

Wilson Area School District Planned Course Guide

Title of planned course: Civil Engineering

Subject Area: Technology Education

Grade Level: 9-12

Course Description: The concepts of civil engineering will be the focus of this course. Civil engineering and architecture is the study of the design and construction of residential and commercial building projects. The course includes an introduction to many of the varied factors involved in building design and construction including building components and systems, structural design, stormwater management, site design, utilities and services, cost estimation, energy efficiency, and careers in the design and construction industry.

Time/Credit for this Course: Half Year / 0.5 credit

Curriculum Writing Committee: Erik Everett & Brian Meckley

First Semester-

August:

- Introduction, What is civil engineering, Measurement

September:

- Technology and Engineering By Design
- Civil Engineering History and Evolution
- Computer Aided Design

October:

- Computer Aided Design
- Fundamental Concepts of Civil Engineering and Architecture
- Surveying and Mapping
- Engineering foundations

November:

- Engineering foundations
- Engineering Structures, Trusses

December/January:

- Architectural design and modeling
- Final Exam

Throughout Course:

- Machine and Tool Use/Safety

Second Semester-

January:

- Introduction, What is civil engineering, Measurement
- Technology and Engineering By Design
- Civil Engineering History and Evolution
- Computer Aided Design

February:

- Computer Aided Design
- Fundamental Concepts of Civil Engineering and Architecture
- Surveying and Mapping

March:

- Surveying and Mapping
- Engineering foundations

April:

- Engineering Structures, Trusses
- Architectural design and modeling

May:

- Architectural design and modeling

June:

- Final Exam

Throughout Course:

- Machine and Tool Use/Safety

Wilson Area School District Planned Course Materials

Course Title: Civil Engineering

Textbook:

- Infrastructure Planning, Engineering and Economics, 2nd Edition
- Engineering Fundamentals: Design, Principles, and Careers 2nd Edition
- Exploring Engineering 4th Edition

Supplemental Books: Engineering Fundamentals Lab Workbook

Teacher Resources:

- Engineering Fundamentals: Design, Principles, and Careers 2nd Edition
- ITEEA Standards for Technological Literacy
- Pennsylvania State Standards

Curriculum Scope & Sequence

Planned Course: Civil Engineering

Unit: Introduction, What is civil engineering, Measurement

Time frame: 1 week

State Standards: 3.4.10.A3, 3.4.10.B4, 3.4.10.C3, 3.4.12.C2

ITEEA Standards: 9

Anchor(s) or adopted anchor:

- Establish positive habits of minds for students to develop through the duration of the course that can be carried on into the future.

Essential content/objectives: At end of the unit, students will be able to:

- Understand the course expectations and timeline for instruction.
- Understand the discipline policy that relates to behavior in this class.
- Develop an understanding of civil engineering and how it relates to our everyday lives.
- Identify civil engineering and the kinds of job related skill associated with that career
- Utilize the customary and Metric systems of measurement and present measurements in simplest form.
- Add, Subtract, and divide fractions and present them in simplest form
- Model and compare values of integers, mixed numbers, fractions, and decimals.

Core Activities: Students will complete/participate in the following:

- Lecture and class discussion
 - Introduce students to the course expectations, discipline policy, and general safety guidelines.
- Note taking handouts
 - Engineering design notes
 - Measurement worksheets
- Hands on lab work
 - Measurement Activities
 - Presentation on a specific area of civil engineering

Extensions:

- Research more specific civil engineering fields and career choices in those areas
- Complete measurement games to retain skills

Remediation:

- Review
- Unit Terms and Questions
- Homework
- Unit Quiz

Instructional Methods:

- Demonstration
- Lecture
- Observation

Materials & Resources:

- Textbook
- Internet
- Video / Projector
- Classroom tools and Materials

Assessments:

- Follow up Quiz
- Weekly progress portfolio write up

Curriculum Scope & Sequence

Planned Course: Principles of Engineering

Unit: Machine and Tool Use/Safety

Time frame: 1 week- Throughout Course

State Standards: 3.4.12.E7

ITEEA Standards: 12

Anchor(s) or adopted anchor:

- Machines and tools help provide humans with more efficient way of completing tasks.
- Eye Safety is important to everyone in the technology labs.
- Safely using tools and machines is a lifelong skill.

