

Springfield Public Schools
Springfield, New Jersey 07081

Automation and Robotics
Grade 8

Curriculum Guide

2026

This curriculum may be modified through varying materials, techniques, and strategies as per an individual student's IEP.

Springfield Board of Education
Approved July 27, 2026

Springfield Public Schools

Cultivating compassionate and extraordinary learners!

EXTRACT OF THE MINUTES OF A MEETING OF
THE BOARD OF EDUCATION OF
THE TOWNSHIP OF SPRINGFIELD
COUNTY OF UNION, NEW JERSEY
AS RECORDED IN THE OFFICIAL MINUTE BOOK

Resolution: 21

Introduced By: Mrs. Gamarekian

Seconded By: Vice President Rinaldi

Adopted: July 27, 2026

Curriculum Adoption

To approve the following new and revised curriculum and courses for the 2026-2027 school year:

1. High School Courses

- a. AP Cybersecurity (new course)
- b. AP Business with Personal Finance (new course)
- c. AP Biology
- d. AP Chemistry
- e. AP Physics 1
- f. PLTW Robotics and Automation
- g. PLTW Introduction to Engineering Design
- h. PLTW Principles of Engineering
- i. Biology
- j. Biology Honors
- k. Chemistry
- l. Chemistry Honors
- m. Conceptual Physics
- n. Physics
- o. Environmental Science
- p. Forensics
- q. Human Anatomy and Physiology
- r. Oceanography
- s. Science 8
- t. Molecular Biology Research Lab (new course)

2. Middle School Courses

- a. Science 6
- b. Science 7

3. Elementary School Courses

- a. Kindergarten Science
- b. Grade 1 Science
- c. Grade 2 Science

Michelle Calas, School Business Administrator/Board Secretary

(continued)

I, Michelle Calas, School Business Administrator/ Board Secretary of the Springfield Board of Education, hereby certify that the extract from the minutes of a meeting of the Board of Education duly called and held on July 27, 2026 has been compared by me with the original minute book of said Board of Education, and is a true, complete and exact copy thereof, as far as the same relates to the subject matter to on said extract.

In WITNESS THEREOF, I have hereunto set my hand and seal of the Springfield Board of Education, this 28th day of July 2026.

SEAL

A handwritten signature in black ink, appearing to read 'Michelle Calas', is written over a horizontal line.

Michelle Calas
School Business Administrator/ Board Secretary



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

**Springfield Public Schools
Springfield, New Jersey**

**Rachel Goldberg
Superintendent of Schools**

**Erica Scudero
Assistant Superintendent of Curriculum and Instruction**

Curriculum Developed By:

Tim Kielty ~ Middle School Principal

Gregory Salmon ~ STEM Supervisor

Robert Hildebrand ~ Science Teacher



Table of Content

New Jersey Student Learning Standards: Page 3 - 4

Course Outline: Page 5 - 27



New Jersey Student Learning Standards - Science

- MS-ETS1-1 - Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- 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.
- MS-PS2-2 - Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in grades 6–8 builds on K–5 experiences and progresses to specifying relationships between variables and clarifying arguments and models.

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)
- Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.

- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

Disciplinary Core Ideas (DCIs)

ETS1.A: Defining and Delimiting Engineering Problems

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)



- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)
- Models of all kinds are important for testing solutions. (MS-ETS1-4)

ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

Computer Science and Design Thinking (Standard 8)

- 8.1.8.CS.2 - Design a system that combines hardware and software components to process data.
- 8.2.8.ED.2 - Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3 - Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
- 8.2.8.ED.4 - Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team
- 8.2.8.ED.5 - Explain the need for optimization in a design process.
- 8.2.8.ED.6 - Analyze how trade-offs can impact the design of a product.
- 8.2.8.ED.7 - Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
- 8.2.8.NT.2 - Analyze an existing technological product that has been repurposed for a different function

Career Readiness (Standard 9):

- 9.2.8.CAP.5 - Develop a personal plan with the assistance of an adult mentor that includes information about career areas of interest, goals and an educational plan.
- 9.2.8.CAP.10 - Evaluate how careers have evolved regionally, nationally, and globally.
- 9.2.8.CAP.12 - Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential.
- 9.2.8.CAP.19 - Relate academic achievement, as represented by high school diplomas, college degrees, and industry credentials, to employability and to potential level
- 9.4.8.CT.1 - Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
- 9.4.8.IML.4 - Ask insightful questions to organize different types of data and create meaningful visualizations.
- 9.4.8.IML.7 - Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a).
- 9.4.8.TL.3 - Select appropriate tools to organize and present information digitally.
- 9.4.8.TL.5 - Compare the process and effectiveness of synchronous collaboration and asynchronous collaboration.



PLTW Professional Development

Automation and Robotics

Automation and Robotics at a Glance

PLTW Automation and Robotics is a nine-week, STEM unit of study. The focus of this unit is the development of automation and robotics and their use to improve daily life. Students investigate mechanical systems, motion transfer, machine automation, and computer control systems. Using the VEX® Robotics platform, students design, build, and program real-world devices, such as food dispenser, robot pet companion, and transport system.

Automation and Robotics uses the PLTW activity-, project-, and problem-based (APB) instructional design approach, which centers on hands-on, real-world activities, projects, and problems that help students understand how the knowledge and skills they develop in the classroom can be applied in everyday life. The APB approach scaffolds student learning through structured activities and projects that empower students to become independent in the classroom and help them build skill sets to apply to an open-ended, real-world problem.

This approach provides students unique opportunities to work collaboratively, identify problems, apply what they know, persevere through challenges, find unique solutions, and lead their own learning.

The student learning progression starts with basic concepts and practices in Lesson 1 and moves to more advanced concepts and practices in Lesson 2. Students learn and add more tools to their tool belts as they progress through the unit and prepare for taking on the challenge of designing and developing solutions that meet the needs of users.

The following is an overview of the lessons in the PLTW Automation and Robotics unit. The lessons scaffold the students' knowledge and skills in basic mechanisms and computer science concepts and practices.

Lesson 1: Automating Mechanisms

Students explore how gear trains and other mechanisms transfer movement in mechanical systems and design, build, and program automated systems to meet the needs of clients. In the end-of-lesson project, students can choose to design an interactive device to keep pets physically and mentally active, a spinning street sign to warn drivers to slow down and stop, or a high-speed dragster.

Activity 1.1 Welcome Interns!

Students build a simple structure to create a gear train with 3 gears, driven by a hand crank. Students are presented with two challenges where they explore how changing the input gear affects the output movements.



PLTW Professional Development

Automation and Robotics

Activity 1.2 On the Move

Using the structure they built in the previous activity, students replace the hand crank with a motor to drive the gears and control the motor using a program in VEXcode.

Activity 1.3 Rescue Mission

Students use the motorized structure from the previous activity to build a chassis for a 4-wheel rescue vehicle prototype. They attach the VEX Brain to the vehicle to make it autonomous.

Activity 1.4 Robot Shuffle

Students add a bumper or limit switch to the four-wheel vehicle they created in the previous activity. They develop a program to make the robot move along a line and change directions based on physical inputs.

Activity 1.5 Looping Shuffles

Students add loops to their programs from the previous activity to create more elaborate dance sequences with programmed actions.

