

GREAT PLAINS TECHNOLOGY CENTER COURSE OF STUDY

Career Cluster: Science, Technology, Engineering and Mathematics (SC)

Career Pathway: Engineering and Technology

Local Program: PLTW Pre-Engineering (SC0040013)

Program Hours: Secondary Students: 720 Hours

<u>Instructors:</u>	Name	Office	E-Mail
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Credits: Secondary Students: 3 high school credits per year – *OK Promise credit

Prerequisites: Enrollment in the Pre-Engineering program is with the home school recommendation. If eligible, a student can enroll in 6 of the 9 course offerings at the Great Plains Technology Center during a 2-year period. See each individual course for specific prerequisites.

Program Description:

This is a two-year academy that will emphasize academics and engineering principles. It will provide the student with a strong foundation to excel in a post-secondary engineering pathway. Students in this program will study pre-engineering through Project-Lead-the-Way curriculum that will introduce them to the concepts and principles of engineering and there will be a strong emphasis on developing problem-solving skills. Students will complete advanced math and science courses, including physics and calculus, which will prepare them to advance to the college or university level.

Program Goals:

This program challenges students to use mathematical, scientific and technological principals in solving real-world problems.

Upon achieving the goals of this program, students will:

- Understand technology as a tool for finding, justifying and solving problems
- Understand problem solving in engineering, and the application of technology in engineering
- Be prepared for the rigor of a college level program in engineering or engineering technology
- Understand technological systems in analyzing and solving programs
- Use mathematical principles to solve problems
- Communicate effectively through reading, writing, listening and speaking
- Work well in a team

Career Opportunities:

- A career in science
- A career in technology
- A career in mathematics
- A career in engineering
- A career in research and development
- A career in laboratory, testing, and investigative service

Program Objectives:

After successful completion of this program, the student will be able to:

- Understand how the skills they are learning in the classroom can be applied in everyday life
 - Increase cooperative learning and higher order thinking skills
 - Develop strategies to direct their own learning
 - Make connections to problems in context and see the value in what they learn
 - Synthesize and construct knowledge to grapple with the complexities of problems
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DESCRIPTION OF COURSES

<u>Course #</u>	<u>Course Name</u>	<u>HST</u>	<u>HSL</u>	<u>Total</u>
ST00023	Intro. to Engineering Design (8709*) – PLTW Course	72	48	120
Introduction to Engineering Design is a course that teaches students problem-solving skills using a design development process. Models of product solutions are created, analyzed and communicated using solid modeling computer design software. This course qualifies for a Computer Science/Computer Technology credit and are Oklahoma Promise approved.				
ST00024	Principles of Engineering (8710*) – PLTW Course	72	48	120
Principles of Engineering helps students understand the field of engineering/engineering technology. Students explore various technology systems and manufacturing processes helping them learn how engineers and technicians use math, science, and technology in an engineering problem solving process to benefit people. This course also includes concerns about social and political consequences of technological change. This course is approved for Computer Science/Computer Technology credit and is Oklahoma Promise approved.				
ST00041	Computer Integrated Manufacturing (8712*) – PLTW Course	72	48	120
Computer-integrated manufacturing deepens the skills and knowledge of an engineering student for how products are manufactured. Building upon their computer-aided design (CAD) experience, students use computer-aided manufacturing (CAM) software. CAM translates a digital design into a program that a computer numerical controlled (CNC) mill uses to transform a block of raw material into a product designed by a student. Students learn and apply concepts PLTW Engineering Computer Integrated Manufacturing related to integrating robotic systems, such as automated guided vehicles (AGV) and robotic arms, into manufacturing systems. This course is approved for Computer Science/Computer Technology credit and is Oklahoma Promise approved.				
ST00021	Digital Electronics (8711*) – PLTW Course	72	48	120
Digital Electronics is a course in applied logic that encompasses the application of electronic circuits and devices. Computer simulation software is used to design and test digital circuitry prior to the actual construction of circuits and devices. Prerequisites: Introduction to Engineering Design, Principles of Engineering				
ST00022	Engineering Design and Development (8716*) – PLTW Course	72	48	120
Engineering Design and Development is an engineering research course in which students work in teams to research, design and construct a solution to an open-ended engineering problem. Students identify a problem, complete extensive research, apply principles developed in the preceding courses, and are guided by a community mentor. They must present progress reports, submit a final written report, and defend their solutions to a panel of outside reviewers at the end of the course. Prerequisites: Introduction to Engineering Design, Principles of Engineering, Digital Electronics				

