

# *A Rigorous, Hands-On, Problem- Based Curriculum in the Biomedical Sciences*

Duane Crum  
November 2009



# What is Project Lead The Way?

- PLTW is a not-for-profit organization.
- PLTW partners with schools, higher education institutions and the private sector to grow the nation's technology workforce; we offer programs in Engineering and Biomedical Sciences.

# PLTW's Three Key Elements:

- ***Curricula - Rigorous and Relevant*** middle and high school courses (with college credit options) that use problem-based learning. It's free to participants, + ...
- ***Professional Development*** – High-quality, rigorous, continuing, and course-specific teacher training, + ...
- ***Partnerships*** – Counselor conferences, articulation agreements and business partners.

# Why Do We Need PLTW?



# Why Do We Need PLTW?

- ✚ Healthcare employs >15 million people and over 10% of national employment.
- ✚ By 2014, more than 3.6 million new healthcare jobs are expected.
- ✚ Eight of the 20 occupations projected to have the greatest growth rate over the next ten years are in healthcare.

# What Can We Do?

*Make a small change in the culture of American high schools by:*

- Strengthening the core academic curricula, (e.g. English, math, science, social studies, etc.)
- Adding a rigorous, technical, standards-based programs of study in biomedical sciences, engineering and technology, that lead to jobs, apprenticeships, trade schools, 2-year, 4-year and post graduate degrees.

# HS Engineering Program

## Foundation Courses:

- ▶ Introduction to Engineering Design
- ▶ Principles of Engineering
- ▶ Digital Electronics

## Specialization Courses (HS offers 1 or more):

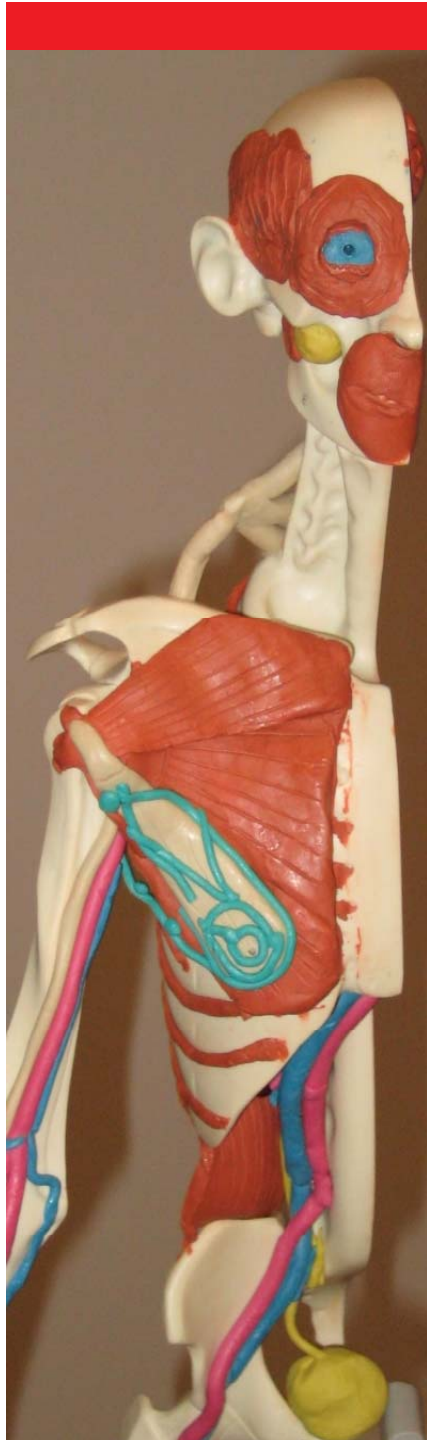
- ▶ Computer Integrated Manufacturing
- ▶ Civil Engineering/Architecture
- ▶ Biotechnology
- ▶ Aerospace Engineering

## Capstone Course:

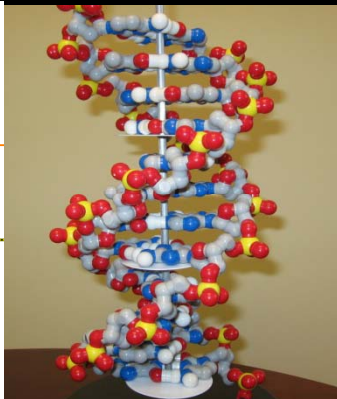
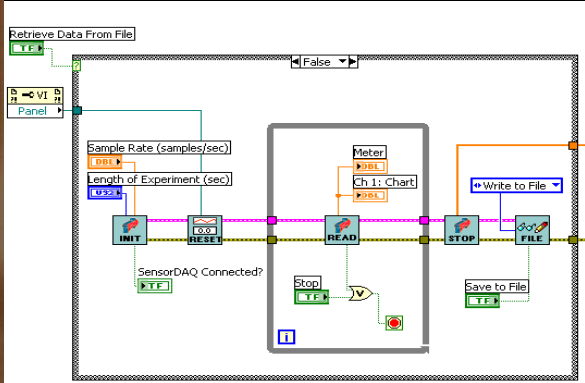
- ▶ Engineering Design & Development

*Note: Course program requires college entrance mathematics each year.*





# Biomedical Sciences Program



# Biomedical Sciences Program

- Driven by 7 states that funded the curriculum development
- Address impending shortage of qualified health professionals.
- prepare students for rigorous post-secondary education at two and four-year colleges or universities.

# Biomedical Careers

--- some examples ---





- Physician
- Nurse
- Dentist
- Veterinarian
- Pharmacist
- Paramedic
- Dietician
- Surgeon
- Research Scientist
- Health Information Manager
- Medical Technologist
- Radiologist
- Medical Technical Writer
- Physicians' Assistant
- Biomedical Engineer

# Standards-Based

- 📌 National Science Education Standards
- 📌 National Health Care Cluster Foundation Standards
- 📌 Principles and Standards of School Mathematics
- 📌 Standards for English Language Arts
- 📌 Standards for Technological Literacy
- 📌 National Content Standards for Engineering and Engineering Technology\*

\* Once finalized

# Biomedical Sciences Sequence of Courses

-  Principles of the Biomedical Sciences™
-  Human Body Systems™
-  Medical Interventions™
-  BMS Capstone Course

# Course #1: Principles of the Biomedical Sciences™



- Student work involves the study of human medicine, research processes and an introduction to bioinformatics.
- Students investigate the human body systems and various health conditions including: heart disease, diabetes, sickle-cell disease, hypercholesterolemia, and infectious diseases.

# Some Student Activities from Course #1 - PBS

- ✚ Build a simple pump
- ✚ Use data acquisition software and sensors to measure EKG, heart rate, and blood pressure
- ✚ Make a chromosome spread
- ✚ Isolate DNA from cells
- ✚ Analyze karyotypes
- ✚ Build models of DNA and proteins
- ✚ Read a genetic map
- ✚ Use computer simulation software to build a designer protein

# Course #2: Human Body Systems™




- ✈ Students study human physiology in relationship to human health. A central theme is how body systems work together to maintain good health.
- ✈ Students use data acquisition software to monitor body functions and use the Anatomy with Clay® Manikens™ to study body structure.

# Some Student Activities from Course #2 - HBS

- 🔍 Use data acquisition software and sensors to compare the response times of voluntary and reflex actions
- 🔍 Create a map of regions of the brain
- 🔍 Build a model of the endocrine system
- 🔍 Dissect a sheep's eye and experiment with lens
- 🔍 Build muscles groups on a skeletal manikin
- 🔍 Design experiments to determine the energy requirements for muscle contraction
- 🔍 Use data acquisition software to evaluate muscle function
- 🔍 Measure pulses to monitor blood flow
- 🔍 Design a training plan for an athlete

# **Course #3: (pilot 2009-10)**

## **Medical Interventions™**

-  *Student projects will investigate various medical interventions that extend and improve the quality of life including: diagnostics, surgery, bio-nanotechnology, pharmacology, prosthetics, rehabilitation, and life style choices.*

