Engineering

COURSE OF STUDY

Technology Department

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Date:
August 2016

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COURSE DESCRIPTION

ENGINEERING **Full Year** **5 Credits** **Grades 10 to 12**

Prerequisite: While there are no prerequisites to this course, students are strongly advised to take Pre-Engineering prior to taking this course.

ENGINEERING is a course created to teach students about general Engineering concepts. Students will learn how to create engineering and design development sketches and drawings, use various basic and advanced equipment and tools, the engineering design process, and electronic systems and circuits.

Basic and advanced equipment, such as CNC router, laser, and shop equipment, will be used to build student designs in this hands-on, project based course, where students acquire important technology literacy skills, and will learn by doing.

COURSE UNITS

1. **Basic Orthographic and Isometric Design Development.**
   Comprehend and develop free hand sketching techniques. Interpret and apply orthographic orientation, interpretation and application of measuring skills.
   (Activities - orthographic and isometric drawings, various measuring activities)

2. **Shop Safety**
   Students learn basic safe shop practices, along with specific tool and machine safety presentations, and demonstrations including written and manual student safety testing.

3. **Manufacturing**
   Research the history of manufacturing. Design, build, and finish a product using 21st century manufacturing processes.
   (Activity- manufactured product)

4. **Technological Design Process and the District Tech. Challenge.**
   Research, design, and construct a car that can withstand the impact test the car crasher launcher.
   (Activity- district wide Tech Challenge Competition)

5. **Electronics**
   Exercise an understanding of magnets and electromagnets, for the purpose of producing electricity and converting electricity to motion.
   (Activities – Breadboard circuits, AC wiring kits)

6. **Reverse Engineering**
   Research, dissect, and build a 3D Display of an existing product, for the purpose of learning about how products are mass produced, and how engineering and designers make decisions regarding product manufacturing.
   (Activity – Product dissection)

7. **Hydraulics**
   Exercise an understating of how hydraulics, and hydraulic systems work, and how it is used to power machines and create motion.
   (Activity – Design and build a hydraulic crane)

8. **Robotics**
   Build and program a Mindstorm based robot, and learn how to use simple programing language to create actions and use feedback sensors, for a robot to perform a specific task.
   (Activity – Mindstorms robot challenges)

Course Expectations and Skills

1. Keep and maintain an engineering notebook.
2. Apply and document the technological design process while solving challenges.
3. Practice proper attitude and safe discipline.
4. Develop an acceptable degree of craftsmanship in each activity.
5. Participate and contribute equally to a group generated solutions.
6. Apply and analyze science and math related concepts to the challenge.
7. Prepare students to be successful in high school and higher level technology courses.

Resources

Text Books: Technology Education: Learning by Design Michael Hacker, David Burghardt 2008

Black Horse Pike Regional School District Curriculum Template

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

PART I: UNIT RATIONALE

WHY ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

<table>
<tr><td>Course/Unit Title:
Engineering
Unit: Safety, Measuring & Technical Drawing</td><td rowspan="2">This introductory course is designed to increase literacy in technology and engineering through a series of hands-on activities that utilize the engineering design process as well as reinforcing basic math, science, and communication skills.

Unit Summary:
• Class procedures and expectations
• General safety practices with tools
• Measurement skills (fractional inches)
• Basic sketching, orthographic, and isometric drawing</td></tr>
<tr><td>Grade Level(s):
10-12</td></tr>
<tr><td>Essential Question(s):
• What are class procedures and rules?
• How to work safely?
• How do we measure accurately?
• What are the methods of drawing a 3D object on paper?
• What is the relationship of the different views in constructing a 3D model?</td><td>Enduring Understanding(s):
• It is important to be aware of and follow organizational and safety procedures.
• Identify and read divisions of a ruler and measure accurately to within 1/16 inch
• Represent (draw) a 3D object with orthographic and isometric views following proper techniques
• Application of measurement and drawing skills to construct a 3D model</td></tr>
</table>

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

After each target, identify the NJCCCS or Common Core Standards that are applicable

Learning Target	NJCCCS or CCS
1. Understand and observe classroom rules, requirements, emergency, and general procedures	***TEC.9-12***
2. Demonstrate accurate measurement skills (fractional inch) to read a ruler to 1/16	***TEC.9-12.8.2.12***
3. Identify and read ruler divisions and transfer divisions to construct a wooden ruler	
4. Demonstrate proper lettering techniques	***MA.K-12.4.5.C.4***
5. Demonstrate basic sketching, orthographic drawing, isometric drawing, and proper dimensioning of various 3D objects	
6. Understand the location and relationship of the different drawing views	
7. Construct a 3D model out of cardstock from student drawings	

Inter-Disciplinary Connections:

Math- Fractional inch, fractions, measurement, geometric principles
English- Creating a design journal of the solutions requires students to write in each step of the process.

Students will engage with the following text:

TECHNOLOGY EDUCATION: LEARNING BY DESIGN
Pearson Prentice Hall
ISBN 0133639894
Periodicals to include but not limited to newspapers, magazine articles, internet web pages.

Students will write:

Students will keep an engineering notebook to include daily journal entries, Cornell notes, research information, information on each TLA covered in the course.

