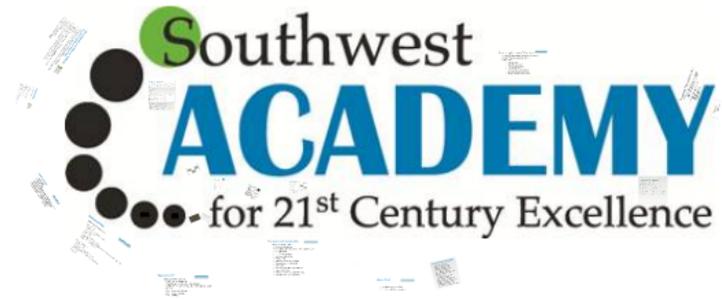


Improving STEM Education With Project Lead the Way



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Introducing the Participants:

Coda Phillips, Student - Platteville HS

Jason Julius, Teacher - Platteville HS

Greg Quam, Consortium Coordinator - Platteville SD

Julie Pluemer, Curriculum Specialist - SWTC

Tom Martin, LVEC/School to Work Project Coordinator - CESA 3

Mary Johannesen, School to Work Project Coordinator - CESA 3

Introducing Southwest Wisconsin



- Located in the Southwest Corner of Wisconsin
- Cover 5 Counties (80 x 100 miles)
- Population
 - 122,000 people
 - 147,000 hogs and pigs
 - 129,000 cattle and calves
 - 131,000 milk cows
 - Does not include white tail deer, wild turkeys, chicken and sheep
 - Average 6 animals to every person

Southwest Wisconsin (cont.)

- 7 School Districts
 - Largest: Platteville High School = 476 students
 - Smallest: Argyle High School = 116 students
- Largest Metropolitan Area
 - Platteville (9,989)
 - Prairie du Chien (6,022)
 - Richland Center (5,165)

- Stop lights
 - Take a guess...

Why Did We Start

- We live in a technical world (all the solutions to issues in environment, poverty, communications, etc. will have technical solutions)
- 70% of the jobs now and in the future will be in the STEM fields
- To use mathematics and the scientific process to solve real problems which increases the rigor and relevance
- To expose our students to performance-based, open-ended problem-solving
- "Brains on and hands on education"
- "Our education failure is the largest contributing factor to the decline of American worker's global competitiveness, particularly at the middle and bottom range"

Thomas L. Friedman

Key Questions that Needed to be Asked:

1. Who will take the courses?
2. Who will teach the course?
3. When will they take it?
4. How much will it cost?
5. Where does this fit in our priorities?
6. Who will manage the program?
7. Do we have the right facilities/capacity?

Activity 8.1a - The BD Project

Purpose

Things move in predictable patterns. A ball thrown in the air moves in a curved path until it strikes the earth. We can analyze where it will strike the ground if we make some basic assumptions about free-fall acceleration and we discount the effects of wind resistance.

Materials

Scrap and recycled materials

Ping pong balls

Tape Measure

Excel

Procedure

Objective: To create a device that will toss a ball accurately within a given range.

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Objective: To create a device that will toss a ball accurately within a given range.

BD Constraints:

- Must be able to fire a projectile (to be specified by the instructor) anywhere within 5' to 15' operating range (design adjustability into your device!)
- Must fit within a 1'x1' footprint (in "collapsed form")
- Cannot utilize high-pressure gases or combustible materials
- Must be constructed primarily out of materials that are found, not bought.
- Must be sketched in engineering journals and approved by your instructor prior to building

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Testing:

- Performance Testing (after completion of final assembly and adjustment)
 - Choose at least ten firing angles between 10 and 80 degrees.
 - For each firing angle, fire the projectile and record range
 - Perform at least three trials for each firing angle
 - Record all procedures, tables, data etc. within engineering journals.
- Final Testing

15 operating range (design adjustability into your device!)

- Must fit within a 1'x1' footprint (in “collapsed form”)
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- Final Testing
 - Must be able to land in a 5-gallon bucket (the target) at a location specified by your instructor on the day of the test (and within the operating range)
 - Each team will have three tries to hit the target

Math Calculations for the Range

Procedure

Recall that the formula for initial velocity of the BD is as follows (see section on Calculating the Velocity of the BD)

$$v_i = \sqrt{\frac{-gx}{\sin 2\theta}}$$

Step 1: Remove the square root by squaring both sides of this equation.

