Verona Public School District
Curriculum Overview

Fabrication & Design II

Curriculum Committee Members:
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Curriculum Developed:
Summer 2016

Board Approval Date:
August 30, 2016

Verona Public Schools
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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:

This course builds upon the woodworking skills learned in Fabrication & Design I and incorporates advanced project planning, digital fabrication, and community based design. This curriculum is project based and the instruction is split between a Design/CAD lab to research and generate solutions and a Fabrication lab to test hypotheses. Projects vary greatly in scale and a variety of materials are used including: wood, metal, plastic & concrete. This course is recommended for any student interested in the study/practice of Woodworking, Carpentry, Industrial Engineering, or Product Design after high school.

Prerequisite(s):

C+ Fabrication I.

Verona High School — Fabrication & Design II

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.*
• Shop Safety Contract Review listing procedures • Shop Safety Review online assessment at ProProfs • Measurement Review to 1/32" inch • Advanced Tools Operation & Safety • Laser Cutter Operation & Safety • Pattern Language Lamp Project Brief & Rubric • CAD Basics Slide Presentation • Cut Sheet Exercise • Theory of Electricity Research • Theory of Acoustics • Speaker Project Brief & Rubric	• Shop Safety Review with visual context and limited answer choices • Measurement Study Materials and Review down to ⅛" • Demonstrations of layout methods to minimize math and maximize accuracy including bisecting corners method. • Graphic organizer for parts of core machinery • Graphic organizer for common tools • Available Online Access to CAD Slide Presentation Via Google Documents • Pattern Language Lamp Exemplars • Pattern Language Pattern Drawings • Guided Notes for Electricity & Acoustic Theory • Teacher Notes for Electricity & Acoustic Theory

Verona High School — Fabrication & Design II

Unit Title / Topic: Advanced Fabrication	Unit Duration: 18 Weeks

Stage 1: Desired Results

Established Goals:

2014 New Jersey Core Curriculum Content Standards - Technology

8.2.12.C.3
Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).
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.
8.2.12.D.3
Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
8.2.12.D.5
Explain how material processing impacts the quality of engineered and fabricated products.

21st Century Life and Career Skills

Architecture & Construction Career Cluster

9.4.12B.4
Perform math operations, such as estimating and distributing materials and supplies, to complete classroom/workplace tasks.
9.4.12B.18
Employ critical thinking skills independently and in teams to solve problems and make decisions, (e.g., analyze, synthesize, and evaluate).
9.4.12B.19
Employ critical thinking and interpersonal skills to resolve conflicts.
9.4.12B.20
Identify, write, and monitor workplace performance goals to guide progress in assigned areas of responsibility and accountability.
9.4.12B.21
Conduct technical research to gather information necessary for decision-making.
9.4.12B.22
Create and implement project plans to accomplish realistic planning in design and construction situations, considering available resources and requirements of a project/problem.
9.4.12B.24
Employ technological tools to expedite workflow.
9.4.12B.72
Employ information management techniques and strategies in the classroom and/or worksite to assist in decision-making.
9.4.12B.73
Employ planning and time management skills and tools in the classroom and/or worksite to enhance results and complete work tasks.
9.4.12B.74
Read, interpret, and use technical drawings, documents, and specifications to plan a project.
9.4.12B.75
Use and maintain appropriate tools, machinery, equipment, and resources to accomplish project goals.
9.4.12.B.(2).17
Use craft skills to meet or exceed teacher and/or employer expectations.

Transfer Goal:

Students will be able to <u>independently</u> use their learning to…Design a custom Industrial product that incorporates a process plan and uses both Traditional and Digital Fabrication processes.

Students will understand that:

- The laser cutter allows for greater efficiency and sophistication over many traditional fabrication methods.
- Use of digital fabrication leaves little room for error in planning the sequence of fabrication
- AutoCAD will allow us to greatly change a pattern with relatively little work
- Digital Fabrication creates exactly what we draw, no more no less!
- Mathematical patterns like the golden ratio, are all around us…..and make sense!
- There are numerous factors that account for optimal acoustic conditions, and most need to be taken into consideration to achieve great or even good sound.
- Sound travels by wave which has physical dimensions that should be designed for
- The assembly sequence of a speaker is incredibly important to sound quality
- Thinner wires have greater resistance to electrical flow greatly changing the quality of sound
- There are many strategies to create bass extension including speaker positioning, speaker porting and passive drivers.

Essential Questions:

- How does the use of Digital Fabrication expand my abilities as a designer?
- How is digital fabrication changing manufacturing?
- How does design opportunity increase when we bring in other senses?
- What do great speakers sound like?

