Progression of Science and Engineering Across K-12

RSD17 BOE Curriculum Subcommittee
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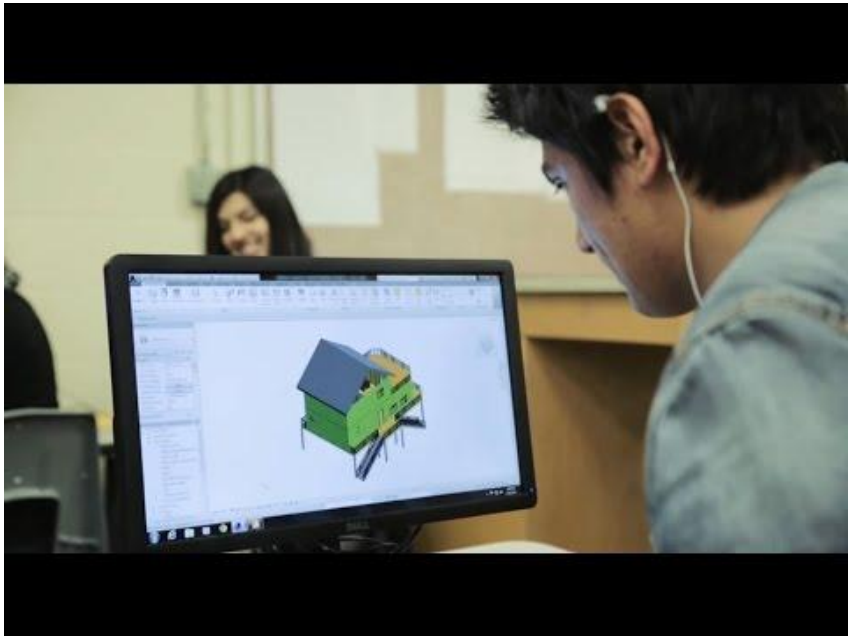
February 8, 2022

What is PLTW?

Students engage in hands-on activities, projects, and problems that are reflective of real-world challenges. Their compelling, real-world approach empowers students to learn essential, in-demand skills validated by the world's leading companies, while also providing an invaluable connection between what students are learning in the classroom today and how it applies to the paths they'll take in the future.

~ PLTW website



Three Uses of PLTW in RSD17

Science Units of Study

Since 2016, K-5 Science teachers have utilized a combination of CREC/Catalyst Curriculum units and PLTW Launch units for their 3-4 science units per year. We have an internal PLTW Trainer and all teachers are trained in their curriculum and methods.

Computer Science and Engineering Exploration Courses

Students in grades 6-12 engage in computer science and engineering concepts through courses in the tech ed department.

Pre-Engineering Path

Course offerings lead students through Intro, Electronics, Civil and Programming and culminate in a senior capstone course where they select yearlong projects to work on with a team.

Why PLTW

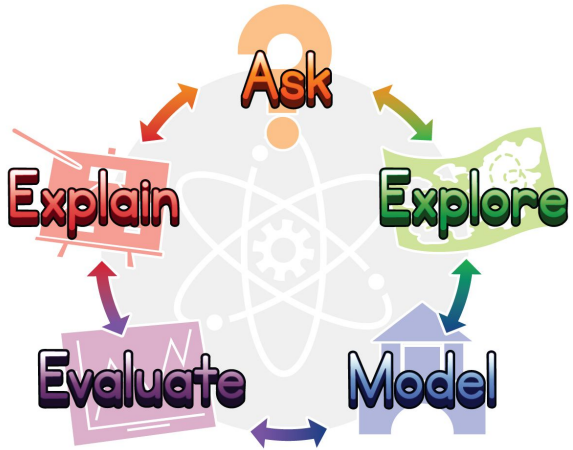
- Science modules are compact, interactive, aligned to standards, rigorous, related to the real-world and include engineering practices.
- Computer science and engineer courses are comprehensive and high quality. Professional development is required to teach and access these courses. They meet the needs of our students with engineering interests.
- PLTW is aligns curriculum with national standards (CCSS ELA/Math, NGSS, Tech/Engineering, 21st Century) and updates as standards do.
- PLTW updates curriculum to match new technologies. They also provide partnerships with software and hardware companies to streamline the process of getting these things built into the curriculum and make it easily accessible to teachers/schools. They provide training/support for both students and teachers with the new technology.