ST00013 Aerospace Engineering (8715*) – PLTW Elective 72 48 120

Aerospace Engineering is a specialty engineering course where students learn through hands-on engineering projects developed with NASA. Students learn about aerodynamics, astronautics, space-life sciences, and systems engineering (which includes the study of intelligent vehicles like the Mars rovers Spirit and Opportunity). **Prerequisites: Introduction to Engineering Design, Principles of Engineering**

ST00019 PLTW Civil Engineering and Architecture – PLTW Elective 72 48 120

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 topics such as: The Roles of Civil Engineers and Architects, Project Planning, Site Planning, Building Design, and Project Documentation and Presentation.

ST00006 Adv. Algebra II (4412)– Academic Math Course 72 48 120

This course will enhance and expand the mathematical foundations of Algebra I and Geometry. The course will stress the fundamental extension of previous mathematics and the preparation for future higher-level mathematics courses. It will involve operations with real and complex numbers as well as matrices. The problem-solving processes will use functions and relations. Within the course applications of math, and while satisfying predictions based on a set of data, the use of data analysis, and statistics will be justified. Students who master CareerTech Algebra II will gain experience with quadratic functions, conic sections, logarithmic and exponential functions, linear functions, solution methods for systems of linear functions, and matrix operations.

ST00009 Adv. Geometry (4520) – Academic Math Course 72 48 120

This course will allow students the chance to relate mathematics to real-life situations and careers. It will build logical reasoning capabilities as well as give students an opportunity to justify conclusions in a structured manner. Students will analyze characteristics and properties of two- and three-dimensional geometric shapes. They will use visualization, spatial reasoning, and geometric modeling to solve problems. Throughout the course students connect the algebra skills previously developed to the geometric concepts. The CareerTech Geometry is a rigorous course that prepares students for higher-level mathematics. It was developed by a group of mathematics instructors while correlating it with NCTM Standards (National Council of Teachers of Mathematics) and the Oklahoma PASS Objectives (Priority Academic Student Skills).

ST00223 Adv. Trigonometry (4750) – Academic Math Course 36 24 60

This semester course is designed to be in preparation for AP Calculus and/or AP Physics. The course includes a study of six basic functions of trigonometry, Topics include right triangle relationships, unit circle, sine, cosine, and tangent functions and their applications, inverse trigonometric functions, identities, and trigonometric form of solutions of right and oblique triangles, trigonometric identities, conics, and complex numbers. The student will analyze and graph mathematical functions. Students will use graphing calculators in activities that are appropriate to the topics being studied.

ST00224 Adv. Pre-Calculus (4611*) Academic Math Course 36 24 60

This semester course is designed to be in preparation for AP Calculus and/or AP Physics. The course includes topics in Algebra ranging from polynomial, rational, and exponential functions to conic sections. The course gives a review study of straight lines, conic sections, algebraic curves, transcendental curves, a completed study of straight lines, simplification of equations, and polar

coordinates. Students will then begin calculus concepts such as limits, derivatives, and integrals. The student will analyze and graph mathematical functions. Students will use graphing calculators in activities that are appropriate to the topics being studied.