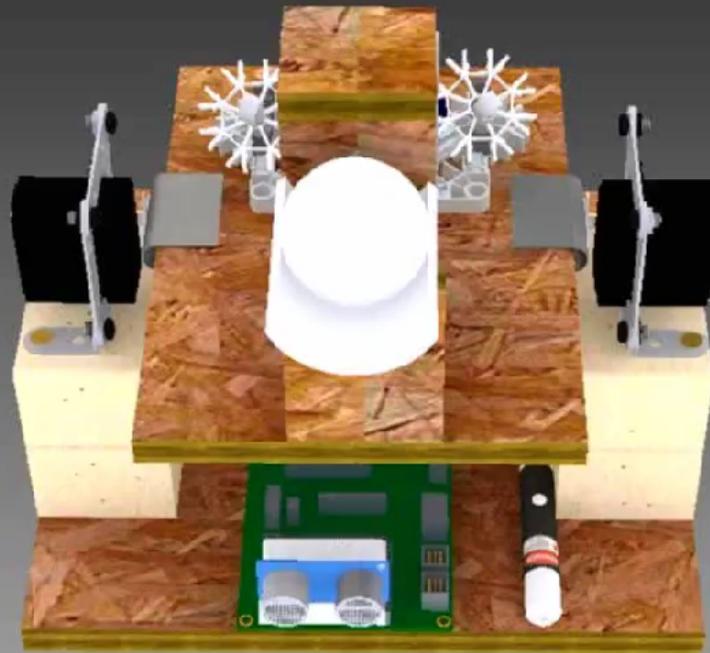
$$v_i^2 = \frac{-gx}{\sin 2\theta}$$

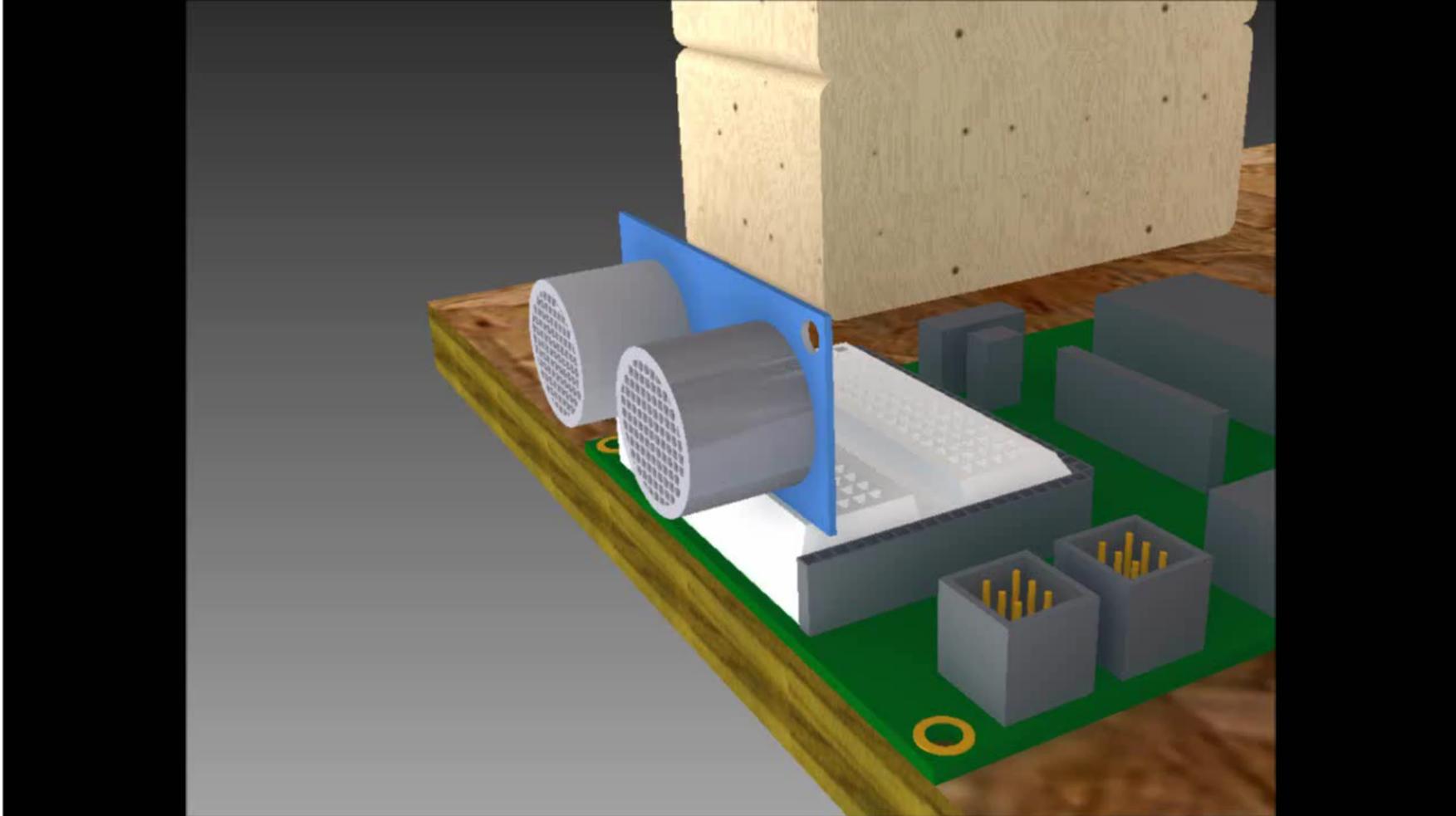
Step 2: Multiply both sides of the equation by $\sin 2\theta$, and divide by $-g$. This results in an equation for x , expressed in terms of v_i , g , and θ .

