Pre-Engineering

COURSE OF STUDY

Technology Department

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Approved by:
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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. Alternative Energy
Investigate multiple types of alternative energies. Integrate alternative energy into a going green project.
(Activity – solar cars or boats, alternative energy and conservation project)

4. Marine Engineering
Research, design, build, and test an efficient boat hull design. Testing includes mathematics efficiency calculations.
(Activity - model boat building)

5. Application of Simple Machines.
Identify and apply the six simple machines, including calculations of mechanical advantage.
(Activity- design and construction of a Rube Goldberg Machine)

6. 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)

7. **Computer Aided Drafting and Solid Modeling**
Use Auto-Desk Inventor to draw orthographic drawings and 3D solid modeling.
(Activity – Solid model plans of a CO2 car, build and test the model car)

8. Electronics
Exercise an understanding of magnets and electromagnets, for the purpose of producing electricity and converting electricity to motion.
(Activities – Breadboard circuits, soldering circuit kits, DC motor kits)

9. Aeronautical Engineering
Research, design, solid model, and construct rocket components to perform a successful rocket launch and safe landing.
(Activity- solid fuel rockets)

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.
6. 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:
PRE-ENGINEERING
Safety, Measuring & Technical Drawing</td><td rowspan="2">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.

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	**1. *TEC.9-12***
2. Demonstrate accurate measurement skills (fractional inch) to read a ruler to 1/16	**2. *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	**3. *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.

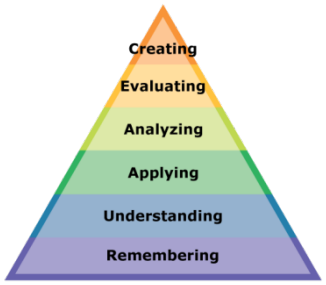
<u>How</u> will students uncover content and build skills.

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)

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?

<table>
<tr><td>Course/Unit Title:
PRE - ENGINEERING
Marine Engineering</td><td rowspan="2">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.

Unit Summary:
Students will learn about the transportation and marine engineering fields including different types of hull designs, hydrodynamics and water displacement concepts. Students will be able to predict handling characteristics of real boats. Students will apply this marine engineering knowledge to design, construct, and race a model boat. Students will also calculate boat speeds and hull efficiency.</td></tr>
<tr><td>Grade Level(s):
10-12</td></tr>
<tr><td>Essential Question(s):
What is the importance of research when developing a technological product or system?

How can we strategically solve problems?

How do science and math relate to transportation and marine engineering?</td><td>Enduring Understanding(s):
This unit will reinforce the technological design process for solving open ended problems as students will research, design and solve a boat design challenge. Students will learn about transportation technologies and all of the scientific principles behind boat hull design including; hydrodynamics, basic hull shapes, efficient hull speeds, water displacement. They will also brainstorm ideas, and use their mechanical drawing skills.</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. Identify and analyze different types of hull designs. 2. Understand concepts of hydrodynamics, water displacement, and apply these concepts to predict handling characteristics of real boats. 3. Apply the technological design process to solve open ended design challenge 4. Design mechanical drawings of a boat and apply knowledge of hydrodynamics to these designs. 5. Students will learn proper layout skills. 6. Safely manipulate use tools and machines to manufacture, carve, and paint their boat models. 7. Calculate speed and efficiency of the boat races.	1. TEC.9-12.8.1 2. TEC.9-12.8.2.12.E.1 3. ELL.9-12.L.A.3 4. ELL.9-12.S.B.3 5. ELL.9-12.R.E.6 6. MA.9-12.4.2.12 D.2 7. MA.9-12.4.5 8. MA.9-12.4.5.12 B.2 9. 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.
Science - Hydrodynamics, buoyancy, center of gravity, friction.
Social Studies – Research and connect with historical and ancient boat designs

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 technological design process and boat hull design.

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

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

This unit will begin with guided research on the ten different hull design types. The students will research each hull design and fill out a Cornell note worksheet. This note sheet will include student sketches and a strengths and weakness analysis of each hull style. Students will also research marine, boating, and nautical terminology.

Students will learn about hydrodynamics and historical boat design through a boat presentation. This presentation will include a note sheet and real life examples of boats and hydrodynamics.

Students will follow along a TLA design packet as they work through the technological design process. The students will document research, brainstorming, design sketches, and mechanical drawings. Students will then construct and test their solution on the TC Marine Engineering Race Track.