C00000 AP Precalculus (4614)– Academic Math Course 72 48 120

This year long course is designed to prepare students for AP Calculus and/or obtain college credit. Students acquire and apply mathematical tools in real-world modeling situations in preparation for using these tools in college-level calculus. Modeling, a central instructional theme for the course, helps students come to a deeper understanding of each function type. By examining scenarios, conditions, and data sets, as well as determining and validating an appropriate function model, students develop a greater comprehension of the nature and behavior of the function itself. The formal study of a function type through multiple representations (e.g., graphical, numerical, verbal, analytical), coupled with the application of the function type to a variety of contexts, provides students with a rich study of precalculus.

ST00061 AP Calculus AB (4615) – Academic Math Course 72 48 120

This is a college course taught to high school students that intend to move on to post-secondary. It offers extreme rigor in a specialized field of study. It will enable the student to be successful on the Advanced Placement AP Calculus AB exam and/or in college calculus. An emphasis will be placed on real world applications as they relate to the various engineering fields as well as development of problem-solving skills. **Prerequisites: Algebra I, Algebra II, Geometry, Trigonometry/Pre-Calculus, Adv. Calculus**

ST00062 AP Calculus BC (4616) – Academic Math Course 72 48 120

The AP Calculus BC covers the same differential and integral calculus topics that are included in Calculus AB, plus additional topics in differential and integral calculus, and polynomial approximations and series. This is material that would be included in a two-semester calculus sequence at the college level. Graphing calculator use is an integral part of the course. Students cannot take both the Calculus AB and Calculus BC exams during the same year.

ST00206 AP Physics I – algebra based (5213) – Academic Science Course 72 48 120

AP Physics 1 course, together with the AP Physics 2 course, replaces the AP Physics B course as of fall 2014. Through inquiry-based learning, AP Physics 1 students will develop critical thinking and reasoning skills, allowing them to cultivate their understanding of physics and science practices. The AP Physics 1 Exam, which debuts in May 2015, will assess students' achievement of the AP Physics 1 learning objectives.

ST00016 Adv. Chemistry (5051) – Academic Science Course 72 48 120

Adv. Chemistry is designed to prepare students for the complex thinking that will be expected in future science courses. This course will focus on the development of the student as a scientist through the study of chemistry. Being a scientist requires a broad set of tools, including theory, problem solving, written and oral communication, interpreting data and laboratory skills. Areas covered are: Matter, atoms & periodic table, molecules & compounds, chemical reactions & stoichiometry, aqueous solutions & reactions, gases, energy & chemical reactions, atomic & molecular Structure.

ST00007 AP Chemistry (5055) – Academic Science Course 72 48 120

Chemistry is the study of the properties of materials and the changes that materials undergo. A student will see how chemical principles operate in all aspects of our lives, from everyday activities to far-reaching matters like the development of drugs to cure cancer. Students will learn through laboratory and lecture methods using group and individual activities, cooperative learning, presentations, and technology to enhance the learning environment. Students will learn how to design and conduct experiments using a variety of laboratory techniques and technology to investigate a chemical concept. They will apply stoichiometric concepts to chemical reactions and analyze how atomic structure relates to periodicity. The student will analyze how atomic structures relate to chemical bonding and apply chemical concepts to reactions in aqueous solutions. They will learn about gas laws as well as study electrochemistry.

HL00597 Anatomy (5333) – Academic Science Elective 36 24 60

Anatomy is the study of the structure and shape of the body and their relationships to one another. This course includes both gross anatomy (anatomy of the large body structures), as well as microscopic anatomy (anatomy of body structures too small to be seen with the naked eye).

HL00598 Physiology (5220) – Academic Science Elective 36 24 60

Human physiology, a branch of general physiology, is concerned with how the human body works. This course will approach the study through an organ-system approach. Organ-systems are collections of cells, tissues, and organs which have dedicated functions in the body.