$$x = \frac{-v_i^2 \sin 2\theta}{g}$$

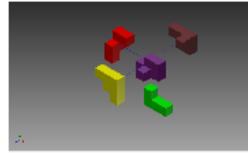
Calculating Velocity from Angle and Range

Horizontal Part of Projectile Motion	Vertical Part of Projectile Motion
<p>Original equation:</p> $x = v_{ix}t + \frac{1}{2}a_x t^2$	<p>Original equation:</p> $y = v_{iy}t + \frac{1}{2}a_y t^2$
<p>Applying concepts & simplifying the equation:</p> <p>Concept: Horizontal motion is constant velocity motion where acceleration = 0</p> <p>Resulting Simplification:</p> $x = v_{ix}t$	<p>Applying concepts & simplifying the equation:</p> <p>Concept: Vertical motion is accelerated and due to gravity, so $a_y = g$. For the entire motion, the overall vertical displacement, y, is zero.</p> <p>Resulting Simplification:</p> $0 = v_{iy}t + \frac{1}{2}gt^2$ <p>or</p> $v_{iy}t = -\frac{1}{2}gt^2$
<p>Substituting v_{ix}:</p> <p>Since $v_{ix} = v_i \cos \theta$</p> $x = v_i \cos \theta t$	<p>Substituting v_{iy}:</p> <p>Since $v_{iy} = v_i \sin \theta$</p> $v_i \sin \theta t = -\frac{1}{2}gt^2$





Puzzle cube



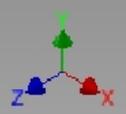
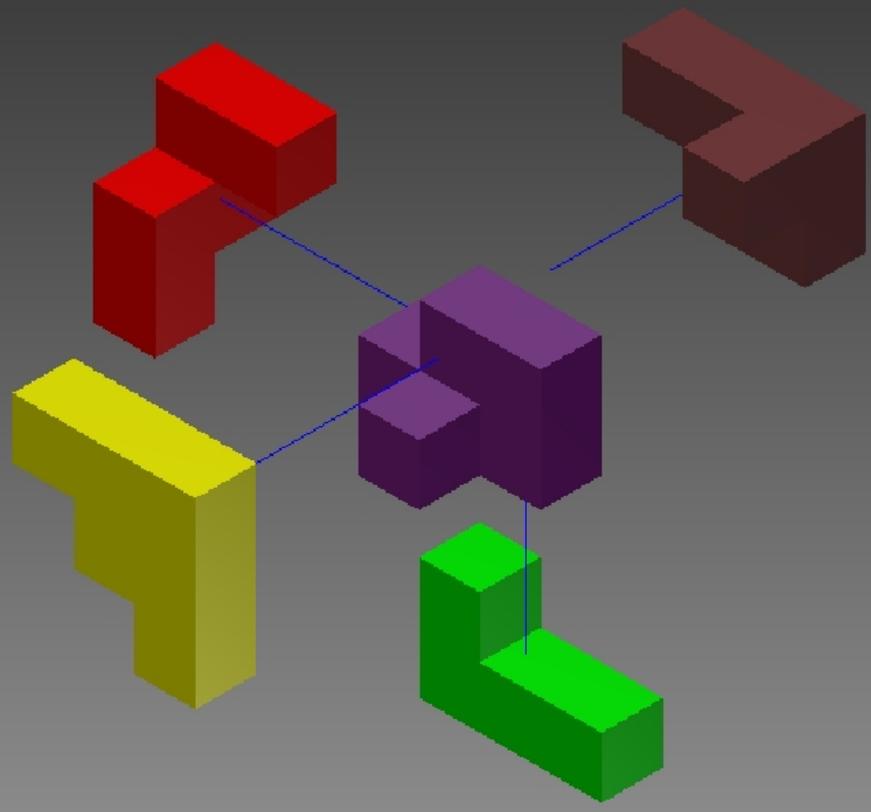
Objective: Design a three dimensional puzzle cube containing 27 wooden cubes.

