

CURRICULUM

FOR

EXPLORING

COMPUTER

SCIENCE

GRADES 9-12

This curriculum is part of the Educational Program of Studies of the Rahway Public Schools.

ACKNOWLEDGMENTS

Dr. Kevin K. Robinson

Supervisor of Math

The Board acknowledges the following who contributed to the preparation of this curriculum.

John Marks

Subject/Course Title:
Exploring Computer Science
Grades 9-12

Date of Board Adoptions:
September 15, 2020

RAHWAY PUBLIC SCHOOLS CURRICULUM

Exploring Computer Science – Grade 9-12

PACING GUIDE

Unit	Title	Pacing
1	Karel the Dog	7 weeks
2	Javascript and Graphics	7 weeks
3	Javascript Control Structures	8 weeks
4	Functions and Parameters	6 weeks
5	Animation and Games	8 weeks

ACCOMMODATIONS

504 Accommodations:

- Provide scaffolded vocabulary and vocabulary lists.
- Provide extra visual and verbal cues and prompts.
- Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials.
- Provide links to audio files and utilize video clips.
- Provide graphic organizers and/or checklists.
- Provide modified rubrics.
- Provide a copy of teaching notes, especially any key terms, in advance.
- Allow additional time to complete assignments and/or assessments.
- Provide shorter writing assignments.
- Provide sentence starters.
- Utilize small group instruction.
- Utilize Think-Pair-Share structure.
- Check for understanding frequently.
- Have student restate information.
- Support auditory presentations with visuals.
- Weekly home-school communication tools (notebook, daily log, phone calls or email messages).
- Provide study sheets and teacher outlines prior to assessments.
- Quiet corner or room to calm down and relax when anxious.
- Reduction of distractions.
- Permit answers to be dictated.
- Hands-on activities.
- Use of manipulatives.
- Assign preferential seating.
- No penalty for spelling errors or sloppy handwriting.
- Follow a routine/schedule.
- Provide student with rest breaks.
- Use verbal and visual cues regarding directions and staying on task.
- Assist in maintaining agenda book.

IEP Accommodations:

- Provide scaffolded vocabulary and vocabulary lists.
- Differentiate reading levels of texts (e.g., Newsela).
- Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials.
- Provide extra visual and verbal cues and prompts.
- Provide links to audio files and utilize video clips.
- Provide graphic organizers and/or checklists.
- Provide modified rubrics.
- Provide a copy of teaching notes, especially any key terms, in advance.
- Provide students with additional information to supplement notes.
- Modify questioning techniques and provide a reduced number of questions or items on tests.
- Allow additional time to complete assignments and/or assessments.
- Provide shorter writing assignments.
- Provide sentence starters.
- Utilize small group instruction.
- Utilize Think-Pair-Share structure.
- Check for understanding frequently.
- Have student restate information.
- Support auditory presentations with visuals.
- Provide study sheets and teacher outlines prior to assessments.
- Use of manipulatives.
- Have students work with partners or in groups for reading, presentations, assignments, and analyses.
- Assign appropriate roles in collaborative work.
- Assign preferential seating.
- Follow a routine/schedule.

Gifted and Talented Accommodations:

- Differentiate reading levels of texts (e.g., Newsela).
- Offer students additional texts with higher lexile levels.
- Provide more challenging and/or more supplemental readings and/or activities to deepen understanding.
- Allow for independent reading, research, and projects.
- Accelerate or compact the curriculum.
- Offer higher-level thinking questions for deeper analysis.
- Offer more rigorous materials/tasks/prompts.
- Increase number and complexity of sources.
- Assign group research and presentations to teach the class.
- Assign/allow for leadership roles during collaborative work and in other learning activities.

ELL Accommodations:

- Provide extended time.
- Assign preferential seating.
- Assign peer buddy who the student can work with.
- Check for understanding frequently.
- Provide language feedback often (such as grammar errors, tenses, subject-verb agreements, etc...).
- Have student repeat directions.
- Make vocabulary words available during classwork and exams.
- Use study guides/checklists to organize information.
- Repeat directions.
- Increase one-on-one conferencing.
- Allow student to listen to an audio version of the text.
- Give directions in small, distinct steps.
- Allow copying from paper/book.
- Give student a copy of the class notes.
- Provide written and oral instructions.
- Differentiate reading levels of texts (e.g., Newsela).

