Kingsway Regional School District

Committed to Excellence

Course Name: CAD II	**Grade Level(s): 9-12**
Department: Technology Department	**Credits: 5**
BOE Adoption Date: October 22, 2015	**Revision Date(s):**

ABSTRACT

This is an intermediate level course that builds upon the foundation of CAD I. The focus of CAD II is on further developing students' knowledge and understanding of the fundamentals of Engineering and Architecture, and to better prepare them for college courses in these fields of study. CAD II also introduces Digital and Analog Electronics along with robotics-focused design projects. Students will hone their design skills by using the Industry Standard AutoCAD Software suite and available classroom technology including a MakerBot 3D printer, 3D Digitizer/Scanner, VEX Robotics kits, Orbotix Spheros, and professional Modeling Foam Board. Students are introduced and have access to professionals from different branches of Engineering and Architecture throughout the year. Students must successfully pass CAD I in order to apply for this course.

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Mission Statement

The Kingsway Regional School District believes that this school district is responsible for developing and maintaining a comprehensive educational program that will foster the academic, social, and personal growth of all students. The Kingsway Regional School District provides a secure, supportive environment. It also provides high quality resources to challenge and empower each individual to pursue his/her potential, to develop a passion for learning in a diverse and challenging world, to encourage active citizenship, and to reach a high standard of achievement at all grade levels as defined by the New Jersey Student Learning Standards (NJSLS).

Curriculum & Instruction Goals

To ensure the District continues to work toward its mission of excellence in G.R.E.A.T. Instruction, the following curriculum and instruction goals direct the conversation:

Goal(s):

1. To ensure students are college and career ready upon graduation
2. To vertically and horizontally align curriculum K-12 to ensure successful transition of students at each grade level
3. To identify individual student strengths and weaknesses utilizing various assessment measures (formative, summative, alternative, etc.) so as to differentiate instruction while meeting the rigor of the applicable content standards
4. To improve student achievement as assessed through multiple measures including, but not limited to, state testing, local assessments, and ongoing progress monitoring

How to Read this Document

This curricular document contains both *pacing guides* and *curriculum units*. The pacing guides serve to communicate an estimated timeframe as to *when* skills and topics will be taught throughout the year. The pacing, however, may differ slightly depending upon the unique needs of each learner. The *curriculum units* contain more detailed information as to the content, goals, and objectives of the course well as how students will be assessed. The terms and definitions below will assist the reader to better understand the sections and components of this curriculum document.

Terms to Know

1. **Accommodation(s):** ***Accommodations*** are adaptations that do not alter the learning goal or standards being measured; accommodations can be for all students.

2. **Differentiated Instruction (DI):** The idea of differentiating instruction to accommodate the different ways that students learn involves a hefty dose of common sense, as well as sturdy support in the theory and research of education (Tomlinson & Allan, 2000). It is an approach to teaching that advocates active planning for student differences in classrooms. Teachers can differentiate content, process, product, or environment. DI can be done according to students' readiness, interest, or learning profile.

3. **Enduring Understanding:** Enduring understandings (aka big ideas) are statements of understanding that articulate deep conceptual understandings at the heart of each content area. Enduring understandings are noted in the alongside essential questions within each unit in this document.

4. **Essential Question:** These are questions whose purpose is to stimulate thought, to provoke inquiry, and to spark more questions. They extend beyond a single lesson or unit. Essential questions are noted in the beginning of each unit in this document.

5. **Formative Assessments:** Formative assessments monitor student learning to provide ongoing feedback that can be used by (1) instructors to improve teaching and (2) by students to improve their learning. Formative assessments help identify students' strengths and weaknesses and address problems immediately.

6. **Learning Activity(s):** Learning activities are those activities that take place in the classroom for which the teacher facilitates and the students participate in to ensure active engagement in the learning process. (Robert J. Marzano, *The Art and Science of Teaching*)

7. **Learning Assignment(s):** Learning assignments are those activities that take place independently by the student inside the classroom or outside the classroom (i.e. homework) to extend concepts and skills within a lesson.

8. **Learning Goal(s):** Learning goals are broad statements that note what students "should know" and/or "be able to do" as they progress through a unit. Learning goals correlate specifically to the NJSLS noted within each unit.

9. **Learning Objective(s):** Learning objectives are more specific skills and concepts that students must achieve as they progress towards the broader learning goal. These are included within each unit and are assessed frequently by the teacher to ensure students are progressing appropriately.

10. **Modification(s):** ***Modifications*** are adaptations that alter the learning goals and grade-level standards. Modifications are warranted when the learner has significant needs that impede his or her ability to access grade-level concepts. They are most appropriate for appropriate some students with IEPs and some English Language Learners.

11. **Performance Assessments: (**aka alternative or authentic assessments) Performance assessments are a form of assessment that requires students to perform tasks that generate a more authentic evaluation of a student's knowledge, skills, and abilities. Performance assessments stress the application of knowledge and extend beyond traditional assessments (i.e. multiple-choice question, matching, true & false, etc.).

12. **Standards:** Academic standards, from which the curriculum is built, are statements that of what students "should know" or "be able to do" upon completion of a grade-level or course of study. Educational standards help teachers ensure their students have the skills and knowledge they need to be successful by providing clear goals for student learning.

    - **State:** The New Jersey Student Learning Standards (NJSLSs) include Preschool Teaching and Learning Standards as well as K-12 standards for: *Visual and Performing Arts; Comprehensive Health and Physical Education; Science; Social Studies; World Languages; Technology; 21st-Century Life and Careers; Language Arts Literacy; and, Mathematics*

13. **Summative Assessments:** Summative assessments evaluate student learning at the end of an instructional time period by comparing it against some standard or benchmark. Information from summative assessments can be used formatively when students or faculty use it to guide their efforts and activities in subsequent courses.
14. **21st Century Skills & Themes:** These elements emphasize the growing need to focus on skills that prepare students to successfully compete in a global environment by focusing on the following: learning and innovation skills; information, media and technology skills; and life and career skills. These concepts are embedded in each unit of the curriculum.

Proficiencies and Pacing:
Course Title: CAD II
Prerequisite(s): Introduction to CAD (CAD I)

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
Unit 1: Engineering Design Process/Class Safety	5 Weeks Sept. 1st – October 9th	**Subject Area:** 8.1.12.B.1 8.1.12.F.2 8.1.12.D.2 8.2.12.C.3 8.2.12.F.3 **Interdisciplinary:** 9.2.12.A.1 9.1.4.F.3 9.1.4.F.1 9.4.12A.16	• Students will be able to identify Machines/Tools in the classroom. • Students will be able to demonstrate proper technique when using machines/tools in classroom. • Students will be able to demonstrate the ability to achieve a higher accuracy of measurement and dimension. • Students will be able to demonstrate and properly utilize the 10 steps of the Design Process. • Students will be able to demonstrate their mastery over basic Inventor 3D modeling skills. • Students will reverse engineer a consumer product to its basic parts. • Students will innovate a current consumer product. • Students will conduct a survey and analyze the results to achive a valid conclusion.	• Classroom Safety • Proper Tool and Machine Usage • Design Differences: Industrial, Graphic, Fashion, Cinematic, etc. • Careers • Utilizing A360 Cloud Sharing Utility in AutoCAD • Using the 10 Step Design Loop/Process • Inventions vs. Innovations • Reverse Engineering • Product Development • Product Marketing • http://bridgecontest.org/ • Building and Material Costs • Time Management • AutoCAD Inventor Review • Parts, Assemblies, and Drawings • Social Collaboration and Crowdsourcing • Google Forms • Patents and Law • Dyson Foundation

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
Unit 2: Advanced Engineering Principles – Hydro-, Fluid-, and Aerodynamics	4 Weeks Oct. 12th – Nov. 13th	**Subject Area:** 8.1.12.C.1 8.2.12.B.1 8.2.12.B.3 8.2.12.C.3 8.2.12.F.3 **Interdisciplinary:** 9.4.12.B.(1).9 9.4.12.B.4 9.4.12.B.75	• Students will determine and understand the relationship between Fluid- and Aerodynamics. • Students will understand the uses and differences between analog and digital inputs by flying a robotic drone. • Students will be able to utilize Inventor to test a design when applying specific forces in a virtual environment. • Students will learn the value of testing their designs in the real world as well as virtual. • Students will be be able to identify, utilize, and define the trajectory of an object.	• Fluid-dynamics and Bernoulli's Principle • Differences between Hydro- and Fluid-Dynamics • From boats to planes • Pitch, Yaw, and Rotation • Propeller Design • Difference between Gliders, Airplanes, Jets, and Rockets • Drag and how that relates to the Coefficient of Friction • Using a Joystick vs. an Accelerometer (Analog vs. Digital Inputs) • Material selection and testing in Inventor • 3D Masking Scale • Interpreting and comparing virtual results to real world outcomes
Unit 3: Analog and Digital Electronics	6 Weeks Nov. 9th – Dec. 23rd	**Subject Area:** 8.2.12.F.3 8.1.12.C.1 8.2.12.B.1 8.2.12.C.3 **Interdisciplinary:** 9.4.12.B.75 9.4.12.B.74 9.4.12B.24	• Students will be able to understand and define the differences between Analog and Digital Electronics. • Students will be able to properly construct an analog electrical circuit. • Students will be able to properly read and create an electrical schematic. • Students will be able to properly identify electrical requirements of equipment	• Analog vs. Digital Electronics • AC/DC – Edison and Tesla • "Fathers" of Innovation • The uses of binary • Using Code • Hour of Code • OHM's Law • Current, Amperage, Amplitude, Resistance, and Voltage • iCircuit • ANSI, IEEE, and ISO organizations and standards

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
			through the use of ANSI Symbol Standards. • Students will be able to apply OHM's Law in order to identify and repair a damaged circuit. • Students will integrate an LED into an existing product's electrical system. • Students will be able to properly design a part in Inventor to integrate an electrical system. • Students will be able to determine the overall economic, societal, and environmental impact of renewable energy sources. • Students will learn the value of properly debating a topic.	• LEDs vs. other light sources • Using resistance to change colors • Switches and Binary (1 or 0) • Soldering techniques and safety • Proper wiring techniques • Self contained battery powered Holiday Part • Complete the train • ELECTRICITY • Renewable, Non-Renewable, and Re-Usable resources • Fracking • HS NJTEA Debate Fomat
Unit 4: Advanced AutoDesk Inventor Techniques	6 Weeks Jan. 4th – Feb. 12th	**Subject Area:** 8.1.12.C.1 8.2.12.B.1 8.2.12.C.3 8.2.12.F.3 **Interdisciplinary:** 9.4.12A.19 9.4.12A.47 9.4.12.B.(1).5 9.4.12.B.(1).11	• Students will be able to properly design irregular shapes in order to be printed out correctly. • Students will complete a puzzle by designing and printing out the missing piece. • Students will learn to collaborate effectively in order to problem solve. • Students will develop fine motor and dimensioning skills by perfectly replicating a	• Glassware and other delicate non-standard items • Utilizing more advanced 3D Sketching and Form tools (Sweep, Revolve, Loft, etc.) • Hand Blown vs. Hand Drawn • Creating an interlocking assembly - Puzzle • Playing "Operator" to Design a Part or Assembly • Bringing a 2D Isometric drawing to life • Art and Engineering

