



***“In math I’m always like ‘how does this relate to a real world problem? And this actually showed how math relates to something that could happen in the real world. So it helped me personally see that the things you learned before are important”***

# Student Engagement



***“You have to think outside the box...think for yourself, instead of having the teacher tell you what to do or think...”***

# What are the PBL Projects?

- **NEBHE PBL PROJECTS' MISSION:** To increase the number of job-ready STEM workers by engaging high school and college students with challenging authentic problems, learning materials and innovative teaching methods.



- Funded by the Advanced Technological Education (ATE) program of the National Science Foundation (NSF).

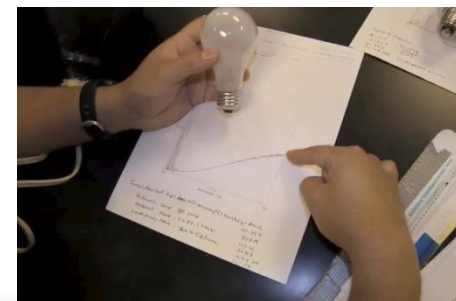


# What are the PBL Projects?



## PHOTON PBL, 2006-2009

- Developed **8 Challenges** based on authentic interdisciplinary problems in optics/photonics
- Provided **professional development** activities for high school and college faculty nationwide



# What are the PBL Projects?



## STEM PBL, 2009-2012

- Developed **6 Challenges** based on authentic interdisciplinary problems in sustainable technologies
- Provided **professional Development** activities for high school, college faculty nationwide
- Developed **online Introduction to PBL course**
- Developed **two new STEM college-level courses** at CCSU



# Undergrad. and Grad. STEM/PBL Courses

- Central Connecticut State University - Technology & Engineering Education Department
- Teaching Technology Engineering
  - (TE 399) - Undergraduate
- STEM in Technology Engineering Education
  - (TE 506-70) - Graduate

# New MS STEM Education Degree for Certified K-12 Teachers

- **Integration** of the STEM discipline areas
- Development of curriculum and assessment through **Problem Based Learning (PBL)**
- **Standards** provide a framework for all coursework.

# What are the PBL Projects?



## PBL in ADVANCED MANUFACTURING, 2012-2015

### Goals:

- Develop 6 authentic industry-based **instructional materials (Challenges)**
- Provide **professional development** for in-service high school and college STEM instructors
- Instruct participants in how to develop own Challenges
- Develop STEM PBL curricula for **teacher educators**
- Conduct **research** on the efficacy of PBL in advanced manufacturing education

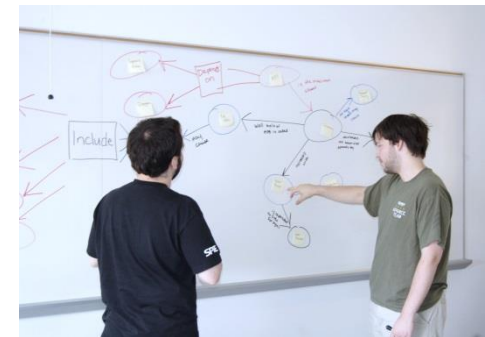
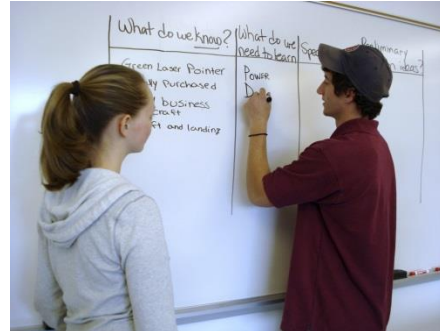


# What are the PBL Projects?

## Why Advanced Manufacturing?

Support **economic growth and competitiveness** of advanced manufacturing in New England by increasing the **pipeline of skilled workers** who have strong technical skills and can:

- Solve problems
- Think critically
- Work in teams



# View a PBL Challenge

**PBL Projects Website**  
[www.pblprojects.org](http://www.pblprojects.org)

introduction

organization overview

problem

discussion

organization's solution

introduction resources

science • technology • engineering • math

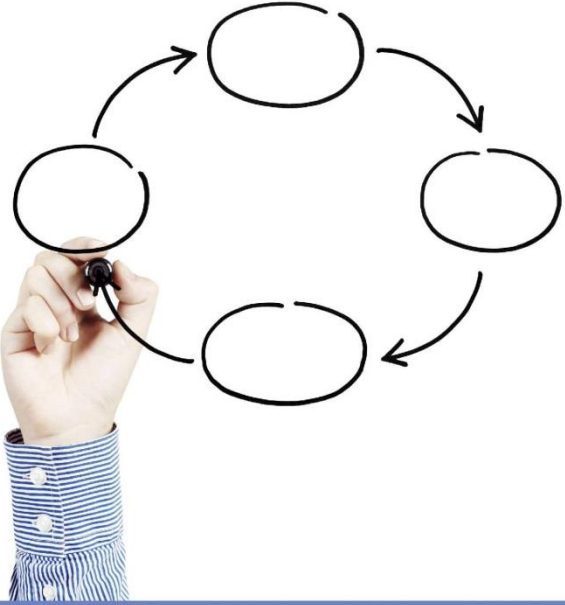
# Problem Solving Tool Box

## Key Features of the NEBHE PBL Projects' Challenges



- Flexible design to support students as they develop their problem solving and technical skills.
- The *Problem Solving Toolbox* was developed with the help of industry scientists and engineers. The problem-solving cycle provides students with a framework for approaching problems.


# What are the Whiteboards?



**THE whiteboards**

HANDOUTS FOR:

- PROBLEM ANALYSIS
- INDEPENDENT RESEARCH
- BRAINSTORMING
- TESTING YOUR IDEA



## Step I. Problem Analysis

The first step in problem solving is to clearly define the problem. Exactly what is the problem you are trying to solve and what is the desired outcome? To do this, you must first identify and list the criteria against which your solution will be measured. You must identify what you know about the problem (i.e., what is given) and any assumption you need to make if information is missing. Once you have clearly defined the problem, you are ready to move forward and seek out the knowledge and skills needed to solve the problem.

Clearly define the problem:

What are the criteria for a successful solution?	What do we know about the problem?	Are there any assumptions we must make?

# Frequently Asked Questions (FAQ)

- How long does a Challenge take to implement?
- At what educational level can Challenges be used?
- How do Challenges fit into existing curricula?
- How do the Challenges meet academic and industry standards?
- Your Questions

# Contact Information

Thank  
You!

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