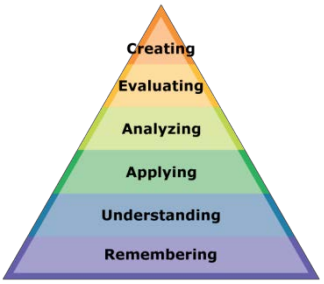
Students will race their boat models.

Students will calculate hull speed and boat efficiency and write a reflection essay reflecting upon the entire project including how knowledge of hydrodynamics was applied to their design, the technological design process and the results of the race.

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

Boat Hull design research and Cornell Notes
Hydrodynamics worksheet
Marine Engineering Design Journal (research, sketches, orthographic drawings, order of operations)

<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:

Written Marine Engineering test on boat hulls, marine engineering terms, and hydrodynamics.

The boat race is test of how well the concepts of hydrodynamics were applied to the boat design

Students will write an end of unit reflective essay explaining what students learned from this unit.

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:

Foam boat model

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:
PRE ENGINEERING

Simple Machines</td><td rowspan="2">Unit Summary:

• The simple machines unit is designed to facilitate critical thinking and problem solving associated with the six simple machines. Students will learn to identify, use, calculate mechanical advantage, and analyze efficiency of simple machine systems. Students will apply the knowledge of simple machines to a simple machines project.</td></tr>
<tr><td>Grade Level(s):
10-11</td></tr>
<tr><td>Essential Question(s):

How can we strategically solve problems?

Why is safety important and what precautions can we take to ensure safety?

How are simple machines used in everyday life to increase human efficiency?</td><td>Enduring Understanding(s):
• Problem solving with the technological design process

• Safe manufacturing processes

• Simple machines are the basis to all technological systems

• Technology is used to extend human capabilities</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. Identify the six simple machines and where each can be found in everyday life. 2. Calculate and discuss mechanical advantages of using simple machines. 3. Apply knowledge of simple machines and use them to generate mechanical advantage. 4. Design and construct a mechanism using simple machines. 5. Constructively reflect upon the technological design process and project.	1. TEC.9-12.8.1 2. TEC.9-12.8.2.12 B.3 3. TEC.9-12.8.2.12.E.1 4. ELL.9-12.L.A.3 5. ELL.9-12.S.B.3 6. ELL.9-12.R.E.6 6. TEC.9-12.8.2.12 B.6 7. MA.9-12.4.5 8. MA.9-12.4.5.12 B.2 9. 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 - Physics, Newtons laws, inertia, gravity

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

Students will write a narrative explaining the sequence of the Rube Goldberg project.

Students will write a reflection paper explaining their project and demonstrate knowledge of the six simple machines.

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills.

Students will learn about the six simple machines through presentations including example and videos. Students will fill out a note worksheet during the presentations.

Students will learn how to calculate the mechanical advantage of the different simple machines through demonstrations, examples and practice problem.

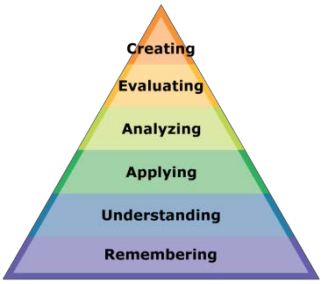
Students will then work through real life simple machine stations. They will manipulate each simple machine to gain mechanical advantage while completing tasks. Students will then calculate the mechanical advantage of each station.

Now that students understand the mechanics of simple machines they will design, construct and test a Rube Goldberg machine

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

Presentation Worksheets
Mechanical advantage station checkpoints
Planning and building checkpoints during the project

<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:

Simple Machines Test

Simple machine and reflection 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:

Students will manipulate simple machines to calculate mechanical advantage

Students will design plans for a Rube Goldberg project

Construction of a Rube Goldberg 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.

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:
PRE ENGINEERING
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. Identify and apply the technological design process to a real design challenge 2. Design a working set of mechanical drawings 3. Students will learn to safely operate tools and machines to process materials 4. Write a creative fictional story that applies to the years challenge 5. Solve challenge related geometric, algebraic, and statistical math problems 6. Show gracious professionalism throughout a competition 7. Constructively reflect upon the technological design process, challenge and teamwork	1. TEC.9-12.8.1 2. TEC.9-12.8.2.12 B.3 3. TEC.9-12.8.2.12.E.1 4. TEC.9-12.8.1.12 B.9 5. ELL.9-12.S.B.3 6. ELL.9-12.R.E.6 7. MA.9-12.4.2.12 D.2 8. MA.9-12.4.5 9. MA.9-12.4.5.12 E

Inter-Disciplinary Connections:

MATH - fractional inch, fractions, measurement, geometric principles, statistical calculations, HSPA math
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 page

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.

