TRUMBULL PUBLIC SCHOOLS

Trumbull, Connecticut

ROBOTICS 1

Grade 10-12

2026

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The Trumbull Board of Education will continue to take Affirmative Action to ensure that no persons are discriminated against in its employment.

COURSE DETAILS

CORE VALUES AND BELIEFS

The Trumbull High School community engages in an environment conducive to learning which believes that all students will read and write effectively, therefore communicating in an articulate and coherent manner. All students will participate in activities that present problem-solving through critical thinking. Students will use technology as a tool applying it to decision making. We believe that by fostering self-confidence, self-directed and student-centered activities, we will promote independent thinkers and learners. We believe ethical conduct to be paramount in sustaining the welcoming school climate that we presently enjoy.

Approved 8/26/2011

INTRODUCTION & PHILOSOPHY

Robotics 1 is an introductory course for students interested in engineering, programming, and automation technologies. Designed to explore the past, present, and future of robotics, this course offers a hands-on approach to learning the fundamentals of mechanical design, engineering principles, and computer programming through the construction and control of robots.

Students will engage in the complete design process—from brainstorming and prototyping to building and coding functional robotic systems. Emphasis is placed on developing problem-solving, critical thinking, and collaborative skills that are essential in technical careers and applicable across all academic disciplines.

As part of Trumbull High School's commitment to expanding course offerings and increasing academic rigor, Robotics 1 serves as a foundational step in introducing students to STEM pathways, particularly in engineering and computer science.

COURSE GOALS

The following course goals derive from the 2014 Connecticut Technology Education Standards, Engineering Technology:

Code	Standard Description
ENG.01.01	Recognize the interrelationships between engineering, technology, society, and the environment.
ENG.02.01	Identify components of the design process (problem, brainstorm, research, develop, test, reflect).
ENG.02.09	Build a prototype from working drawings using appropriate materials.
ENG.02.10	Test prototype to defined criteria.
ENG.02.11	Redesign prototypes.
ENG.02.12	Communicate processes and results.
ENG.03.01	Identify technical careers and the required knowledge and skills.
ENG.04.01	Identify types of drawings used in engineering.
ENG.05.01	Read and understand design documentation and technical manuals.
ENG.05.03	Prepare and present technical information to an audience.
ENG.05.04	Actively contribute to a team project.
ENG.05.05	Identify characteristics of an effective design team.
ENG.06.01	Describe the function of a safety device.
ENG.06.03	Use all tools and equipment safely.
ENG.06.04	Demonstrate proper use of engineering lab equipment.
ENG.06.07	Use proper personal protective equipment (PPE).
EKS.02.01	Organize oral and written information.
EKS.02.02	Deliver effective oral presentations.
EKS.02.05	Present formal and informal communications clearly.

EKS.03.02	Apply data and measurements to solve a problem.
EKS.04.02	Apply scientific methods (data gathering, analysis, observation).
EKS.04.03	Use critical thinking skills to analyze and evaluate situations.
EKS.05.02	Analyze elements of a problem to develop creative solutions.
EKS.05.04	Create ideas, proposals, and solutions to problems.

The following course goals derive from the 2024 ISTE standards:

1.4 Innovative Designer	**Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.**
1.4.a Design Process	Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
1.4.d Open-Ended Problems	Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems

COURSE ENDURING UNDERSTANDINGS

Students will understand that…

- Robotics integrates mechanical engineering, electronics, and computer science to solve real-world problems.
- Automation and robotics have transformed modern industry and continue to shape the future of work and society.
- The engineering design process is iterative and essential to innovation and problem-solving.
- Programming is a critical tool for controlling machines and automating tasks.
- Teamwork, communication, and creative thinking are essential for success in technological fields.

COURSE ESSENTIAL QUESTIONS

- How do robotics and automation influence the way we live and work?
- What roles do engineering and programming play in creating robotic systems?
- How can we use the design process to solve problems in innovative ways?
- What are the ethical, social, and economic impacts of emerging robotics technologies?
- How can we use failure and iteration to improve our designs?

COURSE KNOWLEDGE & SKILLS

Students will know:

- The history and evolution of robotics and automation.
- Key components of a robotic system: sensors, actuators, controllers, and power systems.
- Basic programming concepts and logic structures (e.g., loops, conditionals).
- The steps of the engineering design process.
- Common robotic platforms and tools (e.g., VEX or other systems used).

Students will be able to:

- Identify and describe the major parts of a robot and their functions.
- Apply the engineering design process to solve a challenge.
- Write, test, and debug simple programs to control robotic systems.
- Build and operate robots using mechanical and electronic components.
- Collaborate with peers to design, build, and present a working robot.
- Analyze and reflect on design performance to make iterative improvements.

Vision of the Graduate

The Robotics 1 course purposefully integrates the eight core competencies outlined in Trumbull Public Schools' Vision of the Graduate. These competencies are not treated as abstract ideals, but as real, observable behaviors and mindsets that students cultivate through robotics tasks, teamwork, technical problem-solving, and self-reflection.

Vision of the Graduate Competency	How It Is Embedded Throughout the Course
Communication	Students communicate through team roles, oral presentations, visual diagrams, coding comments, and engineering notebook entries. They are expected to express technical ideas clearly and respond thoughtfully to peer feedback.
Self-Efficacy	Individual driving challenges, debugging tasks, and personal engineering notebook goals build confidence. Students self-monitor progress and overcome setbacks, fostering belief in their own capabilities.
Critical Thinking & Problem Solving	Each unit presents real-world design and programming problems. Students engage in iterative testing, root cause analysis, and strategic thinking to solve increasingly complex robotic challenges.
Collaboration	All builds are team-based, requiring shared decision-making, respectful task division, and ongoing peer accountability. Students use group norms, team logs, and peer evaluations to develop collaboration skills.
Growth Mindset	Students revise code, rebuild mechanisms, and reflect on errors. Feedback is framed around progress and learning, not perfection. Notebook entries and check-ins support positive responses to failure.
Integrity	Emphasized through honest engineering notebook documentation, proper lab safety procedures, and respectful behavior during team tasks and competitions—even when unsupervised.
Innovation	From challenge strategy development to claw and drivetrain customization, students are asked to imagine and test creative solutions, always encouraged to push boundaries and experiment.

Emotional Intelligence	Students participate in team-building, engage in structured debriefs, and reflect on emotions tied to success, frustration, and teamwork. Teachers explicitly model and prompt awareness of team dynamics.

Robotics Progression Plan

Robotics 1 – Foundations of Robotics

Focus: Teamwork, Engineering Process, Block-Based Coding, Starter Kits, VEX Build Basics

Tools: VEX Starter Kits, Green Motors, Block-Based VEXcode, No Gears

Unit	Topic	Activities & Focus
1	Lab Safety & Team Building	Safety protocols, icebreakers, intro to engineering notebooks
2	Intro to Programming with VEXcode VR	Individual block-based coding challenges, driving virtual bots
3	Build Speed Bot	Team build, driving tests, basic block programming, small coding tasks
4	Add Claw Mechanism	Expand robot functionality, manipulative tasks, intro to basic sensors
5	Competition Challenge	Team-based design and strategy, solve an in-class game using the starter box
6	Final & Reflection	Final driving test, notebook check, peer feedback, self-assessment

Robotics 2 – Intermediate Robotics & Automation

Focus: Sensor Integration, Python Programming, Custom Builds, Physics of Motion, Aerial Robotics

Tools: VEX Advanced Sensors, Python (VEXcode), Drone Kits

Unit	Topic	Activities & Focus
1	Lab Safety & Refresher Activities	Safety, team-building, intro challenge, light Python review
2	Programming with Python + Clawbot VR	Move from block to Python, advanced VR challenges using sensors
3	Physics of Robotics	Gear ratios, torque, sensors, motion, real-world applications
4	Custom Robot Competition Build	Students design custom robots (non-starter-kit) to solve a game
5	Drone Engineering	Flight principles, quadcopter programming, obstacle flying
6	Final & Presentation	Final comp, drone challenge, portfolio presentation, notebook submission

Key Differences – Robotics 1 vs. Robotics 2

Aspect	Robotics 1	Robotics 2
Programming Language	Block-Based (VEXcode VR)	Python (VEXcode w/ Text)
Hardware Used	Starter Kits Only	Custom Builds + Advanced Sensors
Motors	Green Motors	Smart Motors
Sensors	Limited (e.g., touch, bumper)	Advanced (e.g., vision, distance, gyro)
Mechanical Systems	No gears or ratios	Gears, torque, leverage explored
Notebook Emphasis	Introduced & Used Teamwide	Required and Evaluated in-depth

Drone Exposure	None	Dedicated Unit on Drones and Flight Dynamics

COURSE SYLLABUS

Course Name:

Robotics 1

Level:

Elective

Prerequisites:

None

General Description of the Course

Robotics 1 is an introductory course for students interested in engineering, programming, and automation technologies. Designed to explore the past, present, and future of robotics, this course offers a hands-on approach to learning the fundamentals of mechanical design, engineering principles, and computer programming through the construction and control of robots.

Students will engage in the complete design process—from brainstorming and prototyping to building and coding functional robotic systems. Emphasis is placed on developing problem-solving, critical thinking, and collaborative skills that are essential in technical careers and applicable across all academic disciplines.

