

Glenbrook High School District 225 Project Lead the Way/STEM Update

Goals & Background

Project Lead the Way (PLTW) was brought to the Glenbrooks to offer a comprehensive course sequence in engineering.

Through PLTW course offerings, we aim to:

- Provide the most relevant and effective curricular offerings to prepare our students for success in college and career
- Increase awareness and exposure to problem-solving, design thinking, and technical literacy skills needed to succeed in STEM fields
- Educate and train students for high demand, high wage earning careers needed in the technology-driven economy, especially underrepresented populations

Project Lead the Way is the leading provider of rigorous and innovative Science, Technology, Engineering, and Mathematics (STEM) curricular programs used in middle and high schools across the country. PLTW curriculum integrates national academic, technical standards and STEM principles while engaging both males and females to pursue careers in engineering. The curriculum was developed and is updated annually by a team of educators utilizing current research and ongoing collaboration with experts in academia and industry. PLTW courses are project-centered, problem-based, and technology-integrated. PLTW teachers are required to participate in a rigorous, in-depth, residential two-week training led by master teachers; pass a certification assessment and participate in yearly professional development. Glenbrook South received National Certification for our program in 2015 based on an extensive review process, including a site visit and observations. Glenbrook North became eligible to apply for National Certification this year and will submit the application when it is available later this spring.

Enrollment

GBS PLTW Enrollment (including enrollment in STEM Learning Community PLTW classes)						
Year	Intro to Eng Design IED	Principles of Engineering POE	Civil Engineering and Architecture CEA	Digital Electronics DE	Engineering Design and Development EDD	Total Students in the Program
2013-2014	155	24				179
2014-2015	139	87			14	240
2015-2016	113	100	15	43	20	291
2016-2017	143	89	18	47	41	338

GBS enrollment in PLTW courses has greatly exceeded our expectations when proposing the course, given that the enrollment in the previous engineering sequence averaged 26 total students in our department for the three years prior to PLTW. In our fourth year, we have enrollment of 338 students studying engineering in PLTW courses.

GBN PLTW Enrollment				
Year	Intro to Eng Design (IED)	Principles of Engineering (POE)	Civil Engineering and Architecture (CEA)	Total Students in the Program
2014-2015	45			45
2015-2016	55	24		79
2016-2017	43	28	11*	82

*This class is run concurrently with Architectural Studio 363 and Architectural Studio 463

The enrollment in PLTW courses has met our expectations at GBN. We are pleased with enrollment, and the number of students able to access the pre-engineering pathway, given that prior to 2014 we did not offer any engineering courses.

Retention

Introduction to Engineering and Design is an exploratory course where students dig deep into the engineering design process, applying math, science, and engineering standards to hands-on projects. This is an elective course and like our other introductory courses, we anticipate a decline in enrollment as students choose their next step whether that is continuing to take advanced engineering courses, or pursuing other interests. In addition, we have high retention in the mastery level courses POE through EDD. It is common in any sequence of courses for enrollment to be lighter at the highest levels as students continue to develop skills and solidify future interests in college and career.

Challenges

Our main challenge at both schools is the underrepresentation of females and underrepresented minority students. Secondary, is the ability to offer specialty upper level courses to students identifying the engineering pathway as their college and potential career interest.

GBS

- Females originally made up 16.9% (35 of 207) of total PLTW enrollment and now make up 25% (84 of 338).
- Minority students have consistently made up less than 2% of total PLTW enrollment, while these traditionally underrepresented (Hispanic and Black) represent 14.7% of the school population.

GBN

- In the first year the PLTW female enrollment was comprised of 3 out of 45 students (7%) and currently there are 13 female students out of 82 (16%).
- In the three years of offering PLTW courses, enrollment of underrepresented minority students has consisted of 1-3 (0.1%) students, while these traditionally underrepresented (Hispanic and Black) represent 4.6% of the school population.

Current and ongoing outreach efforts include:

GBS:

- Presentation to eighth grade girls at the Futures Stem Day at Oakton Community College
- Saturday workshops for incoming freshmen elective courses including PLTW
- Hour of Code sessions held for 6-8th grade students, led by high school PLTW students
- Women in STEM breakfast honoring sophomore STEM students with career speakers
- Incoming Freshman Night table display and interactive experiences
- STEM day for District 34 hosting middle school students for science & engineering workshop
- Engineering club and competitive VEX robotics teams, including a female team
- Middle school visits sharing student projects and engineering club autonomous vehicle
- Coordinated invite for Latino students to visit Makerspace and share opportunities
- Science & Engineering Camp sessions and female assistant instructor positions for our high school students
- Active chapters of the Society of Women Engineers with over 35 active members and a Chapter of the Society of Hispanic Professional Engineers
- Plan for gathering specific feedback on program from female PLTW students with program surveys

GBN:

- Presentation to eighth grade girls at the Futures Stem Day at Oakton Community College
- Presentations on course offerings in Career & Technical Education to students during SRT's before registration
- Incoming Freshman Night table display and interactive experiences
- Plan for gathering specific feedback on program from female PLTW students with program surveys

End-of-Course Assessments

PLTW End-of-course assessments (EOC) are delivered online, not shared with instructors prior to testing, and are incorporated into the course grade. They are rigorous and consist of knowledge and application of skills questions from each of the course units. Instructors are provided information with their students' results comparing their performance to national averages. EOC scores and course grades often are utilized for college admission and scholarship consideration.