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

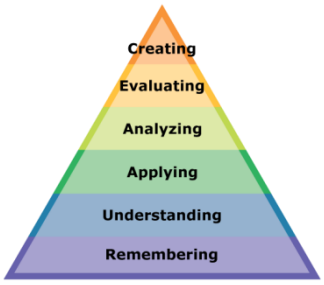
DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills.

Classroom rules will be introduced and students will write them in their notebooks (see Classroom Safety Rules Sheet).
Students will be given a lesson on reading a ruler along with guided practice in using a ruler.
Students will construct their own ruler from a paint stick (see Ruler Construction TLA)
Lettering worksheet and Folder Set up
Orthographic and Isometric drawings (L Block, C block, T block, Step Block)
3D cardstock model project
Materials and supplies
Rulers, ¼ grid graph paper, isometric paper, wooden or plastic ruler slab, try squares

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.
IDENTIFY BLOOM'S LEVELS.



Formative Assessments:

Safe work practice with hand tools as outlines in the lesson: direct teacher observation and guided practice. Students will follow classroom procedures as provided in teacher lecture and written in engineering notebook: direct teacher observation by teacher for safe working habit (see Class Participation Rubric).

Accommodations/Modifications:

Provide students with safety rules and orally review them prior to the start of working with tools. Have assessment method provided to the class before the assessment begins. Make sure all students are sitting in an area of least distractions.

Summative Assessments:

Orthographic and Isometric drawings assignments will be graded for accuracy and neatness.
Creation of orthographic drawings from isometric will be grades for accuracy and neatness.
Creation of isometric drawings from orthographic will be graded for accuracy and neatness.

Accommodations/Modifications:

Allow students extra time to complete the drawings. State expectations to the class prior to start of assessment.

Performance Assessments:

Ruler Construction: accuracy and neatness
3D Cardstock Model: accuracy and neatness

Accommodations/Modifications:

Allow students extra time to complete the drawings. State expectations to the class prior to start of assessment. Allow students to ask questions throughout the assessment for clarification.

Black Horse Pike Regional School District Curriculum Template

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

PART I: UNIT RATIONALE

WHY ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Course/Unit Title: Engineering **Unit: Manufacturing**	**This course is designed to increase literacy in technology and Engineering through a series of hands-on activities that utilize the engineering design process as well as reinforcing basic math, science, and communication skills.**
Grade Level(s): **10-12**	**Unit Summary:** • **Students will learn about the manufacturing engineering field as it pertains to our daily lives and in our careers. They will understand the importance of the systems approach and what it takes to develop a functional and effective product. They will recognize how important safety is in a manufacturing setting and be able to demonstrate the safe and effective use of tools and machinery. Students will construct a product they will design and develop from the ground up.**

Essential Question(s):	Enduring Understanding(s):
What is technology and how does it relate to manufacturing? **What is a systems approach in relation to manufacturing?** **How has the history of manufacturing affected the future trends of manufacturing?** **What important factors are there to consider when choosing a manufacturing system?** **What are the various career opportunities in the field of manufacturing?** **Why is the development of the Occupational Safety and Health Administration (OSHA) so important?** **What is the difference between renewable and exhaustible raw materials used in manufacturing?**	• **Technology is anything humans use to extend their capabilities. Manufacturing encompasses all aspects of technology and engineering.** • **The systems approach is the relation between the input of information, the process of reaching a goal, the output of work, and the feedback and impacts to help make the process better.** • **Humans have been making items to meet their needs since the beginning of time. Those needs are ever changing but always end up using a similar process to reach the end goal** • **There are many important factors to consider when choosing a manufacturing system but mainly ; Volume of products to be produced, availability of necessary inputs, types of products to be made, the life cycle or durability of a product, and production philosophy of the organization** • **There are many career opportunities in the field of manufacturing, some of which include; Management, engineering, production, tooling, marketing, finances, and human resources** • **OSHA has played a very important role in humanizing the workplace which means to make the workplace safe and comfortable for humans. Because of OSHA workers have the right to a safe workplace and companies must comply with the development, implementation and following of regulations.**
What is the importance of using tooling in a manufacturing setting? **What is the importance of creative problem solving?** **What are the different sketching, drawing, and modeling processes product designers go through?** **What is the difference between production engineering processes and methods engineering processes?** **What is the importance of quality control?** **What is the difference between material forming, separating, and combining processes?**	• **Jigs and fixtures greatly improve the accuracy and safety in the manufacturing process of materials.** • **Creative problem solving skills can be learned and are the most sought-after by employers. They involve an understanding of the problem and of specific problem-solving skills.** • **Designers create thumbnail sketches, working drawings, detail drawings, assembly drawings and prototypes before creating a final product.** • **Production engineering focuses mainly on improving productivity while lowering costs. Methods engineering focuses on planning the sequence of processes needed to make parts and assemble a finished product.** • **Quality control ensures that the finished product matches the design in the final working drawings. Inspection stations and gages should be set up throughout the manufacturing process to ensure a quality finished product.** • **Materials forming takes solid raw stock and turns them into one-piece products or components. Materials separating processes convert standard stock into one piece products or components through cutting or removing material. Combining processes are**

