FAIRBANKS NORTH STAR BOROUGH SCHOOL DISTRICT

CAREER & TECHNICAL EDUCATION CURRICULUM

Adopted May 7, 2013

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Science, Technology, Engineering & Mathematics (STEM)

Science, Technology, Engineering & Mathematics (STEM)
Overview

The Science, Technology, Engineering and Mathematics (STEM) Cluster includes planning, managing and providing scientific research and professional and technical services (e.g., physical science, social science, engineering) including laboratory and testing services and research and development services.

The Fairbanks North Star Borough School District STEM Cluster courses may be sequenced into a variety of Programs of Study including, but not limited to:

- *Engineering & Technology*
- *Science & Math*
- *Drafting and Design*

Each school will develop Programs of Study based on availability of courses. Programs of Study are suggestions to help guide the development of individual Personal Learning Career Plans (PLCP). Students may choose courses from multiple clusters as they design a PLCP.

Many courses within this cluster are articulated for credit with University of Alaska Fairbanks/Community and Technical College through a Tech Prep agreement. This agreement allows students to earn postsecondary credit while taking a course from an approved high school instructor.

STEM Overview					
Grade 9	**Grade 10**	**Grade 11**	**Grade 12**	**Grade 13**	**Grade 14**
Introductory Courses	**Concentrator Courses**		**Capstone Courses**	**Post-Secondary**	
• *Introduction to Engineering Design 1A/1B* • *Tools of Tech and Trade*	• *Principles of Engineering 1A/1B* • *Digital Electronics 1A/1B* • *Engineering and Robotics 1A/1B*		• *Civil Engineering & Architecture 1A/1B* • Independent Research	• UAF/CTC	
Various certifications are available through the pathway. Check specific course objectives.					

Course Information	
Course Name	**CIVIL ENGINEERING AND ARCHITECTURE 1A/1B**
Course Number	CTEO309/310
Grade(s)	11-12
Length	Two Semesters
Credit	1
Pre-requisites	Completion of three other engineering courses or Teacher Recommendation
Sequence or CTEPS (You must first have the Sequence or CTEPS entered into the system.)	STEM, Engineering
Date of District Course Revision	Spring 2013
Career & Technical Student Organization (CTSO)	
CTSO Embedded in this Sequence	None
Occupational Standards	
Source of Occupational Standards	Project Lead the Way
Names/Numbers of Occupational Standards	PLTW, C1:1
Registration Information	
Course Description (brief paragraph – as shown in your student handbook or course list)	Students apply what they learn about various aspects of civil engineering to the design and development of a property. Working in teams, students explore hands-on activities and projects to learn the characteristics of *Civil Engineering and Architecture*. In addition, students use 3D design software to help them design solutions to solve major course projects. Students learn about documenting their project, solving problems and communicating their solutions to their peers and members of the professional community of Civil Engineering and Architecture.
Instructional Topic Headings (please separate each heading by a semi-colon)	Overview of Civil Engineering and Architecture, Introduction to Projects, Project Planning, Site Planning, Architecture, Structural Engineering, Presentations and Reviews
Summative Assessments and Standards	
Technical Skills Assessment (TSA)	Project Lead the Way
Course Addresses	Yes
New Alaska ELA and Math Standards	Yes
Alaska Cultural Standards	Yes
All Aspects of Industry (AAI)	Yes
Core Technical Standards	Yes
Employability Standards	Yes
Employability Standards	
Source of Employability Standards	Alaska

Tech Prep	
Current Tech Prep Articulation Agreement? (Y/N)	No
Date of Current Agreement	N/A
Postsecondary Institution Name	N/A
Postsecondary Course Name	N/A
Postsecondary Course Number	N/A
Number of Postsecondary Credits	N/A
Author	
Course Developed By	Project Lead the Way
Course Adapted From	FNSBSD Career & Technical Education Curriculum
Date of Previous Course Revision	May 6, 2006
Course Delivery Model	
Is the course brokered through another institution or agency? (Y/N)	No