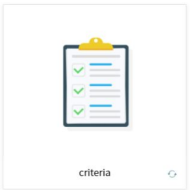
PLTW Approaches

Hands-on

simulation

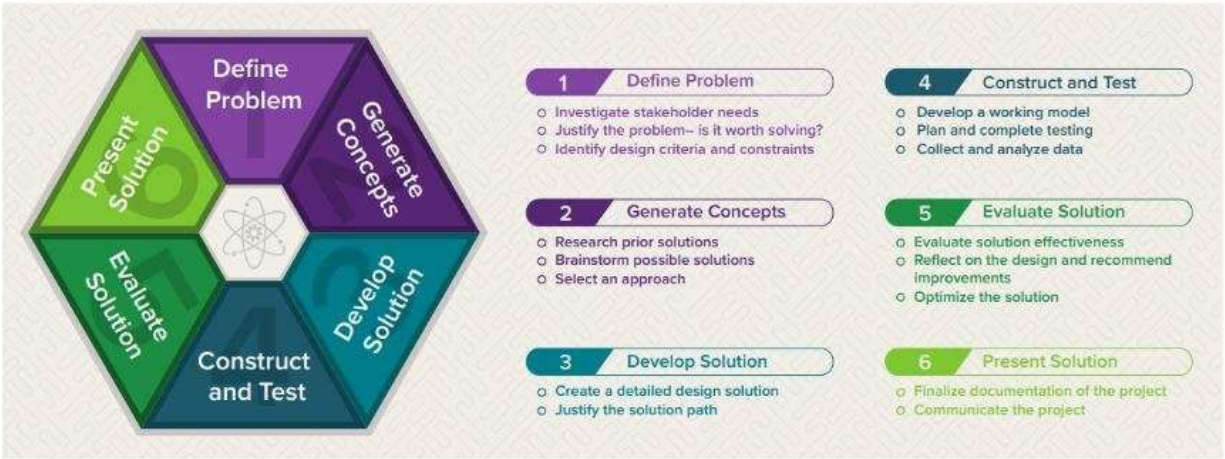
Design Process (Elementary)




criteria


constraint

Design Process (Secondary)



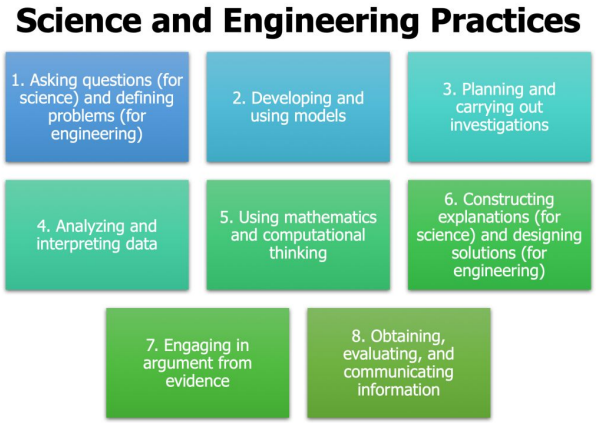
Units of Study / Courses

K-5 → Science

6-8 → Science
→ Engineering

9-12 → Computer Science
→Engineering
→Science

K-5 Science



- All PLTW Launch modules embed a story using three common characters: Angelina, Mylo and Suzi as they notice and wonder about their world.
- Opportunities for collaborative hands-on science.
- The engineering design process is embedded in every module.

The PLTW teaching and learning approach uses activities to build content knowledge and projects and open ended problems to achieve understanding, meaning, and transportable skills.