As part of Trumbull High School's commitment to expanding course offerings and increasing academic rigor, Robotics 1 serves as a foundational step in introducing students to STEM pathways, particularly in engineering and computer science.

Assured Assessments

Formative Assessments

- Unit 1: General
  - Hazard Scavenger Hunt (checklist or peer-reviewed)
- Unit 2: Intro to Engineering
  - Robotics Vocabulary Quiz (10–15 key terms)
  - Career Notes Sheet or One-Pager
  - Notebook Entry Check (setup, daily logs, labels, observations)
- Unit 3: Virtual robots
  - Programming exercises in virtual environment
  - Peer code review sessions
- Unit 4: Speed Bot
  - Team Build Checklist (rubric-based: wiring, part connections, structural integrity)
  - Programming Debug Logs (tracked per student)
  - Peer Evaluation on Team Collaboration
- Unit 5: Clawbot
  - Programming demo checkpoints
  - Claw functionality test
  - Notebook entries and peer check
- Unit 6: Competition
  - Strategy review
  - Prototype design submission
  - Check-in interviews

Summative Assessments

- Unit 1: General
  - General Lab Safety Quiz
- Unit 2: Intro to Engineering
  - Engineering Notebook
- Unit 3: Virtual robots
  - Virtual Robot Challenge Project: Write and test a program in the simulator to complete a task (e.g., navigate a maze)
  - Short quiz on basic coding concepts and robot fundamentals.
- Unit 4: Speed Bot
  - Driving Challenge 1
  - Driving Challenge 2
  - Engineering Notebook
- Unit 5: Claw Bot
  - Engineering Notebook
- Unit 6: Competition
  - Engineering Notebook

Scope, Timing, Standards, and Assessments Overview

Unit	Title	# of Classes	Standards	Major Assessments
1	Lab Safety	2 classes	ENG.06.01, ENG.06.03, ENG.06.04, ENG.06.07	- Hazard Scavenger Hunt - Lab Safety Quiz
2	Intro to Robotics & Engineering Process	4 classes	ENG.01.01, ENG.03.01, ENG.04.01, ENG.05.01, EKS.02.01, EKS.04.03	- Vocabulary Quiz - Career Research or One-Pager - Engineering Notebook Setup & Mini Design Entry
3	Virtual Robots (VEXcode VR)	8 classes	EKS.03.02, EKS.04.02	- Programming Exercises - Peer Code Review - Virtual Robot Challenge - Coding Quiz
4	Speed Bot Build & Drive	8 classes	ENG.02.01, ENG.02.09, ENG.02.10, ENG.05.04, EKS.05.04	- Team Build Checklist - Programming Debug Logs - Peer Evaluation - Driving Challenges 1 & 2 - Engineering Notebook Submission
5	Clawbot Manipulation	8 classes	ENG.02.11, ENG.02.12, ENG.05.01, ENG.05.05, ENG.06.04	- Claw Functionality Test - Programming Checkpoints - Engineering Notebook Submission - Manipulation Challenge
6	Competition Challenge	11 classes	ENG.02.01, ENG.02.09–.12, ENG.05.01, ENG.05.04–.05, EKS.02.02, EKS.05.02, EKS.05.04	- Strategy Review - Prototype Design Check-in- Interviews - Engineering Notebook Final - Final Competition Performance

UNIT 1

Lab Safety

Unit Description

This introductory unit welcomes students into the Robotics 1 course and establishes a foundation in lab safety, tool handling, and expectations for collaborative engineering work. Students will engage in activities to explore the lab layout, discuss safe tool use, and apply hazard-identification skills in real-world robotics settings. The goal is to create a safety-first culture and an understanding of engineering professionalism.

Unit Standards

ENG.06.01	Describe the function of a safety device.
ENG.06.03	Use all tools and equipment safely.
ENG.06.04	Demonstrate proper use of engineering lab equipment.
ENG.06.07	Use proper personal protective equipment (PPE).

Essential Questions

- What makes a robotics lab environment unsafe?
- How does each team member contribute to a safe and effective engineering space?
- What responsibilities do students have when working with tools, electronics, and moving parts?

Key Vocabulary

- SDS (Safety Data Sheets)
- Trip Hazard
- PPE (Personal Protective Equipment)
- Tool Safety
- Emergency Shutoff
- Workshop Etiquette

Unit Goals:

By the end of this unit, students will be able to:

- Identify fire, trip, and electrical hazards in a robotics lab
- Demonstrate safe handling of robotics equipment, tools, and power systems
- Use PPE and lab equipment correctly and responsibly
- Recognize unsafe behaviors and apply appropriate safety protocols
- Exhibit teamwork and communication in a technical workspace

Unit Scope and Sequence

- Locations of emergency equipment.
- Fire escape route.
- Proper use of personal safety practices and personal protective equipment (PPE).

Unit Assured Assessments

Formative Assessments

- Hazard Scavenger Hunt (checklist or peer-reviewed)

Summative Assessments

- General Lab Safety Quiz (multiple choice, true/false, labeling diagrams)
  Covers hazard types, equipment use, emergency procedures, and safe lab behavior.

Vision of the Graduate Integration

This unit develops key competencies from the Vision of the Graduate, including:

- Integrity
- Collaboration
- Emotional Intelligence
- Communication

How it is developed in this unit

- Integrity: Students consistently follow safety protocols and demonstrate ethical tool use, even when not directly supervised.

- Collaboration: Group activities and lab tasks require students to build rapport, practice accountability, and share responsibilities.
- Emotional Intelligence: Team-building and icebreaker exercises foster awareness of group dynamics and respectful interaction.
- Communication: Students engage in group discussions and complete team safety plans, learning to clearly express concerns and listen to others.

Resources

Core:

- Safety Data Sheets
- Safety worksheets
- Robotics Lab Safety Guide
- Tool Safety Videos
- Teacher-made “Hazard Scenario” Slide Deck

Supplemental:

- Note taking worksheets
- VEX Robotics Safety Manual
- OSHA Youth Safety in STEM Environments Toolkit

Time Allotment

- Approximately 3 Classes

UNIT 2

Intro to Robotics

Unit Description

Before programming or building robots, students need to understand what robotics is, how it's applied in the real world, and how engineers approach solving problems. This unit explores what defines a robot, introduces the Engineering Design Process, and highlights the importance of the Engineering Notebook as a documentation tool. Students will also examine real-world robotics careers and future technologies, establishing a strong conceptual foundation for the rest of the course.

Unit Standards

ENG.01.01	Recognize the interrelationships between engineering, technology, society, and the environment.
ENG.03.01	Identify technical careers and the required knowledge and skills.
ENG.04.01	Identify types of drawings used in engineering.
ENG.05.01	Read and understand design documentation and technical manuals.
EKS.02.01	Organize oral and written information.
EKS.04.03	Use critical thinking skills to analyze and evaluate situations.

Essential Questions

- What defines a robot and how is it different from other machines?
- How do engineers solve problems using the design process?
- Why is documenting our work as engineers essential?
- How are robotics used in industries today and in the future?

Key Vocabulary

- Robot
- Automation
- Artificial Intelligence

- Engineering Design Process
- Iteration
- Engineering Notebook
- Input/Output
- Autonomous
- Prototype
- Career Pathways

Unit Goals

By the end of this unit, students will be able to:

- Define a robot and its core components
- Explain and apply the steps of the Engineering Design Process
- Begin using the Engineering Notebook for documentation and reflection
- Identify key careers and industries using robotics
- Describe emerging trends in robotics (AI, medical robotics, space, etc.)

Unit Scope and Sequence

- What is a Robot? Introduction & Comparison to Other Machines (group discussion, video analysis)
- Engineering Design Process Overview – Diagram, Case Study, Apply to Small Task
- Introduction to the Engineering Notebook – Purpose, Examples, Set Up, First Entry
- Robotics in Industry – Career Research Stations or Career Slide Deck
- Future of Robotics – AI, Drones, Medical, Space (article analysis or short TED talks + discussion)

Unit Assured Assessments

Formative Assessments:

- Robotics Vocabulary Quiz (10–15 key terms)
- Career Notes Sheet or One-Pager
- Notebook Entry Check (setup, daily logs, labels, observations)

Summative Assessments:

- Engineering Notebook
    - Students set up their engineering notebook, complete several entries, and demonstrate understanding of its purpose and organization
    - Students go through a simplified design process to solve a classroom problem and document it in full using their notebook (problem, brainstorm, sketch, solution, reflection)

- Written or visual reflection on the role of robotics in today's world and personal interest in the field

Vision of the Graduate Integration

This unit develops key competencies from the Vision of the Graduate, including:

- Innovation
- Critical Thinking & Problem Solving
- Self-Efficacy
- Growth Mindset

How it is developed in this unit:

- Innovation: Students explore the evolving role of robotics and propose new ways robots could solve global challenges.
- Critical Thinking: Students analyze real-world robotics problems and apply the engineering design process to prototype basic solutions.
- Self-Efficacy: By using engineering notebooks and completing entry tasks, students build confidence in documenting and owning their progress.
- Growth Mindset: Through classroom discussions and reflections, students learn that iteration and setbacks are part of the design journey.

Resources

Core:

- VEX Introduction to STEM and Robotics materials
- Engineering Design Process posters
- Sample Engineering Notebooks (paper or digital)
- Robotics Career Exploration Sheets

Supplemental:

- TED-Ed or PBS learning videos on robotics futures
- Videos: Boston Dynamics, NASA Robotics, Medical Robots
- VEX Classroom resources on notebook expectations

Time Allotment

- Approximately 4 Classes

UNIT 3

Virtual Robots

Unit Description

Students explore foundational robotics concepts through VEXcode VR, a virtual programming platform. They simulate autonomous robot movement, sensor use, and logic programming in a safe, browser-based environment. Key focus is on learning basic commands, sequences, loops, and conditionals using virtual robots.

Unit Standards

EKS.03.02	**Apply data and measurements to solve a problem.**
EKS.04.02	Apply scientific methods (data gathering, analysis, observation).

Essential Questions

- How does programming influence robot behavior?
- What basic electrical concepts are essential for robotics?
- How do virtual simulations prepare us for real-world robot programming?

Key Vocabulary

- Algorithm
- Loop
- Conditional Statement
- Simulation
- Debugging
- Sensor

Unit Goals:

By the end of this unit, students will be able to:

- Write simple robot programs using virtual simulators.
- Understand and explain basic electricity concepts (voltage, current, circuits)
- Use logic structures (loops, conditionals) in coding
- Analyze and debug simple programs
- Simulate robot movements and sensor inputs virtually

Unit Scope and Sequence

- Introduction to virtual robotics simulators (VEXcode VR, Tinkercad Circuits, or similar)
- Basics of programming language syntax for robotics (blocks or text-based)
- Fundamentals of electric circuits and sensors in robotics
- Creating, running, and troubleshooting virtual robot code
- Exploration of robot movement commands and sensor feedback loops

Unit Assured Assessments

Formative Assessments

- Programming exercises in virtual environment
- Peer code review sessions

Summative Assessments

- Virtual Robot Challenge Project: Write and test a program in the simulator to complete a task (e.g., navigate a maze)
- Short quiz on basic coding concepts and robot fundamentals.

Vision of the Graduate Integration

This unit develops key competencies from the Vision of the Graduate, including:

- Critical Thinking & Problem Solving
- Self-Efficacy
- Growth Mindset

How it is developed in this unit:

- Critical Thinking: Students create, test, and refine block-based programs to complete virtual movement tasks with precision.
- Self-Efficacy: Each student works independently, measuring success and tracking growth in coding skills and simulation challenges.
- Growth Mindset: Students reflect on failed attempts, revise code, and view each programming challenge as an opportunity to improve.

Resources

Core:

- Virtual robotics programming platforms (e.g., VEXcode VR)
- Introductory coding tutorials and simulation tools
- Teacher-created slide decks and worksheets on electricity and programming

Supplemental:

- Online coding games (e.g., Code.org robotics modules)

Time Allotment

Approximately 8 Classes

UNIT 4

Speed Bot

Unit Description

Students work in teams to assemble a VEX Speed Bot using kits (VEX EXP or V5), then individually complete programming and driving tasks. Programming is done using VEXcode (blocks or text). Emphasis is placed on teamwork during the build and individual accountability for robot operation and understanding. Each team submits a detailed Engineering Notebook documenting the process.

Unit Standards

ENG.02.01	Identify components of the design process (problem, brainstorm, research, develop, test, reflect).
ENG.02.09	**Build a prototype from working drawings using appropriate materials.**
ENG.02.10	**Test prototype to defined criteria.**
ENG.05.04	**Actively contribute to a team project.**
EKS.05.04	Create ideas, proposals, and solutions to problems.

Essential Questions

- What makes a robot move efficiently and predictably?
- How do teams divide roles during engineering builds?
- How do engineers document and reflect on progress?

Key Vocabulary

- Chassis
- Motor
- Autonomous
- Debugging
- Input/Output
- Calibration
- Navigation
- Driver Control
- Command Sequence

Unit Goals:

By the end of this unit, students will be able to:

- Work effectively in a team to assemble a basic robotic platform
- Program simple movements using block- or text-based coding software
- Execute precise robot driving tasks using both autonomous and manual controls
- Troubleshoot and refine robot performance using test data and feedback
- Demonstrate individual mastery through driving tasks and programming checks

Unit Scope and Sequence

- Introduction to Speed Bot components; teams assigned
- Robot assembly in teams (chassis, motors, wiring, sensors)
- Safety check and basic driving interface (manual control)
- Programming basic forward/backward and turning commands
- Individual Driving Challenge 1: Straight line speed + stop at target
- Individual Driving Challenge 2: Navigate an "L" shaped path
- Debugging workshop and retest for incomplete tasks

Unit Assured Assessments

Formative Assessments:

- Team Build Checklist (rubric-based: wiring, part connections, structural integrity)
- Programming Debug Logs (tracked per student)
- Peer Evaluation on Team Collaboration

Summative Assessments:

- Driving Challenge 1- Drive forward to a marked zone and stop with precision
- Driving Challenge 2 - Navigate an L-shaped course using programming OR manual control
- Engineering Notebook
    - Notebook Requirements:
        - Team member roles
        - Daily progress logs
        - Problems encountered
        - Code changes with notes
        - Testing/debugging reflections
        - Photos and diagrams

Vision of the Graduate Integration

This unit develops key competencies from the Vision of the Graduate, including:

- Collaboration
- Self-Efficacy
- Communication
- Critical Thinking

How it is developed in this unit:

- Collaboration: Students must plan builds together, divide tasks, and rely on peer support to complete the robot's structure.
- Self-Efficacy: Each student completes individual driving assessments and logs their development of key mechanical and coding skills.
- Communication: Engineering notebooks and team debriefs ensure ideas, issues, and successes are documented and shared clearly.
  Critical Thinking: Students solve mechanical and coding problems with real-time feedback and structured testing.

Resources

Core:

- Robotics kits (e.g., VEX IQ)
- Compatible programming software (VEXcode)
- Prebuilt driving challenge templates (floor mats or taped course)
- Checklists and rubrics for build and driving tasks

Supplemental:

- Video tutorials on basic movement coding
- Safety and operation guides for robot hardware
- Collaborative troubleshooting forums or whiteboards

Time Allotment

Approximately 8 Classes

UNIT 5

Clawbot

Unit Description

Students upgrade their robot with a VEX claw mechanism and tackle complex, real-world inspired manipulation challenges. Teams must integrate mechanical, electrical, and programming elements effectively. Each team continues maintaining an Engineering Notebook detailing iteration and problem-solving throughout the unit.

Unit Standards

ENG.02.11	**Redesign prototypes.**
ENG.02.12	**Communicate processes and results.**
ENG.05.01	Read and understand design documentation and technical manuals.
ENG.05.05	Identify characteristics of an effective design team.
ENG.06.04	Demonstrate proper use of engineering lab equipment.

Essential Questions

- How do robots manipulate their environment?
- What role does documentation play in effective teamwork?
- How do we improve a robot design through testing?

Key Vocabulary

- Claw
- Manipulator
- Payload
- Precision
- Engineering Notebook
- Collaboration
- Prototype
- Redesign

Unit Goals:

By the end of this unit, students will be able to:

- Design and attach a claw mechanism to their robot
- Program the robot for manipulation tasks (grabbing, lifting, placing)
- Work effectively in teams to strategize and execute challenges
- Maintain detailed engineering notebooks documenting design and testing

Unit Scope and Sequence

- Introduce mechanical principles for claw design
- Build and attach claw assembly
- Program control sequences for claw operation
- Plan and execute complex challenges requiring manipulation (e.g., pick and place)
- Team communication strategies and documentation practices

Unit Assured Assessments

Formative Assessments:

- Programming demo checkpoints
- Claw functionality test
- Notebook entries and peer check

Summative Assessments:

- Engineering Notebook
- Notebook Requirements:
- Detailed problem-solving logs
- Role tracking
- Code versioning and screenshots
- Photos of design evolution
- Challenge strategy + reflections

Vision of the Graduate Integration

This unit develops key competencies from the Vision of the Graduate, including:

- Innovation
- Collaboration
- Critical Thinking
- Growth Mindset

How it is developed in this unit:

- Innovation: Students design, build, and iterate claw attachments to perform manipulation tasks in unique and creative ways.
- Collaboration: Teams strategize roles and test different approaches, with full transparency in documentation and iteration logs.
- Critical Thinking: Programming the claw mechanism and refining task performance requires careful problem-solving and analysis.
- Growth Mindset: Students reflect on prototype failures and improvements in their notebooks as part of the iterative process.

Resources

Core:

- VEX EXP or V5 with Claw Add-On Kits
- VEXcode
- Engineering Notebook guide & rubric
- Teacher sample challenge mats

Supplemental:

- Videos on mechanical design concepts
- Sample engineering documentation examples

Time Allotment

Approximately 8 Classes

UNIT 6

Competition

Unit Description

Teams apply everything they've learned in a cumulative challenge that mirrors real-world robotics competitions. The focus is on collaboration, applying the full engineering design process, and strategic problem-solving. While VEX systems are still used, students will also showcase their skills in documentation and iteration.

Unit Standards

ENG.02.01	Identify components of the design process (problem, brainstorm, research, develop, test, reflect).
ENG.02.09–.12	Build a prototype from working drawings using appropriate materials. Test prototype to defined criteria. Redesign prototypes. Communicate processes and results.
ENG.05.01	Read and understand design documentation and technical manuals.
ENG.05.04–.05	Actively contribute to a team project. Identify characteristics of an effective design team.
EKS.02.01	Organize oral and written information
EKS.05.02	Analyze elements of a problem to develop creative solutions.
EKS.05.04	Create ideas, proposals, and solutions to problems

Essential Questions

- What are the traits of an effective engineering team?
- How do engineers solve complex problems collaboratively?
- Why is iteration and feedback so important in engineering?

Key Vocabulary

- Iteration
- Optimization
- Driver-Controlled
- Engineering Cycle

- Test Plan
- VEX Challenge Field

Unit Goals:

By the end of this unit, students will be able to:

- Write simple robot programs using virtual simulators.
- Understand and explain basic electricity concepts (voltage, current, circuits)
- Use logic structures (loops, conditionals) in coding
- Analyze and debug simple programs
- Simulate robot movements and sensor inputs virtually

Unit Scope and Sequence

- Review of expectations and challenge rules
- Strategy sessions and prototype design
- Programming for mixed control (autonomous + driver)
- Iterative testing and performance improvement
- Final competition / judged round

Unit Assured Assessments

Formative Assessments:

- Strategy review
- Prototype design submission
- Check-in interviews

Summative Assessments:

- Engineering Notebook
- Notebook Requirements:
- Detailed problem-solving logs
- Role tracking
- Code versioning and screenshots
- Photos of design evolution

Vision of the Graduate Integration

This unit develops key competencies from the Vision of the Graduate, including:

- Integrity
- Innovation
- Collaboration
- Communication
- Critical Thinking

How it is developed in this unit:

- Integrity: Students are held to high standards of sportsmanship, honest logging, and respectful play during competition.
- Innovation: Teams design their own strategy, custom builds, and code approaches for solving a unique game-style challenge.
- Collaboration: Each team uses shared roles, time management, and conflict resolution strategies to stay productive.
- Communication: Students communicate design strategies and results clearly through presentations and notebook logs.
  Critical Thinking: Students identify problems, prototype solutions, and adapt tactics based on real-time testing data.

Resources

Core:

- Full VEX Field Setup
- Competition-specific parts and field elements
- Team planning templates
- Judging rubrics and reflection guides

Supplemental:

- Online coding games (e.g., Code.org robotics modules)

Time Allotment

Approximately 11 Classes

CREDIT

Half-year .5 credit in STEM

PREREQUISITES

None

CURRENT REFERENCES

- VEXcode VR: vr.vex.com
- VEXcode: codev5.vex.com
- Carnegie Mellon Robototics Academy:.cmu.edu/roboticsacademy/index.html
- Vex Robotics: vexrobotics.com/v5

ASSURED STUDENT PERFORMANCE RUBRICS

- Trumbull High School Vision of the Graduate Rubrics

OTHER RESOURCES

Build Instructions:

- Online 3d: https://instructions.online/?id=4063-v5_clawbot
- PDF: https://link.vex.com/docs/v5-clawbot-buildinstructions

VEX Robotics - Downloads:

https://www.vexrobotics.com/catalogsearch/result/?q=__empty__&vex_site=downloads

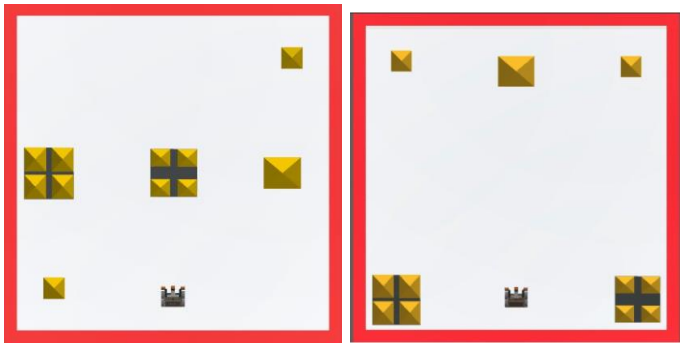
Engineering Notebook:

Engineering Notebook

ASSURED STUDENT PERFORMANCE RUBRICS

Sample VEXcode Vr

Sweep the Castle



Program: [vr.vex.com](vr.vex.com)

Objective: Algorithms

Playground: Dynamic Castle Crasher

Challenges:

Level 1: Create an algorithm to knock over all castle pieces three Playground layouts using the VR Robot. Use the pen to show the robots' path.

Level 2: Create an algorithm to knock over all the castle pieces and clear them off the playground.

Helpful Hints:

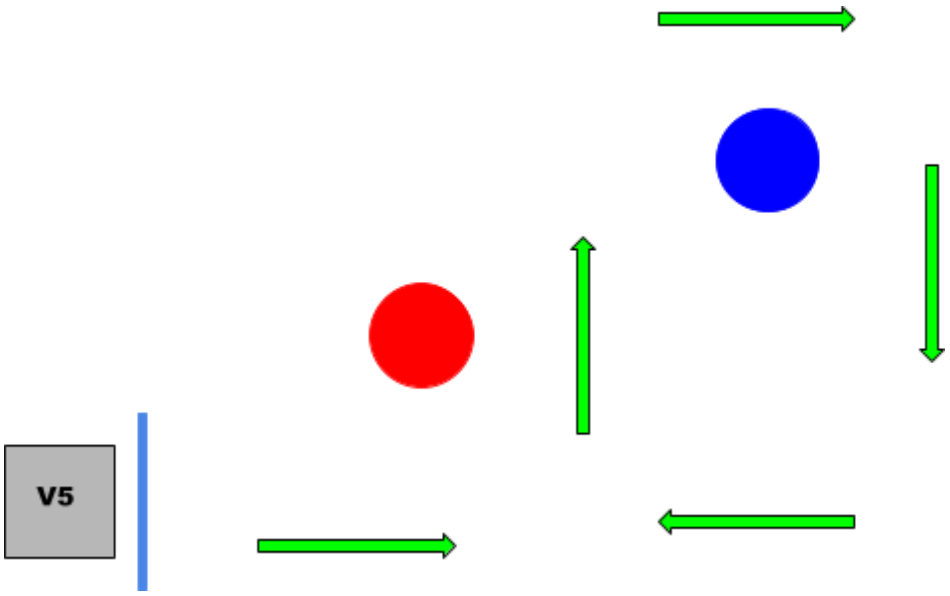
- Each time the Playground is reset, the layout of the buildings randomly changes. There are ten total Castle Crasher Playground layouts.
- Keep in mind that the algorithm should be written so that the VR Robot can knock over all five buildings regardless of the Playground layout.
- Castle building pieces will be detected as objects by the Distance sensor.
- Be careful not to fall off the side of the Playground because there are no walls!

VEXcode VR Sweep the Castle Rubric

Score	Level 1: Knock Over All Castle Pieces (with Pen)	Level 2: Knock Over & Clear Castle Pieces
5 – Excellent	The robot knocks over all pieces on all three layouts, **pen used**, algorithm is logical and efficient.	The robot knocks over **and clears all pieces** efficiently, the algorithm is logical and fully meets requirements.
4 – Proficient	Robot knocks over most pieces on all layouts, **pen used**, algorithm shows good logic with minor inefficiencies.	The robot knocks over and clears most pieces, algorithm is mostly efficient with minor issues.
3 – Satisfactory	Robot knocks over some pieces (1–2 layouts fully), **pen used**, algorithm works but is inefficient.	The robot knocks over all but clears only some pieces, the algorithm is functional but inefficient.
2 – Developing	The robot knocks over a few pieces, **the pen is not used**, and the algorithm has major errors.	The robot clears very few pieces, the algorithm is incomplete or inconsistent.
1 – Needs Improvement	The robot does not complete the task, **pen not used**, algorithm shows little understanding of the challenge.	The robot fails to knock over/clear pieces, and the algorithm shows little understanding of the task.

Sample VEX V5 Project

Two Cones and Back



Objective:

To create a program to have your robot drive around two cones and return back to the start line.

Requirements:

1. Program a drivetrain into the robot
2. Create a program that makes the drive on the right side of the first cone, the left side of the second cone, and turn to the start line facing forward.