Activity 1.6 Time to Switch Gears

Students explore the relationship of the size of the gears and changes to speed and torque in a simple gear train.

Activity 1.7 It is Universal

Students build a device that includes a universal joint, a mechanism that can change the direction of motion through a range of angles while the device is being used.

Activity 1.8 Bevel Up

Students complete an instant design challenge to build a device that includes a bevel gear, a mechanism used to change the direction of motion by 90 degrees.

Project 1.9 Purposeful Design

Students apply their knowledge and skills from Lesson 1 to the end-of-lesson project. The project choices include creating a pet entertainment center for a humane shelter that is short on people volunteers, creating a spinning sign to make a dangerous crosswalk safer, or creating a robot drag racer for a fun drag race contest.

Lesson 2: Sensors and Systems

Students investigate the versatility of an optical sensor as a programmed input device. Students extend their knowledge of mechanisms as they design increasingly complex prototypes to serve the needs of users. In the



PLTW Professional Development

Automation and Robotics

end-of-lesson project, students connect inputs to outputs through programming to create effective solutions that help their communities.

Activity 2.1 Makes Sense

Students explore an optical sensor and further their programming skills to include conditional statements within loops.

Activity 2.2 Color Coded

Students detect color as an input with an optical sensor as they continue to create more complex programs with conditional statements and loops.

Activity 2.3 Follow Me

Students build an interactive decoration that moves using a cam and follower when an optical sensor detects an object.

Activity 2.4 End of the Line

Students build a chain drive system to move cubes of a specific color from a storage location to a shipping location.

Project 2.5 Helping Hand

Students apply their knowledge and skills from Lessons 1 and 2 to the end-of-lesson project. The project choices include creating an amusement park ride that moves along a track and has an animatronic pop up when the cart is detected, creating an automated robot toy that works like a pull toy, or creating an automated animatronic design for a restaurant or store front.

Lesson 3: Create and Automate

Students design solutions using an automated mechanical system and the programming necessary for communication between the sensors, motors, and building components. Students pick their own problems or select problems that highlight their creativity and are of service to others. Throughout the unit students reflect on their growing skills and interests and explore careers in the field.

Project 3.1 Show Your Skills

Students apply their knowledge and skills from Lessons 1 and 2 to the end-of-unit problem. The problem choices include creating an automated art installation, creating automated agricultural systems for a local farm, creating an assembly line to produce a product, creating an automated animatronic set for play or movie, creating an automated system for a food pantry warehouse, or creating a solution to a problem of their own choosing.



PLTW Automation and Robotics Unit Framework

PLTW

PLTW Framework - Overview

PLTW Unit Frameworks provide an overview of the levels of understanding that each build upon the higher level: Knowledge and Skills, Objectives, Domains, and Competencies. The most fundamental level of learning is defined by course Knowledge and Skills statements. Each Knowledge and Skills statement reflects specifically what students will know and be able to do after they've had the opportunity to learn the course content. Students apply Knowledge and Skills to achieve learning Objectives, which are skills that directly relate to the workplace or applied academic settings. Objectives are organized by higher-level Domains.

Essential Questions

- What is the purpose of modeling?
- How does algorithmic thinking help you solve complex problems?
- Why is understanding how parts connect as a system important?
- What are some positive and negative ways that automation has changed or is changing the way people work, live, and play?
- Why is understanding the user perspective an important part of design?
- How do you express yourself and your creativity through engineering and computer science?
- Why are teams of people more successful than an individual when solving problems?
- What does effective teamwork look like?
- What does it take to effectively develop a solution to a problem or need?
- How can failure produce positive outcomes?
- What skills prepare you for diverse career opportunities?

Transportable Knowledge and Skills

Core workplace skills that students and workers need to acquire, that can be used across all stages of a career, and that, because of their universal utility, are transportable from job to job, from employer to employer, across the economy.

Career Awareness and Exploration (CAE):

The skills necessary to prepare and modify a flexible education plan based on interests while discovering career opportunities.

CAE-A.Explore a variety of careers.

CAE-A.1 Explore a variety of careers related to engineering, biomedical sciences, and computer science.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☒	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☐	☐	☒	☒

CAE-A.2 Identify skills that are needed for a variety of careers (such as communication and collaboration).

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☒	☒	☐	☒	☒	☒	☐	☐	☐	☐	☐	☐	☒



Competencies, Domains, Objectives, Knowledge and Skills

CAE-A.3 Explore and reflect on your personal interests and strengths in relation to diverse career opportunities.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒

Communication (COM):

The skills necessary to both provide and receive information with others, including interpersonal skills such as social awareness, conflict management, and empathy.

COM-A. Communicate effectively for specific purposes and settings.

COM-A.1 Use accurate and appropriate terminology.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☒	☒	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

COM-A.2 Communicate to meet the needs of the audience and be appropriate to the situation.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☒	☒	☒	☒	☒	☒	☒	☒	☒	☐	☐	☐	☐	☒	☒

COM-A.3 Document work, including processes, research, and solutions.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

COM-A.4 Use reliable evidence to support a claim.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☒	☐	☐	☒	☐	☐	☐	☐	☐	☐

Collaboration (COL):

The skills necessary for students to work together effectively with a common purpose to achieve desired results.

COL-A. Collaborate effectively on a diverse and multidisciplinary team.

COL-A.1 Demonstrate successful collaboration through effective communication and constructive feedback.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☒	☐	☐	☐	☒	☒	☐	☐	☐	☒	☒	☒

COL-A.2 Apply team norms to encourage productivity and define how a team will function and measure its success.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☒	☐	☐	☐	☒	☒	☐	☐	☐	☐	☒	☒

COL-A.3 Identify and evaluate positive and negative behaviors that impact the team's effectiveness.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☐	☐	☐	☒	☒



Competencies, Domains, Objectives, Knowledge and Skills

COL-A.4 Describe one's individual role and expectations of performance within the team and support other team members, if needed, to meet team goals.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9		2.1	2.2	2.3	2.4	2.5		3.1
☐	☐	☐	☒	☐	☐	☐	☒	☒		☐	☐	☐	☐	☒		☒

Ethical Reasoning and Mindset (ERM):

The skills necessary for students to make decisions between what is considered right and wrong based on evidence, beliefs, values, and emotions.

ERM-A. Demonstrate ethical decision-making.

ERM-A.1 Analyze ethical considerations and their impact in decision making.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9		2.1	2.2	2.3	2.4	2.5		3.1
☐	☐	☐	☐	☐	☐	☐	☒	☐		☐	☐	☐	☐	☐		☐

Critical and Creative Problem-Solving (CCP):

The skills necessary for students to generate ideas and solutions to problems.

CCP-A. Apply the design process to create a solution.

CCP-A.1 Describe major steps of a design process and the typical tasks involved in each step.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9		2.1	2.2	2.3	2.4	2.5		3.1
☐	☐	☐	☐	☐	☐	☐	☒	☒		☐	☐	☐	☒	☒		☒

CCP-A.2 Identify appropriate design requirements (criteria and constraints).