Figure 1 | Activity, Project, Problem-based Learning Approach

Examples of “Problems”:

- K - Game or Toy Design with reusable materials
- 2 - Design and test a prototype to insulate a frozen ice pop
- 5 - Design a device to filter water

K-5 Science - Units

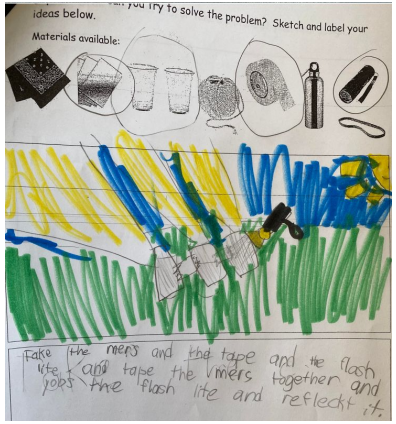
Black - original units
Gray - added

K	Pushes and Pulls; *Living Things: Needs & Impact (pilot)*
1	Light and Sound; Animal Adaptations *(newly adopted 21-22)*
2	Properties of Matter Form and Function; The Changing Earth
3	Forces and Interactions; Variation of Traits; Life Cycles and Survival; Environmental Changes *(both newly adopted 21-22)*
4	Energy Conversion
5	Earth's Water and Connected Systems *(newly adopted 21-22)*

GRADE 1 - Animal Adaptations; Light and Sound

Simulate how camouflage helps animals survive

Understand shadows; Think about how sound travels



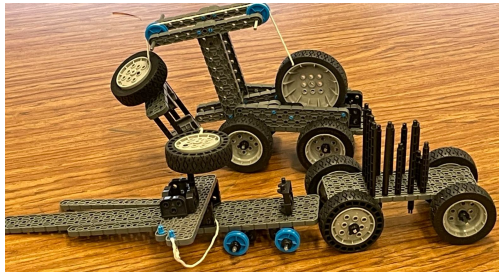
GRADE 2 -
Properties of Matter

Criteria	Constraints
The prototype must: ◦ Be designed and built from available materials ◦ Keep the ice pop frozen for at least 30 minutes	• Time • Available materials

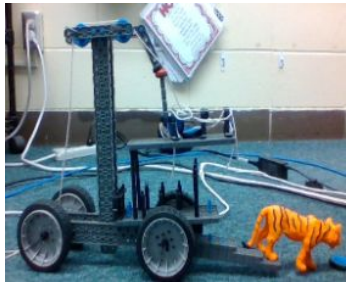
Design a container for an ice pop to stay frozen for 30 min

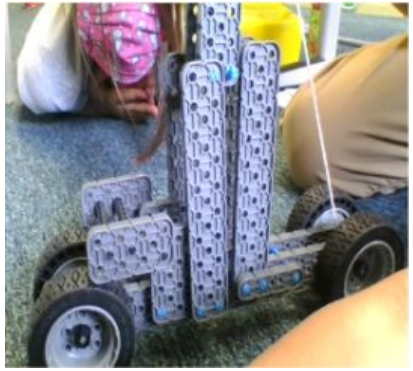
GRADE 3 - Forces

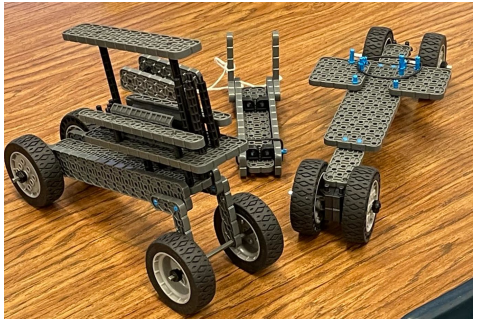
Traits Project



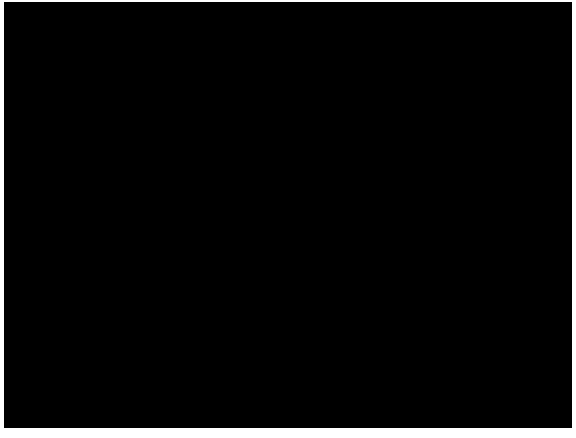
Create simple machines, wheel and axle, pulleys

