Board Approved
August 2018

Wilson Area School District
Planned Course Guide

Title of planned course: Principles of Engineering

Subject Area*:* Technology Education

Grade Level: 9-12

Course Description: This course will explore several areas of technology and engineering through theory and practical hands on experiences. The primary emphasis will be applying the engineering design process to solve real world technological problems. Students will apply engineering concepts to develop and evaluate design solutions, to use technology and produce artifacts, to process resources, and to construct and/or service products and structures. The concepts of electronic control systems, mechatronics, energy, power & transportation, structures, and impacts of technology will be studied.

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

Curriculum Writing Committee: Erik Everett & Brian Meckley

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Curriculum Map

First Semester-

August:
- Introduction, What is Engineering, Measurement

September:
- Technology and Engineering By Design
- Technological Developments and Their Impacts on Humans
- Reverse Engineering

October:
- Computer Aided Design
- Rube Goldburg, Simple Machines
- Intro to gear & mechanical systems
- Kinematic Engineering Project

November:
- Kinematic Engineering Project

December/January:
- Kinematic Engineering Project
- Final Exam

Throughout Course:
- Machine and Tool Use/Safety

Second Semester-

January:
- Introduction, What is Engineering, Measurement
- Technology and Engineering By Design
- Technological Developments and Their Impacts on Humans
- Reverse Engineering

February:
- Reverse Engineering
- Computer Aided Design
- Rube Goldburg, Simple Machines

March:
- Rube Goldburg, Simple Machines
- Intro to gear & mechanical systems

April:
- Kinematic Engineering Project

May:
- Kinematic Engineering Project

June:
- Final Exam

Throughout Course:
- Machine and Tool Use/Safety

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August 2018

Wilson Area School District
Planned Course Materials

Course Title: Principles of Engineering

Textbook:

- 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

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August 2018

Curriculum Scope & Sequence

Planned Course: Principles of Engineering

Unit: Introduction, What is 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 engineering and how it relates to our everyday lives.
- Identify the four main types of engineering fields and the kinds of job related skill associated with them
- 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 field of engineering

Extensions:

- Research more specific 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

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August 2018

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

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August 2018

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

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August 2018

Curriculum Scope & Sequence

Planned Course: Principles of Engineering

Unit: Technological Developments and Their Impacts on Humans

Time frame: 1 week

State Standards: 3.4.10.B1, 3.4.10.B2, 3.4.10.B3, 3.4.12.B, 3.4.10.D3, 3.4.10.D3, 3.4.12.E3

Anchor(s) or adopted anchor:

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

- Understand the industry / consumer cycle of products heavily used
- Describe technological system in modern society
- Understand the global impacts of technology and what can be done to reverse this course
- Develop an understanding of future technology trends

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

- Lecture and class discussion
- Note taking handouts
    - Engineering design notes
- Hands on lab work
    - Choose an environmental problem, gather information and create a summary report of your knowledge
    - Select a technology now considered fiction, write a descriptions on how it will be used every day in the future

Extensions:

- Artificial ecological systems
- Cloning
- Effects of Shopping Bags on the Environment

Remediation:

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

Instructional Methods:

- Lecture
- Demonstration
- Hands on Activities

Materials & Resources:

- Textbook
- Internet
- Video / Projector
- Classroom tools and Materials
- Consumable products with short life cycles

Assessments:

- Follow up Quiz
- Weekly progress portfolio write up

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August 2018

Curriculum Scope & Sequence

Planned Course: Principles of Engineering

Unit: Reverse Engineering

Time frame: 2 weeks

State Standards: 3.4.12.A2, 3.4.10.D2

ITEEA Standards: 2 & 8

Anchor(s) or adopted anchor:

- Reverse engineering provides useful information on how systems function. This may lead to new innovations and inventions.
- Students get a realistic sense of how to properly research and thoroughly comprehend the scope of the competitive design challenges and their inherent challenges.

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

- Utilize a variety of forms of presentation techniques.
- Implement the teamwork performance model to maximize group efficiency.
- Introduce a variety of different materials for usage and processing.
- Utilize the process of reverse engineering to understand how a system works.
- Develop value for the process of reverse engineering.
- Create solutions and ideas for improving the product.
- Maintain a step by step log of parts and steps for re-assembling the product

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

- Lecture and class discussion
- Note taking handouts
    - Engineering design notes
- Hands on lab work
    - Reverse engineer a broken device brought in from home
    - Document the process of disassembling the product
    - Creation of a detailed parts list with specific fastener types and sizes
    - Identify ways of improving the product

Extensions:

- Create an instructable for disassembling and assembling a product

Remediation:

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

Instructional Methods:

- Demonstration
- Lecture
- Observation

Materials & Resources:

- Textbook
- Internet
- Video / Projector
- Classroom tools and Materials
- Cameras
- Broken device
- White boards

Assessments:

- Follow up Quiz
- Weekly progress portfolio write up

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August 2018

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:

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

Board Approved
August 2018

Planned Course: Principles of Engineering

Unit: Rube Goldburg, Simple Machines

Time frame: 1 week

State Standards: 3.4.12.A2, 3.4.10.C1, 3.4.10.C2

ITEEA Standards: 2- X,Y

Anchor(s) or adopted anchor:

- Students explore the different simple machines, mechanical advantage and systems thinking.