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9		2.1	2.2	2.3	2.4	2.5		3.1
☐	☒	☒	☒	☒	☐	☒	☒	☒		☒	☒	☒	☒	☒		☒

CCP-A.3 Generate ideas or build upon other ideas to innovate.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9		2.1	2.2	2.3	2.4	2.5		3.1
☐	☐	☐	☐	☒	☐	☐	☐	☒		☐	☒	☐	☐	☒		☒

CCP-A.4 Evaluate solution ideas against the design requirements and justify the best solution to pursue.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9		2.1	2.2	2.3	2.4	2.5		3.1
☐	☐	☐	☒	☐	☐	☐	☐	☒		☐	☒	☐	☐	☒		☒

CCP-A.5 Iteratively design and develop a solution.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9		2.1	2.2	2.3	2.4	2.5		3.1
☐	☐	☐	☐	☐	☐	☐	☒	☒		☐	☐	☐	☒	☒		☒

CCP-A.6 Develop and implement a plan to test and evaluate a potential solution to verify that it best meets all design requirements.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9		2.1	2.2	2.3	2.4	2.5		3.1
☐	☐	☐	☒	☐	☐	☐	☐	☒		☐	☐	☐	☐	☒		☒



Competencies, Domains, Objectives, Knowledge and Skills

CCP-B. Apply user-centered design principles when creating a solution.

CCP-B.1 Investigate the types of interactions between users and a proposed solution.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☐	☒	☒

CCP-B.2 Explain the importance of involving prospective users early and often during the design process.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☒	☒

CCP-B.3 Consider accessibility and equity when designing and creating solutions.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☐	☒	☒

CCP-B.5 Design solutions to optimize the user experience.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☒	☒

CCP-C. Creatively solve a problem using computational thinking, analytical and critical thinking skills.

CCP-C.1 Create and follow a plan to solve a problem.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☐	☐	☒	☒	☒

CCP-C.2 Decompose a problem into smaller parts.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☒	☐	☐	☐	☐	☒	☐	☐	☐	☐	☒	☒

CCP-C.4 Create a step-by-step process to complete a task.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☒	☐	☐	☐	☐	☒	☐	☒	☐	☐	☒	☒

CCP-C.5 Create and execute a plan to manage and use resources (such as time, materials, tools).

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☒	☒

CCP-D. Analyze and describe design functionality of a product.

CCP-D.2 Describe how the functionality of a product changes depending on how it is used.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☒	☒	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐



Competencies, Domains, Objectives, Knowledge and Skills

Technical Knowledge and Skills

Every career field requires technical literacy and career-specific knowledge and skills to support professional practice.

Algorithms and Programming (AAP):

A wide range of professionals use algorithms and programming to create a solution.

AAP-A. Analyze and create algorithms.

AAP-A.1 Analyze, break down, and explain the logic of an algorithm.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☒	☐	☐	☐	☐	☒	☒	☒	☐	☐	☒	☒

AAP-A.2 Create simple algorithms that involve variables, conditionals, operators, or logic.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☐	☒	☒

AAP-A.3 Create algorithms that use loops or procedures.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☒	☐	☐	☐	☒	☒	☒	☐	☐	☒	☒

AAP-B. Analyze the structure and functionality of a program.

AAP-B.1 Identify and describe the high-level structures of a program, such as user interface components, data components, event handlers, and procedures.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☒	☐	☒	☐	☐	☐	☐	☒	☐	☐	☐	☐	☒	☒

AAP-C. Create programs by developing and testing code in a modular, incremental approach.

AAP-C.1 Plan a program using appropriate strategies (such as flowcharting).

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☒	☒	☐	☐	☐	☒	☒	☒	☐	☐	☒	☒

AAP-C.2 Create appropriate event handlers to respond to runtime events.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☒	☐	☒	☐	☐	☐	☐	☒	☐	☐	☐	☐	☒	☒

AAP-C.3 Apply programming best practices, such as creating or improving documentation, using descriptive variables and procedure names, using comments, and testing code frequently.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☒	☐	☒	☐	☐	☐	☒	☒	☒	☐	☐	☒	☒

AAP-C.4 Debug programs or identify hardware issues.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☒	☐	☒	☐	☐	☐	☒	☐	☒	☐	☐	☒	☒



Competencies, Domains, Objectives, Knowledge and Skills

AAP-D.Adapt and expand existing code to meet a need.

AAP-D.1 Find code relevant to meet a need and extend or apply it to a new purpose.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☒	☐	☐	☐	☐	☒	☐	☒	☐	☐	☒	☒

Computer Systems (CSY):

Software and hardware work together to perform a variety of tasks.

CSY-A.Describe the hardware components of an electronic device and how they interact with software and the environment.

CSY-A. Identify how the parts of a system interact with the environment, and how the parts interact with each other.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☒	☐	☐	☐	☒

CSY-A.1 Identify how a user interacts with the parts of a computational system and how these parts interact with each other.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☒	☐	☐	☐	☐	☒	☒	☒	☐	☐	☒	☒

CSY-A.2 Select and justify the hardware chosen to accomplish a task.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☒

CSY-A.3 Assemble, wire, and program a system to complete a task.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☒	☒

Social Impacts of Computing (SIOC):

Computer science solutions have global impacts in economic, environmental, and societal contexts.

SIOC-A.Analyze the implications of computing in society.

SIOC-A.1 Identify the positive and negative ways that computing has changed or is changing the way people work, live, and play.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☒	☒	☒	☐	☐	☐	☒	☒	☐	☐	☐	☐	☒	☒

Systems Thinking (SYT):

Understanding a system by examining the connections between the parts that compose the entirety of the system.

SYT-A.Analyze why systems are designed and constructed the way they are.

SYT-A.1 Describe how individual parts work together within a system.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☒	☒	☐	☐	☒	☒	☐	☒	☒	☒	☒	☒	☒	☒	☒



Competencies, Domains, Objectives, Knowledge and Skills

SYT-A.2 Trace the flow of movement and energy through a system.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☒	☐	☐	☐	☐	☒	☐	☒	☐	☐	☐	☒	☒	☐	☐

SYT-A.3 Identify the inputs and outputs through a system.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☒	☒	☐	☐	☒	☒	☐	☐	☐	☒	☒	☐	☐	☐	☐

SYT-A.4 Communicate a plan for creating a system using sketches, models, or rapid prototyping.

1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	3.1
☐	☐	☐	☐	☐	☐	☒	☐	☒	☐	☐	☐	☐	☒	☒



Lesson 1 Quick Guide

Automating Mechanisms



Unit Framework

Preface

Students explore how gear trains and other mechanisms transfer movement in mechanical systems and design, build, and program automated systems to meet the needs of clients. In the end-of-lesson project, students can choose to design an interactive device to keep pets physically and mentally active, a spinning street sign to warn drivers to slow down and stop, or a high-speed dragster.

Activity, Project, or Problem	Days
Activity 1.1 Welcome Interns!	2
Activity 1.2 On the Move*	2
Activity 1.3 Rescue Mission*	1
Activity 1.4 Robot Shuffle*	2
Activity 1.5 Looping Shuffle*	1
Activity 1.6 Time to Switch Gears	2
Activity 1.7 It Is Universal*	1
Activity 1.8 Bevel Up*	2
Project 1.9 Design Challenge*	5
Lesson 1 Interim Assessment	1
Total	19 days

*Distance learning resources for this APB are available in the Lesson 1 Distance Learning Support chapter in the student course.