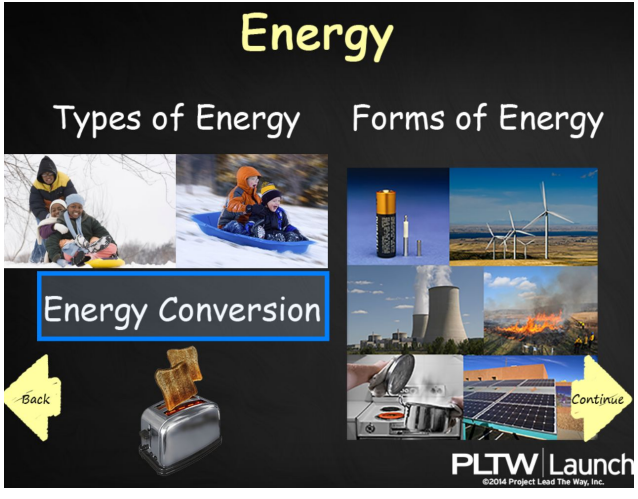


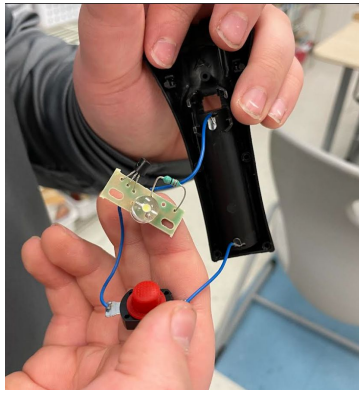




GRADE 4 - Energy Conversions



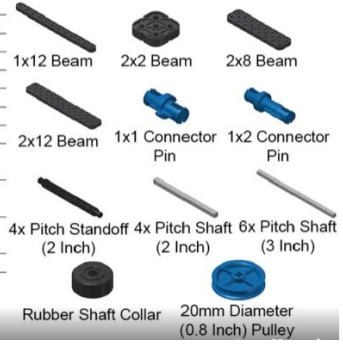




Seeing how a flashlight works

Building a bike pulley

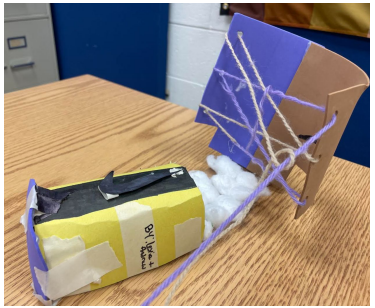
Part Number	Description	Qty
n/a	String	48 Inches
228-2500-011	1x12 Beam	4
228-2500-017	2x2 Beam	2
228-2500-023	2x8 Beam	4
228-2500-026	2x12 Beam	2
228-2500-060	1x1 Connector Pin	26
228-2500-061	1x2 Connector Pin	2
228-2500-070	4x Pitch Standoff (2 Inch)	3
228-2500-120	4x Pitch Shaft (2 Inch)	1
228-2500-122	6x Pitch Shaft (3 Inch)	1
228-2500-143	Rubber Shaft Collar	4
228-2500-164	20mm Pulley (0.8 Inch)	3



6-8 Technology Education

6	Design and Modeling	• Apply the design process to creatively solve problems (foot orthosis) • Communicate design ideas through sketches of top/bottom/front views • Use Tinkercad models to represent an authentic situation (design a birdhouse and 3D print a keychain) • Teams design a toy or game for a child with cerebral palsy, fabricate and test it, and make necessary modifications to optimize the design solution.
7	Exploring Electricity	• Explore electricity, the behavior and parts of atoms, static electricity, conductors and insulator, switches, lights and parallel circuits • Use Snapcircuits, make a Morse code machine and explore DC motors
8	Automation and Robotics	• Use tools such as the engineering design process and an engineering notebook to invent and innovate • Design, build, and program real-world objects using VEX Robotics® programming software and the VEX Robotics® platform • Learn about general robotics and gear ratios; use that to build mechanisms and create a pull toy

Foot orthosis for someone with cerebral palsy (Gr6 Design and Modeling)



Skimmer (Gr6)