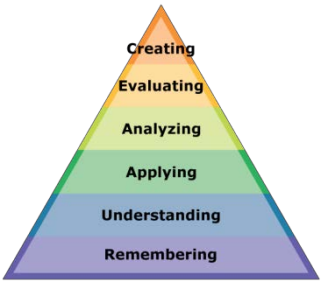
After the design journal is done, students will collect their materials and begin to safely process materials and construct their designs. After building students will test and re-build their project to get the best potential result. The challenge will then move forward with a tournament and the winning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



<u>Formative Assessments</u>:

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.

<u>Accommodations/Modifications</u>:

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?

Course Title: Robotics Unit 2 Intro to Solid Modeling **Grade Level(s):** **10 - 12**	**Unit Summary**: CAD is used for detailed engineering of 2D drawings and 3D models of physical components. It is used throughout the engineering process from conceptual design through completion of a product. The use of CAD has lowered product development costs and has greatly shortened the design cycle. The skills learned are in high demand in today's technical world.
Essential Question(s): • **Why do we create solid models?** • **How do I setup a solid modeling profile?** • **How do I manage layers?** • **How can I use the views of an orthographic projection to create a 3D Model?** • **What are parametric constraints?** • **How do I sketch 2d geometry to create solid models?** • **How do I use geometry to calculate and dimension objects?** • **What are work planes and why are they important?** • **How do you use the advanced 3D modeling tools?** • **What are some of the basic Modify tools?**	**Enduring Understanding(s):** • Determine and explain the use of 3D modeling in engineering world. • Determine when to use 2D and 3D modeling. • Understand why it is important to create detailed models. • Understand the difference between part files, assembly files, and drawing files. • Value the importance of an organizing projects and creating a clean workspace to make solid modeling run smoother and easier. • Explain when to use different layers and annotative styles for different types of projects. • Interpret the dimensions of an orthographic projection and apply problem solving skills to determine the missing dimensions. • Comprehend the use of parametric constraints and summarize the different situations where they are used. • Explain the difference between sketch mode and modeling mode. • Predict what an object will look like by using geometry calculations. • Outline the importance of work planes when creating advanced 3D models. • Explain and determine when to use the different advanced modeling techniques including sweep, extrude, revolve and loft. • Summarize the different types of modify tools when finalizing a part file including fillet, shell, split, and join.

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. Recognize the importance of solid modeling	**1.** ***TEC.9-12.8.2.12 B.4*** ***TEC.9-12.8.2.12 B.6*** ***TEC.9-12.8.2.12.B.3*** ***MA.9-12.4.2.12 A.1*** ***SCI.9-12.5.4.12 A.1***
2. List the advantages and disadvantages are of 3D modeling compared to 2D modeling.	
3. Identify when 3D models need to be drawn.	**2.** ***TEC.9-12.8.2.12 B.1*** ***TEC.9-12.8.1.12.F.2*** ***LA.9-12.3.1.12.A.1***
4. Organize the layers of a drawing file and arrange the workspace to suit the need of the drawing format.	
5. Be able to take two views of an orthographic projection and create a solid model from these views.	**3.** ***TEC.9-12.8.1.12 B.9*** ***TEC.9-12.8.1.12.A.4***
6. Construct parts using parametric constraints including, parallel, horizontal, perpendicular, vertical, tangent, coincident, and equal constrains and troubleshoot over-constrained sketches.	*4.* ***TEC.9-12.8.1.12 B.3*** ***TEC.9-12.8.1.12 B.4***
7. Create a sketch of an object in the sketch mode and be able to finish the sketch that includes a closed entity to be able to extrude the object making it 3D.	*5.* ***TEC.9-12.8.2.12 B.3*** ***TEC.9-12.8.2.12 B.1*** ***MA.9-12.4.2.12 A.2***
8. Use math to determine missing lengths and angles of an object.	***6. TEC.9-12.8.1.12 B.10*** ***TEC.9-12.8.1.12 B.11***
9. Create work planes where sketches can be drawn on to increase the complexity of a part.	*7.* ***TEC.9-12.8.2.12 B.4***
10. Demonstrate the ability to use the advanced modeling techniques by extruding, sweeping, lofting, and/or revolving a part.	***8. TEC.9-12.8.2.12 B.6*** ***MA.9-12.4.2.12 A.2*** ***MA.9-12.4.2.12 A.1***
11. The student will learn the basic commands of solid modeling which are Regions, Extrude, Union, Subtract, Press-Pull, Model space vs paper space, Viewports, Scaling, and Plotting	***9. TEC.9-12.8.1.12 B.11*** ***TEC.9-12.8.2.12.F.3***
12. Apply the finishing modify tools by creating fillets, shelling, splitting, and or joining an object.	*10.* ***TEC.9-12.8.2.12 B.4*** ***MA.9-12.4.2.12 A.1***
	11. TEC.9-12.8.2.12 B.4 ***TEC.9-12.8.2.12.F.3***
	12. TEC.9-12.8.2.12 B.3