PLTW Automation and Robotics APB Framework

PLTW

PLTW Framework - Overview

In this Activity, Project, Problem (APB) the following Knowledge and Skills, Objectives, Domains, and Competencies are targeted for student learning. In addition to the levels of understanding, the Essential Questions are included. These Essential Questions may serve as discussion points with students to help them frame what they will learn about, and to reflect on what they learned during the APB.

Project 1.9

Competencies, Domains, Objectives, Knowledge and Skills

Transportable Knowledge and Skills

Core workplace skills that students and workers need to acquire, that can be used across all stages of a career, and that, because of their universal utility, are transportable from job to job, from employer to employer, across the economy.

Career Awareness and Exploration (CAE):

The skills necessary to prepare and modify a flexible education plan based on interests while discovering career opportunities.

CAE-A.Explore a variety of careers.

CAE-A.1 Explore a variety of careers related to engineering, biomedical sciences, and computer science.

Critical and Creative Problem-Solving (CCP):

The skills necessary for students to generate ideas and solutions to problems.

CCP-A.Apply the design process to create a solution.

CCP-A.1 Describe major steps of a design process and the typical tasks involved in each step.

CCP-A.2 Identify appropriate design requirements (criteria and constraints).

CCP-A.3 Generate ideas or build upon other ideas to innovate.

CCP-A.4 Evaluate solution ideas against the design requirements and justify the best solution to pursue.

CCP-A.5 Iteratively design and develop a solution.

CCP-A.6 Develop and implement a plan to test and evaluate a potential solution to verify that it best meets all design requirements.

CCP-B.Apply user-centered design principles when creating a solution.

CCP-B.1 Investigate the types of interactions between users and a proposed solution.

CCP-B.2 Explain the importance of involving prospective users early and often during the design process.

CCP-B.3 Consider accessibility and equity when designing and creating solutions.

CCP-B.5 Design solutions to optimize the user experience.



Competencies, Domains, Objectives, Knowledge and Skills

CCP-C.Creatively solve a problem using computational thinking, analytical and critical thinking skills.

CCP-C.1 Create and follow a plan to solve a problem.

CCP-C.2 Decompose a problem into smaller parts.

CCP-C.4 Create a step-by-step process to complete a task.

CCP-C.5 Create and execute a plan to manage and use resources (such as time, materials, tools).

Collaboration (COL):

The skills necessary for students to work together effectively with a common purpose to achieve desired results.

COL-A.Collaborate effectively on a diverse and multidisciplinary team.

COL-A.1 Demonstrate successful collaboration through effective communication and constructive feedback.

COL-A.2 Apply team norms to encourage productivity and define how a team will function and measure its success.

COL-A.3 Identify and evaluate positive and negative behaviors that impact the team's effectiveness.

COL-A.4 Describe one's individual role and expectations of performance within the team and support other team members, if needed, to meet team goals.

Communication (COM):

The skills necessary to to both provide and receive information with others, including interpersonal skills such as social awareness, conflict management, and empathy.

COM-A.Communicate effectively for specific purposes and settings.

COM-A.1 Use accurate and appropriate terminology.

COM-A.2 Communicate to meet the needs of the audience and be appropriate to the situation.

COM-A.3 Document work, including processes, research, and solutions.

COM-A.4 Use reliable evidence to support a claim.

Technical Knowledge and Skills

Every career field requires technical literacy and career-specific knowledge and skills to support professional practice.

Algorithms and Programming (AAP):

A wide range of professionals use algorithms and programming to create a solution.

AAP-A.Analyze and create algorithms.

AAP-A.1 Analyze, break down, and explain the logic of an algorithm.

AAP-A.3 Create algorithms that use loops or procedures.



Competencies, Domains, Objectives, Knowledge and Skills

AAP-B. Analyze the structure and functionality of a program.

AAP-B.1 Identify and describe the high-level structures of a program, such as user interface components, data components, event handlers, and procedures.

AAP-C. Create programs by developing and testing code in a modular, incremental approach.

AAP-C.1 Plan a program using appropriate strategies (such as flowcharting).

AAP-C.2 Create appropriate event handlers to respond to runtime events.

AAP-C.3 Apply programming best practices, such as creating or improving documentation, using descriptive variables and procedure names, using comments, and testing code frequently.

AAP-C.4 Debug programs or identify hardware issues.

AAP-D. Adapt and expand existing code to meet a need.

AAP-D.1 Find code relevant to meet a need and extend or apply it to a new purpose.

Computer Systems (CSY):

Software and hardware work together to perform a variety of tasks.

CSY-A. Describe the hardware components of an electronic device and how they interact with software and the environment.

CSY-A.1 Identify how a user interacts with the parts of a computational system and how these parts interact with each other.

CSY-A.2 Select and justify the hardware chosen to accomplish a task.

CSY-A.3 Assemble, wire, and program a system to complete a task.

Social Impacts of Computing (SIOC):

Computer science solutions have global impacts in economic, environmental, and societal contexts.

SIOC-A. Analyze the implications of computing in society.

SIOC-A.1 Identify the positive and negative ways that computing has changed or is changing the way people work, live, and play.

Systems Thinking (SYTH):

Understanding a system by examining the connections between the parts that compose the entirety of the system.

SYTH-A. Analyze why systems are designed and constructed the way they are.

SYTH-A.1 Describe how individual parts work together within a system.

SYTH-A.4 Communicate a plan for creating a system using sketches, models, or rapid prototyping.



① You are currently acting as a learner. [Return to Management](#)



Lesson 2: Sensors and Systems / Lesson 2: Sensors and Systems

Lesson 2 Quick Guide Sensors and Systems



Unit Framework

Preface

Students investigate the versatility of an optical sensor as a programmed input device. Students extend their knowledge of mechanisms as they design increasingly complex prototypes to serve the needs of users. In the end-of-lesson project, students connect inputs to outputs through programming to create effective solutions that help their communities.

Activity, Project, or Problem	Days
Activity 2.1 Makes Sense*	1
Activity 2.2 Color Coded*	2
Activity 2.3 Follow Me*	2
Activity 2.4 End of the Line*	2
Project 2.5 Helping Hand*	6
Lesson 2 Interim Assessment	1
Total	14 days

*Distance learning resources for this APB are available in the Lesson 2 Distance Learning Support chapter in the student course.



PLTW Automation and Robotics APB Framework



PLTW Framework - Overview

In this Activity, Project, Problem (APB) the following Knowledge and Skills, Objectives, Domains, and Competencies are targeted for student learning. In addition to the levels of understanding, the Essential Questions are included. These Essential Questions may serve as discussion points with students to help them frame what they will learn about, and to reflect on what they learned during the APB.

Project 2.5

Competencies, Domains, Objectives, Knowledge and Skills

Transportable Knowledge and Skills

Core workplace skills that students and workers need to acquire, that can be used across all stages of a career, and that, because of their universal utility, are transportable from job to job, from employer to employer, across the economy.

Career Awareness and Exploration (CAE):

The skills necessary to prepare and modify a flexible education plan based on interests while discovering career opportunities.

CAE-A.Explore a variety of careers.