Snap circuits (Gr7 Electricity)

Pull toys created with gears (Gr8 Automation/Robotics)

9-12 Technology Education - Computer Sci

Grades 10-12	**Computer Science Principles (AP)** Students will learn beginning computer programming skills and apply them to projects and problems that include app development, visualization of data, cybersecurity, robotics, and simulation. Students will learn and use multiple programming software/languages such as HTML & Python®. Students will work to develop computational thinking, generate excitement about career paths that utilize computing, and introduce professional tools that foster creativity and collaboration. Students enrolled in this course are required to take the AP Computer Science Principles exam.	**1 section**

9-12 Technology Education - Engineering

9-12	**Introduction to Engineering Design (H)** IED provides students with experiences in solving problems by applying a design development process. Students use powerful computer hardware and software to develop 3-D models or solid renderings of objects. Using a Computer Aided Design system, students learn the product design process through creating, analyzing, rendering, and producing a model. Students will learn to apply math to engineering concepts.	**3 sections**
9-12	**Principles of Engineering (H)** This course helps students understand the field of engineering/engineering technology. Students will construct and test various technology systems and manufacturing processes in order to learn how engineers and technicians use math, science, and technology in an engineering problem-solving process to benefit people. They may also gain an appreciation of the social and political consequences of technological change.	**1 section**
9-12	**Civil Engineering / Architecture (H)** This course provides an overview of the fields of civil engineering and architecture, while emphasizing the interrelationship and dependence of both fields on each other. Students use state-of-the-art software to solve real world problems and communicate solutions to hands-on projects and activities. This course covers such topics as the roles of civil engineers and architects, project planning, site planning, building design, and project documentation and presentation.	**1 section**
10-12	**Digital Electronics (H)** This course is designed to introduce students to the field of electrical engineering. In this course, students design and build digital circuits using computer simulation software and real components to design electronic machinery and Robotics. This course is highly recommended for students interested in any field involving electronic hardware, programming, computer design, and/or Robotics. Students will learn how to use applied logic and binary data in the development of electronic circuits and devices. Students will use simulation software to design and test digital circuitry and construct actual circuits and devices. *This course will be offered alternate years. Will be offered in 2022-2023.*	**1 section**
12	**Engineering Design and Development (H)** This course is a capstone course that encompasses the PLTW courses, math, science, and English. This curriculum is designed to allow the student to learn how to solve technical problems by following methodologies that scientists and engineers use. Students will identify current real-world problems and develop an engineering solution through Research, Design, CAD design, Prototyping and Testing solutions. **Students must have earned college credit in IED and POE in order to earn credit for EDD (University of New Haven only)*	**1 section**

Q & A - High School

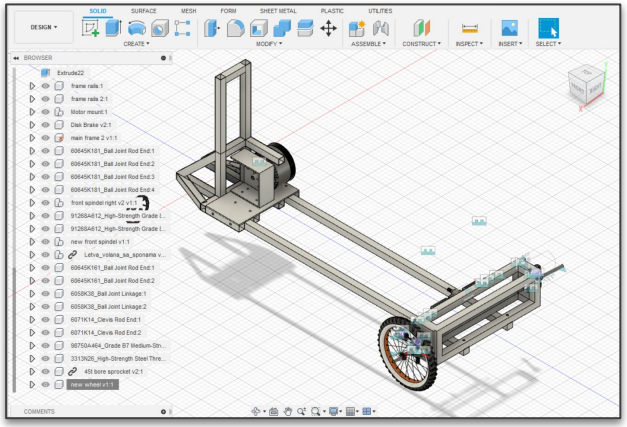
How long have we been offering PLTW courses at HKHS? Since 2004 with the Introduction to Engineering course, total enrollment was about 15 between the 2 classe; Since then we now offer 6 courses with 4 trained instructors, many who are cross certified. One educator is certified in 5 of the 6 courses.

Are there any enrollment trends? We have seen really strong growth over the years. We typically see between 75-100 students annually in the PLTW courses. Many students take more than one course in a year.

