Verona Public School District
Curriculum Overview

STEAM

(Science, Technology, Engineering, Art, Math)

Curriculum Committee Members:
Jason Atkins

Supervisor:
Glen Stevenson

Curriculum Developed:
Summer 2016

Board Approval Date:
August 30, 2016

Verona Public Schools
121 Fairview Ave., Verona, NJ 07044
www.veronaschools.org

Verona Public Schools Mission Statement:

The mission of the Verona Public Schools, the center of an engaged and supportive community, is to empower students to achieve their potential as active learners and productive citizens through rigorous curricula and meaningful, enriching experiences.

Course Description:

The second half of the STEM/STEAM full year course infuses science, technology, engineering and math concepts with Art and Design. Students must not only understand complex academic principles, but they apply these principles to make real world devices with the primary function to delight & entertain. Computer aided design, traditional and digital fabrication including a laser cutter or 3D printer may be utilized.

Prerequisite(s):

C+ Previous STEM course

Standard 8: Technology Standards

8.1: Educational Technology: *All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.*	**8.2: Technology Education, Engineering, Design, and Computational Thinking - Programming:** *All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.*
X A. Technology Operations and Concepts **X** B. Creativity and Innovation **X** C. Communication and Collaboration D. Digital Citizenship E. Research and Information Fluency **X** F. Critical thinking, problem solving, and decision making	**X** A. The Nature of Technology: Creativity and Innovation **X** B. Technology and Society **X** C. Design **X** D. Abilities for a Technological World E. Computational Thinking: Programming

SEL Competencies and Career Ready Practices

Social and Emotional Learning Core Competencies: *These competencies are identified as five interrelated sets of cognitive, affective, and behavioral capabilities*	**Career Ready Practices:** *These practices outline the skills that all individuals need to have to truly be adaptable, reflective, and proactive in life and careers. These are researched practices that are essential to career readiness.*
Self-awareness: The ability to accurately recognize one's emotions and thoughts and their influence on behavior. This includes accurately assessing one's strengths and limitations and possessing a well-grounded sense of confidence and optimism.	**X** CRP2. Apply appropriate academic and technical skills. CRP9. Model integrity, ethical leadership, and effective management. CRP10. Plan education and career paths aligned to personal goals.
Self-management: The ability to regulate one's emotions, thoughts, and behaviors effectively in different situations. This includes managing stress, controlling impulses, motivating oneself, and setting and working toward achieving personal and academic goals.	CRP3. Attend to personal health and financial well-being. **X** CRP6. Demonstrate creativity and innovation. **X** CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP11. Use technology to enhance productivity.
Social awareness: The ability to take the perspective of and empathize with others from diverse backgrounds and cultures, to understand social and ethical norms for behavior, and to recognize family, school, and community resources and supports.	**X** CRP1. Act as a responsible and contributing citizen and employee. CRP9. Model integrity, ethical leadership, and effective management.
Relationship skills: The ability to establish and maintain healthy and rewarding relationships with diverse individuals and groups. This includes communicating clearly, listening actively, cooperating, resisting inappropriate social pressure, negotiating conflict constructively, and seeking and offering help when needed.	**X** CRP4. Communicate clearly and effectively and with reason. CRP9. Model integrity, ethical leadership, and effective management. CRP12. Work productively in teams while using cultural global competence.
Responsible decision making: The ability to make constructive and respectful choices about personal behavior and social interactions based on consideration of ethical standards, safety concerns, social norms, the realistic evaluation of consequences of various actions, and the well-being of self and others.	CRP5. Consider the environmental, social, and economic impact of decisions. CRP7. Employ valid and reliable research strategies. **X** CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP9. Model integrity, ethical leadership, and effective management.