- Shorten assignments.
- Read directions aloud to student.
- Give oral clues or prompts.
- Record or type assignments.
- Adapt worksheets/packets.
- Create alternate assignments.
- Have student enter written assignments in criterion, where they can use the planning maps to help get them started and receive feedback after it is submitted.
- Allow student to resubmit assignments.
- Use small group instruction.
- Simplify language.
- Provide scaffolded vocabulary and vocabulary lists.
- Demonstrate concepts possibly through the use of visuals.
- Use manipulatives.
- Emphasize critical information by highlighting it for the student.
- Use graphic organizers.
- Pre-teach or pre-view vocabulary.
- Provide student with a list of prompts or sentence starters that they can use when completing a written assignment.
- Provide audio versions of the textbooks.
- Highlight textbooks/study guides.
- Use supplementary materials.
- Give assistance in note taking
- Use adapted/modified textbooks.
- Allow use of computer/word processor.
- Allow student to answer orally, give extended time (time-and-a-half).
- Allow tests to be given in a separate location (with the ESL teacher).
- Allow additional time to complete assignments and/or assessments.
- Read question to student to clarify.
- Provide a definition or synonym for words on a test that do not impact the validity of the exam.
- Modify the format of assessments.
- Shorten test length or require only selected test items.
- Create alternative assessments.
- On an exam other than a spelling test, don't take points off for spelling errors.

RAHWAY PUBLIC SCHOOLS CURRICULUM TEMPLATE

UNIT 1 OVERVIEW

Content Area: Exploring Computer Science

Unit Title: Karel the Dog

Target Course/Grade Level: 9-12

Unit Summary: In this unit, students are introduced to computer programming through Karel the Dog. Karel only knows how to move, turn left, put down and pick up tennis balls in a grid world. Students will learn to give Karel these commands to instruct him to do certain things. In doing so, students will discover what it means to program and how their problem solving skills.

Approximate Length of Unit: 7 weeks

LEARNING TARGETS

NJ Student Learning Standards:

- 8.2.12.E.1 Demonstrate an understanding of the problem-solving capacity of computers in our world.
- 8.2.12.E.2 Analyze the relationships between internal and external computer components
- 8.2.12.E.3 Use a programming language to solve problems or accomplish a task (e.g. robotic functions, website designs, applications, and games)
- 8.2.12.E.4 Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

21st Century Life and Career Skills:

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST.6 Demonstrate technical skills needed in a chosen STEM field.

Interdisciplinary Connections and Standards:

- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:

- RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Unit Understandings:

Students will understand that...

- Computer programming is a sequence of commands that are read by a computer in a language it can understand
- Commands are functions that can be created by the user, and then used by the user as they see fit
- Control structures help programmers create efficient, organized programs

Unit Essential Questions:

- What is programming, and how does it work?
- What is a computer command?
- How can computers “get stuck” while trying to execute commands?
- What is a control structure?
- How are complex problems broken down into smaller problems through programming?

Knowledge and Skills:

Students will know.....

- The four basic Karel commands: move, turnLeft, putBall, and takeBall
- The difference between defining a function versus calling a function
- How to create a function
- Where the “beginning” of a program is
- What an if/if-else statement does
- The difference between a for loop and a while loop
- How to comment code
- The importance of “top-down” design when it comes to programming

Students will be able to ...

- Complete various programming tasks on CodeHS
- Use functions, loops and conditionals to solve complex programming tasks
- Explain how their code works using comments

<i>EVIDENCE OF LEARNING</i>

Assessment:

What evidence will be collected and deemed acceptable to show that students truly “understand”?

- CodeHS.com lesson exercises
- Class participation
- Class discussion

- End of Unit Assessment
 - Students will take a test for the unit in which they will have to identify terminology, as well as the key concepts of the unit. Students will also be given a program to solve using programming and explain their thought process for the solution code.

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Group programming projects
- Teacher demonstrations over Screen Share software
- Reinforcement worksheets and extra practice
- Paired-programming challenges
- Individualized student to teacher code demonstrations

<i>RESOURCES</i>

Teacher Resources:

- Demonstrations of worked out solutions from CodeHS.com
- Teacher designed worksheets
- CodeHS.com lesson exercises and videos

Equipment Needed:

- Classroom computers

UNIT 2 OVERVIEW

Content Area: Exploring Computer Science

Unit Title: JavaScript and Graphics

Target Course/Grade Level: 9-12

Unit Summary: In this unit, students will learn the basics of the real programming language called JavaScript. Students will apply many concepts and ideas learned from programming with Karel to help them create their first JavaScript programs, while at the same time, learning about some distinct differences. Key new concepts such as variables and user input provide students with an entirely new dynamic when designing and solving programming tasks. Students will also be introduced to the graphics functions, and how to manipulate various properties of each graphical object.

Approximate Length of Unit: 7 weeks

LEARNING TARGETS

NJ Student Learning Standards:

- 8.2.12.E.1 Demonstrate an understanding of the problem-solving capacity of computers in our world.
- 8.2.12.E.2 Analyze the relationships between internal and external computer components
- 8.2.12.E.3 Use a programming language to solve problems or accomplish a task (e.g. robotic functions, website designs, applications, and games)
- 8.2.12.E.4 Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

21st Century Life and Career Skills:

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST.6 Demonstrate technical skills needed in a chosen STEM field.

Interdisciplinary Connections and Standards:

- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:

- RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Unit Understandings:

Students will understand that...