What do you like about PLTW? What don't you like? They allow us to teach and do things that wouldn't be possible otherwise, They take care of curriculum updates, software agreements, trainings, equipment contracts/purchasing. To write one of these curricula with the level of expertise and depth that have been put into them could be a lifetime of work for one teacher, so to get professional training and feel confident on how to teach the students without the pressure of having to update and maintain things is very powerful.

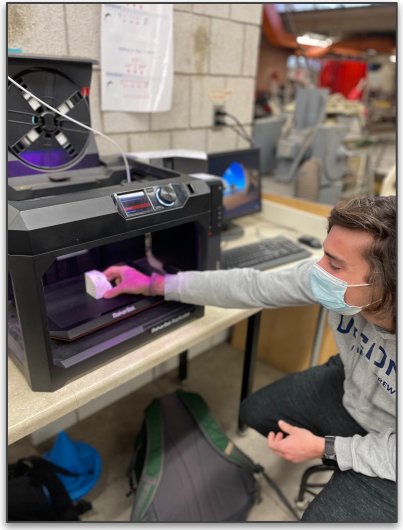
Have you heard from any alum relative to their PLTW experience in terms of being prepared for college or work force? Yes, we constantly hear from graduates how helpful the PLTW course were for them, in some cases students were actually able to use the 'credits' they achieved in HS to count toward their college degree, but in almost all cases they say how much more knowledge and experience they had than their peers when starting down an engineering or tech pathway in college.

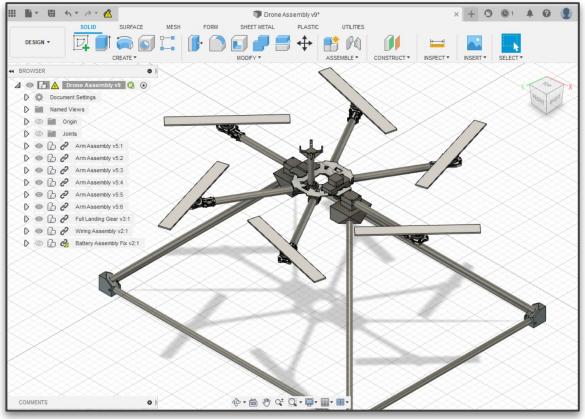
Anything else you think a BOE member or the public should know? It has helped to revitalize and boost the technology department over the years and has served as a great set of complimentary classes to our more traditional 'trades' classes like woods, metals, auto. Most students end up taking some of both type of courses so that they get hands-on experience along with the engineering course work. For educators, the training has greatly increased their teaching and knowledge. One wish? More time in the day or teachers in our department to offer more courses, but being a small school, we offer amazing opportunities to our students in the Tech and Engineering areas.

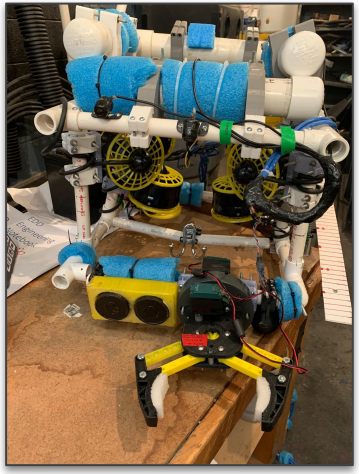


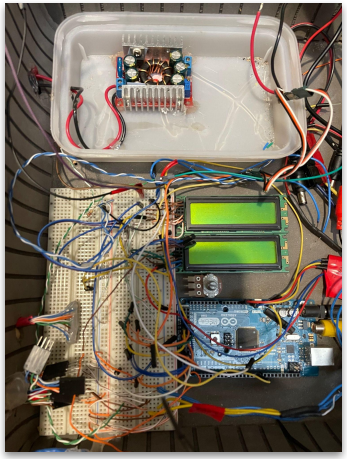
Caption: Drone Competition Project
CAD, 3D print & Assembly