CAE-A.1 Explore a variety of careers related to engineering, biomedical sciences, and computer science.

Critical and Creative Problem-Solving (CCP):

The skills necessary for students to generate ideas and solutions to problems.

CCP-A.Apply the design process to create a solution.

CCP-A.1 Describe major steps of a design process and the typical tasks involved in each step.

CCP-A.2 Identify appropriate design requirements (criteria and constraints).

CCP-A.3 Generate ideas or build upon other ideas to innovate.

CCP-A.4 Evaluate solution ideas against the design requirements and justify the best solution to pursue.

CCP-A.5 Iteratively design and develop a solution.

CCP-A.6 Develop and implement a plan to test and evaluate a potential solution to verify that it best meets all design requirements.

CCP-B.Apply user-centered design principles when creating a solution.

CCP-B.1 Investigate the types of interactions between users and a proposed solution.

CCP-B.2 Explain the importance of involving prospective users early and often during the design process.

CCP-B.3 Consider accessibility and equity when designing and creating solutions.

CCP-B.5 Design solutions to optimize the user experience.



Competencies, Domains, Objectives, Knowledge and Skills

CCP-C. Creatively solve a problem using computational thinking, analytical and critical thinking skills.

CCP-C.1 Create and follow a plan to solve a problem.

CCP-C.2 Decompose a problem into smaller parts.

CCP-C.4 Create a step-by-step process to complete a task.

CCP-C.5 Create and execute a plan to manage and use resources (such as time, materials, tools).

Collaboration (COL):

The skills necessary for students to work together effectively with a common purpose to achieve desired results.

COL-A. Collaborate effectively on a diverse and multidisciplinary team.

COL-A.1 Demonstrate successful collaboration through effective communication and constructive feedback.

COL-A.2 Apply team norms to encourage productivity and define how a team will function and measure its success.

COL-A.3 Identify and evaluate positive and negative behaviors that impact the team's effectiveness.

COL-A.4 Describe one's individual role and expectations of performance within the team and support other team members, if needed, to meet team goals.

Communication (COM):

The skills necessary to both provide and receive information with others, including interpersonal skills such as social awareness, conflict management, and empathy.

COM-A. Communicate effectively for specific purposes and settings.

COM-A.1 Use accurate and appropriate terminology.

COM-A.2 Communicate to meet the needs of the audience and be appropriate to the situation.

COM-A.3 Document work, including processes, research, and solutions.

Technical Knowledge and Skills

Every career field requires technical literacy and career-specific knowledge and skills to support professional practice.

Algorithms and Programming (AAP):

A wide range of professionals use algorithms and programming to create a solution.

AAP-A. Analyze and create algorithms.

AAP-A.1 Analyze, break down, and explain the logic of an algorithm.

AAP-A.2 Create simple algorithms that involve variables, conditionals, operators, or logic.

AAP-A.3 Create algorithms that use loops or procedures.



Competencies, Domains, Objectives, Knowledge and Skills

AAP-B. Analyze the structure and functionality of a program.

AAP-B.1 Identify and describe the high-level structures of a program, such as user interface components, data components, event handlers, and procedures.

AAP-C. Create programs by developing and testing code in a modular, incremental approach.

AAP-C.1 Plan a program using appropriate strategies (such as flowcharting).

AAP-C.2 Create appropriate event handlers to respond to runtime events.

AAP-C.3 Apply programming best practices, such as creating or improving documentation, using descriptive variables and procedure names, using comments, and testing code frequently.

AAP-C.4 Debug programs or identify hardware issues.

AAP-D. Adapt and expand existing code to meet a need.

AAP-D.1 Find code relevant to meet a need and extend or apply it to a new purpose.

Computer Systems (CSY):

Software and hardware work together to perform a variety of tasks.

CSY-A. Describe the hardware components of an electronic device and how they interact with software and the environment.

CSY-A.1 Identify how a user interacts with the parts of a computational system and how these parts interact with each other.

CSY-A.3 Assemble, wire, and program a system to complete a task.

Social Impacts of Computing (SIOC):

Computer science solutions have global impacts in economic, environmental, and societal contexts.

SIOC-A. Analyze the implications of computing in society.

SIOC-A.1 Identify the positive and negative ways that computing has changed or is changing the way people work, live, and play.

Systems Thinking (SYTH):

Understanding a system by examining the connections between the parts that compose the entirety of the system.

SYTH-A. Analyze why systems are designed and constructed the way they are.

SYTH-A.1 Describe how individual parts work together within a system.

SYTH-A.4 Communicate a plan for creating a system using sketches, models, or rapid prototyping.



① You are currently acting as a learner. [Return to Management](#)



Lesson 3: Create and Automate / Lesson 3: Create and Automate

Lesson 3 Quick Guide Create and Automate

Unit Framework

Preface

Students design solutions using an automated mechanical system and the programming necessary for communication between the sensors, motors, and building components. Students pick their own problems or select problems that highlight their creativity and are of service to others. Throughout the unit students reflect on their growing skills and interests and explore careers in the field.

Activity, Project, or Problem	Days
Problem 3.1 Show Your Skills*	11
End-of-Unit Assessment	1
Total	12 days

*Distance learning resources for this problem are available in the Lesson 3 Distance Learning Support chapter in the student course.



PLTW Automation and Robotics APB Framework

PLTW

PLTW Framework - Overview

In this Activity, Project, Problem (APB) the following Knowledge and Skills, Objectives, Domains, and Competencies are targeted for student learning. In addition to the levels of understanding, the Essential Questions are included. These Essential Questions may serve as discussion points with students to help them frame what they will learn about, and to reflect on what they learned during the APB.

Problem 3.1

Competencies, Domains, Objectives, Knowledge and Skills

Transportable Knowledge and Skills

Core workplace skills that students and workers need to acquire, that can be used across all stages of a career, and that, because of their universal utility, are transportable from job to job, from employer to employer, across the economy.

Career Awareness and Exploration (CAE):

The skills necessary to prepare and modify a flexible education plan based on interests while discovering career opportunities.

CAE-A.Explore a variety of careers.

CAE-A.1 Explore a variety of careers related to engineering, biomedical sciences, and computer science.

CAE-A.2 Identify skills that are needed for a variety of careers (such as communication and collaboration).

CAE-A.3 Explore and reflect on your personal interests and strengths in relation to diverse career opportunities.

Critical and Creative Problem-Solving (CCP):

The skills necessary for students to generate ideas and solutions to problems.

CCP-A.Apply the design process to create a solution.

CCP-A.1 Describe major steps of a design process and the typical tasks involved in each step.

CCP-A.2 Identify appropriate design requirements (criteria and constraints).

CCP-A.3 Generate ideas or build upon other ideas to innovate.

CCP-A.4 Evaluate solution ideas against the design requirements and justify the best solution to pursue.

CCP-A.5 Iteratively design and develop a solution.

CCP-A.6 Develop and implement a plan to test and evaluate a potential solution to verify that it best meets all design requirements.

CCP-B.Apply user-centered design principles when creating a solution.

CCP-B.1 Investigate the types of interactions between users and a proposed solution.



Competencies, Domains, Objectives, Knowledge and Skills

CCP-B.2 Explain the importance of involving prospective users early and often during the design process.

CCP-B.3 Consider accessibility and equity when designing and creating solutions.

CCP-B.5 Design solutions to optimize the user experience.

CCP-C. Creatively solve a problem using computational thinking, analytical and critical thinking skills.

CCP-C.1 Create and follow a plan to solve a problem.

CCP-C.2 Decompose a problem into smaller parts.

CCP-C.4 Create a step-by-step process to complete a task.

CCP-C.5 Create and execute a plan to manage and use resources (such as time, materials, tools).

Collaboration (COL):

The skills necessary for students to work together effectively with a common purpose to achieve desired results.

COL-A. Collaborate effectively on a diverse and multidisciplinary team.

COL-A.1 Demonstrate successful collaboration through effective communication and constructive feedback.

COL-A.2 Apply team norms to encourage productivity and define how a team will function and measure its success.

COL-A.3 Identify and evaluate positive and negative behaviors that impact the team's effectiveness.

COL-A.4 Describe one's individual role and expectations of performance within the team and support other team members, if needed, to meet team goals.

Communication (COM):

The skills necessary to both provide and receive information with others, including interpersonal skills such as social awareness, conflict management, and empathy.

COM-A. Communicate effectively for specific purposes and settings.

COM-A.1 Use accurate and appropriate terminology.

COM-A.2 Communicate to meet the needs of the audience and be appropriate to the situation.

COM-A.3 Document work, including processes, research, and solutions.



Competencies, Domains, Objectives, Knowledge and Skills

Technical Knowledge and Skills

Every career field requires technical literacy and career-specific knowledge and skills to support professional practice.

Algorithms and Programming (AAP):

A wide range of professionals use algorithms and programming to create a solution.

AAP-A. Analyze and create algorithms.

AAP-A.1 Analyze, break down, and explain the logic of an algorithm.

AAP-A.2 Create simple algorithms that involve variables, conditionals, operators, or logic.

AAP-A.3 Create algorithms that use loops or procedures.

AAP-B. Analyze the structure and functionality of a program.

AAP-B.1 Identify and describe the high-level structures of a program, such as user interface components, data components, event handlers, and procedures.

AAP-C. Create programs by developing and testing code in a modular, incremental approach.

AAP-C.1 Plan a program using appropriate strategies (such as flowcharting).

AAP-C.2 Create appropriate event handlers to respond to runtime events.

AAP-C.3 Apply programming best practices, such as creating or improving documentation, using descriptive variables and procedure names, using comments, and testing code frequently.

AAP-C.4 Debug programs or identify hardware issues.

AAP-D. Adapt and expand existing code to meet a need.

AAP-D.1 Find code relevant to meet a need and extend or apply it to a new purpose.

Computer Systems (CSY):

Software and hardware work together to perform a variety of tasks.

CSY-A. Describe the hardware components of an electronic device and how they interact with software and the environment.

CSY-A. Identify how the parts of a system interact with the environment, and how the parts interact with each other.

CSY-A.1 Identify how a user interacts with the parts of a computational system and how these parts interact with each other.

CSY-A.2 Select and justify the hardware chosen to accomplish a task.

CSY-A.3 Assemble, wire, and program a system to complete a task.

Social Impacts of Computing (SIOC):

Computer science solutions have global impacts in economic, environmental, and societal contexts.

SIOC-A. Analyze the implications of computing in society.

SIOC-A.1 Identify the positive and negative ways that computing has changed or is changing the way people work, live, and play.



Competencies, Domains, Objectives, Knowledge and Skills

Systems Thinking (SYTH):

Understanding a system by examining the connections between the parts that compose the entirety of the system.

SYTH-A. Analyze why systems are designed and constructed the way they are.

SYTH-A.1 Describe how individual parts work together within a system.

SYTH-A.4 Communicate a plan for creating a system using sketches, models, or rapid prototyping.



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

IEP AND 504 ACCOMMODATIONS AND MODIFICATIONS FOR EARLY CHILDHOOD AND ELEMENTARY SCHOOL STUDENTS:

Large print textbooks
Textbooks for at-home use
Additional time for assignments
Review of directions
Use of mnemonics
Have student restate information
Concrete examples
Adaptive writing utensils
Support auditory presentations with visuals
Use of a study carrel
Assistance in maintaining uncluttered space
Weekly home-school communication tools (notebook, daily log, phone calls or email messages)
Space for movement or breaks
Study sheets and teacher outlines
Extra visual and verbal cues and prompts
Math sheets with highlighted instructions
Graph paper to assist in organizing or lining up math problems
Use of computers and calculators
Books on tape
Graphic organizers
Quiet corner or room to calm down and relax when anxious
Preferential seating
Alteration of the classroom arrangement
Reduction of distractions
Answers to be dictated
Hands-on activities
Use of manipulatives
No penalty for spelling errors or sloppy handwriting
Follow a routine/schedule
Alternate quiet and active time
Teach time management skills
Rest breaks
Verbal and visual cues regarding directions and staying on task
Agenda book and checklists
Adjusted assignment timelines
Visual daily schedule



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Untimed tests
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book tests
Read test and directions to student
Provide study outline prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator and/or number line for math tests
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS MODIFICATIONS:



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

Breaks between tasks
Cue expected behavior
Daily feedback to student
Have contingency plans
Use de-escalating strategies
Use positive reinforcement
Use proximity/touch control
Use peer supports and mentoring
Model expected behavior by adults
Have parent sign homework
Have parent sign behavior chart
Set and post class rules
Chart progress and maintain data



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

IEP AND 504 ACCOMODATIONS AND MODIFICATIONS FOR MIDDLE AND HIGH SCHOOL STUDENTS:

- Large print textbooks
- Textbooks for at-home use
- Additional time for assignments
- A locker with adapted lock
- Review of directions
- Review sessions
- Use of mnemonics
- Have student restate information
- Provision of notes or outlines
- Concrete examples
- Adaptive writing utensils
- Support auditory presentations with visuals
- Weekly or bi-weekly home-school communication
- Space for movement or breaks
- Study sheets and teacher outlines
- Extra visual and verbal cues and prompts
- Lab and math sheets with highlighted instructions
- Graph paper to assist in organizing or lining up math problems
- Use of tape recorder for lectures
- Use of Interactive notebook
- Use of a scribe
- Use of computers and calculators
- Books on tape
- Graphic organizers
- Quiet corner or room to calm down and relax when anxious
- Preferential seating
- Alteration of the classroom arrangement
- Reduction of distractions
- Answers to be dictated
- Hands-on activities
- Ability to type all assignments
- Follow a routine/schedule
- Teach time management and organizational skills
- Rest breaks
- Verbal and visual cues regarding directions and staying on task
- Agenda book and checklists
- Daily check-in with case manager or special education teacher
- Adjusted assignment timelines
- Visual daily schedule



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book or open-note tests
Read test and directions to student
Provide study guides prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Pace long-term projects
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Allow outlining, instead of writing for an essay or major project
Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator for math tests
Film or video supplements in place of reading text
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Pass/no pass option
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS FOR STUDENTS:

Breaks between tasks
Cue expected behavior
Daily feedback to student
Have contingency plans
Use de-escalating strategies
Use positive reinforcement
Use proximity/touch control
Use peer supports and mentoring
Model expected behavior by adults
Have parent sign homework
Set and post class rules
Chart progress and maintain data