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
			rendered assembly in the real world. • Students will design a puzzle to test certain cognitive abilities in fellow classmates. • Students will properly utilize the 3D Digitizer in order to import a complicated part that they will change or fix within Inventor. • Students will properly integrate 3rd party apps and Digital devices to create personalized designs.	• Proper finishing of part including sanding, painting, and Modeling • Using AutoDesk ReCap to create a 3D image from multiple 2D camera shots • Integrating mobile devices into design management and collaboration • Re-creating a missing "thing"
Unit 5: Robotics	8 Weeks Feb. 15th – Apr. 8th	**Subject Area:** 8.2.12.D.1 8.2.12.G.1 **Interdisciplinary:** 9.4.12.B.75 9.4.12.B.74 9.4.12B.21	• Students will understand the essential relationship between Digital Electronics and Robotics. • Students will learn how to properly design a test in order to obtain valid and usable results to influence their designs. • Students will properly communicate in order to complete a series of tasks that restrict certain senses. • Students will properly design a system of integrated parts and assemblies that achieves the highest level of efficiency from itself.	• Gears, Cams, and Simple machines • The power of hydraulics • Getting different robotic assemblies to work and communicate with eachother • RobotC programming language • VEX Robotics • Designing and printing parts for Bebop Drone, Sphero, and VEX kits • Siege Artillery – Determining trajectory (Pumkin Chunkin) • Overcoming physical and behaivioral dissabilities • Molding and Casting

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
			• Students will design, build, and program a robot to perform a given task. • Students will be able to utilize different programming languages to achieve similar results among differing platforms.	
Unit 6: Architecture	10 Weeks Apr. 11th – June 13th	**Subject Area:** 8.2.12.E.1 8.2.12.F.2 8.2.12.C.2 8.1.12.A.1 **Interdisciplinary:** 9.4.12B.28 9.4.12.B.(1).10	• Students will identify major trends through Stone, Bronze, and Iron Ages. • Students will be able to identify key design and engineering concepts utilized in the ancient Egyptian, Mayan, Greek, Roman, Hindu, and Chinese cultures. • Students will understand the significance of "7 Wonders". • Students will be able to relate more modern architectural designs to those they were derived from. • Students will understand Architecture's delicate balance between Engineering and Art. • Students will demonstrate their understanding of the relationship between space, flow, and arrangement through the use of a floor plan. • Students will develop their understanding of Spatial	• Google SketchUp and Layout • AutoDesk Revit • Creating scale models and additions in foam core • Creating a Virtual Tour • Old vs. New and their influences on history and the world • How Zoning, Taxation, and the law influences design • Carefully blending Architectural Design and Engineering Design • The "ZEN" of a good floor plan • Building Codes and requirements • Using mobile devices to survey an area • How Drones and Robots can go where we can't • Adapting designs to those with different needs and abilities

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
			Awareness through the use of robotics. • Students will learn the basic tools and abilities of 3D Architectrual software and how it is used in today's designs. • Students will be able to modify and adapt current designs to better suit future or alternative needs. • Students will be able to construct exact to scale models of existing designs. • Students will learn the value of weaving physical models and virtual ones together in order to increase chances of winning a contract.	• Man vs. Nature – Protection from Acts of God • Environmental Engineering • Bidding for a contract • Integration of modern and classic styles • Frank Lloyd Wright • Designing for different purposes – Art, Residential, Commercial, etc. • TreeHouse Masters

Unit 1: Engineering Design Process/ Class Safety	Recommended Duration: 5 Weeks

Unit Description:
This unit will first cover Student Safety for use of all machines and tools within the classroom. Students will be given a scenario in which they must "Design" their way through a problem testing their previous knowledge from Intro to CAD and now these new elements within the room. They will then Reverse Engineer a commercial product they use frequently down to its basic parts in order to improve upon it. Students will then fol low through the 10 Step Design Process in order to design, develop, test, and market a product that can be an Invention or Innovation.

Essential Questions:	Enduring Understandings:
1. Why are safety precautions important in the workplace? 2. How does the Design Process affect productivity? 3. How does Inventor improve your design? 4. Why is it necessary to know the law?	1. The Engineering Design Process allows an individual to maximize efficiency, productivity, and creativity.

Relevant Standards:	Learning Goals:	Learning Objectives:
Content Standards: **Primary(Power):** 8.2.8.A.1 8.2.8.A.2 8.2.12.A.1 8.2.12.A.3 9.2.12.A.1	1. Students will be able to demonstrate proper technique when using machines/tools in classroom. 2. Students will be able to demonstrate the ability to achieve a higher accuracy of measurement and dimension. 3. Students will be able to demonstrate and properly utilize the 10 steps of the Design Process.	1. Students will be able to identify Machines/Tools in the classroom. 2. Students will be able to demonstrate proper technique when using machines/tools in classroom. 3. Students will be able to define and utilize the 10 step Design Process. 4. Students will be able to use Inventor in order to maximize efficiency. 5. Students will be able to design and devlop a

Secondary(Supportive): 9.1.4.F.3 9.1.4.F.1	4. Students will be able to demonstrate their mastery over basic Inventor 3D modeling skills. 5. Students will reverse engineer a consumer product to its basic parts. 6. Students will innovate a current consumer product. 7. Students will conduct a survey and analyze the results to achive a valid conclusion.	product. **6.** Students will be able to define the difference between Invention and Innovation.

Formative Assessments	**Summative Assessments:**	**Performance Assessments:**	**Major Activities/ Assignments (required):**
- Guided Notes - Engineering Journal - Class Participation - Quizzes	- Design Challenge Reflections	- Prior Knowledge Pre-Assessment - Bridge Designer Competition	- Zombie Escape - Invention/Innovation

Possible Assessment Modifications /Accommodations:

Graded or assessed using appropriate alternative standard, submit answers, responses, and assignments in alternative forms (e.g. electronically, orally, audio visually recorded, or hand written), allow for extra time to complete work, change assignment or project based on ability, utilize a different grading scale, use self-assessment or create individual rubric.

Instructional Strategies (refer to *Robert Marzano's* 41 Elements):

Modeling
Cooperative Learning
Summarizing and Notetaking
Guided and Independent Practice
Cooperative Learning
Reinforcing effort and providing feedback
Cues, questions, and advance organizers (KWL chart)
Monitoring
Scaffolding

Possible Instructional Modifications /Accommodations/Differentiation:

Record lecture audio, change screen and computer settings (Changed back after class), assigned seating, take breaks, listen to music, be given all outlines and worksheets prior to lesson, and allow to work alone or within a specific group.

Unit Vocabulary:
Essential/Non-Essential: **Design Process** – A set of steps that act as a guide in the development of a product or system that maximizes creativity, efficieny, and productivity. **CAD (Computer Aided Design) –** used for detailed engineering of 3D models and/or 2D drawings of physical components, but it is also used throughout the engineering process from conceptual design and layout of products, through strength and dynamic analysis of assemblies to **definition** of manufacturing methods of components. **Design –** a plan or drawing produced to show the look and function or workings of a building, garment, or other object before it is built or made. **Engineering -** the branch of science and technology concerned with the design, building, and use of engines, machines, and structures. **Patent -** a government authority or license conferring a right or title for a set period, especially the sole right to exclude others from making, using, or selling an invention.

Interdisciplinary Connections (Applicable Standards):	**Integration of Technology:**	**21st Century Themes:**	**21st Century Skills:**
Technology: 8.1.12.B.1 8.1.12.F.2 **21st Century Life and Careers:** 9.2.12.A.1 9.1.4.F.3 9.1.4.F.1	Technology: - Computers – Used for research and completing assignments - Smartboard – Used for presentations and demonstrations - 3D Printer – Used for demonstration	____ Global Awareness __x__ Civic Literacy __x__ Financial, Economic, Business, & Entrepreneurial Literacy ____ Health Literacy	__x__ Creativity & Innovation __x__ Media Literacy __x__ Critical Thinking and Problem Solving __x__ Life and Career Skills __x__ Information & Communication Technologies Literacy __x__ Communication & Collaboration __x__ Information Literacy

Resources:
Texts/Materials: - Guided Notes - TopGear Videos - Shark Tank - Presentation/Slide Show - Prototyped Parts/Examples **Major Assignments (required):** - Design Challenge Reflections - Written Review of Unit (Guided Notes) **Major Activities (required):** - Invention/Innovation - Zombie Escape - Bridge Designer Competition

Unit 2: Advanced Engineering Principles – Hydro, Fluid, and Aerodynamics	Recommended Duration: [4 Weeks]

Unit Description:

This unit will expand on the students' previous understanding of basic engineering concepts such as Stress/Strain, Forces, etc. by scaffolding in higher level physics and math concepts such as Fluid Dynamics and the relationship between Bernoulli's Principle and flight. Students will utilize the virtual testing environment of Autodesk Inventor and other 3rd party AutoDesk mobile apps to discover computational fluid dynamic relevances and test those against real world results. Students will also develop flight skills through the utilization of the Parrot Bebop Drone.

Essential Questions:	Enduring Understandings:
1. How are Fluid Dynamics and Flight related? 2. How does a virtual test compare to a real world test? 3. How do Analog and Digital inputs/outputs compare to one another? 4. What is the value of testing a design?	1. Understanding the relationship between theoretical outcomes and reality is necessary to achieve the highest level of accuracy.

Relevant Standards:	Learning Goals:	Learning Objectives:
Content Standards: **Primary(Power):** 8.2.12.E.1 8.2.8.E.2 **Secondary (Supportive):** 8.2.12.F.3 9.4.12A.16	1. Students will determine and understand the relationship between Fluid- and Aerodynamics. 2. Students will understand the uses and differences between analog and digital inputs by flying a robotic drone. 3. Students will be able to utilize Inventor to test a design when applying specific forces in a virtual environment. 4. Students will learn the value of testing their designs in the real world as well as virtual. 5. Students will be be able to identify, utilize, and define the trajectory of an object.	1. Students will be able to relate previous knowledge of applied forces to fluid dynamics, drag, and flight. 2. Students will develop fine motor skills and hand eye coordination through using a joystick and/or digital inputs such as accelerometers. 3. Students will understand and utilize the concept of flight and how it relates to future human endeavors. 4. Students will be able to apply forces and test designs virtually. **5.** Students will develop a better sense of not controlling all variables in the real world.

Formative Assessments	Summative Assessments:	Performance Assessments:	Major Activities/ Assignments (required):
- Guided Notes - Engineering Journal - Class Participation - Quizzes	- Design Challenge Reflection - Design Challenge Rubric	- Propeller Design - Material/Design Test and Results	- Bottle Rocket - Flight Plan

Possible Assessment Modifications /Accommodations:

Graded or assessed using appropriate alternative standard, submit answers, responses, and assignments in alternative forms (e.g. electronically, orally, audio visually recorded, or hand written), allow for extra time to complete work, change assignment or project based on ability, utilize a different grading scale, use self-assessment or create individual rubric.

Instructional Strategies (refer to *Robert Marzano's* 41 Elements):

Modeling
Cooperative Learning
Summarizing and Notetaking
Guided and Independent Practice
Cooperative Learning
Reinforcing effort and providing feedback
Cues, questions, and advance organizers (KWL chart)
Monitoring
Scaffolding

Possible Instructional Modifications /Accommodations/Differentiation:

Record lecture audio, change screen and computer settings (Changed back after class), assigned seating, take breaks, listen to music, be given all outlines and worksheets prior to lesson, and allow to work alone or within a specific group.

Unit Vocabulary:

Bernoulli's Principle – states that for an inviscid flow, an increase in the speed of the fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy
Pitch – Angle of leading edge, or attack, of a shape
Analog – Direct or Indirect physical input into a system
Digital – A programmed or coded input into a system
Coefficient of Friction – the ratio between the force necessary to move one surface horizontally over another and the pressure between the two surfaces.

Interdisciplinary Connections (Applicable Standards):	**Integration of Technology:**	**21st Century Themes:**	**21st Century Skills:**
Technology: 8.1.12.D.2 8.2.12.C.3 8.2.12.F.3 **21st Century Life and Careers:** 9.4.12.16	Technology: - Computer: Research and Bridge Design Program - Smartboard – Presentation - 3D Printer – Demonstration - Drone - Water Table	____ Global Awareness ____ Civic Literacy __x__ Financial, Economic, Business, & Entrepreneurial Literacy ____ Health Literacy	__x__ Creativity & Innovation ____ Media Literacy __x__ Critical Thinking and Problem Solving ____ Life and Career Skills __x__ Information & Communication Technologies Literacy __x__ Communication & Collaboration __x__ Information Literacy
Resources:			
Texts/Materials: - Guided Notes - TopGear Videos - Presentation/Slide Show **Major Assignments (required):** - Bottle Rocket - Flight Plan - Paper Airplane Design **Major Activities (required):** - Bottle Rocket Challenge - Paper Airplane Challenge			

Unit 3: Analog and Digital Electronics	Recommended Duration: 6 Weeks

Unit Description:
This unit will build on the previous unit's introduction of Analog and Digital inputs, but also integrating that into electronic circuits. Students will understand the fundamentals of electricity and its uses in today's society by using OHM's Law to build, diagnose, and repair electronic circuits. Students will learn proper wiring and soldering techniques and how to integrate a circuit into a design virtually using Inventor and iCircuit and also produce a part that includes a power source and a switch to turn on an LED. Students will also research about different energy sources and their impact on the world and the human race through the use of an NJTEEA formatted debate.

Essential Questions:	Enduring Understandings:
1. What is electricity and how is it useful? 2. How do you judge the effectiveness of a power source? 3. What is the relationship between On/Off? 4. What is the value of understanding a differing opinion?	1. Understanding the role energy plays within a system is critical to determining that system's efficiency and viability.

Relevant Standards:	Learning Goals:	Learning Objectives:
Content Standards: **Primary(Power):** 9.4.12.B.75 9.4.12.B.(1).9 **Secondary(Supportive):** 9.4.12.B.4	1. Students will be able to understand and define the differences between Analog and Digital Electronics. 2. Students will be able to properly construct an analog electrical circuit. 3. Students will be able to properly read and create an electrical schematic. 4. Students will be able to properly identify electrical requirements of equipment through the use of ANSI Symbol Standards. 5. Students will be able to apply OHM's Law in order to identify and repair a damaged circuit 6. Students will integrate an LED into an existing product's electrical system. 7. Students will be able to properly design a part in Inventor to integrate an electrical system.	1. Students will understand the significance of business driving innovation and invention at the beginning of the 20th century. 2. Students will be able to read electrical schematics and circuit diagrams in order to re-create or diagnose an electrical system properly and safely. 3. Students will be able to determine the specific energy requirements of a system. 4. Students will be able to create designs virtually that are assemblies of differing systems AND parts. 5. Students will learn the usefulness of coding for digital electronics to carry out a process more efficiently. 6. Students will learn how to correctly wire up a design using a soldering iron. **7.** Students will create a unique part that integrates

	8. Students will be able to determine the overall economic, societal, and environmental impact of renewable energy sources. 9. Students will learn the value of properly debating a topic.	an analog electrical circuit to perform a task involving light emmited from an LED.

Formative Assessments	**Summative Assessments:**	**Performance Assessments:**	**Major Activities/ Assignments (required):**
- Guided Notes - Engineering Journal - Class Participation - Quizzes	- Design Challenge Reflection - Design Challenge Rubric	- NJTEEA Debate - LED wiring of part - Role playing	- History Write-Up - Circuit Schematic - Hour of Code - Debate - Holiday LED Part - Toy Train Repair

Possible Assessment Modifications /Accommodations:

Get graded or assessed using appropriate alternative standard, submit answers, responses, and assignments in alternative forms (e.g. electronically, orally, audio visually recorded, or hand written), allow for extra time to complete work, change assignment or project based on ability, utilize a different grading scale, use self-assessment or create individual rubric.

Instructional Strategies (refer to *Robert Marzano's* 41 Elements):

Modeling
Cooperative Learning
Summarizing and Notetaking
Guided and Independent Practice
Cooperative Learning
Reinforcing effort and providing feedback

Cues, questions, and advance organizers (KWL chart)
Monitoring
Scaffolding

Possible Instructional Modifications /Accommodations/Differentiation:

Record lecture audio, change screen and computer settings (Changed back after class), assigned seating, take breaks, listen to music, be given all outlines and worksheets prior to lesson, and allow to work alone or within a specific group.

Unit Vocabulary:

Alternating Current (AC) – an electric current that reverses its direction many times a second at regular intervals, typically used in power supplies.
Direct Current (DC) – an electric current flowing in one direction only.
OHM's Law - the current through a conductor between two points is directly proportional to the potential difference across the two points. **V= I/R**
LED – Light Emitting Diode

Interdisciplinary Connections (Applicable Standards):	**Integration of Technology:**	**21st Century Themes:**	**21st Century Skills:**
21st Century Life and Careers: 9.4.12.B.(1).9 9.4.12.B.4 9.4.12.B.75	Technology: Computer – Research and Design. Smartboard – Presentation LED, resistor, switch, and wire 3D Printer Multimeter	__x__ Global Awareness __x__ Civic Literacy __x__ Financial, Economic, Business, & Entrepreneurial Literacy __x__ Health Literacy	__x__ Creativity & Innovation __x__ Media Literacy __x__ Critical Thinking and Problem Solving __x__ Life and Career Skills __x__ Information & Communication Technologies Literacy __x__ Communication & Collaboration __x__ Information Literacy

Resources:
Text/Materials: - Guided Notes - Science of Stupid Video - Myth Busters Video - Presentation/Slideshow - NJTEEA Debate Rubric **Major Assignments (required):** - Debate Rubric - iCircuit Schematic - History Write Up **Major Activities (required):** - Hour of Code - Debate - Holiday LED Part - Toy Train Repair

Unit 4: Advanced AutoDesk Inventor Techniques	Recommended Duration: 6 Weeks

Unit Description:
This unit will further enhance a student's ability to utilize Inventors many hidden components and how to incorporate them across a wide range of other AutoDesk software titles, 3rd party apps and applications, and utilizing different digital inputs to gather data. Students will begin by focusing on creating items with irregular shapes and then creating parts to solve puzzles and fill in the missing gaps of a given system. Students will also continue to fine tune their finishing abilities of a properly printed out design with painting and shaping.

Essential Questions:	Enduring Understandings:
1. Why is it necessary to have programs work with one another? 2. Why do you "finish" a completed design? 3. How does a computer generate a naturally occurring design? 4. How can perfection be imperfect?	1. Computers are only tools that can be used to create perfect designs based on input from an imperfect user.

Relevant Standards:	Learning Goals:	Learning Objectives:
Content Standards: **Primary(Power):** 8.2.12.F.3 8.1.12.C.1 8.2.12.B.1 8.2.12.C.3 **Secondary(Supportive):** 9.4.12.B.75 9.4.12.B.74 9.4.12B.24	1. Students will be able to properly design irregular shapes in order to be printed out correctly. 2. Students will complete a puzzle by designing and printing out the missing piece. 3. Students will learn to collaborate effectively in order to problem solve. 4. Students will develop fine motor and dimensioning skills by perfectly replicating a rendered assembly in the real world. 5. Students will design a puzzle to test certain cognitive abilities in fellow classmates. 6. Students will properly utilize the 3D Digitizer in order to import a complicated part that they will change or fix within Inventor.	1. Students will be able to utilize Sweep, Revolve and Loft to created objects with varying curved surfaces. 2. Students will utilize mobile devices to capture data that is then used as an input for a program to create a design. 3. Students will learn the value of having an imperfect design and how that relates to artistic perspective. 4. Students will create and complete puzzles to communicate with one another and test cognitive abilities. 5. Students will further develop fine motor skills by properly finishing a part or assembly with shaping tools, primer, and paint. 6. Students will generate an image of themselves and

	7. Students will properly integrate 3rd party apps and Digital devices to create personalized designs.	then modify it combining AutoDesk ReCap and Inventor. 7. Students will create a 3D object from a 2D source: Schematic, Isometric Drawing, or Picture. **8.** Students will test variances between more delicate materials virtually.

Formative Assessments	**Summative Assessments:**	**Performance Assessments:**	**Major Activities/ Assignments (required):**
- Guided Notes - Engineering Journal - Class Participation - Quizzes	- Design Challenge Reflection - Design Challenge Rubric	- Use of Inventor/ReCap Software - Use of Digital Equipment - Finishing of Design	- Glass Reproduction - Puzzle Piece - Operator/Musical Chairs Design Challenge - Personalized Bobblehead - What's the Missing Piece Design Challenge

Possible Assessment Modifications /Accommodations:

Graded or assessed using appropriate alternative standard, submit answers, responses, and assignments in alternative forms (e.g. electronically, orally, audio visually recorded, or hand written), allow for extra time to complete work, change assignment or project based on ability, utilize a different grading scale, use self-assessment or create individual rubric.

Instructional Strategies (refer to *Robert Marzano's* 41 Elements):

Modeling
Cooperative Learning
Summarizing and Notetaking
Guided and Independent Practice
Cooperative Learning
Reinforcing effort and providing feedback
Cues, questions, and advance organizers (KWL chart)
Monitoring
Scaffolding

Possible Instructional Modifications /Accommodations/Differentiation:

Record lecture audio, change screen and computer settings (Changed back after class), assigned seating, take breaks, listen to music, be given all outlines and worksheets prior to lesson, and allow to work alone or within a specific group.

Unit Vocabulary:

Menu - a list of commands or options, especially one displayed on screen.
Plane - a flat surface on which a straight line joining any two points on it would wholly lie.
Blueprint - a design plan or other technical drawing.
Schematic - a schematic diagram, in particular of an electric or electronic circuit.

Interdisciplinary Connections (Applicable Standards):	**Integration of Technology:**	**21st Century Themes:**	**21st Century Skills:**
Technology: 8.2.12.F.3 **21st Century Life and Careers:** 9.4.12B.5 9.4.12.B.75 9.4.12.B.74	Technology: - Computer: Working with Inventor and electronic communication - Smartboard Presentations - Plotter: Demonstration and Printing - Mobile Devices – Camera Capture - 3D Digitizer/Scanner - Dremel Workstations	____ Global Awareness ____ Civic Literacy ____ Financial, Economic, Business, & Entrepreneurial Literacy ____ Health Literacy	__x__ Creativity & Innovation ____ Media Literacy __x__ Critical Thinking and Problem Solving __x__ Life and Career Skills __x__ Information & Communication Technologies Literacy __x__ Communication & Collaboration __x__ Information Literacy

Resources:

Texts/Materials:

- Guided Notes
- Presentation/Slideshow
- TopGear Video – What is Art?
- Drawings

Major Assignments (required):

- Puzzle Piece
- Missing Piece Design
- Finished Part/Assembly
- Glass Reproduction

Major Activities (required):

- Operator/Musical Chairs Design Challenge
- Personalized Bobblehead
- Solve the Puzzle

Unit 5: Robotics	Recommended Duration: 8 Weeks

Unit Description:
Students will further develop their understanding of Digital Electronics and how they relate to the first Automata. Students will utilize the SPHEROs, Parrot Drone, and VEX robotic kits to carry out specific tasks and work together in a single system. Students will build upon their Hour of Code knowledge by using RobotC and other programming languages to automate robotic tasks. Students will print out and design gears and cams to improve the efficiency of these different robots to pass student created tests. Students will then relate their findings and develop a system for assisiting others with physical, emotional, mental, and behaivioral handicaps.