	TEC.9-12.8.2.12.F.3 *MA.9-12.4.2.12 A.1*

Inter-Disciplinary Connections:

STEM, Mathematics, Geometry, Engineering

Students will engage with the following text:

Mechanical Drawing CAD Communications 12th Edition

Students will write:

Use of Cornell Notes will be used to understand the procedures for completing drawings.

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

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

Project based and self-exploration

Real life engineering problems

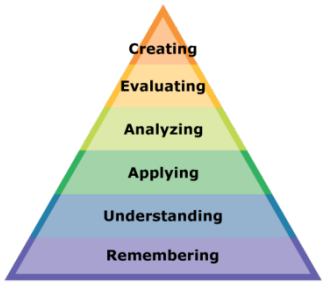
Examples of solution will be given first then students will problem solve and explore to create their own solutions to the problems.

1. **Students will be completing sketches of models before they complete them on the computer.**
2. **Students will use 3D models to create the same model**
3. **Students will use all three views of an orthographic projection to create a 3D solid model.**
4. **Students will use two views to create a solid model.**
5. **Students will use the revolve tool to create round objects**
6. **Students will use the sweep tool to create a profile that will be extruded and a path that with will follow to create parts.**
7. **Students will use the loft tool to create complex parts that include tapers.**
8. **Students will use real objects and take measurements to create a solid model.**

Students will need to have access to Autodesk AutoCAD and Inventor. Drawing will come from the text and other engineering drawings produced by the teacher.

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:

Observation of student progress and skill development, checkpoints of understanding at:

1. Set-up of program, layers, and workspace
2. Sketching of models
3. Parts created coping another model
4. Models created by looking at the three views of an orthographic projection
5. Create using two views
6. Revolving
7. Sweeping
8. Lofting
9. Measure and create part from looking at a real object.

Do-now's and checkpoint quizzes will be given during and at the conclusion of these topics

Accommodations/Modifications:

One-on-one interaction, alternate assessments

Summative Assessments:

Completed drawings, tests, design journal, test drawing after each mini-unit listed in Part III

Accommodations/Modifications:

Additional time, alternate assessment, after-school help

Performance Assessments:

Completion of Portfolio
Completion of a real object that the students bring in will be the culmination of the understanding the unit.

Accommodations/Modifications:

Alternate drawings, additional time, assistance with organization

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:
PRE ENGINEERING

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, build a DC electrical motor, and solder components to create an electronic toy.</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
1. Distinguish between a series and parallel circuit.	1. TEC.9-12.8.1
2. Calculate current, voltage, and resistance in a circuit.	2. TEC.9-12.8.2
3. Identify various electronic components based on their appearance.	3. TEC.9-12.8.2.12.E.1
4. Discuss the advantages of using electromagnets in mechanical systems.	5. ELL.9-12.L.A.3
5. Design and construct an electromagnet motor.	6. ELL.9-12.S.B.3
6. Safely use a soldering iron to solder an electronics circuit board.	7. SCI.9-12.5.7
	8. MA.9-12.4.2.12 D.2
	9. MA.9-12.4.5
	10. MA.9-12.4.5.12 B.2
	11. 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 and DC motor presentation.**
- **Motor reflection and scientific analysis essay.**

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 apply their knowledge of electromagnets and DC circuitry as they follow directions and build an electric DC motor. Students will troubleshoot their motors and fix any problems in the circuitry. Students will write a reflection essay explaining how electricity is created, converted, transmitted, controlled and used in the modern world citing examples and analysis of their electric motor.