Accommodations and Modifications for ESL Students

- Give tests orally
- Give instructions/directions in writing and orally
- Assign a peer tutor, same language or English speaking
- Allow use of bilingual/translation dictionary
- Provide summaries of text or study guides of particular chapters
- Allow errors in speaking
- Allow errors in writing
- Accept writing in first language
- Highlight key vocabulary
- Reduce amount of work required
- Assess comprehension through demonstration or other alternative means (gestures, drawings)
- Rephrase questions, directions, and explanations
- Reduce multiple choices on assessments
- Provide study guides and/ or outlines
- Shorten reading assignments
- Allow extended time for test/project completion
- Use of audio books
- Use of graphic organizers
- Use reduced text, so that print is not dense
- Use visuals/pictures throughout lesson/unit/assignment
- Adapt homework to reflect language proficiency/home support
- Adapt homework to reflect home support
- Provide hands-on activities and explanations
- Allow extended time to answer questions, and permit drawing, as an explanation
- Use of translation dictionaries to locate words in the native language
- Use anecdotal records and portfolio of work as forms of assessment
- Use story retellings to assess comprehension

What Does the Gifted and Talented Experience Look Like? *Springfield Public Schools*

Mission Statement

The Gifted and Talented Program of the Springfield Public Schools aims to provide a meaningful and rigorous education that instills the value of lifelong learning and empowers all students to reach their full potential and become self-fulfilled creative leaders in accordance with the comprehensive standards of our state. We accomplish this by offering challenging, real-world experiences in a student-centered environment.

We recognize that students come from diverse socioeconomic, cultural, and ethnic backgrounds, and the mission of the gifted and talented program is to provide opportunities for students to explore their intellectual, creative, and artistic gifts and talents within the classroom and with beyond-the-classroom experiences. It is essential to provide diverse, appropriate, and ongoing learning experiences and environments that incorporate students' academic, psychological, and social needs. Our responsibility is to provide students with educational alternatives that teach, challenge, and expand their knowledge, while simultaneously stressing the development of independent and self-directed learners who continuously generate questions, analyze, synthesize, and evaluate information and ideas.

New Jersey Administrative Code 6A:8-3.1 defines students who are gifted and talented as those students who possess or demonstrate high levels of ability in one or more content areas when compared to their chronological peers in the local district and who require modification of their educational program if they are to achieve in accordance with their capabilities.

Goals:

To support our mission, we have established the following goals to guide our work:

- To infuse into the general education program a broad range of activities for high-level learning that will challenge all students to perform at advanced levels, and provide extended opportunities, resources, and support in particular areas where student interest or talent is demonstrated.
- To provide a continuum of gifted education services that will strengthen the total school program, offer enriching and challenging learning opportunities for all students, and provide specialized learning experiences
- To promote achievement of students' best potentials and increased ability.

Through a productive and collaborative relationship among the building principals, classroom teachers, and the Gifted and Talented teacher, our schools can create programming that will enhance the learning experience for every student and serve the unique and specialized needs of students currently demonstrating gifted behaviors.

Elements of the Schoolwide Enrichment Model, W.I.N (What I Need), differentiated instruction, advanced classes, or individual programs into a student's regular instruction program are integral to this overarching framework for gifted education in the Springfield School District.

Reference Board Policy and Regulation 2464 – Gifted and Talented Pupils (M)

Early Childhood Center **Edward V. Walton**

Schoolwide Virtual Enrichment

All first and second grade students have access to the [Gifted and Talented Virtual Classroom](#). This virtual classroom is a space for students to complete various challenges and enrichment opportunities at their own pace. Students can receive feedback and additional adaptable resources to meet their individual learning needs. The virtual classroom design expands accessibility to enrichment resources and allows students to choose learning activities according to their unique interests and abilities. The purpose of the activities is to encourage problem-solving, develop critical thinking

skills, and expand curiosity and imagination. Activities are aligned to the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

The Gifted and Talented teacher serves as a resource to all teachers within Edward V. Walton School. Teachers seeking resources for their high-ability learners will receive additional support from the Gifted and Talented teacher in various ways. This support may include additional units of study, challenging resources, and student projects.

Elementary Schools

James Caldwell

Thelma L. Sandmeier

The goal is to engage small groups of students in intensive learning experiences through standards-based, rigorous, and relevant units of study that supplement, not supplant, the grade-level curriculum and support students' unique learning needs.

Enrichment Experience Grade 3

Beginning in third grade, the G&T teacher will cycle through all classrooms to work on problem-solving and enrichment tasks with students. Driven by assessment data, academic performance, student interest, and teacher observation, small groups of students will meet with the G&T teacher during W.I.N. (What I Need) periods throughout the week that the teacher is assigned to their classroom teacher. Groupings will be flexible and monitored to best meet each student's needs throughout the school year. Activities will include brain teasers, puzzles, strategic thinking, problem-solving, and STEM challenges.

Targeted Gifted and Talented Programing Grades 4-5

Students may become identified as Gifted and Talented in fourth grade. Students that are identified may receive support from the G&T Teacher for up to five periods (200 minutes) a week during W.I.N. (What I Need) periods. Identified students will meet to explore grade-level content while incorporating depth and complexity in a student-centered, problem-based environment. The Gifted and Talented Program aims to provide students with various advanced and challenging learning experiences across content areas to promote independent thinking skills, refine critical thinking and communication skills, cultivate joy in learning, and expand student interests through problem-solving. The instruction that students receive incorporates 21st Century Skills and advanced content that is challenging, hands-on, and relevant to the real world.

Strategies and Practices that Support Gifted and Talented Students

- Adjusted Pace of Lessons
- Inquiry-Based Instruction
- Higher-Order Thinking Activities
- Interest-Based Content
- Real World Problem Solving/Problem Based Learning
- Independent Study/Passion Projects
- Units of Study with Like-Minded Peers

Schoolwide Virtual Enrichment

All JCS and TLS students have access to grade level-specific [Gifted and Talented Virtual Classrooms](#). These virtual classrooms are a space for students to complete various challenges and enrichment opportunities at their own pace. Students are able to receive feedback and additional opportunities based on their needs. The virtual classrooms have expanded the accessibility of enrichment resources directly to the students and allows for students to choose opportunities according to their interests and abilities. The purpose of the activities is to encourage problem solving, develop critical thinking skills, and expand curiosity and imagination in conjunction with the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

In addition to classroom support, the Gifted and Talented teacher also serves as a resource to all teachers in the building. Teachers that are seeking resources for their high ability learners will receive additional support from the Gifted and Talented teacher in various ways. This may include additional units of study, challenging resources, student projects, and meeting with the G&T teacher as needed.

Additional Enrichment Opportunities

Across all grade levels 3-5, as recommended by the classroom teacher, students exhibiting a need for additional enrichment may have the opportunity to meet with the G&T teacher as the schedule allows. Groupings will be flexible and monitored to best meet the students' needs throughout the school year. Activities will include, brain teasers, puzzles, strategic thinking activities, problem-solving challenges, and STEM challenges. Students engage in an extended process of asking questions, using resources, and developing answers that lead to thinking about what and how they are learning. Students are held accountable for how they work and use their time by demonstrating their learning through products or presentations.

