WARREN COUNTY SCHOOL DISTRICT

PLANNED INSTRUCTION

COURSE DESCRIPTION

Course Title: Engineering & Industrial Technology STEM Pathway
Course Number: 00781 – 1 credit; 00782– 2 credits; 00783– 3 credits
Course Prerequisites: None

Course Description: The WCSD Engineering and Industrial Technology Pathway will explore eight systems of technology. Students will then be provided an in-depth exploration of robotics and control technology. Students will utilize a variety of robotics systems to design, build, and program robots to solve relevant challenges. It will go also go beyond the scope and sequence of robotics and allow students to explore other engineering and industrial aspects such as 3D Design, fabrication, coding and programming, as well as drone technology. This pathway is specifically designed to build upon the skills developed in the SmartLab and to allow students to explore potential career interests.

Suggested Grade Level: Grades 9-12
Length of Course: Two Semesters
Units of Credit: 1
PDE Certification and Staffing Policies and Guidelines (CSPG) Required Teacher Certifications:
CSPG65 – Technology Education
To find the CSPG information, go to CSPG
Certification verified by the WCSD Human Resources Department: ☒Yes ☐No

WCSD STUDENT DATA SYSTEM INFORMATION

Course Level: Academic
Mark Types: Check all that apply.
☒F – Final Average ☒MP – Marking Period ☒EXM – Final Exam

GPA Type: ☐ GPAEL-GPA Elementary ☐ GPAML-GPA for Middle Level ☒ NHS-National Honor Society
☒ UGPA-Non-Weighted Grade Point Average ☒ GPA-Weighted Grade Point Average

State Course Code: 21003
To find the State Course Code, go to State Course Code, download the Excel file for *SCED*, click on SCED 6.0 tab, and chose the correct code that corresponds with the course.

TEXTBOOKS AND SUPPLEMENTAL MATERIALS

Board Approved Textbooks, Software, and Materials:

Title:	No text used within this course.
Publisher:	No text used within this course.
ISBN #:	No text used within this course.
Copyright Date:	No text used within this course.
WCSD Board Approval Date:	No text used within this course.

Supplemental Materials: Creative Learning Computer Lab and STEM Resources

Curriculum Document

WCSD Board Approval:

Date Finalized:	4/1/2021
Date Approved:	5/10/2021
Implementation Year:	2021-2022

SPECIAL EDUCATION, 504, and GIFTED REQUIREMENTS

The teacher shall make appropriate modifications to instruction and assessment based on a student's Individual Education Plan (IEP), Chapter 15 Section 504 Plan (504), and/or Gifted Individual Education Plan (GIEP).

SCOPE AND SEQUENCE OF CONTENT, CONCEPTS, AND SKILLS

ENGINEERING and INDUSTRIAL TECHNOLOGY PATHWAY

- Foundational STEM
- SmartLab 1
- SmartLab 2
- Exploring Future Technologies
    - Drone Tech
    - Virtual Reality
    - 3D Fabrication
- Innovation Capstone Project

SmartLab Learning (Throughout)

SmartLab Learning is a researched based program of student-led, project-based learning. Each project (outlined below) asks students to explore a technology, plan a project that incorporates both academic content and the technology, execute that project in the appropriate timeline, and share their results (which is termed EPDRS – Explore, Plan, Do, Reflect, and Share). Students repeat the process as they progress through the fifteen engagements. It is through this process that students develop generational skills and digital literacy.

Core Standards:

Explore: ISTE 1d, 3a, 3d, 6a

Plan: ISTE 1a, 3b, 3d, 4a, 4b, 5a, 7d

Do: ISTE 2c, 3d, 4c, 5b, 7b, 7c

Reflect: ISTE 1c, 4c, 5b

Share: ISTE 1b, 3c, 6c, 6d, 6b

NGSS: Students Progress through ETS1a, ETS1b, and ETS1c.

Foundational STEM (Approximately 180 hours)

Within the orientation and introductory piece of the STEM Academy, fifteen activities will be going on at one time. Students will rotate every ten days without repeating an engagement activity throughout all eight systems of technology. Each system of technology is listed below:

- Circuitry
- Computer Graphics
- Digital Communications
- Mechanics and Structures
- Robotics and Control Technology
- Scientific Data and Analysis
- Software Engineering
- Sustainability

These activities and engagements are built within the Level 1 curriculum in the Creative Learning Lab Launchpad.