We did not have expectations for these test scores as the end-of-course assessment is rigorous, and does not align with any prior practice. However, we do have a comparison from our NSERVE consortium of IED end-of-course assessment average scores, in which both GBS and GBN scores were in the top three of the nine schools, in many cases significantly higher.

GBS End-of-Course Assessment Score Trends				
Course	National Averages	2013-14	2014-15	2015-16
IED				
Basic (1-3)	35%	.64%	4%	4%
Proficient (4-7)	47%	77.46%	46%	39%
Advanced (8-9)	18%	21.9%	50%	57%
POE				
Basic (1-3)	34%	4.2%	25.3%	11%
Proficient (4-7)	49%	75%	67.8%	53%
Advanced (8-9)	17%	20.8%	6.9%	36%
DE				
Basic (1-3)	36%			67%
Proficient (4-7)	44%			33%
Advanced (8-9)	20%			0%
CEA				
Basic (1-3)	35%			0%
Proficient (4-7)	46%			40%
Advanced (8-9)	19%			60%

Note: There is no end of course assessment for Engineering Design & Development

GBS: PLTW Students have consistently exceeded national averages and EOC scores have increased in all classes each year. In IED the percentage of students achieving Advanced scores more than doubled over 3 years, and was 3x higher than the national average last year. In POE the percentage of students achieving advanced scores more than doubled over 3 years. DE was offered for the first time last year and scores reflect the challenge in completing all of the units in preparation for the assessment.

GBN End-of-Course Assessment Score Trends			
Course	National Averages	2014-15	2015-16
IED			
Basic (1-3)	35%	1%	2%
Proficient (4-7)	47%	25%	27%
Advanced (8-9)	18%	74%	71%
POE			
Basic (1-3)	34%		4%
Proficient (4-7)	49%		33%
Advanced (8-9)	17%		63%

GBN: PLTW Students have exceeded the national averages on the EOC assessment for the last two years. IED students have scored 4 times higher than the national average for advanced scores. POE students have scored 3.7 times higher than the national average for advanced scores.

Relevance of Student Scores to College Credit

As with AP scores, there are a variety of ways schools use the scores toward college credit, scholarships and other benefits.

- University of IOWA: requires end of course assessment score of 6-9 to receive credit
- Purdue Polytechnic Institute: college credit for PLTW courses with grade of B or better
- University of Minnesota: college credit for a score of 4 or better and grade average of 85%
- Northern Illinois University offers up to 7 hours of credit for students who have completed various PLTW courses and earned a B or better
- Bradley University and Milwaukee School of Engineering offers scholarships for students who have completed PLTW courses

STEM Learning Community

The purpose of the STEM Learning Community (SLC) at Glenbrook South is to provide an interdisciplinary pathway that [integrates science and engineering](#) in order to develop the habits of mind and problem solving skills necessary for scientists and engineers. The SLC incorporates PLTW classes and science classes. These PLTW classes are the same as the courses taken by students not in the SLC except that they are taught in conjunction with a science class so that students are able to see the applications of their science learning and so they are able to develop deep understandings of the science behind the devices they create. Such integration allows for the overlapping of content and skills between disciplines.

This program is currently in its third year. The program was highly selective with approximately 140 applicants and a maximum enrollment of 48 students per grade level. The administrative team and program teachers conducted an extensive program review in Summer and Fall 2016. As a result of the program review, the following changes are being implemented in preparation for the 2017-2018 school year.

Change: The name of the program, STEM Learning Community (SLC), was changed to Science and Engineering Learning Community (SELC).

Rationale: The original name led some students, parents, and community members to perceive the SLC as the *only* STEM option at GBS. The new name more accurately reflects the content of the program. In addition, it reinforces the fact that there are *many* STEM opportunities at GBS.

Change: We have shifted away from an application and selection process and toward a placement and opt-in process.

Rationale: This change deemphasizes the elite nature of the program and instead asks the student and parent to decide if this course of study is a good fit. All students who are placed into honors level math and science classes have the option to join the SELC. Previously, the application process came *before* the communication of course placement, so many students who were not selected were actually never eligible. As it turns out, almost the exact same

number of students opted into the program as they did when there was an application process. For 2017-2018, 46 students will participate in the SELC as freshmen.

Change: There is no longer an expectation of participating for at least two years. Students can only enter the program as freshmen, and students can choose to exit the program at the end of each school year.

Rationale: The program is designed as a four-year course sequence with vertical alignment of skills and habits of mind for science and engineering. However, we want to provide flexibility for students as they discover their passions and pursue their interests during high school.

STEM Learning Community Enrollment Two-year commitment; Four-year offering aligned to PLTW					
Year	Intro to Eng Design IED	Principles of Engineering POE	Digital Electronics DE	Engineering Design and Development EDD	Total Students in the Program
2014-2015	49				49
2015-2016	48	49			97
2016-2017	48	48	25*		121

*There are two major reasons why students have chosen not to continue after sophomore year: (1) a desire to take an AP science course in the junior year and (2) a realization by students that engineering may not be for them. This shift also mirrors the trends we've seen in PLTW as students plan for college and career.

Course Sequence:

