Washington Township School District

The mission of the Washington Township Public Schools *is to provide a safe, positive, and progressive educational environment that provides opportunity for all students to attain the knowledge and skills specified in the NJ Learning Standards at all grade levels, so as to ensure their full participation in an ever-changing world as responsible, self-directed and civic-minded citizens.*

Course Title:	Invention and Innovation in STEM
Grade Level(s):	7th grade

Duration:	*Full Year:*		*Semester:*		*Marking Period:*	X
Course Description:	Invention and Innovation is a 9-week course designed for 7th grade students and provides students with opportunities to apply the design process in the invention or innovation of a new product, process, or system. In this course, students will learn about invention, innovation, their history and how they impact our lives. They will learn about the core concepts of technology and about the various approaches to solving problems, including computer aided design and traditional engineering design practices and experimentation. Students will apply their creativity in the invention and innovation of new products, processes, or systems. Students participate in engineering-design activities to understand how criteria, constraints, and processes affect designs. Students are involved in activities and experiences where they learn about brainstorming, visualizing, modeling, constructing, testing, experimenting, and refining designs. Students also develop skills in researching for information, communicating design information, and reporting results.					
Grading Procedures:	Grades are based on 50% Major assessments, 35% minor and 15% supportive					
Primary Resources:	Teacher Created Materials, 3D Drafting Software, Lego Robotics or equivalent and Classroom equipment and tools					

Washington Township Principles for Effective Teaching and Learning

- Implementing a standards-based curriculum
- Facilitating a learner-centered environment
- Using academic target language and providing comprehensible instruction
- Adapting and using age-appropriate authentic materials
- Providing performance-based assessment experiences
- Infusing 21st century skills for College and Career Readiness in a global society

Designed by:	Patrick Goliszewski

Under the Direction of:	Malika Moore

Written: 8/2023

Revised: _____

BOE Approval: _____

Unit Title: 1 – Introduction and Overview

Unit Description: Unit 1 provides an overview of: the course, the grading procedure, and the classroom rules. Emergency procedures in the classroom will be reviewed. The cycle project which will tie all the segments of the unit together. Emphasis is placed on good classroom citizenship, listening skills and how the information and skills presented, as part of this course, will possibly shape the students career path choice.

Unit Duration: 2 days

Desired Results

Standard(s): 8.2.8.ED.1-7, 8.2.8.ITH.1-5, 8.2.8.NT.1-4, 8.2.8.ETW.1-4, 8.2.8.EC1-2, 9.2.12.CAP.2-6, 9.3.12.AC.1-7, 9.3.12.AC-CST.1-7 & 9, 9.3.12.AC-DES.1-8, 9.3.12.AR.1,2 &5, 9.3.12.AR-PRF.1, 9.3.12.AR-TEL.3, 9.3.MN.1, 9.3.MN.4, 9.3.MN-HSE.1, 9.3.ST.1, 3-6, 9.3.ST-ET.1-6, 9.3.ST-SM.1,2, 9.4.12.CI.1-3, 9.4.12.CT.1-2

Indicators: Students will be able to appropriately react to classroom emergencies and identify differences in engineering career fields.

Understandings:

Students will understand that…

1. Technology is the application of knowledge and use of resources to solve problems.
2. In an emergency situation following established procedures is the appropriate behavior for the situation.
3. Learning and innovation skills are necessary for an increasingly complex life and work environments in the 21st century.

Essential Questions:

1.What outcomes should a student expect from this course?
2. Why is it important to understand emergency procedures?
3. How will the content from this course help me as a lifelong learner?
4. What is technology and how has it changed society?

Assessment Evidence

Performance Tasks:

1. Overarching goals and Grades
2. Expected behavior and conduct.
3. Define Technology

Other Evidence:

Teacher observations
Informal checks for understanding
Independent reading/student conferences
Independent writing/student conferences
Class discussions
Collaboration with others
Group work
Classwork
Teacher-created tests and quizzes
Teacher-created multimedia project

Benchmarks:
Career Assessment
Emergency Safety Review

Learning Plan

Learning Activities:
1. Goals and Grades
2. Emergency procedures
3. What is Technology Activities
4. Lab tour scavenger hunt

Resources:
1.Handouts
2.Teacher made web resources
3. Devices and internet

Unit Modifications for Special Population Students	
Advanced Learners	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students
Struggling Learners	• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Chunk Assignments • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability
English Language Learners	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class
Learners with an IEP	Each special education student has an Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process, or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here.

	Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: Students will be making connections to Math (measuring, fractions, decimal conversions), Health (safety), Digital Literacy (computer software) and ELA (design loop paperwork)

Integration of 21st Century Skills

Indicators:

1. Critical thinking
2. Communication skills
3. Creativity
4. Problem solving
5. Perseverance
6. Collaboration
7. Information literacy
8. Technology skills and digital literacy
9. Media literacy
10. Global awareness
11. Self-direction
12. Social skills
13. Literacy skills
14. Civic literacy
15. Social responsibility
16. Innovation skills
17. Thinking skills

Unit Title: 2 Safety and Measurement

Unit Description:
This unit provides an overview of: Safety in the classroom, at home and in the workplace, The use of measuring tools and forms of measurement, Introduction to hand tools and power tools.

Unit Duration: 10 days

Desired Results

Standard(s): 8.2.8.ED.1-7, 8.2.8.ITH.1-5, 8.2.8.NT.1-4, 8.2.8.ETW.1-4, 8.2.8.EC1-2, 9.2.12.CAP.2-6, 9.3.12.AC.1-7, 9.3.12.AC-CST.1-7 & 9, 9.3.12.AC-DES.1-8, 9.3.12.AR.1,2 &5, 9.3.12.AR-PRF.1, 9.3.12.AR-TEL.3, 9.3.MN.1, 9.3.MN.4, 9.3.MN-HSE.1, 9.3.ST.1, 3-6, 9.3.ST-ET.1-6, 9.3.ST-SM.1,2, 9.4.12.CI.1-3, 9.4.12.CT.1-2

Indicators: Students will pass the safety Quiz with a 100% and be able to accurately measure to 1/16 of an inch

Understandings:
Students will understand that…

They are responsible for their own safety and the safety of those around them while they are using tools in the classroom, at home and in the workplace

Measuring tools assist with the design and material processing

Hand and power tools assist with manufacturing, construction and modification

Essential Questions:

What situations can be dangerous and how do I minimize the risk of injury?

How do you create objects to uniform or specified sizes?

What can be used to modify materials to meet specific needs?

Assessment Evidence

Performance Tasks:
Students will use proper protective equipment and conduct themselves in a safe and appropriate manner in the classroom and the lab
Use a ruler to measure
Draw various straight edges and angles
Reduce to the nearest 1/16th of an inch
Utilize hand tools in order to manufacture the cycle project(s)
Utilize basic computer programs to design the cycle project(s)

Other Evidence:
Teacher observations
Informal checks for understanding
Independent reading/student conferences
Independent writing/student conferences
Class discussions
Collaboration with others
Group work
Classwork
Teacher-created tests and quizzes
Teacher-created multimedia project

Benchmarks:
Students will appropriately apply measuring and safety practices to complete a tool skills project

Learning Plan

Learning Activities:

Demonstration
1.Safety
2.First aid procedures
3.Measurement Techniques
4.Computer sketches
5.Hand tools
6.Power tools
Learning Activity Examples
1. Classroom Measuring
2.Tool Skills Projects

Resources:

Middle school level Safety resources
1. Safety Packet
2. Review Worksheet
3. Safety Quiz
(Paper or Schoology or other web-based platform) Various Measuring devices
1. Rulers (metric and standard)
2. Measuring tapes
3. Tape measures
Assorted hand and power tools as per laboratory and individual project
Wood and materials as available or required

Unit Modifications for Special Population Students	
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Learners with an IEP	Each special education student has an Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process, or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that

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Interdisciplinary Connections

Indicators:
Students will be making connections to Math (measuring, fractions, decimal conversions), Health (safety), Digital Literacy (computer software) and ELA (design loop paperwork)

Integration of 21st Century Skills

Indicators:

1. Critical thinking
2. Communication skills
3. Creativity
4. Problem solving
5. Perseverance
6. Collaboration
7. Information literacy
8. Technology skills and digital literacy
9. Media literacy
10. Global awareness
11. Self-direction
12. Social skills
13. Literacy skills
14. Civic literacy
15. Social responsibility
16. Innovation skills
17. Thinking skills

Unit Title: 3 Design, The Design Loop and Problem Solving

Unit Description:
This unit introduces the concept of Design in its many forms (i.e., artistic, industrial and engineering) and the Design Process / Problem Solving. Problem solving will be explained through the steps of the design loop. Students will use the elements of design to create an original design of a product and Students will use the design loop to design / engineer a solution to a real-world problem. An emphasis will be placed on the use of CAD software to create design ideas.