Constraints:

- Cube must consist of 5 individual pieces
- Each piece must contain between 3-5 individual cubes

Key Concepts Covered:

- Measurement in both the English and metric scales
- Conversion factors (1 inch = 2.54cm)
- Working with decimals and fractions ($\frac{5}{8} = .625$)
- Scale Factors (3:1)
- Mean, Median, Mode, and Range
- Mathematical modeling and graphing using Excel



Desk Set Organizer



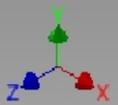
Objective: Design a desk set organizer for a given occupation

Constraints:

- Organizer must hold pens, pencils, and post-it notes
- Foot print cannot exceed 6" x 8" (48in²)

Key Concepts Covered:

- Mass property analysis: Area, Volume, Surface Area
- Tolerances (1.25 +/- .01)
- Continued work with fractions and decimals
- Parametric constraints: $D_I = d_{oin} * (5/3)$
- Graphing using the X,Y,Z coordinate system



Reverse Engineering

Reverse Engineering is the process of taking something apart and analyzing its workings in detail, usually with the intention of understanding its function.

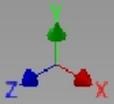
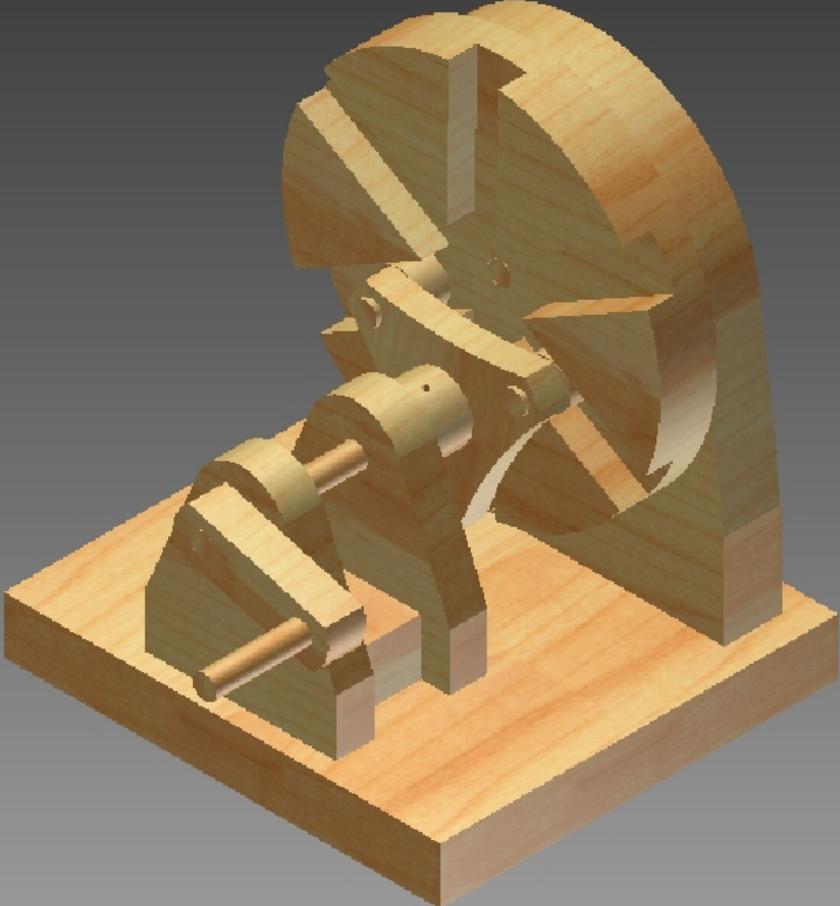
Products looked at in the past include:

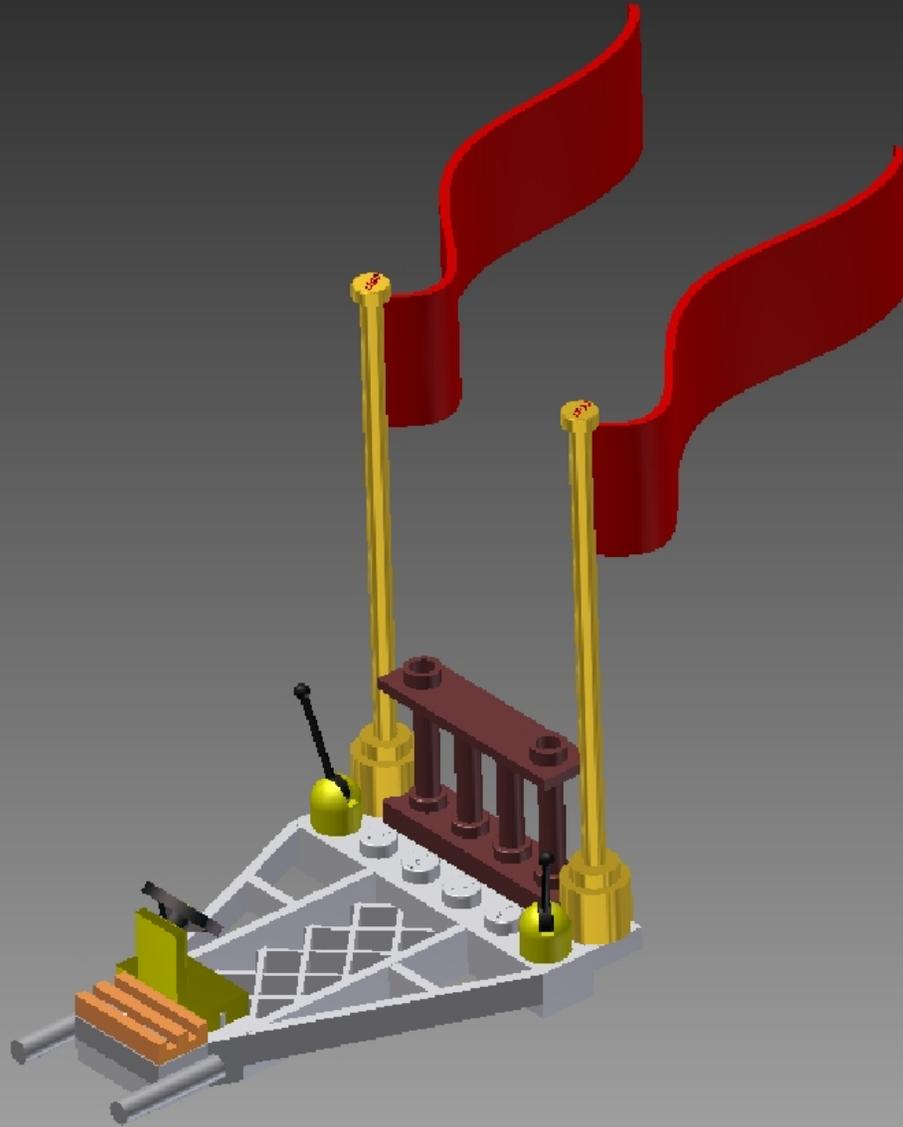
- Legos
- flashlight
- roller gear mechanism
- VEX robotic components



Key concepts covered

- Visual Analysis: Why does it look the way it looks?
- Structural Analysis: How is it put together and what is it made out of?
- Functional Analysis: What are its intended uses and how does it work?
- Continued work with mass properties
- Testing and Evaluation







PLTW's curriculum makes math and science relevant for students. By engaging in hands-on, real-world projects, students understand how the skills they are learning in the classroom can be applied in everyday life. This approach is referred to as activities-based learning, project-based learning, and/or problem-based learning.