Essential Questions:	Enduring Understandings:
1. What is a Robot? 2. How do you integrate analog and digital inputs into a system to work together? 3. What language do digital electronics speak? 4. What is the advantage of having a dissability?	1. Robots are controlled by coded inputs to automatically carry out a specific task designed by the user.

Relevant Standards:	Learning Goals:	Learning Objectives:
Content Standards: **Primary(Power):** 8.2.12.D.1 8.2.12.E.1 8.2.12.E.2 8.2.12.E.3 8.2.12.B.1 9.4.12A.19 **Secondary(Supportive):** 8.2.12.C.3	1. Students will understand the essential relationship between Digital Electronics and Robotics 2. Students will learn how to properly design a test in order to obtain valid and usable results to influence their designs 3. Students will properly communicate in order to complete a series of tasks that restrict certain senses 4. Students will properly design a system of integrated parts and assemblies that achieves the highest level of efficiency from itself. 5. Students will design, build, and program a robot to perform a given task.	1. Students will understand the development of robotics from the very first Automata up until current technology. 2. Students will combine analog and digital inputs/outputs within a system. 3. Students will design and print out cams and gears to increase the efficiency of a robot to perform a specific task. 4. Students will learn about Siege artillery and how those developed some of the first automated systems in the world. 5. Students will create a challenge that requires the use and collaboration of different robots that communicate using different languages. 6. Students will design and develop a part that assists

8.2.12.F.3 9.4.12A.47 9.4.12.B.(1).5 9.4.12.B.(1).11	6. Students will be able to utilize different programming languages to achieve similar results among differing platforms.	those with a physical handicap. 7. Students will develop a code to allow a robot to perform a task automatically.

Formative Assessments	**Summative Assessments:**	**Performance Assessments:**	**Major Activities/ Assignments (required):**
- Guided Notes - Engineering Journal - Class Participation - Quizzes	- Design Challenge Reflection - Design Challenge Rubric	- Robot Testing Design Challenge - Utilization of Inventor and RobotC - Piloting of robot	- Siege Artillery - Cam and Gear Production - Testing Design Challenge - Robot Code - Handicap Design

Possible Assessment Modifications /Accommodations:

Graded or assessed using appropriate alternative standard, submit answers, responses, and assignments in alternative forms (e.g. electronically, orally, audio visually recorded, or hand written), allow for extra time to complete work, change assignment or project based on ability, utilize a different grading scale, use self-assessment or create individual rubric.

Instructional Strategies (refer to *Robert Marzano's* 41 Elements):

Modeling
Cooperative Learning
Summarizing and Notetaking
Guided and Independent Practice
Cooperative Learning
Reinforcing effort and providing feedback
Cues, questions, and advance organizers (KWL chart)
Monitoring
Scaffolding

Possible Instructional Modifications /Accommodations/Differentiation:

Record lecture audio, change screen and computer settings (Changed back after class), assigned seating, take breaks, listen to music, be given all outlines and worksheets prior to lesson, and allow to work alone or within a specific group.

Unit Vocabulary:			
Robot - a machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer. **Gear -** one of a set of toothed wheels that work together to alter the relation between the speed of a driving mechanism (such as the engine of a vehicle or the crank of a bicycle) and the speed of the driven parts (the wheels). **Disability –** a physical or mental condition that limits a person's movements, senses, or activities. **Test –** a procedure intended to establish the quality, performance, or reliability of something, especially before it is taken into widespread use.			
Interdisciplinary Connections (Applicable Standards):	**Integration of Technology:**	**21st Century Themes:**	**21st Century Skills:**
Technology: 8.2.12.F.3 **21st Century Life and Careers:** 9.4.12A.19 9.4.12A.47 9.4.12.B.(1).5 9.4.12.B.(1).11	Technology: - Computer – Inventor and RobotC - Mobile Computing Device – Remote Controller - Smartboard – Presentation - Drone, VEX Kit, and SPHERO – robotics demonstrations	____ Global Awareness __x__ Civic Literacy ____ Financial, Economic, Business, & Entrepreneurial Literacy __x__ Health Literacy	__x__ Creativity & Innovation ____ Media Literacy __x__ Critical Thinking and Problem Solving __x__ Life and Career Skills __x__ Information & Communication Technologies Literacy __x__ Communication & Collaboration __x__ Information Literacy
Resources:			
Texts/Materials: - Presentation/Slideshow - Guided Notes - TopGear Video - PumpkinChunkin Video - Robotics Kits - Molding/Casting Supplies			

- RobotC

Major Assignments (required):

- Disability Design
- Gear/Cam Design
- Robot Code

Major Activities (required):

- Robotics Testing Design Challenge
- Siege Artillery
- Handicap Re-Design

Unit 6: Architecture	Recommended Duration: 10 Weeks

Unit Description:
This unit will cover the field of Architecture and how Design plays a role. Students will learn about basic Architectural Styles and parts of a standing structure. Students will create floor plans and understand how traffic patterns and workflow inspire design. Students will create a scale addition to the high school and have a printed floor plan to match with exterior features. They will also work on landscape and environmental design around the school utilizing AutoDesk Revit and Google Layout. Students will come to grasp with building codes and how law, taxes, cultures, and politics have influenced design from ancient times until now. Students will also learn about how Nature affects Architectural Design from art to insurance.

Essential Questions:	Enduring Understandings:
1. What key design and engineering principals are just as relevant today as they were in ancient times? 2. How does Architecture balance Art and Engineering? 3. How does the Natural World influence the Human and Designed Worlds? 4. How does Spatial Awareness influence Design? 5. How do physical and virtual models relate to one another?	1. What man has designed through the years is a direct representation of that time period's technological, societal, economic, religious, and natural impact on the human race.

Relevant Standards:	Learning Goals:	Learning Objectives:
Content Standards: **Primary(Power):** 8.1.12.C.1 8.2.12.B.1 8.2.12.D.2 9.4.12A.19 **Secondary(Supportive):** 8.2.12.C.3 8.2.12.F.3 9.4.12A.47 9.4.12.B.(1).5 9.4.12.B.(1).11	1. Students will identify major trends through Stone, Bronze, and Iron Ages. 2. Students will be able to identify key design and engineering concepts utilized in the ancient Egyptian, Mayan, Greek, Roman, Hindu, and Chinese cultures. 3. Students will understand the significance of "7 Wonders". 4. Students will be able to relate more modern architectural designs to those they were derived from. 5. Students will understand Architecture's delicate balance between Engineering and Art. 6. Students will demonstrate their understanding of the relationship between space, flow, and arrangement through the use of a floor plan. 7. Students will develop their understanding of Spatial Awareness through the use of robotics. 8. Students will learn the basic tools and abilities of 3D Architectrual software and how it is used in today's designs. 9. Students will be able to modify and adapt current designs to better suit future or alternative needs. 10. Students will be able to construct exact to scale models of existing designs. 11. Students will learn the value of weaving physical models and virtual ones together in order to increase chances of winning a contract.	1. Students will be able to identify and show what Architectural and Engineering principals have guided and influenced human designs most from ancient times until now 2. Students be able to represent the relationship between flow and spatial awareness through the use of a properly designed and to scale floor plan 3. Students will create 3D models to represent structures and additions to the high school that utilize facades captured through camera images 4. Students will learn basic Architectural terminology and styles of buildings and other structures 5. Students will learn the impact of Commercial, Residential, or Religious design on a building or structure 6. Students will demonstrate the usefulness of a physical model of a virtual design in order to better incorporate different peoples cognitive abilities 7. Students will use the drone and their mobile devices to accurately survey an area and create virtual tours **8.** Students will create a structure to withstand a natural disaster

Formative Assessments	Summative Assessments:	Performance Assessments:	Major Activities/ Assignments (required):
- Engineering Notebook - Guided Notes - Quizzes - Class Participation	- Design Challenge Reflection - Design Challenge Rubric	- Building Proposal Challenge - Team Work - History Presentation	- Foamcore Addition - Earthquake vs. Hurricane Design Challenge - Floor plans - Virtual Tour - Ancient Times Presentation and Reflection

Possible Assessment Modifications /Accommodations:

Graded or assessed using appropriate alternative standard, submit answers, responses, and assignments in alternative forms (e.g. electronically, orally, audio visually recorded, or hand written), allow for extra time to complete work, change assignment or project based on ability, utilize a different grading scale, use self-assessment or create individual rubric.

Instructional Strategies (refer to *Robert Marzano's* 41 Elements):

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Cooperative Learning
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Cooperative Learning
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Cues, questions, and advance organizers (KWL chart)
Monitoring
Scaffolding

Possible Instructional Modifications /Accommodations/Differentiation:

Record lecture audio, change screen and computer settings (Changed back after class), assigned seating, take breaks, listen to music, be given all outlines and worksheets prior to lesson, and allow to work alone or within a specific group.

Unit Vocabulary:

Architecture - the art or practice of designing and constructing buildings.
Landscape - all the visible features of an area of countryside or land, often considered in terms of their aesthetic appeal.
Floor Plan – a scale diagram of the arrangement of rooms in one story of a building.
Traffic Pattern – the characteristic distribution of traffic on a route.
Scale - a graduated range of values forming a standard system for measuring or grading something.
Self-Assessment - of one's performance at a job or learning task considered in relation to an objective standard.

Research - the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions.			
Interdisciplinary Connections (Applicable Standards):	**Integration of Technology:**	**21st Century Themes:**	**21st Century Skills:**
Technology: 8.1.12.C.1 8.2.12.B.1 8.2.12.C.3 8.2.12.F.3 **21st Century Life and Careers:** 9.4.12A.19 9.4.12A.47 9.4.12.B.(1).5 9.4.12.B.(1).11	Technology: - Computer – AutoDesk Revit and Google Layout for design and Exporting File - Foam Core – 3D Model - Foam Cutter - Drone – Survey of Area - Smart phone – Video capture - Smartboard – Presentation and Demonstration	__x__ Global Awareness __x__ Civic Literacy __x__ Financial, Economic, Business, & Entrepreneurial Literacy __x__ Health Literacy	__x__ Creativity & Innovation ____ Media Literacy ___x_ Critical Thinking and Problem Solving __x__ Life and Career Skills __x__ Information & Communication Technologies Literacy __x__ Communication & Collaboration __x__ Information Literacy
Resources:			
Texts/Materials: - Presentation/Slide Show - Guided Notes - How's it Made Video Clip - TopGear Video – Mobile Homes - Foam Core and Foam Cutter - Google Cardboard Goggles - Drone **Major Assignments (required):** - History of Architecture Report - Design Proposal - High School Addition - Video Tour **Major Activities (required):**			

- Earthquakes and Hurricanes – Man vs. Nature Design Challenge
- Virtual Tour of world places
- Building walkaround