Standard 9: 21st Century Life and Careers

9.1: Personal Financial Literacy: *This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers.*	**9.2: Career Awareness, Exploration & Preparation:** *This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.*	**9.3: Career and Technical Education:** *This standard outlines what students should know and be able to do upon completion of a CTE Program of Study.*
A. Income and Careers B. Money Management C. Credit and Debt Management D. Planning, Saving, and Investing **X** E. Becoming a Critical Consumer F. Civic Financial Responsibility G. Insuring and Protecting	A. Career Awareness (K-4) B. Career Exploration (5-8) **X** C. Career Preparation (9-12)	A. Agriculture, Food & Natural Res. **X** B. Architecture & Construction C. Arts, A/V Technology & Comm. D. Business Management & Admin. E. Education & Training F. Finance G. Government & Public Admin. H. Health Science I. Hospital & Tourism J. Human Services K. Information Technology L. Law, Public, Safety, Corrections & Security **X** M. Manufacturing N. Marketing **X** O. Science, Technology, Engineering & Math P. Transportation, Distribution & Log.

Course Materials

Core Instructional Materials: *These are the board adopted and approved materials to support the curriculum, instruction, and assessment of this course.*	**Differentiated Resources**: *These are teacher and department found materials, and also approved support materials that facilitate differentiation of curriculum, instruction, and assessment of this course.*
• Elements of Design Examples & Critical Thinking Blog Exercise & Rubric • Principles of Design Examples & Critical Thinking Blog Exercise & Rubric • Elements & Principles of Design Quiz • Rhythm & Balance Sculpture Project Brief, Rubric & Blog Reflection • Does the Center Hold Project Brief, Rubric & Blog Reflection • The Physics of a Boomerang Research Exercise • The Physics of a Boomerang Project Brief , Rubric & Blog Reflection • Portfolio	• Alternate Blog Exercise: Reduced # of Compare and Contrast Principles of Design • Alternate Blog Exercise: Reduced # of Compare and Contrast Elements of Design • Alternate Quiz on Elements & Principles of Design including visual examples and fewer choices. • Web Resource : Art, Design & Visual Thinking. A website which has very clear explanations of each element and principle of design. http://char.txa.cornell.edu/language/principl/principl.htm • Video Resource: Minute Faith, Dreamtime. A video clearly describing the notion of Dreamtime, the Religious/Philosophical belief of many Aboriginal Australians. https://www.youtube.com/watch?v=IEP6yFv21_c

	● Video Resource: The Secret of Dreaming: An Australian Aboriginal Myth of Creation. A Video resource which gives a clear auditory account of the main dreamtime story, the origin story. https://www.youtube.com/watch?v=gYgdBRCb88o ● Exemplar Boomerangs to throw and examine. ● Alternate Boomerang Design: Students may use a pattern to design the mass of the Boomerang rather than the CAD software. ● Alternate Boomerang Rubric changing the return circumference required for full attainment in Function category. ● Exemplar Portfolios and fewer content requirements.

Unit Title/Topic:STEAM	Unit Duration: 18 Weeks

Stage 1: Desired Results

Established Goals:

2014 New Jersey Core Curriculum Content Standards - Technology

8.2.12.B.3
Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs.
8.2.12.C.1
Explain how open source technologies follow the design process.
8.2.12.C.4
Explain and identify interdependent systems and their functions.
8.2.12.C.5
Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
8.2.12.C.6
Research an existing product, reverse engineer and redesign it to improve form and function.
8.2.12.D.1
Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.

21st Century Life and Career Skills

9.1.12.A.1
Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.B.2
Create and respond to a feedback loop when problem solving.
9.1.12.B.3
Assist in the development of innovative solutions to an onsite problem by incorporating multiple perspectives and applying effective problem-solving strategies during structured learning experiences, service learning, or volunteering.
9.1.12.F.3
Defend the need for intellectual property rights, workers' rights, and workplace safety regulations in the United States and abroad.
9.3.12.C.3
Develop personal interests and activities that support declared career goals and plans.

Architecture & Construction Career Cluster

9.4.12B.24
Employ technological tools to expedite workflow.
9.4.12.B.(1).2
Employ appropriate representational media to communicate concepts and design.