Essential content/objectives: At end of the unit, students will be able to:

- Outline the specific safety guidelines of the classroom and shop rules.
- Follow the necessary precautions prior to using or starting any machine.
- Demonstrate effective practice of eliminating hazards, poor decisions, and unsafe conditions that could lead to accidents.
- Differentiate between primary and secondary eye protection devices.
- Safely operate a CNC laser engraver/cutter, CNC router, table saw, router, band saw, scroll saw, drill press, disk and belt sander, hand drill, etc.
- Safely use hand tools- hammer, screwdriver, hand saw, coping saw, hacksaw, sandpaper

Core Activities: Students will complete/participate in the following:

- Lecture and class discussion
- Note taking handouts
 - Safety reviews
 - Study Guide
- Hands on lab work
 - Safety demonstrations
 - Machine and tool practice with teacher supervision

Extensions:

- Creation of a safety poster to improve lab safety
- Lab safety assessment

Remediation:

- Review
- Unit Terms and Questions
- Homework
- Unit Quiz

Instructional Methods:

- Demonstration
- Lecture
- Observation

Materials & Resources:

- Textbook
- Internet
- Video / Projector
- Classroom tools and Materials

Assessments:

- Safety quiz for machines being used
- Weekly progress portfolio write up

Curriculum Scope & Sequence

Planned Course: Principles of Engineering

Unit: Technology and Engineering By Design

Time frame: 1 week

State Standards: 3.4.12.A2, 3.4.10.B1, 3.4.10.B2, 3.4.10.B3, 3.4.10.C1, 3.4.10.C2

ITEEA Standards: 2- W,X,Y,AA,CC,DD,FF

Anchor(s) or adopted anchor:

- Technology is a human process.
- Using the Engineering design process, you should evaluate and redesign at any time.
- Your first idea is never your best idea.
- Visual connections are critical when developing documentation.

Essential content/objectives: At end of the unit, students will be able to:

- Identify and understand the eight step engineering design process
- Discuss the nature and development of technological knowledge and processes.
- Describe the difference between science and technology.
- Describe technology as a system.
- Discuss the positive and negative impacts of different technological systems.
- Apply the design loop (engineering design process) as it relates to real world problems and situations.
- Maintain and understand the importance of a design log

Core Activities: Students will complete/participate in the following:

- Lecture and class discussion
- Note taking handouts
 - Engineering design notes
- Hands on lab work
 - Create a solution to a problem using the engineering design process
 - Maintain a design log with visual documentation
 - Present the solution to the class

Extensions:

- Research other methods of problem solving
- Creation of an instructable with detailed step by step directions

Remediation:

- Review
- Unit Terms and Questions
- Homework
- Unit Quiz

Instructional Methods:

- Demonstration
- Lecture
- Observation

Materials & Resources:

- Textbook
- Internet
- Video / Projector
- Classroom tools and Materials
- Whiteboards
- Problem related materials (Based on constraints)

Assessments:

- Follow up Quiz
- Weekly progress portfolio write up

Curriculum Scope & Sequence

Planned Course: Civil Engineering

Unit: Civil Engineering History and Evolution

Time frame: 1 week

Essential content/objectives: At end of the unit, students will be able to:

- Understand the basic concepts of civil engineering
- Recite some historical breakthrough in civil engineering
- Cite examples of civil engineering in ancient civilizations
- Discuss how civil engineering and architecture are interrelated
- Identify and evaluate historical structural designs that have both succeeded and failed.

Core Activities: Students will complete/participate in the following:

- Lecture and class discussion
- Note taking handouts
 - Engineering design notes
- Hands on lab work
 - Research civil engineering accomplishments of the Romans, Inca's, Egyptians, and Visigoths and report finding to the class
 - Design and construct a simple solution to make water move

Extensions:

- Report on Archimedes and his effects on civil engineering

Remediation:

- Unit Terms and Questions

Instructional Methods:

- Lecture
- Video
- Demonstration
- Hands on Activities

Materials & Resources:

- Text Book
- Laptop
- CADD Program

Assessments:

- Follow up Quiz
- Weekly progress portfolio write up

Curriculum Scope & Sequence

Planned Course: Principles of Engineering

Unit: Computer Aided Design

Time frame: 2 weeks

State Standards: 3.4.12.A2,

ITEEA Standards: 12- P

Anchor(s) or adopted anchor:

- The field of engineering requires the use of computer generated animations for modeling, testing, and construction purposes.