Standards Alignment

Student Performance Standards (Learner Outcomes or Knowledge & Skill Statements)	Specific Occupational Skills Standards	Common Core Technical Standards	New Alaska ENG/LA Standards	New Alaska Math Standards	Alaska Cultural Standards	Alaska Employability Standards	All Aspects of Industry/Systems	Assessments
Students will be able to compare and contrast civil engineering and architecture.	PLTW	ST.3, 5			B3; E4	A2, 5; B2, 4	Technology; Community	PLTW Assessments
Students will communicate ideas for designing a development project using various drawing methods, sketches, graphics or other media collected and documented.	PLTW	ST.2; ST-ET.1-2	RL.4b, 6		B3; E2	A1-2	Technology; Community	PLTW Assessments
Students will communicate understandings of the relationship of structures and land and the responsibility of designers to handle resources in an ethical manner.	PLTW	ST.2; ST-ET.1-2	RT.7-9		A6; B3; E2	A1-2	Technology; Community	PLTW Assessments
Students will mathematically compute utility needs of a project and size the utility supply lines correctly.	PLTW	ST-SM.1-4				A1-2	Technology; Community	PLTW Assessments
Students will analyze and determine the selection and placement of plantings to ensure the proper use of resources and determine if landscaping adds aesthetic appeal.	PLTW	ST-SM.1-4			E2	A1-2	Technology; Community	PLTW Assessments
Students will research and design an appropriate energy system for the team's project.	PLTW	ST-ET.1-6	WT.8-9		B3-4	A1-2	Technology; Community	PLTW Assessments
Students will calculate and determine the heat loss or gain of the energy systems used in their team project.	PLTW	ST-SM.1-4		F-TF	B4	A1-2	Technology; Community	PLTW Assessments
Students will identify and create the necessary schedules for their team's project.	PLTW	ST-ET.1-6	RT.7-9; WT.8-9			A1-2	Technology; Community	PLTW Assessments
Students will determine the live and dead loads of a structure using load tables and appropriate mathematics.	PLTW	ST-ET.1-6		A-REI		A1-2	Technology; Community	PLTW Assessments
Students will size floor members according to loads and modify section details to show the sizing of supporting materials for their team's project.	PLTW	ST-ET.1-6; ST-SM.1-4		A-REI			Technology; Community	PLTW Assessments

Course Information	
Course Name	**DIGITAL ELECTRONICS 1A/1B**
Course Number	CTEO307/308
Grade(s)	10-12
Length	Two semesters
Credit	1
Pre-requisites	*Introduction to Engineering Design* and *Principles of Engineering*; *Algebra II* recommended (may be enrolled concurrently)
Sequence or CTEPS (You must first have the Sequence or CTEPS entered into the system.)	Science, Technology, Engineering & Mathematics (STEM); Engineering
Date of District Course Revision	Spring 2013
Career & Technical Student Organization (CTSO)	
CTSO Embedded in this Sequence	N/A
Occupational Standards	
Source of Occupational Standards	Project Lead the Way (PLTW)
Names/Numbers of Occupational Standards	PLTW, C1:1
Registration Information	
Course Description (brief paragraph – as shown in your student handbook or course list)	*Digital Electronics* is the study of electronic circuits that are used to process and control digital signals. *Digital Electronics* is the foundation of all modern electronic devices. The major focus of the course is to expose students to the design process of combinational and sequential logic design, teamwork, communication methods, engineering standards and technical documentation. Utilizing the activity-project-problem-based (APPB) teaching and learning pedagogy, students will analyze, design and build digital electronic circuits. While implementing those designs, students will continually hone their interpersonal skills, creative abilities and understanding of the design process.
Instructional Topic Headings (please separate each heading by a semi-colon)	Fundamentals of Analog and Digital Electronics, Combinational Logic, Sequential Logic, Microcontrollers
Summative Assessments and Standards	
Technical Skills Assessment (TSA)	PLTW Assessments
Course Addresses	Yes
New Alaska ELA and Math Standards	Yes
Alaska Cultural Standards	Yes
All Aspects of Industry (AAI)	Yes
Core Technical Standards	Yes
Employability Standards	Yes
Employability Standards	
Source of Employability Standards	Alaska