New Jersey Core Curriculum Content Standards for Visual and Performing Arts

1.1.12.D.1
Distinguish innovative applications of the elements of art and principles of design in visual artworks from diverse cultural perspectives and identify specific cross-cultural themes.
1.3.12.D.1
Synthesize the elements of art and principles of design in an original portfolio of two- and three-dimensional artworks that reflects personal style and a high degree of technical proficiency and expressivity.
1.3.12.D.2
Produce an original body of artwork in one or more art mediums that demonstrates mastery of visual literacy, methods, techniques, and cultural understanding.
1.3.12.D.4
Analyze the syntax and compositional and stylistic principles of two- and three-dimensional artworks in multiple art media (including computer-assisted artwork), and interpret themes and symbols suggested by the artworks.
1.3.12.D.5
Identify the styles and artistic processes used in the creation of culturally and historically diverse two- and three-dimensional artworks, and emulate those styles by creating an original body of work.
1.4.12.B.1
Formulate criteria for arts evaluation using the principles of positive critique and observation of the elements of art and principles of design, and use the criteria to evaluate works of dance, music, theatre, visual, and multimedia artwork from diverse cultural contexts and historical eras.

Transfer Goal:

Students will be able to <u>independently</u> use their learning to…apply a STEM approach and strategically manipulate artistic elements and principles in solving complex real world problems.

Students will understand that:	Essential Questions:
● The Engineering Design Cycle can be applied to other problems….like Art, Science, Finance Etc. ● The 6 Degrees of Freedom must be planned for ● That Everyone is capable of Meaningful Design ● Design means a preplanned fabrication where the sum are more than the parts ● Positive Critique is the most valuable type of critique ● Everyone can improve ● Math has many fun and practical applications	● What do Art & Engineering have in Common? ● What makes something beautiful? ● How can the combination of Art & Engineering create value in the world?
Students will know:	**Students will be able to:**
● The impact of iconic Designers who have fused Art & Engineering into mainstream consumption like: Eames, Ive, Dyson, Fuller, Wright, Stark & Vignelli	● Pitch an idea of how to add value to world by addressing a Global problem through Art and Engineering.

- The work and importance of Kinetic Sculptors like Alexander Calder and Theo Jansen….
- How to create both conceptual pictorial drawings & digital orthogonal drawings of their designs.
- Basic Artistic Vocabulary including elements, principles & fundamentals
- How to apply artistic strategy to basic artistic elements in composition
- Calculations for Centroid both Algebraically and Geometrically
- How to Create Free body diagrams in solving for moment/torque equations in a mobile
- How to solve for Moment Algebraically
- How Manipulate mass, position and Moment Equation variables to produce the desired Spatial/Aesthetic results.
- How to calculate areas of a circle, triangle and rectangle.
- How to calculate density of a heterogeneous material.
- How to apply the Pythagorean Theorem to solve a problem
- How to apply simple Trigonometric functions based on: OH AH OA SCT or SOHCAHTOA

- Create a Digital Portfolio Highlighting their work in the course
- Apply Artistic Elements such as line, shape, form, value, color, texture, and space.
- Compose the design of physical machines so that the Sum is greater than its parts
- Use Algebraic expressions and Geometric Equations for Area and Volume
- Use Density to calculate and design the massing of counterweights/design elements
- Select the appropriate method to solve for Center of Mass of an object
- Create a 3 Arm Asymmetrical Mobile that balances and spins on axis
- Take the Artwork of another Culture and make it relevant to our Culture through story and graphic design
- Use Trigonometry to calculate the ideal wing shape for a Boomerang.
- Apply Color strategically for perceptive value or symbolism

Stage 2: Acceptable Evidence

Transfer Task

The 3 Arm Asymmetrical Mobile-Students collaborate to design and optimise a 3 Arm mobile for not only function, but for Conceptual and Aesthetic impact.

The Boomerang- Students study Australian Aboriginal history and artwork to translate core themes and make them relevant in an American context through story and symbols. These stories and symbols will become the basis of their Boomerang Graphic Design. Groups research and experiment with throwing different types of boomerangs and create a poster which Physics and

Other Evidence of Learning

Digital Portfolio- Students will compose a visual presentation of their work throughout the course. Portfolio will be graded both on function and design.
Performance Assessments- Students design, construct, and test solutions to various technological challenges. Student work cooperatively to complete design activities and deliver presentations. Students are evaluated using performance and process rubrics.
Summative Assessments- Students complete minor pre/post content knowledge assessments, as well frequent do nows and closing exercises to target immediate critical knowledge.