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

After each target, identify the NJCCCS or Common Core Standards that are applicable

Learning Target	NJCCCS or CCS
1. Describe and discuss the impacts of technology and how they have effected people, the environment, and further developments or uses of technology	TEC.9-12.8.1
2. Explain the systems model and apply the model to something used in daily life.	
3. Compare and contrast the manufacturing materials, processes, purpose, and evolution of a product that we use today.	TEC.9-12.8.2.12 B.4
4. Describe and discuss the advantages and disadvantages of the various types of manufacturing systems.	TEC.9-12.8.2.12.E.1
5. Recognize the kind of work, educational requirements, and job outlook for skilled, semiskilled, and unskilled manufacturing workers.	ELL.9-12.L.A.3
6. Identify safety awareness and explain the improvements that have been made to the workplace because of OSHA.	
7. Differentiate between materials that are candidates for recycling, and justify why recycling and repurposing is a good idea.	ELL.9-12.S.B.3
8. Identify the different materials processing tools and explain why and how computers, robots, and lasers have helped make these processes easier and safer for workers.	ELL.9-12.R.E.6
9. Describe how important it is for manufacturing engineers and workers to be creative problem solvers.	
10. Compose and organize sketches for a proposed product idea.	MA.9-12.4.2.12 D.2
11. Compare and contrast the charts and roles of a production engineer and a methods engineer in the manufacturing world.	
12. Demonstrate the inspection of parts and creation of quality control gauges during the manufacturing process.	MA.9-12.4.5
13. Recognize and identify the major purposes for material forming, separating, and combining processes.	MA.9-12.4.5.12 B.2
	MA.9-12.4.5.12 E

Inter-Disciplinary Connections:

MATH - fractional inch, fractions, measurement, geometric principles,
English - Creating a design journal of the solutions requires students to write in each step of the process.
Social Studies – Research and connect with the history of manufacturing

Students will engage with the following text:

TECHNOLOGY EDUCATION: LEARNING BY DESIGN
Pearson Prentice Hall
ISBN 0133639894
Periodicals to include but not limited to newspapers, magazine articles, internet web pages.

Students will write:

Students will keep an engineering notebook to include daily journal entries, Cornell notes, research information, reflection essays analyzing the engineering processes of manufacturin

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

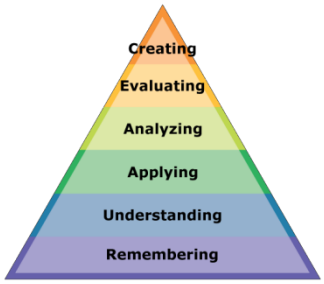
DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills.

1. **Students will research the developments of a certain technology and explain in essay form how this technology has developed over the years.**
2. **Students will bring in an object from home and verbally explain how the systems model relates to the construction and functionality of that object.**
3. **Students will disassemble and reverse engineer an object from home.**
4. **Students will determine which manufacturing system will work best for their manufacturing project.**
5. **Students will delegate positions for each student on their manufacturing team. Each person will have a job to keep the team running.**
6. **Students will endure that every process in their manufacturing sequence is safe.**
7. **Students will research different materials that can be recycled and also develop a project out of repurposed material.**
8. **Students will use our CNC equipment to develop templates, jigs, and fixtures for the manufacturing project.**
9. **Throughout the design and manufacturing process students will use creative problem solving skills to develop their project.**
10. **Students will design and develop a product through carious sketches and sketching techniques. They will develop final plans using Autodesk Inventor.**
11. **Students will practice the role of a production engineer and manufacturing methods engineer.**
12. **Students will develop quality control checkpoints and go no go gages for their manufacturing process.**

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.
IDENTIFY BLOOM'S LEVELS.



<u>Formative Assessments</u>:

WARM UP ACTIVITIES

All activities will be based on either student exploration of content area, or reflection of prior lessons.

CHECKPOINTS OF UNDERSTANDING

1. **Knowledge of machines**
2. **Set-up CNC machines**
3. **Sketching of models**
4. **Exporting of parts**
5. **Models created by looking at the three views of an orthographic projection**
6. **Design process**
7. **Measure and create part from looking at a real object.**

<u>Accommodations/Modifications</u>:

Alternative assignments, additional time for assignments, preferential seating arrangements, one on one interaction, after school help, and assistance for organization. Check frequently for student understanding. Allow students to get their work checked frequently as the assessments are build-ups.

Summative Assessments:

Manufacturing Cornell Notes and Research
Rough sketch design ideas
Group design sketches
Working Drawings
Flow process charts
Operation analysis sheets
Operation process charts
Operation sheets
Proper tooling design and function
Quality control gages and systems

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Performance Assessments:

Completion of a fully finished manufactured product made of repurposed material.

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Black Horse Pike Regional School District Curriculum Template

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

PART I: UNIT RATIONALE

WHY ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

<table>
<tr><td>Course/Unit Title:
ENGINEERING
Unit: Technological Design Process</td><td rowspan="2">Unit Summary:

Students will learn to use the technological design process (TDP) to solve
open ended problems. Students will learn to safely use tools and machines to extend human capabilities. Students will learn physics and apply this knowledge with the TDP to research, brainstorm, sketch, refine, build, test, rebuild, re-test, and reflect on a solution and project to a district design challenge.</td></tr>
<tr><td>Grade Level(s):
10-11</td></tr>
<tr><td>Essential Question(s):

How can we strategically solve problems?