Students self-select to participate in individual and/or group projects based on interest and commitment. The classroom teacher and/or the enrichment teacher will help guide and monitor student exploration of chosen topics, facilitating their learning with resources and teaching of needed skills.

Secondary Schools
Florence M. Gaudineer Middle School
Jonathan Dayton High School

Grades 6-12: Access to specific content programs with higher levels of academic challenges (i.e. Pre-Algebra, Accelerated Communication Arts, and Advanced Placement Classes)

Dual Credit Courses provide students the opportunity to obtain high school credit, and college credit, simultaneously through partnerships with several institutions.

Project Lead the Way (PLTW) students become builders of technology by engaging in real world activities. Students are empowered as design thinkers collaborating on real world projects.

Gifted and Talented Identification Criteria

The Springfield Schools Gifted and Talented Program recognizes that students require differentiated learning experiences beyond the core curriculum being taught because of their advanced abilities in one or more content areas. These students may also have other cognitive qualities such as curiosity, creativity, motivation, leadership, and passion that require modifications to their academic experience.

Multiple Measures of Eligibility

Kindergarten through grade twelve identification process for gifted and talented students includes multiple measures. Multiple measures may include but are not limited to: achievement test scores; grades; student performance or products; intelligence testing; parent, student, and/or teacher recommendation; and other appropriate measures. The identification methodology is developmentally appropriate, non-discriminatory, and related to the programs and services offered by the Springfield School District. The identification procedures are reviewed annually.

According to N.J.A.C. 6A:8-3.1, all public school districts must have a board-approved gifted and talented identification process and provide services for identified students enrolled in the grades of that school district. The regulations require that identification and services be made available to students in grades K-12.

When students are recommended for the Gifted and Talented Program there are multiple measures that are considered to determine if services are necessary and appropriate. The assessments used are as follows:

- *Cognitive Abilities Test (CogAT)*
- *Classroom Performance/Student Portfolios*
- *DRA2 Level*
- *iReady Diagnostic Scores*
- *Gifted Indicators Checklist*
- *Start Strong/NJSLA Assessment Data*

The N.J.A.C. requires that students be compared to their chronological peers in the local school district. The New Jersey Department of Education has not established state-level criteria for identifying students who are gifted, such as mandated tests or assessments, grade point averages, or IQ scores. Local school districts must use multiple measures to identify students.

Procedures

<https://www.straussesmay.com/seportal/Public/DistrictPolicy.aspx?policyid=2464&id=b8a33a9f505e4998a6db3fb8e1de778b>

Gifted and Talented Program Identification Matrix

Minimum Score Required for Consideration: 14 Points

1 Point	2 Points	3 Points
Cogat Assessment Overall Stanine Score of a 7	Cogat Assessment Overall Stanine Score of an 8	Cogat Assessment Overall Stanine Score of a 9
iReady Math Assessment Just Below Current Grade Level	iReady Math Assessment On Grade Level	iReady Math Assessment ½ Year + Above Current Level
iReady ELA On Grade Level	iReady ELA ½ Year Above Current Level	iReady ELA One Full Grade Level + Above Current Level
NJSLA Math Approaching Expectations	NJSLA Math Met Expectations	NJSLA Math Exceed Expectations
NJSLA ELA Approaching Expectations	NJSLA ELA Met Expectations	NJSLA ELA Exceed Expectations
HOPE Teacher Rating Scale Raw Score: 11 - 29	HOPE Teacher Rating Scale Raw Score: 30 - 49	HOPE Teacher Rating Scale Raw Score: 50-66

Team meetings present the opportunity to review data and assess the educational needs of all students. Teacher provides examples of student work exhibiting above and beyond grade level expectations, creativity, leadership, critical and abstract thinking. Programs for gifted and talented students will be periodically evaluated for their continuing efficacy and adjusted accordingly. The parent of any student identified as gifted or talented shall be consulted regarding any program designed to address the student's particular needs.

Resource Links

https://riversideinsights.com/cognitive_abilities_test

<https://www.curriculumassociates.com/programs/i-ready-learning>

<https://www.nj.gov/education/assessment/resources/>

<https://www.routledge.com/HOPE-Teacher-Rating-Scale-Involving-Teachers-in-Equitable-Identification/Gentry-Pereira-Peters-McIntosh-Fugate/p/book/9781618214522#:~:text=The%20HOPE%20Teacher%20Rating%20Scale,making%20it%20easy%20to%20use.>

Gifted and talented student: The "[*Strengthening Gifted and Talented Education Act*](#)" defines a gifted and talented student as a "student who possesses or demonstrates a high level of ability in one or more content areas when compared to their chronological peers in the school district and who require modifications of their educational program if they are to achieve in accordance with their capabilities."

Twice-exceptional (2E) students: A twice-exceptional (2E) student is defined as "a student who is both gifted and a student with a disability. These students may also be referred to as having dual exceptionalities or as being gifted with learning disabilities (GT/LD). This also applies to students who are gifted with ADHD or gifted with autism" (New Jersey Association for Gifted Children, www.nagc.org).

Instructional adaptation: An adjustment or modification to instruction enabling a student who is gifted and talented to participate in, benefit from, and demonstrate knowledge and application of the New Jersey Student Learning Standards in one or more content areas at the instructional level of the student, not just the student's grade level.

Identifying gifted and talented students: The focus of identification is to provide programming and services in which students' specific learning needs and potential are appropriately addressed and met. In every New Jersey school district, there are students who require modifications to the general education curriculum if they are to achieve in accordance with their abilities. By identifying a student's general intellectual ability, creativity, or specific academic area aptitudes, we are acknowledging that they need programming and services outside of the general education/grade level curriculum to advance their learning.

NJDOE Fast Facts

<https://www.nj.gov/education/standards/gifted/>

<https://www.nj.gov/education/standards/gifted/legislation.shtml>

Supplemental Resources/Programming for Gifted Students

Edward V. Walton

- PETS Program – Primary Education Thinking Skills
- Group Solutions/Group Solutions 2 – Cooperative Logic Activities
- Lollipop Logic
- Beginning Thinking Skills
- AIMS Education Programming

James Caldwell and Thelma L. Sandmeier

Math/ELA

- Project M3: Mentoring Mathematical Minds
- Junior Great Books
- AIMS Education Programming
- Borenson Hands on Equations
- BizWorld
- Perplexors
- Advanced Math Explorations grade 3-5
- Challenging Units for Gifted Learners (ELA and Math)
- Creative Curriculum Extenders
- Differentiated Lessons & Projects
- Challenge Math Grades 4+
- Differentiating Instruction with Menus (All Content Areas)
- Jacob's Ladder
- Genius Hour/Passion Project
- Spatial Reasoning
- Logic Puzzles, Brain Games, Analogies

STEM

- Engineering is Elementary
- Engineer Throughout the Year
- PBS Design Squad
- DefinedSTEM
- Project Lead the Way (PLTW)

Enrichment Events

Experience for all students to be enriched through events related to the curricular or extracurricular activities. Examples include after school clubs, PTA-sponsored events, leadership opportunities, visual and performing arts, and community service opportunities.