Model and Electrathon Vehicle

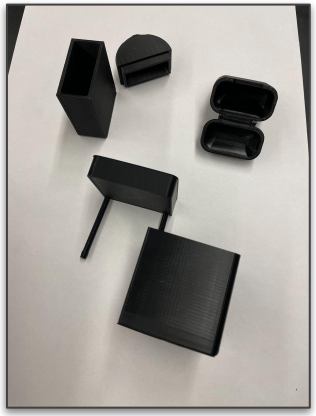


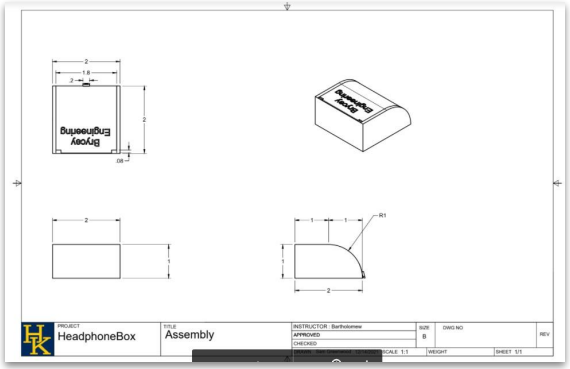




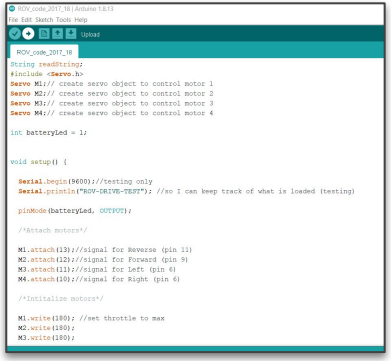


Code, Wiring and Model for Underwater Robot

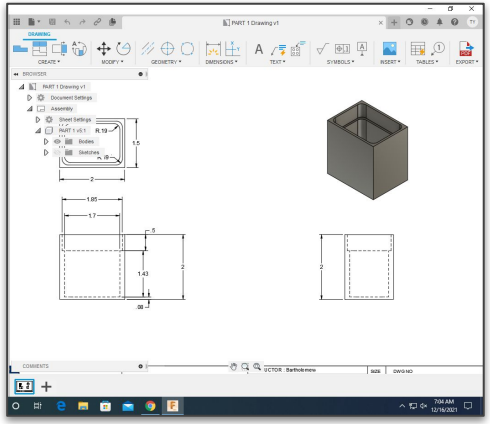


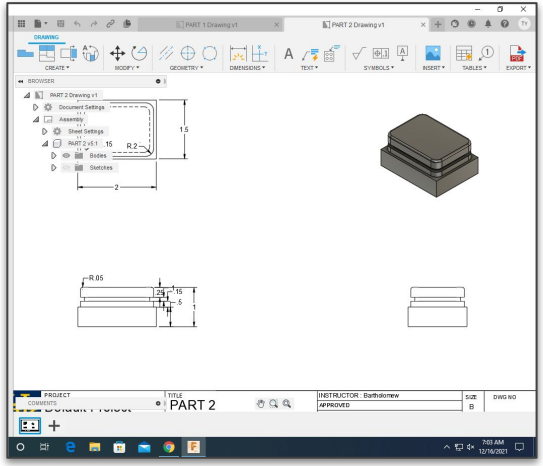


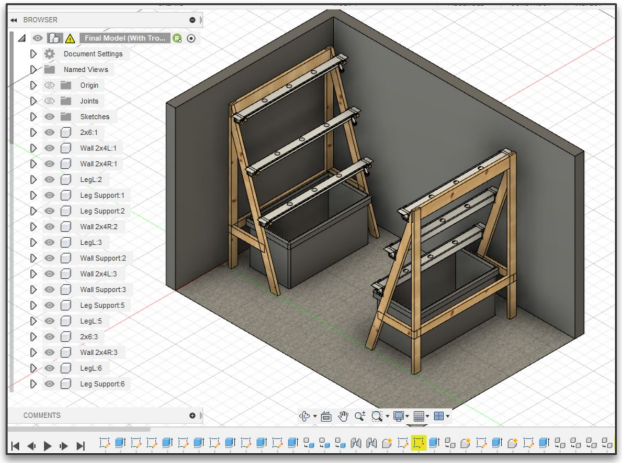
Airpod Holder Redesign 3D print and CAD models