Tech Prep	
Current Tech Prep Articulation Agreement? (Y/N)	No
Date of Current Agreement	N/A
Postsecondary Institution Name	N/A
Postsecondary Course Name	N/A
Postsecondary Course Number	N/A
Number of Postsecondary Credits	N/A
Author	
Course Developed By	Project Lead the Way
Course Adapted From	FNSBSD Career & Technical Education Curriculum
Date of Previous Course Revision	May 6, 2006
Course Delivery Model	
Is the course brokered through another institution or agency? (Y/N)	No

Standards Alignment

Student Performance Standards (Learner Outcomes or Knowledge & Skill Statements)	Specific Occupational Skills Standards	Common Core Technical Standards	New Alaska ENG/LA Standards	New Alaska Math Standards	Alaska Cultural Standards	Alaska Employability Standards	All Aspects of Industry/Systems	Assessments
Students will understand that the process of designing an electronic circuit takes into account many factors, including environment concerns and will be familiar with precautionary measures.	PLTW	ST.3; ST-SM.1				A1-3	Finance; Technology; Community	PLTW Assessments
Students will understand numerical place value.	PLTW	ST-SM.1		N-RN.1		A2	Technology; Community	PLTW Assessments
Students will use schematics and symbolic algebra to represent digital gates in the creation of solutions to design problems.	PLTW	ST-SM.1-2; ST-ET.1, 3		A-CED.2-4; A-REI.5-9		A1-2	Technology; Community	PLTW Assessments
Students will be able to create Boolean Expressions, logic circuit diagrams or truth tables from information provided in the solution of design problems.	PLTW	ST-SM.1-2; ST-ET.1, 3		MP.3; S-CP.1, 4		A2	Technology; Community	PLTW Assessments
Students will be able to design and implement combinational logic circuits using reprogrammable logic devices.	PLTW	ST-SM.1-2; ST-ET.1, 3		S-CP.4		A1-2	Technology; Community	PLTW Assessments
Students will demonstrate understanding of binary addition and subtraction by designing circuits to produce correct answers.	PLTW	ST-SM.1-2; ST-ET.1, 3				A1-2	Technology; Community	PLTW Assessments
Students will be able to interpret waveform diagrams from circuits they construct and compare them with combinational waveforms.	PLTW	ST-SM.1-2; ST-ET.1, 3		F-TF.5		A1-2	Technology; Community	PLTW Assessments
Students will conduct experiments to determine the basic principles of how shift registers work.	PLTW	ST-SM.1-2; ST-ET.1, 3				A1-2	Technology; Community	PLTW Assessments
Students will be able to correctly setup and use an oscilloscope to observe and measure propagation delay in a digital circuit.	PLTW	ST-SM.1-2					Technology; Community	PLTW Assessments
Students will be able to design and create a program in correct syntax allowing a microprocessor to evaluate external data in order to operate motors and other devices to control the external environment.	PLTW	ST-SM.1-2					Technology; Community	PLTW Assessments