Eight Systems of Technology

Circuitry

The study of circuitry is explored through electricity, pneumatics and microelectronics. Students develop an understanding of the scientific and technological principles underlying each of these systems. With this foundation, students design complex systems utilizing each technology. SmartLab resources for the study of circuitry include:

- Advanced Circuitry Exploration System
- Makey Makey
- Conductivity Exploration Systems with Accessory Collection
- Snap circuit rover
- Snap Circuits Electricity Exploration Collection with Multimeter
- Snap Circuits Green Energy Collection
- Snap Circuits Extreme Microelectronics System
- Digital Sandbox Programmable Microelectronics Systems
- Arduino Programmable Microelectronics Systems
- Curriculum and/or additional learning resources for all above listed items

Core Standards:

NGSS HS-PS4-5, HS-PS2A, HS-PS3A

Computer Graphics

In Computer Graphics, students explore areas such as graphic arts, image capture, photo processing and manipulation, animation and special effects. They learn to distinguish between, and effectively use, bitmap graphics (digital "painting"), and object-oriented graphics (computer-aided "drawing" or "CAD") applications. As learners progress, they integrate computer graphics with other software applications to create advanced graphic and commercial art, websites and multimedia presentations. Computer graphics also serves as an important portfolio development tool for documenting projects and learning processes. Examples of computer graphics tools included in the SmartLab are:

- 360 Degree Camera System
- 3D Printing System and TinkerCAD
- Adobe Photoshop Elements Software Packages - class license
- Digital Still Motion Cameras
- Digitizing Tablets
- Doodle for Google Art Contest
- Google Arts and Culture
- Google SketchUp Software
- Oculus Go VR headsets
- Photo Tripod
- Portable Lighting Studio
- Tech-4-Learning Introductory Graphics software packages
- Curriculum and/or additional learning resources for all above listed items

Core Standards:

NGSS HS-PS4C, HS-PS3C, HS-LS1A

Digital Communications

Engagements in the Digital Communications system provides new experience and reinforces the ability to communicate effectively utilizing single, blended, and advanced media. Digital Communications encompasses the capture and production of content in any single media, such as print, sound or electronic media. It includes word processing, presentations, and graphic representation of data or processes in the form of flowcharts, tables and graphs. It also includes the capture, production and presentation of single-media content such as audio, video and digital still images. Learners quickly progress from developing core competencies in these areas to the regular application of these tools to document their learning throughout the SmartLab. Also, learners develop advanced communications skills through the integration of two or more

media using technology-based tools. Students explore linear and interactive presentations and the applications for each. Digital communications resources include:

- Adobe Premiere Elements Software Packages (class license)
- Flexible Video Arm and Clamping System
- Tech-4-Leaming Claymation Animation Kit and Refill Kits
- Frames Stop Motion Software Packages (class license)
- Comic Life Software (class license)
- Digital Cameras
- Digitizing Tablets
- Google Sites Software for ePortfolio Creation
- Microsoft Office Software Suite (class license)
- Padcaster
- Photo Tripod
- Portable Lighting Studio
- Sound engineering collection
- STEM Career Exploration
- USB Microphone and Stand
- Virtual Reality Viewing Systems
- Curriculum and/or additional learning resources for all above listed items

Core Standards:

NGSS XCut: Scale, Proportion, and Quantity; Cause and Effect; Patterns

Mechanics and Structures

In Mechanical Systems, learners create and study structures and machines. Hands-on learning engagements foster an understanding of simple and complex machines and structural physics. Mechanics and structures construction sets include:

- Engino Architecture Collections
- Fischertechnik Mechanics and Statics Collections
- West Point Bridge Designer
- Zoob Construction System for Rapid Visualization and Prototyping
- Curriculum and/or additional learning resources for all above listed items

Core Standards:

NGSS XCut: Influence of Engineering, Interdependence of Science Engineering and Technology.