How is technology used to extend human capabilities?

Why is safety important and what precautions can we take to ensure safety?</td><td>Enduring Understanding(s):

This unit is designed to introduce the technological design process. This process will be used to solve all challenges throughout all engineering courses and projects. It is also designed to safely introduce students to the
technology, tools, and machines used to prototype solutions to challenges and projects. The students will learn to solve open ended problems and to design and build the solutions and projects. The goal is for the students to gain better skills toward problem-solving, the ability to confidently use tools and machines to process multiple types of materials, to work cooperatively with others, and to understand physics related to objects in motion. After this unit, students will continue to apply the TDP to more complex and technologically advanced problems and mediums.</td></tr>
</table>

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

After each target, identify the NJCCCS or Common Core Standards that are applicable.

Learning Target	NJCCCS or CCS
1. Students will Identify and apply the technological design process to a real design challenge.	**TEC.9-12.8.1**
2. Students will design a working set of mechanical drawings.	**TEC.9-12.8.2.12 B.3**
3. Students will learn to safely operate tools and machines to process materials	**TEC.9-12.8.2.12.E.1**
4. Students will write a creative fictional story that applies to the years challenge	**TEC.9-12.8.1.12 B.9**
5. Students will solve challenges related to geometric, algebraic, and statistical math problems	**ELL.9-12.S.B.3**
6. Students will show gracious professionalism throughout a competition	**ELL.9-12.R.E.6**
7. Students will constructively reflect upon the technological design process, challenge and teamwork.	**MA.9-12.4.2.12 D.2**
	MA.9-12.4.5
	MA.9-12.4.5.12

Inter-Disciplinary Connections:

MATH - fractional inch, fractions, measurement, geometric principles,
English - An engineering notebook including written documentation of the technological design process

Students will engage with the following textbook

TECHNOLOGY EDUCATION: LEARNING BY DESIGN Pearson
Prentice Hall
ISBN 0133639894
Periodicals to include but not limited to newspapers, magazine articles, internet web pages.

Students will write:

Students will maintain a design journal throughout the unit. In this journal students will write a design brief problem statement including all constraints and rules of the challenge.

Students will write a creative fictional story that explains why the challenge must take place and why the design problem must be solved.

Students will write a reflection essay on the entire Tech. Challenge process and their results.

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills.

Students will read a Technological Design Challenge design packet. This will include all of the information related to this years challenge including the challenge rules, constraints, materials, design journal components, timeline, and rubric.

Students will now create a technical design journal schedule as they document the process in which they solve the challenge. This starts with students writing a design brief statement showing comprehension and understanding of the challenge and project at hand. Students will design and sketch a team logo and cover page. Students will write a creative fictional story related to the design challenge. Students will then brainstorm and sketch multiple solutions to the challenge using only the required and limited materials. Students will now list pros and cons of each design and then choose their favorite design to make a detailed rough sketch of. Next, the design will be developed into a final working mechanical drawing with an included bill of materials and order of operations. Students will also solve a challenge related engineering math worksheet. During this entire design journal work, students will also document a timesheet listing what was accomplished on each day.

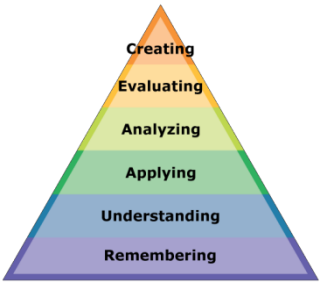
After the design journal is done, students will collect their materials and begin to safely process materials and construct their designs. After building students will test and re-build their project to get the best potential result. The challenge will then move forward with a tournament and the winning students will go to the district Tech. Challenge Championship to compete against the other schools.

After the project, students will write an essay reflecting upon the entire technological design process and their own personal results.

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.

IDENTIFY BLOOM'S LEVELS.



Formative Assessments:

WARM UP ACTIVITIES

Students will read the timeline, direction and constraint page for the current design journal page.
Students will check the daily entry log to ensure see where they left off and ensure it is up to date
Students will get safety glasses on and get their plans and materials ready.

CHECKPOINTS OF UNDERSTANDING

The design journals with be checked and graded after every 2 components.

Accommodations/Modifications:

Students have guided packets with questions that outline the research, and brainstorming.
The students will have an adjusted writing and mathematics packet to suit particular needs.
Students will receive extra one on one instruction to ensure safety and understanding.

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.

Summative Assessments:

Final evaluation of the project based on a rubric.
Final grade of design journal as it is re-graded in its entirety
Reflection paper about the entire project

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Performance Assessments:

Construction of a solution to the challenge
Safely utilizing shop tools and machines

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Black Horse Pike Regional School District Curriculum Template

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

PART I: UNIT RATIONALE

WHY ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

<table>
<tr><td>Course/Unit Title: ENGINEERING

Unit: Electronics</td><td rowspan="2">Unit Summary:

• This unit is designed to introduce students to electricity, electronics, and basic electrical engineering. Students will learn what electricity is, how it is created, transmitted, altered and used. Students will learn the about DC and AC electrical systems, series and parallel circuitry, electrical motor function, ohms law, and electronic components. Students will learn to read and draw electrical schematics. Students will apply the electrical concepts with three hands on projects. Students will build simple DC and light bulb circuits, solve circuit challenges, and complete AC electrical circuits.</td></tr>
<tr><td>Grade Level(s):
10-12</td></tr>
<tr><td>Essential Question(s):

How does electricity impact the way in which we live our lives?