Course Information	
Course Name	**INTRODUCTION TO ENGINEERING DESIGN 1A/1B**
Course Number	CTEO303/304
Grade(s)	9-10
Length	Two Semesters
Credit	1
Pre-requisites	*Algebra I* (may be enrolled concurrently)
Sequence or CTEPS (You must first have the Sequence or CTEPS entered into the system.)	Engineering
Date of District Course Revision	Spring 2013
Career & Technical Student Organization (CTSO)	
CTSO Embedded in this Sequence	N/A
Occupational Standards	
Source of Occupational Standards	Project Lead the Way (PLTW) (www.pltw.org/aindex.htm)
Names/Numbers of Occupational Standards	PLTW
Registration Information	
Course Description (brief paragraph – as shown in your student handbook or course list)	*Introduction to Engineering Design* is recommended for students with a good math and science background and an interest in engineering and robotics. It is a project-based course designed to develop the student's problem-solving skills. Students will learn the process of developing a three-dimensional model or solid rendering of a designed object. Students will learn how to design and analyze products using visualization processes and tools provided by modern, state-of-the-art computer hardware and software. The course will emphasize the design and operation of basic robotic systems including the fundamental electronic and mechanical systems. Students will learn to use basic prototyping tools in order to construct fundamental robotic components and turn their designs into reality.
Instructional Topic Headings (please separate each heading by a semi-colon)	Design Process, Design Exercises, Reverse Engineering, Open-Ended Design Problems
Summative Assessments and Standards	
Technical Skills Assessment (TSA)	PLTW Assessments
Course Addresses	Yes
New Alaska ELA and Math Standards	Yes
Alaska Cultural Standards	Yes
All Aspects of Industry (AAI)	Yes
Core Technical Standards	Yes
Employability Standards	Yes

Employability Standards	
Source of Employability Standards	Alaska
Tech Prep	
Current Tech Prep Articulation Agreement? (Y/N)	No
Date of Current Agreement	N/A
Postsecondary Institution Name	N/A
Postsecondary Course Name	N/A
Postsecondary Course Number	N/A
Number of Postsecondary Credits	N/A
Author	
Course Developed By	PLTW
Course Adapted From	FNSBSD Career & Technical Education Curriculum
Date of Previous Course Revision	May 6, 2006
Course Delivery Model	
Is the course brokered through another institution or agency? (Y/N)	No

Standards Alignment

Student Performance Standards (Learner Outcomes or Knowledge & Skill Statements)	Specific Occupational Skills Standards	Common Core Technical Standards	New Alaska ENG/LA Standards	New Alaska Math Standards	Alaska Cultural Standards	Alaska Employability Standards	All Aspects of Industry/Systems	Assessments
Students will explore the concepts of form and function and explain its use in product design.	PLTW	ST-ET.1-2			E3	A1-2	Technology; Community	PLTW Assessments
Students will apply the steps of the design process to solve a variety of design problems.	PLTW	ST-ET.1, 4		Modeling	E6	A1-2	Technology; Community	PLTW Assessments
Students will develop a portfolio to organize and display evidence of their work.	PLTW	ST.5, 6			A1	A3	Technology; Community	PLTW Assessments
Students will evaluate and select the necessary views to graphically communicate design solutions.	PLTW	ST-ET.1, 4		Modeling		A1-2	Technology; Community	PLTW Assessments
Students will identify major geometric shapes.	PLTW	ST-ET.1, 4		G-MG.1-3; Modeling		A1-2	Technology; Community	PLTW Assessments
Students will draw a two-dimensional sketch using a CAD package.	PLTW	ST-ET.1, 4		G-CO.12-13; Modeling		A1-2	Technology; Community	PLTW Assessments
Students will explore and demonstrate assembly-modeling skills to solve a variety of design problems.	PLTW	ST-ET.1, 4		G-MG.1-3; Modeling		A1-2	Technology; Community	PLTW Assessments
Students will translate a three-dimensional drawing or model into corresponding orthographic drawing views.	PLTW	ST-ET.1, 4		G-CO.12-13; Modeling		A1-2	Technology; Community	PLTW Assessments
Students will interpret data, which have been statically analyzed to ensure product quality.	PLTW			S-CP; S-MD		A1-2	Technology; Community	