Unit Duration: 10 days

Desired Results

Standard(s): 8.2.8.ED.1-7, 8.2.8.ITH.1-5, 8.2.8.NT.1-4, 8.2.8.ETW.1-4, 8.2.8.EC1-2, 9.2.12.CAP.2-6, 9.3.12.AC.1-7, 9.3.12.AC-CST.1-7 & 9, 9.3.12.AC-DES.1-8, 9.3.12.AR.1,2 &5, 9.3.12.AR-PRF.1, 9.3.12.AR-TEL.3, 9.3.MN.1, 9.3.MN.4, 9.3.MN-HSE.1, 9.3.ST.1, 3-6, 9.3.ST-ET.1-6, 9.3.ST-SM.1,2, 9.4.12.CI.1-3, 9.4.12.CT.1-2

Indicators: Students will be able to follow the 7-step design loop to create an original solution to a real world problem

Understandings:
Students will understand that…
The design loop is a guideline/ systematic approach for problem solving and can be used in any circumstance

There are 4 elements of design and 7 principles of design

CAD software is more accurate and easier to manipulate variables in than traditional paper and pencil drawings

Essential Questions:
1. What are the seven steps to the design loop/ problem solving model

2. What are the 4 elements of design and 7 principles of design?

3. How can a computer create a drawing quicker and more accurate than traditional drafting?

4. How does following the design loop aid the design process?

Assessment Evidence

Performance Tasks:

Learn the seven sequential steps to the design loop to problem solving and use skills such as research, sketching, 3D modeling, and testing to solve problems

Identify how a product's use of line, shape & form, texture, and color was used to create an appealing design

Identify the use of the elements; balance, proportion, harmony, contrast, pattern, movement and rhythm in an existing designed work

Use Computer Aided Design (CAD) software to create drawings, 3D models or renderings of an original design

Other Evidence:

Teacher observations
Informal checks for understanding
Independent reading/student conferences
Independent writing/student conferences
Class discussions
Collaboration with others
Group work
Classwork
Teacher-created tests and quizzes
Teacher-created multimedia project

Benchmarks:
Students will document their design process following the 7-step problem solving model
Students will create an artifact to solve a real-world problem

Learning Plan

Learning Activities:

1. Label the 7 steps to the design process by creating a poster or PowerPoint
2. Apply the elements and principles of design in all possible solutions for design briefs
3. Use CAD software to re-create and create drawings of simple objects
4. Use CAD to create a design of a room within a house or a floor plan of a single-story home
5. Use CAD and the design loop to create a solution to a real-world problem.

Resources:
Computers, projectors and presentation software
Examples of engineered products
Assorted materials- wood, foam core, cardboard, etc.
Various hand and power tools

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Integration of 21st Century Skills

Indicators:

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17. Thinking skills

Unit Title: 4 Robotics

Unit Description:

Unit 4 uses the Lego EV-3 Mindstorm Robotics package or other programable robotic platforms from which students may explore robotics. Robotics is an approachable and flexible platform to present STEM. The students will use advanced programming techniques, which support mathematical concepts. Students will participate in manipulative activities that foster problem solving. Investigation of career pathways is encouraged.

Unit Duration: 10 days

Desired Results

Standard(s): 8.2.8.ED.1-7, 8.2.8.ITH.1-5, 8.2.8.NT.1-4, 8.2.8.ETW.1-4, 8.2.8.EC1-2, 9.2.12.CAP.2-6, 9.3.12.AC.1-7, 9.3.12.AC-CST.1-7 & 9, 9.3.12.AC-DES.1-8, 9.3.12.AR.1,2 &5, 9.3.12.AR-PRF.1, 9.3.12.AR-TEL.3, 9.3.MN.1, 9.3.MN.4, 9.3.MN-HSE.1, 9.3.ST.1, 3-6, 9.3.ST-ET.1-6, 9.3.ST-SM.1,2, 9.4.12.CI.1-3, 9.4.12.CT.1-2

Indicators:

Understandings:

Students will understand that…

Engineering and technology are important to extend human capabilities.
Robots are only as useful as their programing.
There are multiple ways to program a robot to complete the same task.

Essential Questions:

What are the differences between Engineering and technology?
How can robots enhance the quality of human life and society as a whole?
What is a robot?
What methods are used to control a robot and make it perform specific tasks?

Assessment Evidence

Performance Tasks:

1. List examples of where robots are used in the real world.
2. Describe the reasons that robots are used instead of humans for certain jobs.
3. How do robots sense their environment?
4. How do we teach robots to do a task
    - Move forward
    - Turn
    - Use sensors
    - Use switches / and/ or / and not controls
5. Create original programs for the robots.