How do technological systems work together to accomplish goals and extend human capabilities?</td><td>Enduring Understanding(s):

Technological systems are designed to solve problems and extend human capabilities.

Most of our mechanical systems are all reliant on the successful utilization of the electrical systems.

Plans are used to ensure correct placement of components in a complicated electrical system.</td></tr>
</table>

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

After each target, identify the NJCCCS or Common Core Standards that are applicable

Learning Target	NJCCCS or CCS
14. Students will distinguish between a series and parallel circuit.	TEC.9-12.8.1
15. Students will calculate current, voltage, and resistance in a circuit.	TEC.9-12.8.2
16. Students will identify various electronic components based on their appearance.	TEC.9-12.8.2.12.E.1
17. Students will discuss the advantages of using electromagnets in mechanical systems.	ELL.9-12.L.A.3 ELL.9-12.S.B.3
18. Students will wire a single pole switch to include a light, a light receptacle, and wall receptacle.	SCI.9-12.5.7
19. Students will wire three way switches and a light	MA.9-12.4.2.12 D.2
20. Students will install a dimmer switch	MA.9-12.4.5
21. Students will install a GFI (ground fault interrupter)	MA.9-12.4.5.12 B.2
22. Students will safely use all electrical tools and equipment	MA.9-12.4.5.12 E

Inter-Disciplinary Connections:

Math - Fractional inch, fractions, measurement, geometric principles,
English - An engineering notebook including written documentation of the technological design process
Science – Understanding the relationship between positive and negative charges

Students will engage with the following textbook

TECHNOLOGY EDUCATION: LEARNING BY DESIGN Pearson
Prentice Hall
ISBN 0133639894
Periodicals to include but not limited to newspapers, magazine articles, internet web pages.

Students will write:

- **Students will keep an engineering notebook.**
- **Notes from electronics presentations.**
- **Schematic drawings.**

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills.

Students will begin by learning the importance and significance of electricity in the modern world by analyzing the frequency in which the average person uses electricity and products made with electricity.

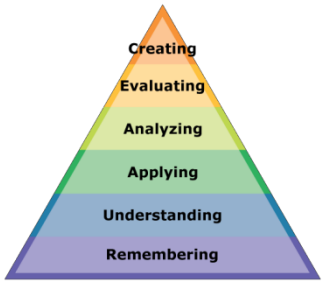
Students will engage in a presentation and watch videos that will explain where electricity comes from, how it is transmitted, how it is converted into AC and DC current and how that can be converted into mechanical energy. Students will learn about series and parallel circuits, voltage, amperage, resistance, and ohms law in electric circuits. Students will take notes and fill out worksheets during these presentations, and solve math equations and conversions with an ohms law worksheet. Students will build series and parallel circuits.

Next, students will learn about AC electric circuitry and components through presentations and examples. Students will learn to identify different electric components. Students will learn safe residential house wiring techniques through demonstration, and then students will practice by building their own

Students will take an electronics test to test knowledge of concepts, vocabulary, and electrical schematics.

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.
IDENTIFY BLOOM'S LEVELS.



Formative Assessments:

WARM UP ACTIVITIES

All activities will be based on either student exploration of content area, or reflection of prior lessons.

CHECKPOINTS OF UNDERSTANDING

- **Ohm's Law worksheet**
- **Electronic Component worksheet**
- **Soldering safety worksheet**
- **Soldering practice circuit**

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Summative Assessments:

Electronics Test
AC house wiring test

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding Allow students to get their work checked frequently as the assessments are build-ups.

Performance Assessments:

DC electronics circuits
AC wiring circuits

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Black Horse Pike Regional School District Curriculum Template

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

PART I: UNIT RATIONALE

WHY ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Course/Unit Title: Engineering **Unit: Reverse Engineering & Manufacturing Processes**	**Unit Summary:** • **Students will learn about consumer products, and how these products are mass-produced. Students will learn about production processes, such as plastic injection molding, circuit board manufacturing, metal stamping and die cutting, among other manufacturing techniques. Students will reverse engineer a mass produced product, in the form of an autopsy, and investigate which techniques were used, how, and why.**
Grade Level(s): **10-12**	