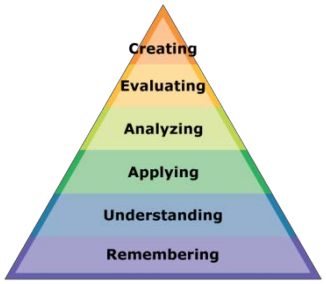
Next, students will learn about electronic circuitry and components through presentations and examples. Students will learn to identify different electronics components. Students will learn safe soldering techniques through demonstration, and then students will practice soldering on electronics toy soldering kits.

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.



<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

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

<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>:

Electronics Test
Motor reflection and concepts 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:

Students will construct an electro-magnetic motor
Solder and troubleshoot an electronics kit

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:
PRE ENGINEERING

Alternative Energy</td><td rowspan="2">Unit Summary:

This unit will introduce alternative energy engineering concepts while helping students become environmentally conscious individuals. Students will to learn about non-renewable resources, alternative energies, global energy demand, and current energy production rates. Students will research and present alternative energies and green technologies.

Students will utilize their understanding of the current global energy and natural resource situation and apply the engineering and technological design process to solve an alternative energy design challenge.

Students will need to be able to think critically and analyze individual and global plans for environmental sustainable lifestyles.</td></tr>
<tr><td>Grade Level(s):
10-12</td></tr>
<tr><td>Essential Question(s):

How can we use a system to solve technological problems?

What can we do as individuals to protect natural resource?

Why are sustainable alternative energies important in the future?</td><td>Enduring Understanding(s):
• Students will use the technological design process to solve problems and think critically.</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. Investigate various forms of alternative energy and their uses.	1. TEC.9-12.8.1
2. Compare and contrast solar energy with traditional energy sources.	2. TEC.9-12.8.1.12 B.3
3. Analyze energy costs on various different forms of energy.	3. TEC.9-12.8.1.12 B.5
4. Discuss alternative energies that are affecting global industry.	4. TEC.9-12.8.2.12.E.1
5. Design and construct a device that collect a form of alternative energy and converts it into electrical and mechanical energy or have real life natural resource conservation results.	5. TEC.9-12.8.2.12 C.1 6. ELL.9-12.S.B.3 7. ELL.9-12.R.E.6 8. MA.9-12.4.2.12 D.2 9. MA.9-12.4.5 10. MA.9-12.4.5.12 B.2

Inter-Disciplinary Connections:

MATH - fractional inch, fractions, measurement, geometric principles,
English - An engineering notebook including written documentation of the technological design process
Science - Alternative energy, physics, chemistry, earth sciences.
Social Studies - The history and development of global energy needs and sources

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 to document research, designs and reflect upon the technological design process.

Students will write a research paper on an emerging alternative energy source.

Students will write a reflection and scientific analysis essay about their alternative energy project.

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills.

Students will begin to learn about non-renewable resources, global energy demand, and current energy production rates through presentation and videos. Students will take notes on a worksheet.

Students will be assigned an alternative energy to research and present to the rest of the class. All students will be responsible for 2 main ideas or facts from each presentation that will be reproduced in a class generated test.

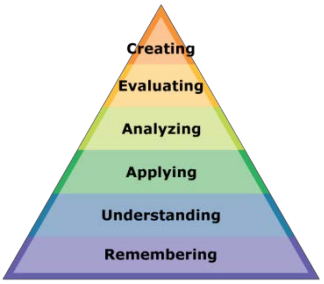
Students will research, design, solid model and build an alternative energy project. This project may be a device that will collect an alternative energy source and convert the energy into useful mechanical energy. The project may be a green design that will have real contributions to conserving natural resources and protecting planet earth from destructive non-sustainable manufacturing processes.

Students will then write a reflection paper about becoming a greener society by using traditional conservation efforts along with integrating alternative energies. Students will propose individual and global plans for environmental sustainable lifestyles.

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 worksheet during lessons

Presentations on alternative energies and green technologies

Checkpoints during the technological design process

<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:

Classroom driven alternative energy test

Alternative energy and analysis reflection paper

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:

Design and construct an alternative energy 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.