ST00028 AP Biology (5035) 72 48 120

CareerTech AP Biology is designed to be the equivalent of a first year Biology post-secondary course. The range and depth of knowledge of the content area, types of labs, and time expenditure is elevated and extensive. Students will develop a conceptual framework for biology and an appreciation of science as a process. The course follows College board's outline and covers eight major themes. They are: Science as a Process, Evolution, Energy Transfer, Continuity and Change, Relationship of Structure to Function, Regulation, Interdependence in Nature, Science, Technology, and Society. Labs play an integral part of this course and there are twelve lab topics that will be covered. They will provide the student with an opportunity to learn a variety of skills and facts, principles, and concepts of biology. Lab investigations will encourage higher-order thinking, generating ideas, and formulating hypotheses. All students are expected to take the AP Exam upon completion of this course.

ST00263 Aviation I (8874) - STEM Elective Course 72 48 120

This course is the first course in the aviation pathway. Some possible courses are below:

- Launching into Aviation
- Exploring Aviation & Aerospace

ST00264 Aviation II (8875) – (Oklahoma's Promise – Computer Credit) 72 48 120

This course is the second course in the aviation pathway. Some possible courses are below:

- Introduction to Flight
- Aircraft Systems and Performance

ST00261 Renewable Energy (8872) - STEM Elective Course 72 48 120

An introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application.

ST00142 Robotics Engineering (8833) - STEM Elective Course 72 48 120

Students will learn to design, build, program, and control robotic devices. A rigorous study and application of electrical concepts will include sources of energy, electrical safety, use and identification of basic

electronic components, sensors and actuators. Engineering concepts will include mechanical design, prototype development, design testing, programming and proper engineer documentation.

ST00255 Advanced Robotics Engineering (8866)- - (Oklahoma's Promise – Computer Credit)
72 48 120

This is an advanced robotics engineering and automation course that delivers thorough and engaging STEM education. This course should deliver comprehensive, standards-based instruction through relevant activities and engagement. This introduces the design method in C programming software and robotics hardware building. It ultimately teaches science, technology, engineering and math in a robotics-based, exciting, refreshing and engaging environment for students

Program Total:

- Theory Hours – Dependent on courses taken
 - Lab Hours – Dependent on courses taken
 - Total Hours Year One – 360
 - Total Hours Year Two – 360
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Evaluation Policy:

Project Lead the Way (PLTW) Courses:

Academic Grades (25% of final grade)

Students are expected to complete all practice exercises whether assigned in class or for homework. Knowledge assignments will include, but not limited to, vocabulary, notes, supplemental problems, quizzes, and tests.

Employability Grades (Percentage of final grade varies from course-to-course)

The employability skills grade is based on 20 points per day (which may include: attitude, attendance, safety, punctuality, cooperation, participation, clean-up, class preparation, school/classroom rules, and time management). Points will be deducted if these responsibilities are not met at the instructor's discretion. Students will be allowed to make up unearned employability points for **excused** absences only. Full credit will be given for assignments/tests that have been made up due to excused absences only (see Student Handbook)

Performance Grades (75% of final grade)

The performance and assessment portion of your grade will be based on how well you can effectively demonstrate your understanding of skills and concepts through projects, labs, various activities and student employability skills. You will also be required to develop a portfolio of your work and maintain your unit notes. The instructor will provide guidelines on how the development of your portfolio as well as how to maintain organization of unit notes.

Academic Courses:

Performance Grades (Percentage of final grade varies from course-to-course)

The performance assessment portion of your grade will be based on how well you can effectively demonstrate your understanding of skills and concepts through projects and activities. You will

also be required to develop a portfolio of your work and maintain your unit notes. The instructor will provide guidelines on how the development of your portfolio as well as how to maintain organization of unit notes.

Knowledge Grades (Percentage of final grade varies from course-to-course)

Students are expected to complete all practice exercises whether assigned in class or for homework. Knowledge assignments will include, but not limited to, vocabulary, notes, supplemental problems, and vocabulary quizzes (tests).