Essential Question(s):	Enduring Understanding(s):
What is mass production, and why is it important to today's society? **What is injection molding, and why is it an important manufacturing technique?** **What considerations must an engineer have when designing a new product, in relation to which manufacturing techniques will be applied?** **How does product function and its intended use relate to how a product is manufactured?** **What is a Printed Circuit Board, and how is it used in mass produced electronics?** **What is an exploded view, and why is it an important representation of a product, in relation to manufacturing?**	• **Technology is anything humans use to extend their capabilities. Manufacturing encompasses all aspects of technology and engineering.** • **Mass production has enabled access to products more than ever before.** • **Different methods of manufacturing are intended to be used in different situations and applications, whether a product is high volume or low volume production.** • **Some products are made to be inexpensive, without consideration for recycling or disassembly.** • **Designers and engineers must consider the cost and purpose of a product and choose the proper manufacturing technique that is appropriate for the product, and the production size of the product order.** • **Even small and simple products can have very intricate design, and several parts. The importance of good design must be considered when mass producing consumer goods meant for the mass market.** • **Electronic products are generally difficult to be serviced without great knowledge of PCBs and electronic components.** • **Know how products function makes it possible for us to become better consumers of technology, and aid in decision making when purchasing and consuming technological mass produced goods.**
Why is recycling especially important when it comes to products that have electronic components? **How does design impact the recyclability and sustainability of mass produced products?**	

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

After each target, identify the NJCCCS or Common Core Standards that are applicable

Learning Target	NJCCCS or CCS
23. Describe and discuss the impacts of technology and how they have effected people, the environment, and further developments or uses of technology	TEC.9-12.8.1
24. Explain the systems model and apply the model to something used in daily life.	
25. Compare and contrast the manufacturing materials, processes, purpose, and evolution of a product that we use today.	TEC.9-12.8.2.12 B.4
26. Describe and discuss the advantages and disadvantages of the various types of manufacturing systems.	TEC.9-12.8.2.12.E.1
27. Differentiate between materials that are candidates for recycling, and justify why recycling and repurposing is a good idea.	ELL.9-12.L.A.3
28. Identify the different materials processing tools and explain why and how computers, robots, and lasers have helped make these processes easier and safer for workers.	
29. Describe how important it is for manufacturing engineers and workers to be creative problem solvers.	ELL.9-12.S.B.3
30. Compose and organize sketches for a proposed product idea.	
31. Recognize and identify the major purposes for material forming, separating, and combining processes.	ELL.9-12.R.E.6
32. Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.	NJCCS 8.2.12.B.2
33. Discover how a product works by taking it apart, sketching how parts fit, and putting it back together.	NJCCS 8.2.2.D.2
34. Identify and explain how the resources and processes used in the production of a current technological product can be modified to have a more positive impact on the environment.	NJCCS 8.2.8.D.6

Inter-Disciplinary Connections:

MATH - fractional inch, fractions, measurement, geometric principles. Percentages, and projections.

English - Creating a design journal of the solutions requires students to write in each step of the process.

Social Studies – Relate manufacturing to the environment, and how it impacts it. Relate the design of products to recyclability, repair, and reuse of mass produced products.

Students will engage with the following text:

TECHNOLOGY EDUCATION: LEARNING BY DESIGN Pearson Prentice Hall

ISBN 0133639894

Periodicals to include but not limited to newspapers, magazine articles, internet web pages.

Students will write:

Students will keep an engineering notebook to include daily journal entries, Cornell notes, research information, reflection essays analyzing the engineering processes of mass production techniques.

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

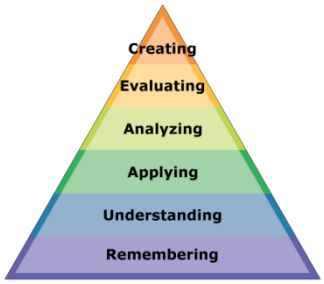
DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills.

13. **Students will research about the evolution of manufacturing, and the prominence of mass produced products in today's society.**
14. **Students will bring in an object from home and dissect it, by taking it apart.**
15. **Students will document the dissection process with photo evidence, and note how different parts interact with one another, and how they are put together.**
16. **Students will determine which manufacturing technique was used to produce the different parts of their object, and research how each technique is applied, and what are each techniques advantages and disadvantages.**
17. **Students will create a 3D display of their dissected product, by reassembling it in an exploded view format, to represent how the parts of the object come together. The parts will be named and labeled accordingly.**
18. **Students will create a research document which will include descriptions and photos of different parts and how they are made, and describe the manufacturing techniques for each part.**

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.
IDENTIFY BLOOM'S LEVELS.



<u>Formative Assessments</u>:

WARM UP ACTIVITIES

All activities will be based on either student exploration of content area, or reflection of prior lessons.

CHECKPOINTS OF UNDERSTANDING

1. **Knowledge of manufacturing techniques.**
2. **Tool usage and handling.**
3. **Product disassembly and cataloguing of parts**
4. **Creating of 3D display**
5. **Written research of manufacturing techniques.**

<u>Accommodations/Modifications</u>:

Alternative assignments, additional time for assignments, preferential seating arrangements, one on one interaction, after school help, and assistance for organization. Check frequently for student understanding. Allow students to get their work checked frequently as the assessments are build-ups.

Summative Assessments:

Manufacturing Cornell Notes and Research
3D Product Display
Environmental Impact assessment
Research Document

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Performance Assessments:

Completion of a 3D Display of a manufactured product, and a research document about the manufacturing techniques used on said product.