Submit:

1. Have the teacher watch your robot complete its program when finished
2. PDF of your code

2 Cones & Back

Score	Performance Description
5 – Excellent	**The robot drives fully around both cones and returns to start with no collisions. Code is submitted, clear, and well-structured. The teacher observes a smooth and accurate run.**
4 – Proficient	**The robot completes the course but may brush against a cone or wall (1 deduction). Code is submitted, mostly correct, with minor inefficiencies. The teacher observes a successful run with small errors.**
3 – Satisfactory	**The robot completes most of the course but hits cones or walls 2–3 times (deductions). Code is submitted but may be inefficient or require corrections. The teacher observes partial task completion.**
2 – Developing	**The robot attempts the course but has multiple collisions (4+ deductions) or fails to return to the start. Code is submitted but incomplete or has major errors. The teacher observes significant issues.**
1 – Needs Improvement	**The robot does not complete the course, collisions prevent progress, or code is missing. The teacher observes little understanding of programming logic.**

Additional Rules

- **Code submission is required (no grade without it).**
- **The teacher must observe the robot run in real time.**
- **Deductions: -1 point per collision with a cone or wall (up to the max score possible).**

Sample VEX V5 Project

Robo Rally

In this challenge, you need to drive your robot through your race course combined with another individual or team's course! To successfully complete the challenge, teams must also create a correctly scaled map of the new combined course using the dimensions and scales from both students or teams. Each team from the combined course will have a Driver that will navigate the robot through the course. The team with the Driver who completes the course the fastest, wins!

Challenge rules:

- The robot must begin and end at the finish line.
- Both teams will use the Drive Program on the Robot Brain.
- As one team member drives the robot, others should ensure the robot is not hitting the sides of the course or losing control.
- You may drive the robot through the race course one time as a practice round before time is recorded.
- The dimensions of both courses must be in the same units and scale.
- Each team must complete a new correctly scaled map, with measurements, based on the values of the combined race courses.
- Whichever team completes the same course in the shorter amount of time - wins!
- Have fun!

Robo Rally Ruberic

Criteria	Excellent (Full Points)	Proficient	Developing	Needs Improvement
Team Collaboration & Roles (30 pts)	All team members actively participated (driver on controller, spotters guiding, others resetting barriers). Example: Driver uses the VEX Controller while teammates watch closely and communicate, preventing side collisions.	Most team members contributed; roles were mostly clear. Example: Driver uses the VEX Controller while one teammate gives feedback, but another is mostly silent.	Uneven contribution; some team members did most of the work. Example: Only one student drives while another occasionally helps reset the robot, the rest watch.	Little to no collaboration; unclear roles or lack of participation. Example: One student controls the robot while others are distracted and not helping.
Driving Performance (30 pts)	Driver completed course smoothly with no crashes or major corrections; excellent joystick control. Example: Using the VEX Controller joysticks, the robot drives straight and turns precisely without hitting walls.	Driver completed course with few small corrections, minimal side contact. Example: Robot touches a wall once but continues smoothly after a quick joystick adjustment.	Driver had frequent corrections, some wall contact or hesitations. Example: Robot often drifts into walls and needs repeated joystick adjustments.	Driver had significant difficulty, frequent wall hits, or loss of control. Example: Robot gets stuck multiple times and needs frequent resets.
Course Completion Time (20 pts)	Completed the course quickly and efficiently; among the fastest times. Example: Team completes the full course in 1:15 with strong control.	Completed course in a reasonable time, slight delays. Example: Team finishes in about 1:45, with only a couple of slowdowns.	Completed course but with slow pace or multiple restarts. Example: Team takes over 2:30, stopping often to readjust.	Did not complete course or took excessive time. Example: Robot cannot finish or takes more than 4 minutes with repeated resets.
Following Challenge Rules (20 pts)	Fully followed all rules: start/finish at correct line, used VEX Drive Program, and did only one practice round. Example: Robot is placed on the start tile, finishes correctly on the finish tile, and only one practice run is done.	Followed most rules; minor slip-ups. Example: Robot started slightly off the line but still used the correct program and finished properly.	Multiple rule issues. Example: Team switched units mid-course or took more than one practice round.	Did not follow rules. Example: Team never used the Drive Program or skipped the start/finish line requirement.

Robo Soccer

In this challenge, you will play soccer with your VEX V5 Speedbot along with any attachments you may have added to it. You will be controlling your robot controller using the Drive program on your V5 Robot Brain.
One person will referee the game and ensure each team follows the rules.

Challenge rules:

- The ball should be placed in the center of the field at the start of each game and after each goal.
- The robot must begin in front of your net.
- Players must stand behind their own goal throughout the duration of the game.
- Each game is 5 minutes long.
- On smaller fields (3m x 3m or less), there should only be one player on each team. Teams can increase in size (2v2 or 3v3) for larger fields.
- The ball must completely be in the goal for the point to count.
- Each goal is worth 1 point.
- After a goal is scored, each team's robot(s) must be returned to the front of their goal and both teams have to give a thumbs up to the referee to indicate they are ready to start the match.
- The referee will start the game and stopwatch by saying "Go!" at the beginning of the game and after each goal.
- The team with the most points at the end wins!
- Have fun!

Robo Soccer - Rubric

Criteria	Excellent (Full Points)	Proficient	Developing	Needs Improvement
Team Collaboration & Roles (30 pts)	All team members actively participate (driver controls robot, teammates reset ball, referee role is clear). Example: Driver uses the VEX Controller while teammates cheer, reset after goals, and confirm "thumbs up" with ref.	Most team members contributed; roles were mostly clear. Example: One teammate takes the referee role seriously, driver controls robot, but another does little.	Uneven contribution; one or two do most of the work. Example: Driver plays while others watch, referee doesn't track rules well.	Little to no collaboration; roles unclear or ignored. Example: Only the driver participates while others are disengaged.
Robot Control & Gameplay (30 pts)	Robot is controlled smoothly, consistently makes clean contact with the ball, and shows strategy (blocking, dribbling). Example: Using joysticks on the VEX Controller, robot dribbles ball to goal without hitting walls.	Robot is mostly controlled well, occasional crashes or missed kicks. Example: Robot pushes ball toward goal but sometimes bumps walls or loses control.	Robot shows frequent control issues, poor ball handling. Example: Robot misses ball often, spins in circles, or repeatedly crashes.	Robot is very difficult to control, unable to play effectively. Example: Robot rarely touches the ball or gets stuck during play.
Following Challenge Rules (20 pts)	Team fully follows all rules: starts at net, resets after goals, waits for referee, stands behind goal. Example: After scoring, robot is returned to the net, players give "thumbs up," referee restarts with "Go!"	Team follows most rules, with only minor mistakes. Example: Players forget "thumbs up" once but otherwise reset properly.	Multiple rule issues during play. Example: Robot doesn't always return to net after a goal or players step onto field.	Team disregards rules. Example: Robot starts in wrong place, ball isn't reset, players ignore referee.
Game Performance (20 pts)	Team scores efficiently, shows clear strategy (attacking/defending), and works well within time limit. Example: Team scores 3+ goals with coordinated driving and defense in 5 minutes.	Team scores some goals, shows basic strategy. Example: Team scores 1–2 goals, makes some defensive moves.	Team struggles to score, limited strategy. Example: Team only manages one goal late in the game.	Team cannot score or shows no attempt at strategy. Example: Robot never gets ball into the goal.

AutoMed Challenge

In this challenge, you need to program your robot to navigate a hospital as it delivers medications to patients in several different rooms. To successfully complete this challenge, you will need to program your robot to move from the Start Zone and stop in the Pharmacy for 5 seconds to pick up medications.

The project should then move the robot to each of the Patient Rooms (1, 2, and 3 in no particular order) and stop in the room for 3 seconds to deliver the medication. In order to move between floors in the hospital, the robot needs to park in the area designated as the Elevator for 5 seconds to indicate it is moving to another floor.

After medication has been delivered to all of the rooms, the robot should then return to the Start Zone. You should recreate the hospital map above on your floor using tape and a meter stick or ruler. Be sure to indicate where the Start Zone, Pharmacy, Elevator, and Patient Rooms are located.

To complete the challenge, you will need:

- Roll of tape (to create the hospital layout on the floor)
- 1.8 meter by 2 meter open area
- Meter stick or ruler

AutoMed - Rubric

Criteria	Excellent (Full Points)	Proficient	Developing	Needs Improvement
Programming Accuracy & Logic (35 pts)	Robot follows a **well-structured VEXcode program**, completes all steps (Pharmacy stop, Patient Rooms, Elevator, return to Start). **Example:** Robot runs autonomously, stops for exactly 5 seconds at Pharmacy, 3 seconds at each Patient Room, 5 seconds at Elevator, then returns to Start Zone without errors.	Robot completes most steps correctly with only minor timing or sequence errors. **Example:** Robot delivers to all rooms but pauses slightly too long/short at one stop.	Robot completes some but not all required steps; sequence is inconsistent. **Example:** Robot reaches Pharmacy but skips a Patient Room or misses correct timing.	Robot cannot follow programmed sequence; does not complete challenge. **Example:** Robot drives randomly, misses stops, or never returns to Start Zone.
Navigation & Control (30 pts)	Robot drives with **smooth, precise movements**, stays on taped hospital layout, and enters each zone cleanly. **Example:** Robot follows straight lines and turns accurately to reach each zone.	Robot mostly stays on layout, with occasional corrections or small overshoots. **Example:** Robot wobbles slightly but still makes it into each zone.	Robot struggles to stay on layout; often overshoots zones or drifts off tape. **Example:** Robot misses the edge of a room and requires adjustment.	Robot cannot reliably follow layout; misses multiple zones. **Example:** Robot frequently leaves taped path and doesn't reach rooms.
Timing at Zones (25 pts)	All pauses are **accurate to challenge requirements** (5s at Pharmacy & Elevator, 3s at each Patient Room). **Example:** Robot pauses exactly 5 seconds at Pharmacy before continuing.	Most pauses are accurate; only one is slightly off. **Example:** Robot pauses 4 seconds instead of 5 at Elevator but completes other zones correctly.	Multiple pauses are off in length; delivery timing inconsistent. **Example:** Robot pauses 1–2 seconds instead of 3 in Patient Rooms.	Robot does not pause correctly at most zones. **Example:** Robot passes through rooms without stopping.
Team Collaboration (10 pts)	Team members **share roles** (coding, testing, timing) and communicate effectively. **Example:** One codes in VEXcode, another tests, another records timing.	Most team members contribute, though roles are uneven. **Example:** Two members work hard, one less involved.	Contribution uneven; one person does most of the work. **Example:** Only one student codes and tests, others observe.	Little/no collaboration. **Example:** One person does entire challenge with no teamwork.

It's a Draw!

In this challenge, you will be tasked with using your robot to draw the things on your set of It's A Draw cards (Google Doc / .pdf) as a second person tries to guess the drawing! To perform your best in this challenge, you should practice drawing with your robot.

Criteria	Excellent (Full Points)	Proficient	Developing	Needs Improvement
Robot Drawing Accuracy (35 pts)	Drawing is **clear, recognizable**, and matches the chosen card. Robot is well-controlled with smooth lines. **Example:** Robot uses a mounted marker and draws a house with clear walls and a roof that teammates identify correctly.	Drawing is mostly recognizable with some uneven lines. **Example:** Robot draws a car shape that is identified but looks uneven.	Drawing is somewhat unclear or incomplete; guesser struggles to identify. **Example:** Robot draws a stick figure missing arms, guesser hesitates.	Drawing is unrecognizable or incomplete. **Example:** Robot scribbles or the marker falls off, guesser cannot identify.
Robot Control & Precision (25 pts)	Robot moves are **smooth and controlled**, marker maintains consistent contact with paper/floor. **Example:** Driver uses VEX Controller joysticks with precise turning to trace lines.	Robot mostly stays under control, with only minor wobbles or marker lifts. **Example:** Robot lifts marker briefly but continues the drawing.	Robot control is inconsistent; frequent jerky motions make drawing messy. **Example:** Robot repeatedly overshoots lines and circles back.	Robot is hard to control; cannot keep marker on paper/floor. **Example:** Robot drives off page or drags marker without forming shapes.
Team Collaboration (20 pts)	Both team members contribute actively — one drives, the other guesses. Strong communication. **Example:** Driver carefully draws while guesser gives feedback and guesses accurately.	Both members participate, though one takes more of the lead. **Example:** Driver works well, guesser makes correct guesses with a little delay.	Uneven participation; one does most of the work. **Example:** Driver struggles while guesser watches passively.	Little to no collaboration. **Example:** Driver works alone, guesser doesn't engage.
Guessing Accuracy & Engagement (20 pts)	Guesser **identifies most drawings correctly** within a short time; stays engaged throughout. **Example:** Guesser quickly identifies "tree," "car," "house."	Guesser identifies some drawings correctly but needs extra time. **Example:** Guesser figures out 2 of 3 drawings with hints.	Guesser identifies only 1 drawing or takes a long time to respond. **Example:** Guesser struggles to identify even simple shapes.	Guesser cannot identify drawings or is disengaged. **Example:** Guesser gives up or guesses randomly.

Groove Machine

In this challenge, you will break up into teams and program your robot to go through a dance routine using your knowledge of loops. Your teacher will set a time limit for developing/testing the dance and a time limit for the length of the dance. Everyone not on the competing head-to-head dance-off teams will judge the dances and vote on the team that they think is best.

Rules:

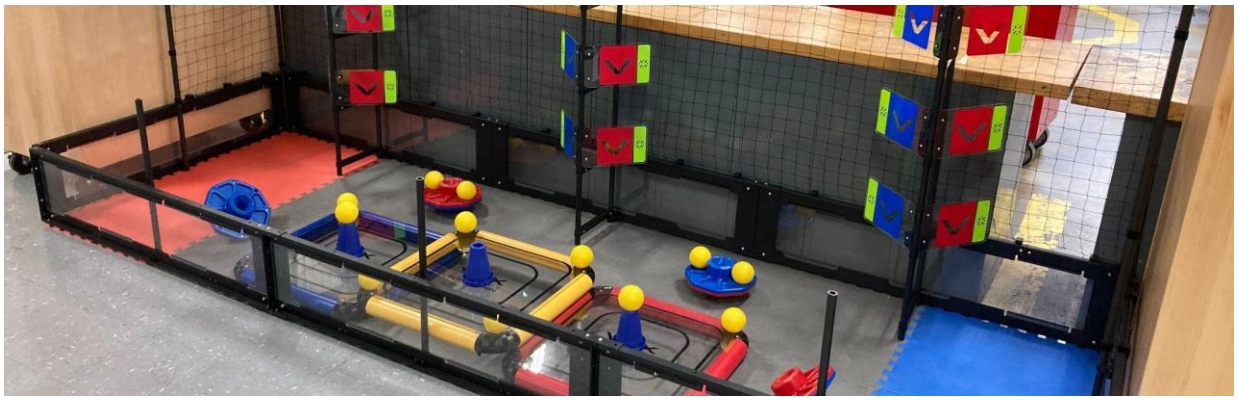
- Each Clawbot will dance one-at-a-time within the 1x1 meter area.
- The dancing continues until the Stop button on the Brain's screen is pressed to stop the project from running.
- The arm must be raised and lowered.
- The claw must open and close.
- The Clawbot must turn left and right.
- The Clawbot must drive forward and in reverse.
- The project needs to be stopped immediately if the Clawbot collides with anything or falls over. That is a losing dance.

Groove Machine - Rubric

Criteria	Excellent (Full Points)	Proficient	Developing	Needs Improvement
Programming & Use of Loops (30 pts)	Dance routine uses **loops effectively** to repeat smooth, creative sequences. All required moves (arm, claw, forward/reverse, left/right turns) are included. **Example:** VEXcode program loops a sequence where Clawbot spins, lifts arm, opens claw, and reverses, repeating seamlessly.	Most required moves included; loops are present but repetitive or basic. **Example:** Clawbot drives forward/backward and turns with some looping but limited variety.	Some moves missing; loops are minimal or poorly structured. **Example:** Arm doesn't raise or claw never opens, program runs straight-line commands.	Dance routine lacks loops and required movements. **Example:** Clawbot only drives forward and backward without variety.
Choreography & Creativity (25 pts)	Routine is **fun, well-coordinated, and looks like a dance**. Movements match rhythm and show creativity. **Example:** Clawbot "bobs" arm up and down while spinning and reversing like it's grooving.	Routine shows some rhythm and creativity, but feels repetitive. **Example:** Clawbot turns and moves with slight arm/claw action but lacks flair.	Routine shows limited creativity; looks mechanical or uncoordinated. **Example:** Clawbot repeats the same turn without variation.	Routine lacks creativity; movements appear random or incomplete. **Example:** Clawbot jerks forward/backward only.
Execution & Control (25 pts)	Robot runs routine **smoothly within 1x1 meter area**, with no collisions or falls. **Example:** Clawbot dances in place, stops correctly with Stop button.	Routine mostly smooth, with only small bumps or hesitations. **Example:** Clawbot nudges tape border once but stays upright.	Routine has multiple control issues; jerky motions or partial collision. **Example:** Clawbot bumps into boundary tape and wobbles.	Routine fails due to collision, tipping over, or out-of-bounds. **Example:** Clawbot drives off area and must be stopped.
Team Collaboration & Presentation (20 pts)	Team works together on coding and testing, presents routine confidently. **Example:** One codes, another tests, another introduces dance to the audience.	Most members contribute; presentation is clear but not engaging. **Example:** Two team members explain routine, third is quiet.	Uneven contribution; one member does most work. **Example:** One student codes while others only watch.	Little collaboration or presentation effort. **Example:** One student runs program silently with no team input.

Sample VEX V5 Competition Project

TURNING POINT



Game Description

VEX Robotics Competition Turning Point is played on a 3'x12' square field configured as seen above. Two (2) Alliances -- one (1) "red" and one (1) "blue" -- composed of one (1) Team each, compete in matches consisting of a one minute (60) second Autonomous Period, followed by a five minute (5:00) Driver Controlled Period.

The object of the game is to attain a higher score than the opposing Alliance by Flipping Scoring Caps, Toggling Flags, Mounting Cones and by Alliance Parking or Center Parking Robots on the Platforms.

Details

There are four (4) Caps, three (3) Posts, three (3)cones, nine (9) Flags, fourteen (14) Balls, two (2) Alliance Platforms, and one (1) Center Platform.

Caps can be Scored for the Alliance whose color is facing up at the end of the match. Flags can be Toggled to red or blue, and are Scored for the Alliance whose color is Toggled at the end of the match. Low Flags can be Toggled by Robots, but High Flags can only be Toggled by Balls. Turning Point is intended to be a back and forth game, no scored object is safe! Cones can be scored by placing them on the poles and can only be scored once by any team.