Essential content/objectives: At end of the unit, students will be able to:

- Understand the ability of computers to generate 3-D models of objects.
- Identify and create Isometric, orthographic and pictorial drawings
- Understand how a 2-D representation correlates to the actual 3-D object.
- Develop a greater understanding of spatial relationships and design systems
- Communicate orally and in writing concepts/explanations using CAD terms.
- Demonstrate the ability to draw an orthographic view of a structure.

Core Activities: Students will complete/participate in the following:

- Lecture and class discussion
- Note taking handouts
 - Engineering design notes
- Hands on lab work
 - Introduction to Autodesk Fusion 360
 - Navigation of user interface and tools
 - Creation of a simple 3D geometric shape from paper to computer animated drawing

Extensions:

- Create a moving 3D part using Autodesk Fusion 360

Remediation:

- Review
- Unit Terms and Questions
- Homework
- Unit Quiz

Instructional Methods:

- Demonstration
- Lecture
- Observation

Materials & Resources:

- Textbook
- Internet
- Video / Projector
- Classroom tools and Materials
- Solid geometric shape

Assessments:

- Follow up Quiz
- Weekly progress portfolio write up

Curriculum Scope & Sequence

Planned Course: Civil Engineering

Unit: Fundamental Concepts of Civil Engineering and Architecture

Time frame: 1 week

ITEEA Standards: 8-12,20

Anchor(s) or adopted anchor:

- A technological world requires that humans develop capabilities to solve technological challenges and improve products for the way we live.

Essential content/objectives: At end of the unit, students will be able to:

- Understand basic building planning including basic requirements of a buildings proper orientation, energy efficiency, and planning for utility
- Read and understand a floor plan or working drawing
- Estimate materials and timetables for basic construction
- Differentiate types of super structures based on load transfer
- Gain an understanding and demonstrate the use, roles, and application of structural design in society.
- Identify and define human made and natural structures.
- Identify the types of structures: mass, frame and shell.
- Identify and evaluate shapes that resist failure.
- Identify careers related to structures.

Core Activities: Students will complete/participate in the following:

- Lecture and class discussion
- Note taking handouts
 - Engineering design notes
- Hands on lab work
 - Reference the International Construction Code and plan a basic house structure with four rooms
 - Draw a floor plan using a CADD program or Architectural drawing tools

Extensions:

- Research an instance where a superstructure failed and report how and why it could have been prevented

Remediation:

- Unit Terms and Questions

Instructional Methods:

- Lecture
- Video
- Demonstration
- Hands on Activities

Materials & Resources:

- Text Book
- Laptop
- CADD Program
- Project Materials

Assessments:

- Follow up Quiz
- Weekly progress portfolio write up

Curriculum Scope & Sequence

Planned Course: Civil Engineering

Unit: Surveying and Mapping

Time frame: 1 week

Essential content/objectives: At end of the unit, students will be able to:

- Understand the uses of and primary divisions of surveying
- Read and understand basic maps and survey drawings
- Create basic maps and survey drawings
- Recite the differences between a chain survey, compass survey, and plane table survey
- Use a compass to navigate to coordinates on a map

Core Activities: Students will complete/participate in the following:

- Lecture and class discussion
- Note taking handouts
 - Engineering design notes
- Hands on lab work
 - 3 leg compass walk activity
 - Practice reading maps and determine elevation and location
 - Use a transit to survey a building lot
 - Create a land plot using the 5 basic descriptive elements

Extensions:

- Visit a local government office and learn how survey and land plot documents are recorded

Remediation:

- Unit Terms and Questions

Instructional Methods:

- Lecture
- Demonstration
- Video
- Hands on Activities

Materials & Resources:

- Compass
- Maps
- Smart Phone
- Laptops
- Directions
- Map Making Materials

Assessments:

- Follow up Quiz

- Weekly progress portfolio write up

Curriculum Scope & Sequence

Planned Course: Principles of Engineering

Unit: Engineering foundations

Time frame: 2 weeks

State Standards:

Anchor(s) or adopted anchor:

Essential content/objectives: At end of the unit, students will be able to:

- Calculate the size of a proper foundation
- Understand the importance of sampling and testing soil characteristics for foundation planning
- Compare and contrast types of foundations used in different applications based on soil type and geological region
- Identify how science and math play a major role in selecting an appropriate foundation
- Analyze different foundation materials for pros and cons
- Understand the process of creating a structurally sound foundation
- Demonstrate the ability to function positively and effectively as a group to: design, build and test a structure.