Course Information	
Course Name	**PRINCIPLES OF ENGINEERING 1A/1B**
Course Number	CTEO301/302
Grade(s)	9-12
Length	Two Semesters
Credit	1
Pre-requisites	*Geometry with Trigonometry* (may be enrolled concurrently)
Sequence or CTEPS (You must first have the Sequence or CTEPS entered into the system.)	Science, Technology, Engineering & Mathematics (STEM); Engineering
Date of District Course Revision	Spring 2013
Career & Technical Student Organization (CTSO)	
CTSO Embedded in this Sequence	N/A
Occupational Standards	
Source of Occupational Standards	Project Lead the Way (PLTW) (www.pltw.org/aindex.htm)
Names/Numbers of Occupational Standards	PLTW
Registration Information	
Course Description (brief paragraph – as shown in your student handbook or course list)	*Principles of Engineering* (POE) is a high school-level survey course of engineering with a focus on the physical science nature of engineering. The course exposes students to some of the major concepts that they will encounter in a postsecondary engineering course of study. Students have an opportunity to investigate different engineering and high-tech career options. POE gives students the opportunity to develop skills and understanding of course concepts through activities, projects and problem-based learning. There are a variety of different team and individual projects that students work to complete by applying the engineering principles learned in this course.
Instructional Topic Headings (please separate each heading by a semi-colon)	Mechanisms, Energy Sources, Energy Applications, Machine Control, Fluid Power, Statics, Material Properties, Material Testing, Statistics, Kinematics
Summative Assessments and Standards	
Technical Skills Assessment (TSA)	PLTW Assessments
Course Addresses	Yes
New Alaska ELA and Math Standards	Yes
Alaska Cultural Standards	Yes
All Aspects of Industry (AAI)	Yes
Core Technical Standards	Yes
Employability Standards	Yes
Employability Standards	
Source of Employability Standards	Alaska

Tech Prep	
Current Tech Prep Articulation Agreement? (Y/N)	No
Date of Current Agreement	N/A
Postsecondary Institution Name	N/A
Postsecondary Course Name	N/A
Postsecondary Course Number	N/A
Number of Postsecondary Credits	N/A
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Course Developed By	PLTW
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Course Delivery Model	
Is the course brokered through another institution or agency? (Y/N)	No

Standards Alignment

Student Performance Standards (Learner Outcomes or Knowledge & Skill Statements)	Specific Occupational Skills Standards	Common Core Technical Standards	New Alaska ENG/LA Standards	New Alaska Math Standards	Alaska Cultural Standards	Alaska Employability Standards	All Aspects of Industry/Systems	Assessments
Students will differentiate between engineering and engineering technology while exploring careers and various engineering disciplines.	PLTW	ST.4-5			B3; E8	B2-5	Labor	PLTW Assessments
Students will understand, design and evaluate simple and compound machines, machine systems and machine designs.	PLTW	ST-ET.1, 4	RT.3	S-CP; S-MD		A1-2, 5; B1	Technology; Tech/Prod	PLTW Assessments
Students will identify and categorize energy sources as nonrenewable, renewable or inexhaustible while researching specific energy sources.	PLTW	ST.3; ST-ET.6	RT.7-9			A1-2, 5; B1	Technology; Tech/Prod	PLTW Assessments
Students will demonstrate understanding of energy and power by testing and applying the relationship between voltage, current and resistance relating to a photovoltaic cell and a hydrogen fuel cell, as well as the relationship between R-values and recyclable insulation.	PLTW	ST-ET.5	RT.7-9	S-CP; S-MD		A1-2, 5; B1	Technology; Tech/Prod	PLTW Assessments
Students will apply the steps of the design process to solve a variety of design problems.	PLTW	ST-ET.1, 4		G-MG.1-3; Modeling		A1-2, 5; B1	Technology; Tech/Prod	PLTW Assessments
Students will create free body diagrams of objects, identifying, testing and evaluating all forces acting on the object.	PLTW	ST-ET.1-5		Modeling		A1-2, 5; B1	Technology; Tech/Prod	PLTW Assessments
Students will investigate specific material properties related to common household products and manufacturing processes associated with those products.	PLTW	ST-ET.1-5		F-TF		A1-2, 5; B1	Technology; Tech/Prod	PLTW Assessments
Students will utilize computer software to create and demonstrate flowchart logic.	PLTW	ST-TM.1, 4		A-REI		A1-2, 5; B1	Technology; Tech/Prod	PLTW Assessments
Students will demonstrate understanding of concepts and functions related to fluid power.	PLTW	ST-TM.1, 4				A1-2, 5; B1	Technology; Tech/Prod	PLTW Assessments