Alliance Platforms can be used for Alliance Parking by Robots of the same color Alliance as the Platform. The Center Platform can be used by Robots from either Alliance for Center Parking. An additional bonus is awarded to the Alliance that has the most total points at the end of the Autonomous Period.

Field



Scoring

Each Low Flag Toggled	1 Point
Each Medium Flag Toggled	5 Points
Each High Flag Toggled	10 Points
Each Cap Scored	10 Points
Each Cone Scored	15 Points
Robot that is Alliance Parked	5 Points
Robot that is Centre Parked	25 Points
Autonomous Bonus	X2 Any points scored during the autonomous round

Turning Point - Rubric

Criteria	Excellent (25 pts)	Good (20 pts)	Satisfactory (15 pts)	Needs Improvement (10 pts)
Autonomous Performance (Robot movement and scoring during the 1-minute autonomous period)	Robot consistently completes multiple tasks in autonomous (e.g., toggles at least 2 flags and flips a cap).	Robot completes at least 1 scoring action in autonomous (e.g., flips 1 cap or toggles 1 flag).	Robot moves correctly but does not complete a scoring task (e.g., drives to the object but doesn't flip it).	Robot does not run a valid autonomous or fails to move.
Driver-Controlled Skills (5-minute driver period, accuracy & control)	Robot is driven with precision, consistently scores on high-value targets (e.g., toggles medium/high flags, center parks).	Robot scores on a mix of low and medium-value tasks (e.g., flips caps, toggles low flags, alliance parks).	Robot moves and interacts but has trouble scoring consistently.	Robot is out of control, frequently stalls, or fails to score.
Game Strategy & Scoring Variety (Use of multiple ways to score: caps, flags, cones, parking)	Robot uses at least 3 scoring methods effectively (e.g., flags, caps, and center park).	Robot uses at least 2 scoring methods effectively.	Robot only uses 1 scoring method (e.g., only flips caps).	Robot does not attempt scoring variety or only drives around.
Teamwork & Problem-Solving (Coding, driving, adapting strategy, collaboration)	Team collaborates well, adjusts strategy mid-match, and communicates clearly (e.g., fixes code quickly if robot misbehaves).	Team works together but needs occasional teacher reminders to stay on task.	Team has uneven participation or struggles to adapt when robot has issues.	Team does not collaborate effectively; one person does all the work.

Engineering Notebook - Rubric

Criteria	Excellent	Proficient	Satisfactory	Needs Improvement
Identify the Problem (10 pts)	Clearly identifies game and robot design challenges with detailed descriptions and visuals. States clear goals for the challenge. Example: "Our Clawbot needs to flip caps and toggle flags efficiently in Turning Point. Goal: maximize autonomous scoring and driver control points."	Identifies the challenge but lacks detail or clarity in words, visuals, or goals. Example: "Robot needs to score in Turning Point. Goal: score as many points as possible."	Identifies the challenge, but details are minimal. Example: "Robot must move and score."	Does not identify the challenge clearly. Example: "Build a robot."
Brainstorm, Diagram, or Prototype Solutions (10 pts)	Lists 3+ solutions with labeled diagrams; cites external sources. Example: Draws 3 drivetrain options (tank, mecanum, omni wheels) with sketches and references VEX tutorials.	Lists 1–2 solutions; citations present. Example: Draws tank drive and claw attachment only.	Provides vague solutions or unclear diagrams. Example: Sketch of robot with minimal labels.	No solutions listed. Example: Blank or unrelated sketches.
Select Best Solution and Plan (10 pts)	Thorough explanation of selected solution, includes testing results and implementation plan. Example: "We chose tank drive with claw attachment after testing speed and turning efficiency. Program includes autonomous routine and driver control plan."	Explains selected solution but lacks depth. Example: "We chose tank drive. Program will move robot."	Brief explanation of solution/plan. Example: "We will build the robot with wheels and claw."	No explanation. Example: "We will build it."
Build and Program the	Records detailed build/program steps, allowing others to recreate the design. Example: Step-by-step	Records key steps but lacks full clarity. Example: Assembly noted, but sensor connections unclear.	Minimal steps; hard to follow. Example: "Attach wheels, program robot."	No relevant steps recorded. Example: Blank notebook.

Solution (10 pts)	assembly notes, VEX V5 motor assignments, sensor ports, VEXcode logic blocks listed.			
Test Solution (10 pts)	Records all testing steps, includes results and analysis. Example: "Tested autonomous path three times, robot flipped 3 caps each trial, analyzed why claw missed 1 cap and adjusted motor speed."	Records key steps; analysis limited. Example: "Tested autonomous, some caps flipped."	Some testing recorded; lacks details. Example: "Tested robot, worked okay."	No testing steps recorded. Example: Blank or incomplete.
Repeat Design Process (10 pts)	Shows multiple iterations for improvement. Example: "Iteration 1: claw too weak, Iteration 2: adjusted motor torque, Iteration 3: optimized path."	Some repetition; lacks detail. Example: "Improved claw after first test."	Minimal evidence of iteration. Example: "Adjusted robot once."	No evidence of iteration. Example: Built robot once, no changes.
Independent Inquiry (10 pts)	Strong independent inquiry; ideas well documented. Example: "Researched VEX forums for claw designs, added a ball intake module inspired by other teams."	Some inquiry; partial documentation. Example: "Looked at VEX examples online for reference."	Limited inquiry documented. Example: "Asked friend for ideas."	No independent inquiry. Example: Copied another team without research.
Usability and Completeness (10 pts)	Records design/development in clear detail, easy to follow. Example: Notebook includes labeled diagrams, program screenshots, test notes, and reflections.	Completes process; some missing detail. Example: Notebook readable but missing sensor diagrams.	Lacks sufficient detail. Example: Minimal steps and unclear drawings.	Fails to document effectively. Example: Blank pages or unrelated content.
Record of Team & Project	Comprehensive record of assignments, meetings, resource constraints. Example: Notes	Records most relevant info; somewhat inconsistent. Example: Some meeting notes, unclear roles.	Missing key aspects of project management. Example: Only lists who built robot.	No record of project management. Example: No notes.

Management (10 pts)	showing who built, coded, tested; lists battery/motor availability.			
Notebook Format (10 pts)	Organized, dated entries, easy to navigate. Example: Sections labeled: Problem, Brainstorm, Build, Test, Reflection; pages numbered.	Some organization; could improve clarity. Example: Sections present but inconsistent order.	Lacks consistency/organization. Example: Notes scattered, hard to follow.	No organization. Example: Random notes, undated.

Skill Rubric: Communication 9-12 (currently under revision)

Indicator of Attainment	Beginning 1	Meets 2	Exceeds 3	Score
PURPOSE Expresses ideas in alignment with the intended purpose.	Limited demonstration of understanding. Purpose is not identified and/or not fully articulated. Does not or partially expresses ideas in alignment with purpose.	Purpose is identified and articulated but may be occasionally unclear. Expresses ideas with purpose.	Purpose is identified and clearly articulated and enhanced. Clearly expresses ideas in alignment with the intended purpose. Makes connections beyond the intended purpose.	
AUDIENCE Demonstrates an awareness of the intended audience.	Demonstrates little to no awareness of the audience. Language and content is inappropriate and/or ineffective for the audience.	Demonstrates an awareness of the audience. Language and content is appropriate and helps the audience understand the topic/position.	Clearly and consistently demonstrates a complete awareness of the intended audience by connecting to the audience and adjusting as needed. Engages with and responds to the intended audience in a developmentally appropriate manner. Language and content is appropriate and precise which helps the intended audience further understand the topic/position.	

ORGANIZATION Organizes and supports ideas in alignment with the intended purpose.	The organizational structure is not and/or minimally effective for the purpose. The topic/position is not focused and/or minimally supported by details.	Effective organizational structure supports the purpose. The topic/position is focused, well thought out, and supported by accurate and effective details.	Clearly expresses ideas in alignment with the intended purpose. Purpose is clearly identified and connections are made beyond the intended purpose. Substantive and accurate details support and extend the topic/position with exceptional development, specificity, and depth.	
LISTENING Receives and responds to ideas in alignment with the intended purpose.	Limited to no ability to listen to others. Unable to ask relevant questions. Can not paraphrase/restate the message.	Listens to, evaluates, and responds to others. Asks relevant questions. Demonstrates understanding by accurately paraphrasing/restating the message.	Actively listens to, evaluates and responds to others. Asks relevant questions that indicate an interest to learn more and understand further. Demonstrates understanding by accurately paraphrasing/ restating the message and expanding upon the ideas presented.	

SCORING Beginning: 4 - 6 **Meets: 7 - 8 GOAL** Exceeds: 10 - 12 ___/ 12

Skill Rubric: Collaboration 9-12 (currently under revision)

Indicator of Attainment	Beginning 1	Meets 2	Exceeds 3	Score
PLANNING Works effectively with and is receptive to the ideas/contributions of group members.	Does not or lacks a discussion on the strengths of each group member. Does not define group roles.	Assigns roles and defines contributions of those in the group. Suggests ways the group can approach the task.	Assigns roles and defines contributions based upon the unique knowledge, abilities, or interests of those in the group. Plans the approach to the task and anticipates challenges and resolutions.	
COMMUNICATION Thinks with the group and acknowledges multiple perspectives.	Does not or rarely listens to the thinking of the group. Provides little to no feedback.	Utilizes the thinking of the group in order to work toward the completion of the task. Provides feedback.	Synthesizes and expresses the multiple perspectives of the group in order to complete the task. Provides feedback that improves the quality of the task.	