Core Activities: Students will complete/participate in the following:

- Lecture and class discussion
- Note taking handouts
 - Engineering design notes
- Hands on lab work
 - Practice calculations for proper foundation size for different sizes and types of construction
 - Design and create a computer aided design of a foundation meeting specific design criteria and constraints
 - Produce a foundation prototype based on selected and drawn design
 - Test foundation design for resistance to movement and weight
 - Present design solution to the class

Extensions:

- Calculating Materials and Bids

Remediation:

- Unit Terms and Questions

Instructional Methods:

- Lecture
- Demonstration
- Hands on Activities

Materials & Resources:

- Textbook
- Internet
- Video / Projector
- Classroom tools and Materials
- Whiteboards
- Consumable materials for foundation prototype
- ¼ " plywood
- Soil
- Cement
- Wire (rebar)
- CNC laser cutter/engraver
- 3D printer

Assessments:

- Follow up Quiz
- Weekly progress portfolio write up
- Project presentation
- Project Rubric

Curriculum Scope & Sequence

Planned Course: Principles of Engineering

Unit: Engineering Structures, Trusses

Time frame: 2 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Describe the importance of structural analysis in structural design.
- Identify and define types of bridges and their applications.
- Understand gravity and other forces which act on structures
- Identify and define types of bridges and their applications.
- Define and describe the way various forces play a role in structures: tension, compression, shearing, torsion, and bending.
- Compare and contrast internal and external forces.
- Compare and contrast static and dynamic loads.
- Demonstrate the ability to design and fabricate a prototype bridge that is within certain design constraints.
- Demonstrate the ability to calculate the efficiency of a structure through strength to weight ratios.
- Demonstrate the ability to function positively and effectively as a group to: design, build and test a structure.
- Apply structural design, material processing, and material properties in the design and fabrication of a structure that will be tested and evaluated.
- Apply scientific principles and mathematical analysis to understand efficiency.

Core Activities: Students will complete/participate in the following:

- Lecture and class discussion
- Note taking handouts
 - Engineering design notes
- Hands on lab work
 - Design and create a computer aided design of a bridge truss structure meeting specific design criteria and constraints
 - Produce a bridge truss structure prototype based on selected and drawn design
 - Test bridge truss structure design for resistance to movement and weight
 - Present design solution to the class

Extensions:

- Calculating Materials and Bids

Remediation:

- Unit Terms and Questions

Instructional Methods:

- Lecture
- Demonstration
- Hands on Activities

Materials & Resources:

- Textbook
- Internet
- Video / Projector
- Classroom tools and Materials
- Whiteboards
- Consumable materials for bridge truss structure prototype
- ¼ " plywood
- Balsa wood
- CNC laser cutter/engraver
- 3D printer

Assessments:

- Follow up Quiz
- Weekly progress portfolio write up
- Project presentation
- Project Rubric

Curriculum Scope & Sequence

Planned Course: Civil Engineering

Unit: Architectural design and modeling

Time frame: 2 weeks

Anchor(s) or adopted anchor:

Essential content/objectives: At end of the unit, students will be able to:

- Demonstrate the ability to function positively and effectively as a group to: design, build and test a structure.

Core Activities: Students will complete/participate in the following:

- Lecture and class discussion
- Note taking handouts
 - Engineering design notes
- Hands on lab work
 - Design and create a computer aided design of a building meeting specific design criteria and constraints
 - Produce a building prototype based on selected and drawn design
 - Evaluate the building for proper orientation, energy efficiency, and design creativity
 - Present design solution to the class

Extensions:

- Discuss the design layout in relation to economic benefits

Remediation:

- Unit Terms and Questions

Instructional Methods:

- Lecture
- Demonstration
- Hands on Activities

Materials & Resources:

- Textbook
- Internet
- Video / Projector
- Classroom tools and Materials
- Whiteboards
- Consumable materials for architectural design
- ¼ " plywood
- Foam board
- CNC laser cutter/engraver
- 3D printer

Assessments:

- Course Final Exam
- Final Project Presentation
- Final portfolio