# ***Course #4: (pilot 2010-2011)***

## ***Biomedical Innovation***

***In this Capstone Course students will apply their knowledge and skills to solve problems related to the biomedical sciences.***

- They may work with a mentor or advisor from a university, hospital, physician's office, or industry to complete their research.***
- Students will present their findings and results in a symposium style format to an audience which may include representatives from the local healthcare or business community or the school's PLTW® partnership team***



# PLTW's Comprehensive Resource Packages (“the curriculum”):

- Aligns key learning concepts to national learning standards
- Includes:
  - day-by-day lessons
  - support and enrichment activities
  - course vocabulary
  - instructional resources including numerous PowerPoint presentations
  - evaluation and assessment tools aligned to the key concepts
  - plus there's more...

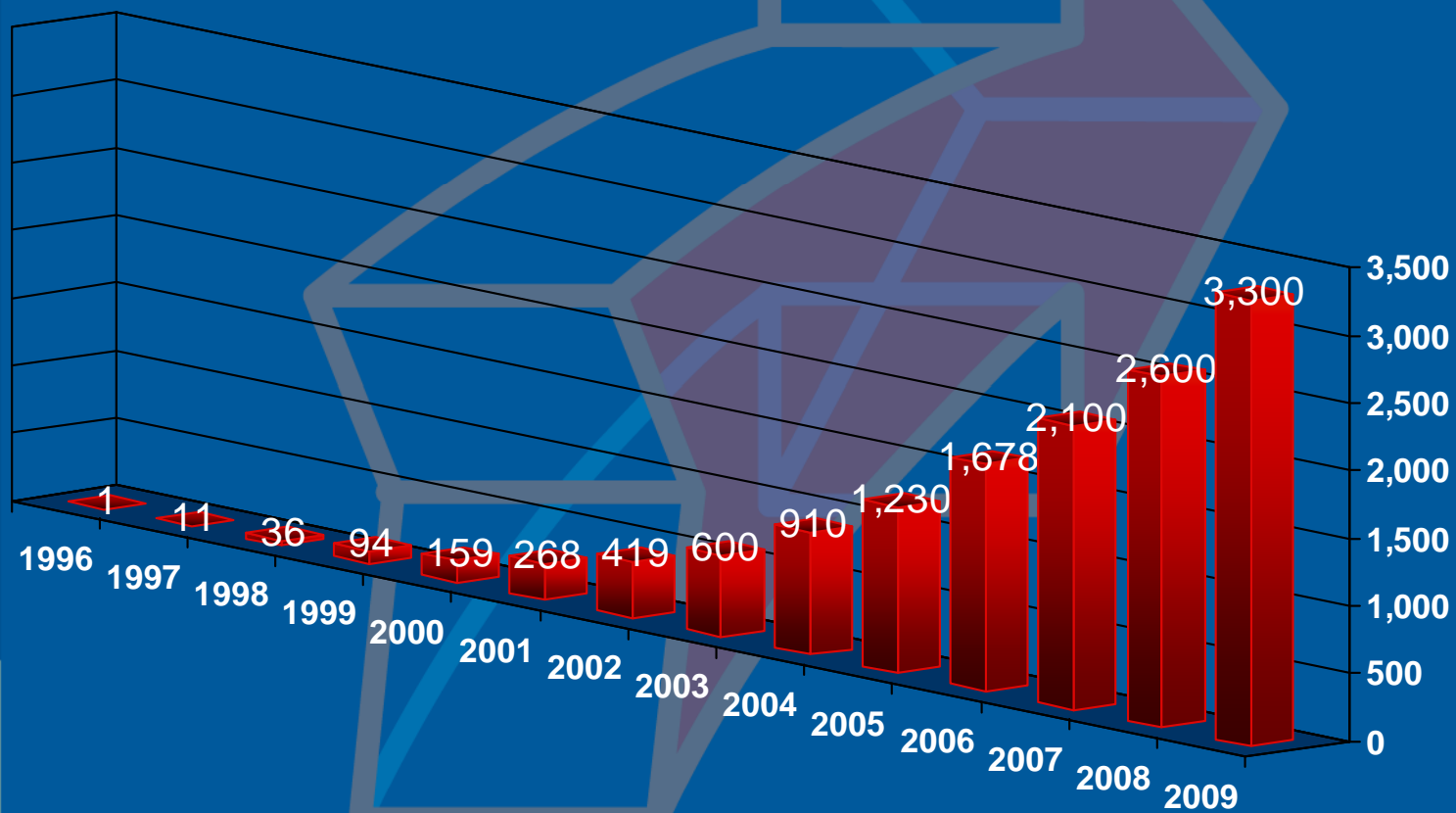
# The Focus of PLTW is Problem-Based Learning