Engineering is Elementary

- Standards Based
- Research Based
- Classroom tested curriculum
- more at www.mos.org/eie

Each unit includes a story book where a child character engineers a solution to a problem using math and science.

Different countries are featured in the stories and incorporates social studies.



Gateway to Technology

Grades 6-8

Six independent nine week courses

- Design & Modeling
- Automation & Robotics
- Energy & the Environment
- Flight & Space
- Science of Technology
- Magic of Electrons



Pathway to Engineering

Grades 9-12

Foundation Courses

- Introduction to Engineering
- Principles of Engineering

Specialization Courses

- Digital Electronics
- Aerospace Engineering
- Biotechnical Engineering
- Civil Engineering and Architecture
- Computer Integrated Manufacturing

Capstone Course

PLTW Facts:



- PLTW students outperform non-PLTW students
- PLTW closes the achievement gap
- PLTW's programs are inclusive, reaching a diverse group of students
- PLTW high school graduates are college and career ready
- PLTW college freshmen stick with innovation

Why PLTW?



- Professional development--
Summer Training Institutes (STI),
Virtual Academy and yearly
conferences
- Post-secondary articulations
- Curriculum alignment
- Networking opportunities (Forum
and list-serves)

Development of Southwest Academy for 21st Century of Excellence



- Engineering Design and Development (EDD)
- Students must have completed a minimum of 2 PLTW classes
- Taught by a Southwest Technical College Instructor
- Each student receives a laptop computer to use
- Students are assigned mentor/engineer from the community
- Research based class
- Students are dual enrolled

Implementation



Introduction Meetings

Instructors

- Discussed the curricula
- Implementation plan
- School visits
- Grant opportunities

Instructors / Administration

- What would PLTW add to your school?
- Grant opportunities and funding
- Sustainability

Implementation



- Yearly Plan
- Monthly Plan
- Each school implemented 2 classes (IED, POE)
- Most schools did not add additional classes
- Shared equipment (Release of liability)
- Communication was a key component

Implementation



Advisory Committees

Instructors

- Meet four times per year
- Location???
- Agenda
- Set two goals per year
- Discussion on PLTW issues at the state and national level
- Instructor discussion

Entire Committee

- Instructors
- Post secondary instructors
- Business and community members
- Student
- Parent

Implementation



Funding and sustainability

- Kern Family Foundation
- Department of Workforce Development
- Southwest Wisconsin Workforce Development Board
- WIRED
- Carl Perkins (10% Grant)
- Small School Funding
- Local Funding

Promotion and Sustainability



What is working for us

- Creative Scheduling
- Collaboration with SWTC, UWP and CESA 3
- STEMposium
- PLTW Scholarship
- Business partnership
- Why STEM
- Summer Gateway Academy
- Engineering is Elementary
- Newsletter
- Business and Education Summit
- Legislative Day
- Website: www.swacademy21.org
- **DEVELOP A LEADER**

What's Next?



- Academy Satellite School
- PLTW Biomedical Sciences

Members of the Consortium:

Argyle School District

Cuba City School District

Highland School District

Iowa-Grant School District

Platteville School District

Prairie du Chien School District

New Schools:

Darlington School District

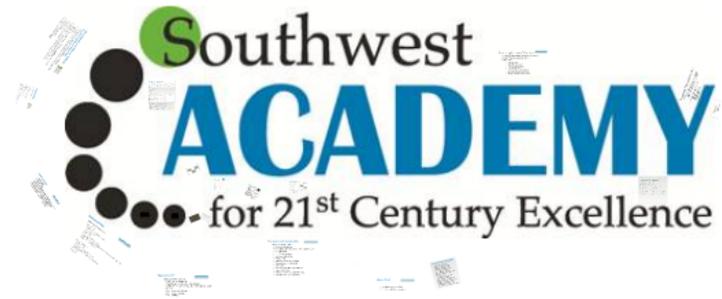
Lancaster School District

Mineral Point School District

Richland Center School District

Shullsburg School District

(North Crawford School District)



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