NGSS HS-PS-3b, HS-PS-3c, HS-PS-2a, HS-PS-2b

Robotics and Control Technology

In this area of study, mechanical processes are managed through automation control interfaces and learners design and program robotic systems to perform task-oriented challenges. Students explore logical programming and explore how sensors, electronic and computer controllers are used to manage complex mechanical processes. The concept of sense, decide, and act is introduced and students develop whole-systems perspectives. SmartLab robotics and control technology resources include:

- Lego EV3 Control System with Software
- Programmable drone systems
- Sensors to integrate with Lego EV3
- Curriculum and/or additional learning resources for all above listed items

Core Standards:

CSTA CS-01, CS-02, CS-03, DA-09, DA-10, DA-11, DA-12

Scientific Data and Analysis

In this system of technology, students collect experimental data using testing equipment and probe ware, typically linked with a computer controlled interface. Data is then analyzed to draw conclusions from experiments. Students engineer and test scale models and analyze materials and structure. Using chemical, physical and bioscience probe ware, students collect and analyze experimental data to explore principles of science though hands-on, inquiry-based projects. SmartLab scientific data and analysis tools include:

- Astronomy Experiences with MicroObservatory
- Extreme Weather and Monster Storms
- Fischertechnik Optics system
- Global Information Systems with ArcGIS
- Global Information Systems with Google Maps, Worldmapper, and the Welikia Project
- Vernier Materials Analyzer with accessories and bridge and truss collection
- Curriculum and/or additional learning resources for all above listed items

Core Standards:

NGSS HS-LS-1a, HS-LS-1c, HS-LS-1d

Software Engineering

In this area of study, students learn to create mobile and computer desktop applications. Initially in their experience, students create interactive online greeting cards, and computer animations. They simulate real systems and processes, and even create basic computer games.

Later students have the opportunity to create real desktop and mobile app games that they can eventually publish and sell. Software engineering resources include:

- App Inventor Software
- Digital Sandbox Programmable Microelectronics Collections
- MIT Scratch Version 3 Software
- Stencyl Software
- Touch Develop Software
- Curriculum and/or additional learning resources for all above listed items

Core Standards:

CSTA 3A: AP-13, AP-14, AP-15, AP-16, AP-17

Sustainability

Now your SmartLab students can explore one of the most exciting areas of emerging technology- Sustainability. Alternative energy and power efficiency projects connect core academic content with 21st century skills through engaging, inquiry-based exploration. Students explore this exciting area technology with hands-on, minds-on activities connecting · math, science, social studies and economics. Here are just some of the projects the students will explore:

Solar Energy Discovery Collection

- Understanding photovoltaic cells
- Solar Energy and High-Performance Homes
- Solar cooker design and testing
- Solar race car design and testing

Wind Energy Discovery Collection

- Understanding wind turbines
- Propeller blade design
- Wind farm design
- Storing Wind Power Hydrogen Fuel Cell Discovery Collection
- Electrolyzing water for hydrogen fuel
- Generating power from hydrogen fuel cells
- Design a hydrogen highway
- Hydrogen fuel cell race cars

Core Standards:

NGSS HS-PS-3a, HS-PS-3d, ESS-3C, ESS-3D, ESS-2E, ESS-2A

SmartLab Systems of Technology (Portion 1) (Approximately 90 hours)

This portion of the STEM Academy focuses on four systems of technology. With the STEM facilitator approval, students will choose the four areas of technology they wish to focus on during the duration of SmartLab 1. Once the four systems of technology are selected, students will work through a leveled curriculum within the Creative Learning Lab Launchpad enabling them to go in-depth within each system of technology. Each area has a Level 2 and Level 3 portion of curriculum that will challenge students at various stages of the course.

SmartLab Systems of Technology (Portion 2) (Approximately 90 hours)

This portion of the STEM Academy focuses on the remaining four systems of technology that were not the focal point within Smart Lab2. Students will work through leveled curriculum within the Creative Learning Lab Launchpad enabling them to go in-depth within each system of technology. Each area has a Level 2 and Level 3 portion of curriculum that will challenge students at various stages of the course.

Exploring Future Technologies (Approximately 180 hours)

Future generations will face social and global problems beyond what we can imagine. They will learn and engage with each other, with *technology* and with information in entirely new ways. Students will enter a workforce where job functions and roles will be dramatically different from today. Through their work in the STEM Innovation Academy, students will investigate technologies of the future. Some examples of these technologies will include, drone technology, virtual reality, and 3D fabrication. Through this investigative work, students will learn how these technologies impact career paths.

ASSESSMENTS

PSSA Academic Standards, Assessment Anchors, and Eligible Content: The teacher must be knowledgeable of the PDE Academic Standards, Assessment Anchors, and Eligible Content and incorporate them regularly into planned instruction.

Formative Assessments: The teacher will utilize a variety of assessment methods to conduct in-process evaluations of student learning.

