SCHOOL DISTRICT OF THE CHATHAMS
CURRICULUM PROFILE

CONTENT AREA(S): iSTEM **GRADE LEVEL(S):** 6th Grade

COURSE: Robot Design Studio *(formerly Robotics)* **TIME FRAME:** Quarterly (39-40 days)

I. Course Overview

In this course, students develop a working knowledge of the basic hardware and software required to construct and program robots that can navigate and manipulate real-world situations. Students will be exposed to concepts related to structures, mechanisms, control systems, and basic coding frameworks. They will then be challenged to apply these concepts at varying levels of complexity using the engineering design process to solve problems and develop solutions to unique contextualized design challenges.

II. Units of Study

1.) Critical Thinking, Robotics, and the Design Process *(~5 days)*
2.) Robotics Hardware and Software *(~10 days)*
3.) Robotic Applications & Design Challenges *(~24 days)*

III. Essential Questions

Unit 1: Critical Thinking, Robotics, and the Design Process

- Why is it important to design, visualize objects, transform ideas into sketches, and use the design process to solve problems?
- How do I conduct research and generate new ideas?
- Why is failure inevitable and important for successful designs?
- What are the advantages and disadvantages of various computer applications?
- How are things made and how can they be improved?
- What does it mean to be a robot?
- How can we define technology?
- How does robotic technology present itself in our day-to-day life and decision-making processes?
- What are robots used for in everyday life and what kinds of tasks to they help accomplish?
- How does the hardware of a robot affect the capabilities of a robot?
- How does the structure of a robot lend itself to the tasks a robot is able to accomplish?

Unit 2: Robotic Hardware and Software

- How can the EV3 robot interact with the environment around it?
- How can we use brainstorming to develop and organize ideas and thoughts?

Unit 3: Robotic Applications & Design Challenges

- In what ways could a robot be programmed to assist in a real world scenario?
- How does the application of sensors help a robot understand, interact, or navigate the world around it?

- What are some ways we can improve a program if the robot does not react in the way we want it to?
- In what ways can a robot's structure be improved to better meet the needs of a goal?

IV. Learning Objectives

NJSLS - Design Technology

- 8.2.8.C.1 Explain how different teams/groups can contribute to the overall design of a product.
- 8.2.8.C.3 Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
- 8.2.8.C.4 Identify the steps in the design process that would be used to solve a designated problem.
- 8.2.8.C.6 Collaborate to examine a malfunctioning system and identify the step-by-step process used to troubleshoot, evaluate and test options to repair the product, presenting the better solution.
- 8.2.8.C.8 Develop a proposal for a chosen solution that include models (physical, graphical or mathematical) to communicate the solution to peers.
- 8.2.8.D.1 Design and create a product that addresses a real world problem using a design process under specific constraints.
- 8.2.8.D.3 Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.
- 8.2.8.E.2 Demonstrate an understanding of the relationship between hardware and software.
- 8.2.8.E.3 Develop an algorithm to solve an assigned problem using a specified set of commands and use peer review to critique the solution.

Technology Integration | NJSLS 8.1

- 8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.
- 8.1.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

21st Century Integration | NJSLS 9

- 9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

Career Ready Practices

- CRP2. Apply appropriate academic and technical skills.
- CRP6. Demonstrate creativity and innovation.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

Interdisciplinary Connections:

- NGSS | Science
    - MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

  - MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
  - MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
- NJSLS | Mathematics
  - 6.EE.A.2.a Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation "Subtract y from 5" as 5 – y.
  - 6.EE.A.2.c. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). For example, use the formulas V = s3 and A = 6s2 to find the volume and surface area of a cube with sides of length s = 1/2.

V. Instructional Materials

Core Materials:

- LEGO EV3 Programming Software
- LEGO EV3 Curricular Materials
- Robot Architecture, Design, Programming and Game Strategies by Sanjeev Dwivedi
- The LEGO MINDSTORMS EV3 Idea Book: 181 Simple Machines and Clever Contraptions by Yoshihito Isogawa
- The Art of LEGO MINDSTORMS EV3 Programming by Terry Griffin
- LEGO EV3 Robotics: A Guide for Educators by Mariappan Jawaharlal
- LEGO EV3 Robotics Kits
- Teacher computer with Internet access and projector/Smart Board
- Document Camera
- Desktop Computing Devices

Supplemental/District Created Materials:

- Robot Care Handouts
- First Day of Class PPT
- Lego EV3 Hardware PPT
- Quick Start Guide PPT
- Design Process PPT
- Basic Movements PPT
- Basic Movements Handout (worksheet)
- Flow Control PPT
- Totes McGoats Rubric Handout
- Totes McGoats Project Introduction Video
- Sensing Colors and Light PPT
- Ultrasonic Sensor PPT
- Gyro Sensor PPT
- Special Delivery Rubric Handout
- Battle Bots Rubric Handout
- Battle Bots Introduction Video

- Multitasking PPT
- Special Delivery Intro

VI. Key Performance and Benchmark Tasks

Assessment Methods:

- Students will complete approximately three (3) projects between unit 1 and 3.
- When a student completes a project, s/he will complete a checklist, reflect on their work and answer thoughtful questions on their design process.
- A rubric is outlined on the checklist sheet, delineating the project parameters and expectations.