Students will know:

- The laser cutter cuts only 2D media
- The limit of the material thickness the cutter can cut is ⅜” acrylic or ¼ solid wood

Students will be able to:

- Create a pattern from the guiding principals of other patterns in the AutoCAD program
- Optimize the etch function of the laser cutter to create areas of opacity and translucency in wood veneer

● The laser cutter can etch many materials including aluminum, plastic, wood, plywood and paper ● Digital Fabrication requires additional steps of producing precise digital drawings ● Woofers are designed to create lower frequencies ● Tweeters create High Frequencies ● Crossovers work like a series of filters ● Bigger Speakers Deliver better low frequencies than smaller speakers ● Higher Efficiency speakers require cheaper power sources ● As sound drops in frequency it, the resistance encountered by a speaker increases ● A heavy front baffle deadens resonance ● Bracing deadens resonance ● Each speaker has a specific impedance and wattage rating	● Design a working LED based Table Lamp ● Design an optimized speaker enclosure and Baffle ● Troubleshoot and optimize sound quality from speakers

Stage 2: Acceptable Evidence

Transfer Task

Pattern Language Lamp- Prior to building, students design, draw, and create a process plan for a project that includes digital fabrication to affect the transparency/opacity of a lamp shade. Students document changes in the sequencing and design.

Speaker Design- Prior to building, reverse engineer from a built speaker, or interpolate between raw materials and an exemplar product to design, draw, and create a process plan for a project that includes digital fabrication speaker enclosure pieces and or etch. Students document changes in the sequencing and design.

Other Evidence of Learning

Project Report- Students will summarize, respond to questions, include drawings, a process plan, process and final photographs of each project.
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: Fabrication & Design II / Process Planning for Digital Fabrication
Students learn course projects/expectations.
Students learn how digital fabrication is infused into typical process planning work flow.

Week 2: Safety & Measurement
Students review safety and measurement

Week 3: Pattern Language & Lighting Design / Using Digital Fabrication & Light to reveal hidden Structures
After an introduction to pattern language including video and physical examples, students will explore patterns with cultural and or scientific significance, and use these patterns in designing a lamp shade in a custom lamp.

Research is initially conducted on recursive patterns in Celtic, Islamic, & Mathematical studies to create a pattern book.

Week 4: CAD Basics for Laser Cutting
Students learn basic autocad commands to begin simple digital patterns as a basis for their custom lighting design.

Week 5: Laser Cutting a Simple Pattern
Students complete and laser cut/etch a piece of the pattern to experiment with its opacity/transparency with a light source.

Week 6: Lamp Design & Critique
Students are assigned with creating their own massing and hidden pattern, or following the exemplar pattern.
Students create a process plan and orthographic drawings, including both the base and the shade.

Week 7: Lamp Fabrication
Students use the laser cutter to create a frame for the table lamp base, then assemble using traditional joining techniques.
The frame will likely be laminated with wood veneer as per student design.

Week 8: Shade Fabrication
Students will further develop pattern design to be etched into the back side of the wood veneer, creating opaque masking from which the light will not pass.

Week 9: Electrical Assembly
Students source and mount an LED electrical socket to the base of the lamp.

Week 10: Optimization/ Final Lamp Presentation & Critique

Week 11: Speaker Theory & Design Intro.
Students are introduced to different home audio loudspeaker types, types of amplification, and music sources. Students record the differences heard between each system.
Some donated example speakers are pulled apart to visualize the anatomy of a 2-Way loudspeaker. Basic vocabulary is reviewed.

Students are given the choice to;

1. Purchase a DIY speaker kit at a cost of between $110-$300 / & Design Enclosure
2. Reverse engineer a speaker enclosure from a working pair of speakers & improve the sound quality
3. Create their own transducer and enclosure
4. Opt to plan and conduct an independent community project

Students conduct guided research on the basis of enclosure design, acoustic theory, and best practices in fabrication.

Week 12: Baffle & Enclosure Design & Critique
Students examine the example enclosure and reflect on their research to Design a Custom Baffle & Enclosure for their Speaker Set
Designs are critiqued by peers for reflection and response.

**Student designs must be approved for each level of Difficulty as per academic progress: Expert, Intermediate, Learning*

Week 13: Process Planning & Digital Fabrication
Students create a process plan for full Speaker completion to include any intended Digital Fabrication.
Students develop any graphics they would like on their speaker in AutoCAD and

Week 14: Enclosure Fabrication
Sides and Back of Enclosure are joined and braced.

Week 15: Baffle Fabrication
Front Baffle is carefully laminated and woofer holes placed/sized to create a sonically dead surface.

Week 16: Finish & Assembly
Enclosure may be painted, or laminated. Surfaced may be etched. Electronics may be mounted. Seams may be sealed with silicone. Woofers and tweeters may be mounted.

Week 17 Finish & Assembly
All finish work and assembly will be completed.

Week 18 Final Critique and Documentation
Students discuss process related success, setbacks, future development and intention of design.
Students in class form constructive critiques.