Final Grade (Semester)

Semester grade will be calculated by averaging grades in each category and summing each category according to their assigned weight. Progress reports will be sent to home schools at six and twelve-week intervals each semester as required or requested. Grades are accessible on-line at <http://sonisweb.greatplains.edu/studsect.cfm>

Grading Scale:

The grading scale as adopted by the Board of Education is as follows:

A = 90 – 100	W = Withdrawn
B = 80 – 89	I = Incomplete
C = 70 – 79	N = No Grade
D = 60 – 69	
F = Below 60	

Make-Up Work Policy:

All Make-Up Work Is the Responsibility Of The Student. Make-up work will be handled as specified in the Student Handbook. Please be sure to read and understand all student policies, especially make-up of assignments, tests and employability due to absences. Students should always arrange for any make-up work with the instructor as per the Student Handbook. Students should keep track of his or her progress and grades.

Safety Precautions:

Computers, printers, graphing calculators, measurement tools (compasses, etc.), and all other equipment are for educational purposes only! Students should not attempt to “fix”, tamper or play with any school property. The instructor should be informed immediately of any problems with equipment.

Attendance Policy:

For specific information related to attendance and tardiness refer to the Student Handbook. Students should keep a written record of their absences and tardiness.

Program Requirements and Expectations:

The general course requirements and expectations include:

- Training methods will consist of lecture, individualized instruction and practical application.
- All students must adhere to policies and procedures in the GPTC student handbook.
- TSA is the student organization for Pre-Engineering. This student organization offers an outstanding opportunity to develop leadership and social skills. Students are highly encouraged to participate.

Student Behavior Includes:

- Students should enter the engineering classroom as a young professional.
- Employability skills are EXPECTED behaviors.

- Students not riding school buses should be in the classroom by 8:00 a.m. and 11:50 p.m. to be punctual.

NOTE: For additional information or questions regarding the GPTC School policies and procedures, please refer to the Student Handbook and/or the Instructor.

Accountability Measures and Assessments:

- End of course assessment administered through Project Lead The Way (PLTW), college credit available
- Oklahoma Priority Academic Student Skills (2003). Oklahoma State Department of Education - PASS www.sde.state.ok.us
- Principles and Standards for School Mathematics. 4th ed. National Council of Teachers of Mathematics, Reston, VA. 2005.
- National Science Standards. 5th ed. National Research Council, Washington, D.C., National Academy of Sciences. 1998.
- All AP Courses undergo an AP Course Audit through College Board. Please refer to their website for further information

CIP & SOC:

- CIP: 14.0101 – Engineering, General
- SOC: 17-2199.00 – Engineers, All Other

OCAS program codes:

- 9862 – Pre-Engineering Program (first year)
- 9871 – Pre-Engineering Program (second year)

OCAS course codes:

- 8711 – PLTW Digital Electronics
- 8709 – PLTW Introduction to Engineering Design
- 8710 – PLTW Principles of Engineering
- 8712 – PLTW Computer Integrated Manufacturing
- 8713 – PLTW Civil Engineering & Architecture
- 8715 – PLTW Aerospace Engineering
- 8716 – PLTW Engineering Design & Development
- 5213 – AP Physics I Algebra-Based
- 4750 – Adv. Trigonometry
- 4611 – Adv. Pre-Calculus
- 4614 - AP Precalculus
- 4615 – AP Calculus AB
- 5035 – AP Biology
- 5333 – Anatomy
- 5220 – Physiology
- 8874 - Aviation I
- 8875 - Aviation II
- 8872 - Renewable Energy
- 8833 - Robotics Engineering
- 8866 - Advanced Robotics Engineering

Instructional Materials and Supplies:

Students are not required to purchase textbooks or supplemental materials.

eLearning Curricula:

Project Lead the Way, Inc." PLTW Curriculum." *pltw.org*. Project Lead the Way, Aug 2021. Web.
<<http://www.pltw.org>>

Textbooks:

Giancoli, Douglas C. Physics: Principles with Applications. 7th ed. 0-13-344768-5. Boston: Pearson, 2013.

Larson, Ron, Robert Hostetler, and Bruce Edwards. Calculus of a Single Variable. 7th ed. 0-618-14943-0. New York: Houghton Mifflin, 2001.