CONTRIBUTION Works with others to complete a task and shares the credit.	Little or no contribution to the task.	Shares work, reviews others' contributions and offers general feedback.	Shares work beyond the individual task, constructively critiques others' contributions, and offers feedback to improve the overall quality of the task.	
REFLECTION Monitors individual and collective contributions of each group member throughout the completion of the task.	Little or no reflection on ways to adjust the group's collaboration process throughout the task/product. Focuses only on individual contributions to the task.	Reflects and suggests individual and/or collective contributions to adjust the group's collaboration process to improve the quality of the task.	Applies relevant and diverse individual and collective contributions to monitor and adjust the quality of the task.	

SCORING Beginning: 4 - 6 **Meets: 7 - 8 GOAL** Exceeds: 10 - 12 ___/ 12

Skill Rubric: Critical Thinking/Problem Solving 9-12 (currently under revision)

Indicator of Attainment	Beginning 1	Meets 2	Exceeds 3	Score
UNDERSTANDING Identifies the problem, question or issue being addressed.	Exhibits limited and/or no understanding of key concepts.	Exhibits an understanding of key concepts.	Exhibits a thorough and accurate understanding of key concepts and can access those concepts from multiple perspectives.	
PLANNING Applies systematic thinking and selects strategies to address the problem, question or issue.	Shows limited to no evidence of a plan, model or strategy to solve a problem.	Shows a plan, model or strategy to solve a problem.	Shows innovative and creative thinking to solve a problem.	
QUESTIONING	Unable to or has difficulty questioning and analyzing numerical, written, or visual data and identifying related evidence.	Questions and analyzes numerical, written, or visual data and selects the relevant evidence.	Questions and analyzes numerical, written, or visual data and selects the most relevant and impactful evidence.	

Analyzes relevant information related to the problem, question or issue.			Describes why different approaches to a problem or situation could yield the same or similar results.	
REFLECTION Makes evidence-based conclusions/solutions and makes adjustments as needed to address the problem, question or issue.	Solution is inadequately supported or supported with minimal evidence, limited analysis of data and relevant information.	Solution is accurately supported by evidence and the student makes conclusions based on appropriate evidence.	Solution is thorough, accurate, and evidence-based. Shows extensive, thoughtful and reflective thinking on how a problem is solved and makes adjustments as needed.	

SCORING Beginning: 4 - 6 **Meets: 7 - 8 GOAL** Exceeds: 10 - 12 ___/ 12

Disposition Rubrics 9-12

Draft Rubrics

Draft Rubrics/Frameworks (9-12)
1. **Self-Efficacy** 2. **Growth Mindset** 3. **Innovation** 4. **Emotional Intelligence** 5. **Integrity**

DRAFTSelf-Efficacy 9-12

PORTRAIT OF A GRADUATE

- GRADES 9-12

Definition: Self-Efficacy is the belief that you are capable of successfully performing a task or managing a situation.

Reflective Opportunities	**A secondary student may demonstrate self-efficacy by:** ● Asking for extra help to clarify a concept in math class so he/she can complete the homework with success. ● Dealing with frustration by taking a deep breath and reminding herself that she can look back at the textbook and go to extra help before the test. ● Participating in class discourse despite being unsure of the answer ● Tackling new challenges with a positive attitude ● Using positive self talk while playing sports even when losing ● Entering a new grade and thinks that she will pass all of her classes, even though she struggled in the past. ● Setting personal goals and celebrating successes ● Confidently participating in class discussions ● Willingly accepting feedback from students and peers ● Standing up for yourself or a peer after observing name calling	**Areas of Growth**

	Feedback to Students	
	Goals (growth areas) for Future Learning	

Growth Mindset 9-12

PORTRAIT OF A GRADUATE

- GRADES 9-12

Definition: The belief that one that can improve their intelligence or skills through continued hard work and adapt when faced with challenges.

Reflective Opportunities	**A secondary school student may demonstrate a growth mindset by…** ● Analyzing errors on assessments with the intent to expand their learning ● Exhibiting grit in task completion regardless of obstacles ● Setting, adapting, and completing short term and long term goals ● Understand that failure is a part of being a life-long learner, and responds with persistence and/or trying other methodologies ● Shows resourcefulness by consulting with other entities as needed in order to find ways to accomplish a task ● Taking breaks when needed in order accomplish small components towards the larger goal ● Identify the leverage aspects of a task that will move completion forward ● Exhibiting flexibility and adaptability while going through the process of goal setting ● Develop a path to succeed by evaluating one's own abilities ● Shows drive and motivation with an end goal in mind. ● Continuing in a course of action, using discouragement, opposition or previous failure as learning opportunities to continue towards achieving goals.	**Areas of Growth**
	Feedback to Students	
	Goals (growth areas) for Future Learning	

Innovation 9-12

PORTRAIT OF A GRADUATE

- GRADES 9-12

Definition: Innovation is the ability to look at something familiar and see new possibilities, which leads to curiosity about new learning and the desire to create something original or imaginative

Reflective Opportunities	**Behavioral Examples:** **A secondary school student may demonstrate innovation/creativity/curiosity by…** ● Giving a presentation that has a high degree of creativity. ● Trying a unique, different method to solve a problem instead of the one shown by the teacher ● Incorporating new technology, such as creating a podcast, to enhance their final project in class. ● Independently researching a topic from class that was of particular interest ● Expressing excitement about the opportunity to do/try something new ● Suggests a new and different approach to the assignment, such as creating a song instead of writing an open ended response ● Demonstrating eagerness to take learning beyond the classroom, like researching your own family history after learning about ancestry ● Asking questions to intellectually challenge teachers and peers ● Designing or improving new processes or approaches ● Generating ideas for how to approach the group project	**Areas of Growth**
	Feedback to Students	
	Goals (growth areas) for Future Learning	

Emotional Intelligence 9-12

PORTRAIT OF A GRADUATE

- GRADES 9-12

Definition: Students exhibit an aptitude for being able to identify how and why they are feeling, and how to regulate and address those emotions.

Reflective Opportunities	**A secondary school student may demonstrate emotional intelligence by…** ● Showing empathy for others; for example, understanding when a classmate may not be able to complete an assignment at the same level. ● Working with classmates cooperatively despite differences. ● Using strategies to regulate their own emotions and behaviors and/or helps peers when they are frustrated or sad. ● Exercising empathy in a way that spreads joy and positivity through representing the strengths of others or the situation (eg. we have the materials to finish the project or our differences in the team give us strengths to accomplish goals even better than on our own) ● Accurately expressing their emotional state when faced with frustration (eg. failing a test, not being asked to the dance) ● Talking about conflicts such as deciding on roles in a group in order to respectfully and sensitively find solutions ● Encouraging classmates to behave properly for a substitute teacher (showing self-control of their behavior and emotions). ● Building relationships despite differences (has friends with different abilities and backgrounds)	**Areas of Growth**

	• Recognizing group dynamics during collaborative tasks and communicating so that roles are distributed with sensitivity (choosing teammates for a sport or project, volunteering for roles, suggesting configurations sensitively) • Accepting responsibility for actions after making a mistake • Honoring classmates in their work together by understanding people have different perspectives and ways of expressing their emotions. • Handling setbacks and adapting when things don't go according to plan. • Following through with commitments showing reliability and trustworthiness with peers and adults. • Demonstrates confidence by volunteering to present materials to a large crowd for the first time.	
	Feedback to Students	
	Goals (growth areas) for Future Learning	

Integrity 9-12

PORTRAIT OF A GRADUATE

GRADES 9-12

Definition: Integrity is doing the right thing even when it's hard or when no one is looking.

Reflective Opportunities	**A secondary school student may demonstrate integrity by…** ● Showing up on time to class and doing homework in a timely manner ● Noticing when another student drops her/his books in the hallway, and helps to pick them up ● Returning a wallet that is found in the parking lot with the content intact ● Helping an individual who is struggling with learning - offers to help with Algebra homework by solving similar problems (peer to peer learning) ● Volunteering to help with a service project with the Trumbull Food Bank-creates flyers and collects canned food items with permission from the principal. ● Respecting her peer who is wearing a sari ● Speaking up when student overhears a peer being teased and/or by privately letting the teacher know what happened/Name calling is hurtful, think before you speak ● Advocating for a peer after observing another student calling someone names ● Volunteering to help at practice for the Unified basketball team. ● Taking pride in their work and behaviors ● Using school resources such as WeVideo appropriately; when asked to use it for school assignments and not personal video making, the students only created the science video to document learning. ● Dressing and accessorizing in their own style and confidently walking into school regardless of the reactions of others. Be yourself in the face of adversity ● Modeling appropriate behavior and ignoring negative/bad behavior when provoked by others	**Areas of Growth**
	Feedback to Students	

	Goals (growth areas) for Future Learning	