Summative:

Unit 1: Critical Thinking, Robotics, and the Design Process

- Utilize robotic parts to create a fully functioning robot.
- Identify a robot's capabilities by looking at its hardware.
- Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.
- Create a robotic structure to solve a problem.

Unit 2: Robotic Hardware and Software

- Identify functions of basic sensors.
- Demonstrate how to program a basic or single sensor.
- Utilize flow control while programming.
- Explain the importance of flow control while programming.
- Students will be able to utilize the Engineering Design Process to solve a real-world problem.
- Explain how different teams/groups can contribute to the overall design of a product.
    - Totes McGoats

Unit 3: Robotic Applications & Design Challenges

- Implement problem-solving strategies to solve a problem that meets certain constraints.
- Program multiple sensors to accomplish a given task.
- Utilize or improve elements to the structure of the robot to help the robot accomplish its goals.
- Utilize flow control while programming advanced sensors.
- Program a robot to multitask using separate strings of code to be carried simultaneously.
    - Special Delivery
    - Battle Bots!

Formative:

- Peer Feedback: TAG (Tell, Ask, Give) Sticky Notes
- Peer Feedback Form
- Self-Reflection: 2 Stars & 1 Wish
- Critique Guide
- Reflective Exit Tickets/Slips (example 1 | example 2)

Alternative:

- Student choice is built into each project, which makes each project unique for each and every student.
- Adjustments to assessment criteria and assessments themselves are described below in Section VII.

VII. Accommodations & Modifications for Special Education, Students at Risk for School Failure, English Language Learners, Gifted & Talented, and 504s

Special Education

- Student choice in projects to allow for appropriate skill levels to be applied.
- Clarify and repetition of expectations, review of expectations at the start of class, highlighting expectations on student hardcopies, provide specific tasks as needed to clarify goals.
- Support of student focus: verbal prompts, visual cues (lights out, etc.).
- Positive reinforcement.
- Pacing and guidance in long term projects.
    - Work chunked out based on tasks, individual check ins.
    - Extended projects are broken down into manageable tasks with frequent check-ins from the teacher.
- Copies of Notes:
    - Ev3 Hardware Notes
    - Engineering Design Process Notes
    - Action Block Notes
    - Touch Sensor Notes
    - Robot Cheat Sheet
    - Color Sensor Notes
    - Ultrasonic Sensor Notes
    - Multitasking Notes
    - Gyro Sensor Notes
    - Multitasking Notes
    - Special Delivery Intro
    - Battle Bots Intro

English Language Learners

- Use of Google Translate to assist students with instructions and lessons so they can follow along.
- Adjust goals to allow for language acquisition.
- Visual prompts and demonstrations.
- Teacher modeling of skills.
- Simplified written and verbal instructions. Include written instructions to supplement verbal.

- Preferential seating.

Gifted & Talented

- Access to additional materials to develop ideas and project details.
    - Quick Start Guide
    - Action Block Notes
    - Touch Sensor Notes
    - Color Sensor Notes
    - Ultrasonic Sensor Notes
    - Multitasking Notes
    - Gyro Sensor Notes
    - Special Delivery Intro
    - Battle Bots Intro

Students at Risk of School Failure

- Student choice in projects to allow for appropriate skill levels to be applied.
- Clarify and repetition of expectations, review of expectations at the start of class, highlighting expectations on student hardcopies, provide specific tasks as needed to clarify goals.
- Support of student focus: verbal prompts, visual cues (lights out, etc.).
- Positive reinforcement.
- Pacing and guidance in long term projects: Work chunked out based on tasks, individual check ins.
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- Copies of Notes:
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504s

- Completely dependent on the student's 504 plan.

- If the student cannot utilize computers or look at screens, research, planning, and computer-based learning experiences can be done on paper.
- If the students' level of mobility is limited, making it difficult for the students to navigate the classroom, the student will be assigned a buddy to help with acquiring the necessary materials and supplies.
- If the students' fine or gross motor skills are impacted, s/he will receive assistance from the teacher for the specific hands-on skills that require them.

GENERAL NOTES:

- The order in which the units are taught can be adjusted at the teacher's discretion.
- Days are fluid and some activities may extend longer.
- Lessons and units will be adjusted as per students' prior knowledge.