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

- Form a critical opinion about the importance of the everyday machines they encounter.
- Explain that mechanical advantage is not always the best way to measure the value of a machine.
- Explain how systems thinking is useful when prototyping a complex system.
- Visually explain kinetic and potential energy differ.
- Apply acquired knowledge into the development of a working prototype.
- Execute structured learning experiences to maximize efficient use of time and material.
- Present evidence of project detail to classmates and instructor.

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

- Lecture and class discussion
- Note taking handouts
    - Engineering design notes
    - Document entire design process from ideation to creation
- Hands on lab work
    - Create a solution to a problem using the engineering design process
    - Design and construct a Rube Goldburg device using atleast three simple machines

Extensions:

- Research and study previous made Rube Goldburg devices

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
- Consumable materials for Rube Goldburg device
- ¼ “ plywood
- CNC laser cutter/engraver
- 3D printer

Assessments:

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

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August 2018

Curriculum Scope & Sequence

Planned Course: Principles of Engineering

Unit: Intro to gear & mechanical systems

Time frame: 1 week

State Standards: 3.4.10.C1, 3.4.10.C2

ITEEA Standards: 2- AA, 16- N

Anchor(s) or adopted anchor:

- The application of mechanical advantage to different systems is essential to a highly functioning designed world.
- Speed and torque are inversely related to one another.
- Materials that cannot be glued together present unique challenges.
- Structural failure can compromise mechanical function.
- Proper classroom organization facilitates efficient time management.

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

- Research the history and application of modeling systems.
- Recognize the challenges of design under constraint.
- Communicate evidence of the design principles and necessary content in portfolio development.
- Identify the various types and functions of gear systems.
- Specify the gear ratio between the drive and driven gear in simplest form.
- Differentiate between systems designed for speed and torque.
- Demonstrate the ability to calculate mechanical advantage.
- Demonstrate the ability to construct structurally sound prototypes.
- Demonstrate how to achieve different results using the same materials.
- Execute structured learning experiences to maximize efficient use of time and material.
- Present evidence of project detail to classmates and instructor.

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

- Lecture and class discussion
- Note taking handouts
    - Engineering design notes
    - Document entire design process from ideation to creation
- Hands on lab work
    - Create a solution to a problem using the engineering design process
    - Design and construct a simple gear reduction project to turn the driven gear at a specific rate of speed

Extensions:

- Research mechanical drive systems such as transmissions

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
- small electric motor
- Consumable materials for gears
- ¼ “ plywood
- CNC laser cutter/engraver
- 3D printer

Assessments:

- Follow up Quiz
- Weekly progress portfolio write up
- Project Presentation
- Project rubric

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August 2018

Curriculum Scope & Sequence

Planned Course: Principles of Engineering

Unit: Kinematic Engineering Project

Time frame: 6 weeks

State Standards: 3.4.10.A2, 3.4.12.A2, 3.4.10.C1, 3.4.10.C2

ITEEA standards: 1-13

Anchor(s) or adopted anchor:

- Identifying the problem to "solve" will be the most challenging part of the process.
- Meeting the criteria and the constraints of the design brief requires attention to detail and effective communication with partners.
- When developing a new idea or an innovation to an existing idea, product marketing and packaging is important.
- Time management is necessary for a long term application of the design process.
- Students get hands on experience in solving a real world design problems and use their multidisciplinary knowledge to do so.

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

- Apply the principles and practices of engineering and universal design in developing an effective and practical solution to a specific design problem that they have identified.
- Apply Science, Technology, Engineering, and Mathematics concepts into both their prototype design and final documentation.
- Demonstrate the application of technology.
- Assess the impact of the solution on a specific individual and on society.
- Make a detailed plan to complete a project in a desired amount of time.
- Apply past experience into determining their timeline.
- Apply acquired knowledge into the planning of their subsystem design.
- Make a detailed list of goals and foreseen problems as well as a list of evaluation steps that define what it means for the project to be done.
- Efficiently manage their time and learn to coordinate and distribute jobs throughout their development team.
- Apply acquired knowledge into the development of a working prototype.
- Understand the amount of time that goes into the development of new technologies/systems.

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

- Lecture and class discussion
- Note taking handouts
    - Engineering design notes
    - Document entire design process from ideation to creation

Board Approved
August 2018

- Hands on lab work
    - Create a solution to a problem using the engineering design process
    - Design and construct a working system of gears and simple machines to create a movement that assembles and disassembles a letter or shape

Extensions:

- Weekly progress portfolio write up

Remediation:

- Review
- Homework
- Unit Quiz
- Review of course materials

Instructional Methods:

- Demonstration
- Lecture
- Observation
- Experimentation

Materials & Resources:

- Textbook
- Internet
- Video / Projector
- ¼ “ plywood
- CNC laser cutter/engraver
- 3D printer

Assessments:

- Course Final Exam
- Final Project Presentation
- Final portfolio