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Black Horse Pike Regional School District Curriculum Template

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

PART I: UNIT RATIONALE

WHY ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

<table>
<tr><td>Course/Unit Title: ENGINEERING

Unit: Hydraulics</td><td rowspan="2">Unit Summary:

• This unit is designed to introduce students to Hydraulics, the study of the motion of fluids, and to apply a project based approach to apply the knowledge acquired of hydraulic systems and machines, by having students design and build a machine that performs a specific task, and is powered by a hydraulic system.</td></tr>
<tr><td>Grade Level(s):
10-12</td></tr>
<tr><td>Essential Question(s):

How does the science of Hydraulics impact current technology?

What current human developments are made possible by the practical application of hydraulics?

What are some common examples of hydraulic technologies that are used around us? Which ones do you interact with on a daily basis?

How does transfer of power work to create motion?

What is the importance of planning when designing a technological system, such as a hydraulic crane?</td><td>Enduring Understanding(s):

• Technological systems are designed to solve problems and extend human capabilities.

• Many of our mechanical systems are all reliant on the successful utilization of hydraulics systems.

• Plans are used to ensure the successful build and completion of a design project.

• Hydraulics is an essential technology in all manufacturing and construction fields, and without it, a lot of contemporary technology would not be possible.

• Hydraulics allows for efficient transfer of power, and for an easy way to produce great force with a relatively low input.

• We are surrounded by systems that use hydraulics, from car breaks, to construction equipment, as well as machines used for production of mass produced goods.</td></tr>
</table>

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

After each target, identify the NJCCCS or Common Core Standards that are applicable

Learning Target	NJCCCS or CCS
1. Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.	**NJCCCS 8.2.12.D.1**
2. Explain and identify interdependent systems and their functions.	**NJCCCS 8.2.12.C.4**
3. Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.	**NJCCCS 8.2.12.A.2**
4. Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution	**NJCCCS 8.2.8.D.3**
5. Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.	**NJCCCS 8.2.12.C.5**

Inter-Disciplinary Connections:

Math - Fractional inch, fractions, measurement, geometric principles.
English - An engineering notebook including written documentation of the technological design process
Physics – Understanding transfer of force and Hydraulic principles.

Students will engage with the following textbook

TECHNOLOGY EDUCATION: LEARNING BY DESIGN Pearson
Prentice Hall
ISBN 0133639894
Periodicals to include but not limited to newspapers, magazine articles, internet web pages.

Students will write:

- **Students will keep an engineering notebook.**
- **Notes from hydraulics presentations.**
- **Schematic drawings.**

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills.

Students will begin by learning the importance and significance of hydraulic systems, and the frequency in which they come in contact with technologies and goods that are only made possible by the use of hydraulic systems.

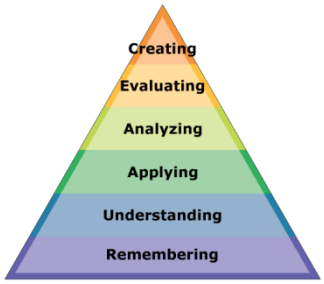
Students will engage in a presentation and watch videos that will explain the physiscs pricinciples of fluid dynamics, and how hydraulics are used in different technological systems, such as construction equipment (e.g. Cranes, excavators, backhoes), manufacturing equipment (metal stamping machines, injection molding machines), and technologies they use on a frequent basis (car breaks, elevators). Students will take notes and fill out worksheets during these presentations.

Next, students apply previous knowledge of the Engineering Design Process to design, plan, draw, and build a hydraulics machine, with syringes and rubber tubbing. This machine will be build to perform a specific task.

Students will then participate in a competition in which they will use they built machines to try to best their peers on a pre-determined task.

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.
IDENTIFY BLOOM'S LEVELS.



<u>Formative Assessments</u>:

WARM UP ACTIVITIES

All activities will be based on either student exploration of content area, or reflection of prior lessons.

CHECKPOINTS OF UNDERSTANDING

- **Hydraulics worksheet**
- **Hydraulics quiz**
- **Design drawings**
- **Project construction**

<u>Accommodations/Modifications</u>:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

<u>Summative Assessments</u>:

Hydraulic Arm Competition and design protype.

<u>Accommodations/Modifications</u>:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding Allow students to get their work checked frequently as the assessments are build-ups.

Performance Assessments:

Hydraulics System
Working Protype
Design Completion
Engineering Drawing Completion

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Black Horse Pike Regional School District Curriculum Template

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

PART I: UNIT RATIONALE

WHY ARE STUDENTS LEARNING THIS CONTENT AND THESE SKILLS?

Course/Unit Title: **ENGINEERING** **Introduction to Robotics**	**In this course students will expand their knowledge of control systems by engaging in designing and building robotics. This unit is an overview of robotic systems where students will explore the following topics: Motion planning, mobile mechanisms, sensors, control mechanisms and programming. Students in this unit will be engaged in designing, building, and programming autonomous robots.**
Grade Level(s): **10-12**	

Essential Question(s):	Enduring Understanding(s):
How can robotics technologies extend human capabilities? **What approach do we use to solve technological problems using advanced technological systems?** **How will effective planning effect the outcome of autonomous programming?** **How can we analyze the accuracy and outcomes of a robots work and predict troubleshoot variances in the system?**	• **Technology is used to extend human capabilities and is constantly growing, changing, and improving.** • **The Technological design process is a systematic approach to solving complicated open ended problems and design challenges.** • **The impacts of robotics in the technological and economic world are drastic and human paradigms must shift to adapt to the new emerging technological resources.** • **Quality control must be maintained and analyzed throughout a system.**

PART II: INSTRUCTIONAL STRATEGIES AND RESOURCES

DESCRIBE THE LEARNING TARGETS.