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:
PRE ENGINEERING

Aeronautical Engineering</td><td rowspan="2">Unit Summary:
• Students will learn to use the technological design process (TDP) to solve open ended problems involving space travel and flight related concepts. Students will solid model their rockets using Autodesk Inventor to design their own model rocket that is aerodynamically sound. Students will learn to safely use tools and machines to extend human capabilities and build their solutions to the aeronautical challenge. Students will use math to calculate the success and altitude of their rockets.</td></tr>
<tr><td>Grade Level(s):
10-12</td></tr>
<tr><td>Essential Question(s):

How can we strategically solve problems?

Why is safety important and what precautions can we take to ensure safety?

How are rockets propelled into space?

What physical forces act upon an object in flight?</td><td>Enduring Understanding(s):
• This unit is designed to introduce and reinforce the technological design process. The students will learn to solve open-ended problems and to design and build the solution or projects. Students will walk away with a new attitude towards solving problems, the ability to confidently use tools and machines to process multiple types of materials, to work cooperatively with others, understand physics related to objects in flight and understand how trigonometry can be used to determine altitude.</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. Apply the Technological design process to solve problems and design challenges.	1. TEC.9-12.8.1
2. Understand and identify the different parts of an aircraft and their function.	2. TEC.9-12.8.2.12 B.4
3. Integrate basic aerodynamics pertaining to aeronautical engineering	3. TEC.9-12.8.2.12.E.1
	5. ELL.9-12.L.A.3
4. Understand math concepts that that pertain to rocket fight	
	6. ELL.9-12.S.B.3
5. Design a sold model rocket using Autodesk Inventor	
6. Construct a model rocket by safely using tools and machines	7. ELL.9-12.R.E.6
7. Launch a rocket following a strict rocket launching safety protocol	
8. Calculate the altitude of the rocket in flight	8. MA.9-12.4.2.12 D.2
	9. MA.9-12.4.5
	10. MA.9-12.4.5.12 B.2
	11. 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 – Physics, Newton's Laws, Geometry, aerodynamics

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

Aeronautical engineering presentation notes

Solid fuel rocket safety protocol guidelines

PART III: TRANSFER OF KNOWLEDGE AND SKILLS

DESCRIBE THE LEARNING EXPERIENCE.

How will students uncover content and build skills.

Students will learn basic aeronautical engineering principles through presentations, videos, and demonstrations. Students will take notes during these presentations.

Students will now complete guided research on the different components of a model rocket.

Students will follow along a TLA design packet as they work through the technological design process. The students will document research, brainstorming, design sketches, and mechanical drawings. Students will then solid model their rocket on Autodesk Inventor.

Students will then construct their rockets using tools, machines, and efficient procedures.

Next, students will research and write rocket launching safety protocol.

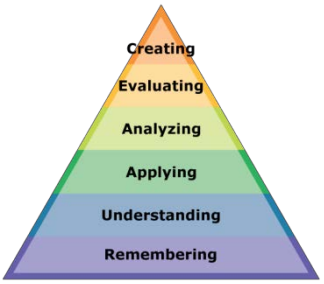
Students will launch their rockets and use trigonometry to calculate the altitude the rocket flight.

Students will critically and constructively reflect upon aeronautical concepts, aeronautical engineering as a career, and the technological design process used to design, build, and safely launch a rocket.

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
Notes on presentations
Research on rocket components
Solid Modeling parts completion checkpoints

Accommodations/Modifications:

Students will be accommodated on a case by case basis. Students with physical needs will be accommodated by use of custom and specialized jigs, guards and fixtures to ensure complete safety and to maximize ability. Students will also be given extra time on tests and projects when necessary. Extra help is available for questions and clarification.

Summative Assessments:

Aeronautical engineering test
Aeronautical engineering reflection paper

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. Students will be given extra time, and also reminders (oral and written) of how physics concepts affected their rocket.

Performance Assessments:

Students will design a sold model rocket on Autodesk Inventor
Construct a solid fuel rocket model

Accommodations/Modifications:

Students will be accommodated on a case by case basis. Students with physical needs will be accommodated by use of custom and specialized jigs, guards and fixtures to ensure complete safety and to maximize ability. Students will also be given extra time on tests and projects when necessary. Extra help is available for questions and clarification.