Stage 3: Activities to Foster Learning

Learning Activities

Week 1: STEAM, The Poetic Combination of Engineering and Art (Writing pre-assessment)
Students will explore key concepts and terminology of Art and Engineering. Exemplars for discussion will including industrially designed objects, installation sculptures, architecture and civic works.
Students reflect on how Art and Engineering can bring Value to the World. Students will research a Global problem and pitch an idea on how Art & Engineering can help find a solution (writing pre-assessment)

Week 2: Safety Review
Students review safety and laser cutter workflow.

Week 3: Design & Fabrication Pre-Assessment : Create a Sculpture that Defies Gravity / Review of Elements and Principles of Art
Students will create a sculpture that defies gravity. This project is Pre-Assessment to judge students progress through the course. Art elements and principles are used to form a dialogue during critique of the sculptures.

Week 4: Digital Drawing Review(Tangrams) / Color Theory
Students learn about color theory by examining examples. Students learn the basics of CAD commands and working strategies to create and compete with a TANGRAM game. Students compete in a visual spatial intensive game.

Week 5: Kinetic Artwork/Charette for Building an (almost) Impossible Mobile
Students discover multiple creative kinetic artists and profile one as an influence in a short portfolio writing assignment. To explore the idea of kinetic artwork, students are split up into groups and given a challenging mobile condition to try to fabricate with only 3 work days. Student will learn how center of gravity works by working with it and attempting to do what may look like on paper….impossible.

Week 6: Centroid & the Center of Mass
Students Reflect on Center of Mass and how it affected their last build. Students watch a Rigolo performance and other balance related performance artists. Students apply the theories of center of mass as related to the Rigolo performance to balance two forks from a cork at the end of a toothpick. Students try a series of in class exercises to locate centroid, or center of mass/area in a homogeneous material of uniform thickness. If time allows: students create a complex asymmetrical composition of multiple shapes with a predetermined centroid, then test the composition to see if it spins on its COM.

Week 7: Levers & Moments, Point Loads and Uniformly Distributed Loads
Students are introduced to the vocabulary, concepts and application of Moments and the moment equation. Students complete in class instruction and homework exercises to cement an understanding of how moments works.

Week 8: Design of a 3 Arm Asymmetrical Mobile
Students work in groups to create individually 3 distinctly different designs for an Asymmetrical Mobile (no beam segments may be of equal size about a fulcrum) with varying degrees of difficulty.
Students are given feedback and optimise their design drawings to prepare for construction. Students will be prepared to discuss design decisions regarding color theory, rhythm, composition etc.

*Based on ability of groups, some groups will complete a Math proof of 1 Arm, 2 Arms or 3 Arms.

Week 9: Fabrication of the Mobile
Students work to create part and part assemblies, measure and adjust calculations/design.

Week 10: Assembly of the Mobile
Students assemble their mobiles and optimize function to ensure it moves within normal room air currents. Students will problem solve malfunctions.

Week 11: Mobile Critique & Documentation
Students will prepare a presentation of the Mobile and respond to Critique. Students will reflect on their designs, document their work and write a reflection.

Week 12: Intro to the Boomerang and Aboriginal Culture
After discussing their understanding of Australian Aboriginal culture, Students will complete a reading and short answer writing assignment with an overview of their history post English settlement.
Students will watch a video based on the Dreamtime and create a story in which they transfer the Aboriginal vectors of Story and Symbols and the theme of Life Saving Allegories to an American context through a story of their own in writing and in pictograms/symbols.

Week 13: The Physics of the Boomerang
Students discuss throwing technique, practice throwing exemplar boomerangs and begin guided research on Boomerang Flight. Students present their research in their Digital Portfolio.

Week 14: Design of the Boomerang
Students utilize AutoCAD software to layout the elevation and section of the wing shape. Students use trigonometry to solve for the profile of the wing.
Student pictograms are refined into a holistic graphic design for their Boomerang.

Week 15: The Fabrication of the Boomerang
Students use the laser cutter to sketch the profile of their boomerang before finishing through hand cutting and drum sanding.

Week 16: The Fabrication of the Boomerang
Students drum sand and finish sand the boomerang.

Week 17: Testing/Optimization of the Boomerang
Students test and steam bend the boomerang to improve flight path performance.

Week 18: Finish Application for the Boomerang
Students apply a durable finish to seal the boomerang and add aesthetic appeal.