After each target, identify the NJCCCS or Common Core Standards that are applicable

Learning Target	NJCCCS or CCS
35. Organize and identify all Mindstorms components 36. Build the advanced Task bot from the construction booklet in the kit 37. Become familiar with NXT programing software 38. Control robot movement using the NXT brick with autonomous programing 39. Solve a distance challenge course 40. Alter the robot design to accept various sensors 41. Utilize sensors and autonomous programing to solve sensor challenges 42. Re-Design and add multiple sensors to the robot to solve a complicated robot design challenge 43. Calculate and create gear trains to alter torque and speed of the robot. 44. Become familiar with data logging section of software – run a live program (the NXT brick is connected to the computer, stationary and just collecting data) 45. Manipulate graph and use analysis from the data logging software	1. TEC.9-12.8.2.12.A.1 - 2. TEC.9-12.8.1.12 B.3 3. TEC.9-12.8.1.12 B.9 4. TEC.9-12.8.1.12 B.11 5. TEC.9-12.8.2.12 B.4 7. TEC.9-12.8.1.12 A.4 8. MA.K-12.4.5.A.1 9. MA.K-12.4.5.F.2 10. MA.K-12.4.5.A.5 11.MA.K-12.4.5.C.4 12. MA.K-12.4.5.C.6

Inter-Disciplinary Connections:

MATH - fractional inch, fractions, measurement, geometric principles, rotational measurements, degrees of movement.

English - An engineering notebook including written documentation of the technological design process

Science – Robotics is used in many medical and highly controlled scientific studies

Social Studies – Impacts of emerging technologies on the social and economic level

Students will engage with the following textbook

TECHNOLOGY EDUCATION: LEARNING BY DESIGN Pearson
Prentice Hall
ISBN 0133639894
Periodicals to include but not limited to newspapers, magazine articles, internet web pages.

Students will write:

Students will write the following in their engineering notebooks:

Program plan summaries explaining the sequence of events for their robot

Reflections to analyze information learned and improvements for future challenges

Robotics and engineering current events

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

<u>How</u> will students uncover content and build skills.

Students will learn robotics fundamentals, terminology and real life applications through presentations, videos, and current events.

Students will then be introduced to the Lego Mindstorms robotics kits. Next, all kits will be organized and all parts identified. Students will follow the construction booklet and build the Taskbot robot. Students will then be given demonstrations using the NXT programming software and the NXT brick. Students will now program their robots to move a certain distance. Students must use math to calculate the amount of tire rotations necessary to move a given distance.

The first challenge is a distance challenge, students must measure and record a course and then write a written summary of the course obstacles and necessary calculations and actions needed to complete the course. Students will now use the NXT programming software to program the NXT brick to complete the course. Students will need to use the TDP to solve the challenge.

The next part of this unit deals with added robotics sensors. Students will add the touch, light, infrared, and noise sensors independently and solve a challenge designed for that particular sensor. The final sensor challenge is an open ended problem course that must be completed with the use of multiple sensors.

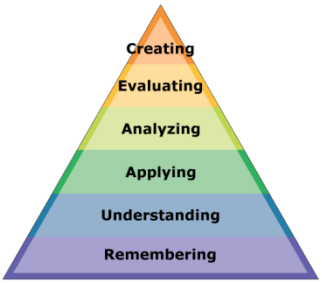
Students will learn about the mechanical advantage of gears and create a gear train on the robot to create a robot with greater speed or more torque. Students will calculate the mechanical advantage and torque/speed ratios.

Introduce datalogging section of software – run a live program (the NXT brick is connected to the computer, stationary and just collecting data) – walk students through how to manipulate graph and use the analysis software.

PART IV: EVIDENCE OF LEARNING

IDENTIFY THE METHODS BY WHICH STUDENTS WILL DEMONSTRATE THEIR UNDERSTANDING OF CONTENT AND THEIR ABILITY TO APPLY SKILLS.

IDENTIFY BLOOM'S LEVELS.



<u>Formative Assessments</u>:

WARM UP ACTIVITIES

All activities will be based on either student exploration of content area, or reflection of prior lessons.

CHECKPOINTS OF UNDERSTANDING
Note worksheets
Checkpoints at each robot stage, sensor and challenge
Written program summaries
Engineering notebook checks

<u>Accommodations/Modifications</u>:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Summative Assessments:

Robotics test
Mindstorms robotics reflective essay

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.

Performance Assessments:

Construct the Taskbot
Write autonomous programing
Solve multiple autonomous challenges

Accommodations/Modifications:

Alternative assignments, additional time for assignments, preferential seating arrangements one on one interaction, after school help, and assistance for organization. Check frequently for student understanding.
Allow students to get their work checked frequently as the assessments are build-ups.