- 🏗️ Students do authentic real-world work and may work in teams.
- 🏗️ Learning is contextual—not a disjointed series of concepts.
- 🏗️ Expectations are clearly articulated.

Activities and projects have ***predictable*** outcomes.

Problems have ***unpredictable*** results.

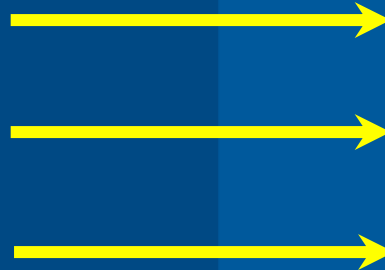
# Growth in PLTW Schools



PLTW is in all 50 states and more than 3,000 schools in 2008-2009.

# 3 Phase Professional Development

Self-  
Assessment  
& Pre-Core  
Training



Ready for core  
training

## Core Training *Summer Training Institute*

- Gateway To Technology (Middle School)
- All Eight High School Courses
  - Principles of Engineering
  - Introduction To Engineering Design
  - Digital Electronics
  - Computer Integrated Manufacturing
  - Civil Engineering/Architecture
  - Aerospace Engineering
  - Biotechnology
  - Engineering Design and Dev.
- All Three Biomedical Courses
  - Principles of Biomedical Sciences
  - Human Body Systems
  - Medical Interventions

Continuous  
Training  
(Virtual  
Academy)



Ready for  
teaching



# What Courses are “A-G” Approved?

- ▶ *All eight engineering courses are approved as “G” electives.*
- ▶ *The capstone class is also approved as a “D” lab science.*
- ▶ *The design class is also approved as “F” visual and performing arts.*
- ▶ *We have met with the UC representatives and expect approval of the first biomedical classes later this year.*

# The CSU Initiative

~6 CSU Campuses have initiated an engineering outreach effort:

- Designated Person on each campus
- First BMS Training site will be SJSU
- Counselors Conferences
- Competitions
- Additional Training Sites
- Preferred Admission (SDSU)
- Set-Aside Scholarships
- Summer Interns

# Research Findings



# How Well is PLTW Working?

## Research Data from TrueOutcomes (July 2006)

Key Findings based upon 450 PLTW students

- ▶ **80%** of PLTW seniors plan to attend a 2 year or 4 year college, vs **65%** of all seniors nationwide.
- ▶ **54%** plan to study engineering or engineering technology versus **10%** of all seniors nationally.
- ▶ **19%** plan to attend Community College or a Technical School.
- ▶ **85%** student retention in 2<sup>nd</sup> year of Engineering or Eng. Tech. versus **~60%** nationwide.
- ▶ Students in schools of average affluence did as well as students in more affluent schools.
- ▶ In College, PLTW graduates have an average GPA >3.0 and average grades of B or better in freshman physics, chemistry and calculus.



# Want More Information?

- 📌 [PLTW.org](http://PLTW.org) – National Website/free literature.
- 📌 [PLTWCA.org](http://PLTWCA.org) – State website with CA specific Information
- 📌 Webforums and Listserve – Sign up at [PLTWCA.org](http://PLTWCA.org)
- 📌 Informational Conference – Dec 3 at SDSU
- 📌 PLTW National Symposium in Austin, Nov 12-14, 2009



**Duane Crum**  
CA State Leader  
[dbcrum@live.com](mailto:dbcrum@live.com)