Effective formative assessments for this course include: Entry/Exit Slips; Teacher Questioning; Classroom Discussions; Journals; Projects; Graphic Organizers; Peer-Self Assessments; Questionnaires

Summative Assessments: The teacher will utilize a variety of assessment methods to evaluate student learning at the end of an instructional task, lesson, and/or unit.

Effective summative assessments for this course include: Please see Innovation Capstone Project

Innovation Capstone Project(s) (Approximately 180 hours)

The Innovation Capstone Project prepares students for College and Careers. It is a rigorous curriculum for 11th and 12th grade students aligned to various CTE Standards. The Innovation Capstone Project is a powerful new program to prepare students for college and career success. Fully integrated with a high school SmartLab, Innovation Capstone Project curriculum guides students through a rigorous, standards-aligned approach to planning, execution and presentation of projects relevant to their own interests and academic focus. Students dig deeper into topics of personal interest, apply technology to academic content and make career connections. The Innovation Capstone Project program focuses on and further develops critical workplace skills like project planning, time management, collaboration, communication, problem-solving, and critical thinking. With the Innovation Capstone Project curriculum, students will develop project-based solutions to real-world problems and use a wide range of applied technologies.

- *Rigorous Project-Based Curriculum*

  Curriculum is flexible, standards-based, and supports capstone projects in a wide range of academic subjects. Students learn to identify and define real-world problems, design, plan and execute solutions, and create e-portfolios to document and present their work.

- *Critical Workplace Skills Development*

Projects are designed to encourage students to think critically, solve challenging problems, and develop critical workplace skills, such as oral communication, public speaking, research skills, teamwork, goal setting, and more.

With Innovation Capstone Project, students will:

- Explore various STEM disciplines and career paths
- Take ownership of their education and future career
- Develop critical workplace skills, such as effective oral communication, critical thinking, & more
- Produce Capstone Projects that align with any course
- Develop a professional portfolio of projects and outcomes
- Apply knowledge from coursework to conduct a school or community-based project

The Innovation Capstone Project Framework is provided in the Creative Learning Lab and Media Transformers curriculum. Consumables, kits and various materials will be available to assist students.

The Innovation Capstone Project provides a project framework for students to complete long-term, in-depth projects with their peers. Students can focus on the systems of technology that they explored previously, community project, business plan, drone business; advanced projects, capstone projects. The opportunities are endless!

Three Phases

Phase 1: Plan

1. Project Ideas
2. Project Planning
3. Goal Setting
4. Time Management
5. Research
6. Find an Expert Mentor
7. Building a Business Plan

Phase 2: Do/Reflect

1. Collect and Organize Data
2. Analyze Data
3. Citations

Phase 3: Share

1. Business Writing
2. Scientific Writing
3. Presentation Skills

If students accelerate through the various STEM Innovation Academy coursework, they will be permitted to work on another Capstone Project or revamp an existing project with the understanding of the three phases needing a completion satisfactory mark based on facilitator rubric(s).

Examples of Innovation Projects from the past have included:

ART

- Commission a sculpture, painting, or other art installation somewhere in your community (use your art to bring awareness to an issue, tell a story, or inspire others)
- Coordinate a large scale community project with students, senior citizens, or an after school program to create a mural or another large scale art project in a public space
- Start a community gallery to showcase local amateur artists
- Create a business that will allow you to commission your art for clients
- Create a business to sell t-shirts with your art
- Design a website for a non-profit

Music

- Coordinate a community music festival
- Start a program to provide refurbished instruments to students in the community interested in learning to play music
- Record, produce, market, and sell your music or the music of a client

Public Service

- Create a PSA to bring awareness to a critical issue in your community like drug and alcohol abuse, domestic violence, social justice, or water/land pollution
- Create a donation center to provide clothing and toiletries to the homeless

Health and Education

- Create a community garden to provide work opportunities and food to populations in need
- Start a tutoring non-profit to support local students
- Start a food bank, recycling program, or another service for your community

Science and Environment

- Install birdhouses or bug hotels in a local park to support critical animal populations like bees
- Organize a monthly cleanup group to clean your community
- Collect data about your community's water, air, and land health and present it to the city council with suggestions on ways to improve it

Film

- Create a drone video for a local farmer or real estate agent
- Produce a radio or TV program to share information with your community

Engineering

- Design a play environment, run a fundraiser, and build an inclusive playground for your school
- Invent a device to help people improve their quality of life like a water purifier or a bike-powered washing machine