Other Evidence:

Teacher observations
Informal checks for understanding
Independent reading/student conferences
Independent writing/student conferences
Class discussions
Collaboration with others
Group work
Classwork
Teacher-created tests and quizzes
Teacher-created multimedia project

Benchmarks:

Learning Plan

Learning Activities:
Lecture, Demonstration and Discussion

- What is a robot?
- Where do we use robots?
- Robot vs. machine
- Why do we need robots?

Programing activities

- Timing methods
- Using sensors
- Switches
- Logic controls

Resources:
Programing Software
Demonstration software
Handouts

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Indicators:

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9. Media literacy
10. Global awareness
11. Self-direction
12. Social skills
13. Literacy skills
14. Civic literacy
15. Social responsibility
16. Innovation skills
17. Thinking skills

Unit Title: 5 Renewable / Sustainable energies

Unit Description: Unit 5 explores renewable / sustainable energy, as appropriate for the grade level, through the application of scientific principles, mathematical concepts, and hands-on activities. These STEM activities promote problem solving in the student projects / investigations of sustainable energy. Investigation of career pathways is encouraged.

Unit Duration:10 days

Desired Results

Standard(s): 8.2.8.ED.1-7, 8.2.8.ITH.1-5, 8.2.8.NT.1-4, 8.2.8.ETW.1-4, 8.2.8.EC1-2, 9.2.12.CAP.2-6, 9.3.12.AC.1-7, 9.3.12.AC-CST.1-7 & 9, 9.3.12.AC-DES.1-8, 9.3.12.AR.1,2 &5, 9.3.12.AR-PRF.1, 9.3.12.AR-TEL.3, 9.3.MN.1, 9.3.MN.4, 9.3.MN-HSE.1, 9.3.ST.1, 3-6, 9.3.ST-ET.1-6, 9.3.ST-SM.1,2, 9.4.12.CI.1-3, 9.4.12.CT.1-2

Indicators:

Understandings:

Students will understand that…

1. What is energy?
2. What is energy conversion?
3. What is renewable energy?

Essential Questions:

1. Energy cannot be created or destroyed; it only changes form
2. Energy is the ability to do work.
3. Students know that energy appears in different forms, and can be transferred and transformed.
4. Students will understand the difference between renewable and nonrenewable energy
5. Students will be able to identify and distinguish between different forms of renewable energy
6. The concept of "green energy" is defined and related to sustainable energy.

Assessment Evidence

Performance Tasks:

A. Intro To Energy

1.Explain where energy comes from and where it goes.
2. Explain why it is important to change energy into electricity.
3. Explain why energy choice impacts the quality of life now and in the future.
4. Understand that power is a measure of energy transfer rate.

B. Energy Conversion

1.Demonstate basic understanding of the history of human energy use.
2. Explain how an electric current is induced in a wire.
3. Explain how the sun's energy creates a current in a wire.

C.Sustainable Energy

1.Is able to make informed energy and energy use decisions based on an understanding of impacts and consequences
2. Is able to transform energy from one form to a more useful form.
3. Identify occupations and careers that are related to sustainable – renewable energy.

Other Evidence:

Teacher observations
Informal checks for understanding
Independent reading/student conferences
Independent writing/student conferences
Class discussions
Collaboration with others
Group work
Classwork
Teacher-created tests and quizzes
Teacher-created multimedia project

Benchmarks:

Learning Plan

Learning Activities:

1. Investigational Activity
- Explore the difference between renewable and nonrenewable energy.
- Investigate, develop, test, and present a renewable or sustainable energy device.
- Career potential in sustainable energy.
- Socio-economic impact of sustainable energy
- Sustainable energy related STEM project such as but not limited to:

Solar cooker-heater Windmill
Solar vehicle Solar greenhouse

Resources:

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Struggling Learners	• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Chunk Assignments • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. Prepare materials at varying levels of ability
English Language Learners	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class
Learners with an IEP	Each special education student has an Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process, or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that

	can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: Students will be making connections to Math (measuring, fractions, decimal conversions), Health (safety), Digital Literacy (computer software) and ELA (design loop paperwork)

Integration of 21st Century Skills

Indicators:

1. Critical thinking
2. Communication skills
3. Creativity
4. Problem solving
5. Perseverance
6. Collaboration
7. Information literacy
8. Technology skills and digital literacy
9. Media literacy
10. Global awareness
11. Self-direction
12. Social skills
13. Literacy skills
14. Civic literacy
15. Social responsibility
16. Innovation skills
17. Thinking skills