Robotics Club for VEX competition

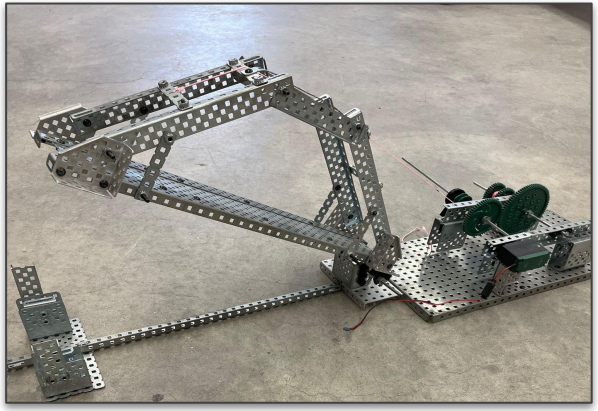




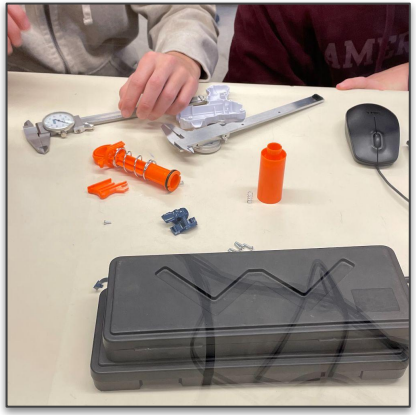


Caption: CAD design and electronics for Automated Garden

Models for Civil Engineering

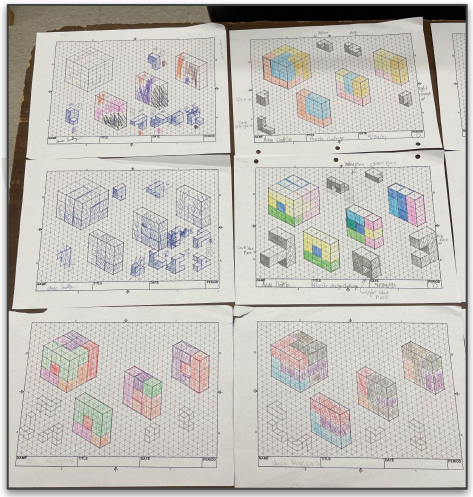


Simple Machines Model

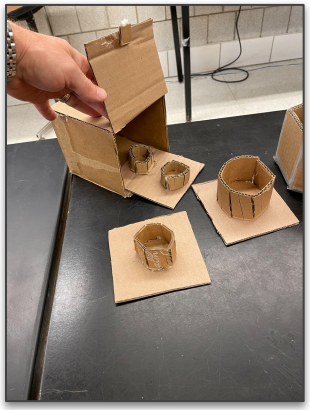


Reverse Engineering

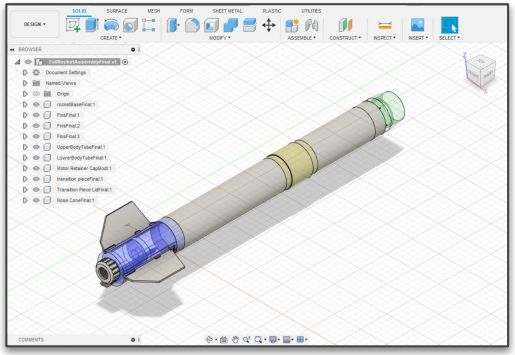
Instant Challenge Testing



Puzzle Cube technical drawings



Cupcake Packaging Design Contest



Rocket Contest design, model and test flight

What's Next?

- New modules:
  - PLTW now has modules that align with all K-5 science standards. We continue to consider these units and pilot them in classrooms before full implementation.
- Professional Development:
  - Continue to train *new* K-5 teachers via our PLTW Launch Leader (internally)
  - Train HKMS teacher in Electricity; Automation & Robotics
  - Train HKHS teachers in updates, as per PLTW
- Resources:
  - Fund purchase of kits, replacement kits or general supplies needed to implement science units
  - VEX V5 kits are needed for middle and high school based on PLTW curriculum updates.
  - Budget lines 22-23: HKMS: $3245, HKHS: $3000

VEX V5 will replace VEX Cortex equipment or other similar equipment completely beginning in the 2022-23 curriculum.