- JavaScript is a real-world programming language that is still used today in many websites and software programs
- Variables are used to store information inside our programs, and help us solve complicated tasks that would otherwise be very difficult without their use
- User input allows for interaction between the program and the person running the computer program
- Arithmetic expressions are an integral part of computer programming and its functionality
- Graphics can be created and modified in JavaScript in a variety of ways

Unit Essential Questions:

- What is similar in how programs are created in JavaScript versus Karel, and what is distinctly different?
- How do variables change our approach to solving programming tasks?
- How does user input affect our ability to create complex, engaging programs?
- What are graphics in JavaScript, and how do we manipulate their various features?

Knowledge and Skills:

Students will know.....

- How to print text on a screen
- How to prompt a user to enter data (text data, numerical data, etc.)
- How to create a variable, assign it a value, modify its value, and use it within a program
- What the mathematical operator modulus does, and why it is used in programming
- How to create and manipulate graphics in JavaScript

Students will be able to ...

- Print basic text on a screen to a user running a program
- Create and use variables to store information in a program
- Create programs that allow input from the user
- Use arithmetic expressions to help solve programming tasks
- Create graphics on a screen in JavaScript

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly “understand”?

- CodeHS.com lesson exercises
- Class participation

- Class discussion
- End of Unit Assessment
 - Students will take a test for the unit in which they will have to identify terminology, as well as the key concepts of the unit. Students will also be given a program to solve using programming and explain their thought process for the solution code.

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Group programming projects
- Teacher demonstrations over Screen Share software
- Reinforcement worksheets and extra practice
- Paired-programming challenges
- Individualized student to teacher code demonstrations

<i>RESOURCES</i>

Teacher Resources:

- Demonstrations of worked out solutions from CodeHS.com
- Teacher designed worksheets
- CodeHS.com lesson exercises and videos

Equipment Needed:

- Classroom computers

UNIT 3 OVERVIEW

Content Area: Exploring Computer Science

Unit Title: JavaScript Control Structures

Target Course/Grade Level: 9-12

Unit Summary: In this unit, students will learn how to create the various control structures in JavaScript that they first learned in Karel. With the introduction to variables from Unit 2, there are now several new concepts that students will need to master, including Booleans, Logical Operators, and Comparison Operators. These new topics and concepts play an integral role in the functionality of many of the control structures students have used in Karel (and continue to use in JavaScript). Students are also introduced to the random function, which allows a user to obtain random numbers, colors or Booleans from the computer for use in their programs.

Approximate Length of Unit: 8 weeks

LEARNING TARGETS

NJ Student Learning Standards:

- 8.2.12.E.1 Demonstrate an understanding of the problem-solving capacity of computers in our world.
- 8.2.12.E.2 Analyze the relationships between internal and external computer components
- 8.2.12.E.3 Use a programming language to solve problems or accomplish a task (e.g. robotic functions, website designs, applications, and games)
- 8.2.12.E.4 Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

21st Century Life and Career Skills:

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST.6 Demonstrate technical skills needed in a chosen STEM field.

Interdisciplinary Connections and Standards:

- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:

- RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Unit Understandings:

Students will understand that...

- Booleans are a primitive form of data that can be read directly by a computer
- Comparison and Logical operators are an integral part of the control structures of programming
- Nested control structures add an even greater level of complexity to programming

Unit Essential Questions:

- What is a Boolean, and how is it used in JavaScript?
- How do Comparison and Logical Operators make the various control structures work?
- How do you decide when and how to nest control structures when programming?

Knowledge and Skills:

Students will know.....

- Booleans can take on either a true or false value
- Logical operators are used to combine Boolean expressions and are used in if/if-else statements and while loops
- Comparison operators are used for mathematical expressions and are used in loop structures
- Control structures help solve large and complex problems in programming

Students will be able to ...

- Create and use Boolean variables and expressions
- Determine whether a combination of Boolean expressions is true or false based on the truth tables for the Logical Operators AND or OR
- Use Comparison Operators to solve programming tasks
- Create and use If/If-Else Statements in Javascript
- Create and use For Loops in Javascript
- Use the Random function to solve programming tasks
- Create and use While Loops in Javascript

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly “understand”?

- CodeHS.com lesson exercises
- Class participation
- Class discussion
- End of Unit Assessment
 - Students will take a test for the unit in which they will have to identify terminology, as well as the key concepts of the unit. Students will also be given a program to solve using programming and explain their thought process for the solution code.

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

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RESOURCES

Teacher Resources:

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- Teacher designed worksheets
- CodeHS.com lesson exercises and videos

Equipment Needed:

- Classroom computers

UNIT 4 OVERVIEW

Content Area: Exploring Computer Science

Unit Title: Functions and Parameters

Target Course/Grade Level: 9-12

Unit Summary: In this unit, students will learn how to create and use functions in JavaScript. Students learned what a function was and how to both define and call them with Karel. Functions in JavaScript are similar, but with one key difference: the inclusion of parameters. Students will learn what parameters are, and how to send them along while calling a function. Also, students will learn how functions with return values work, and why return values are preferred in certain situations.

Approximate Length of Unit: 6 weeks

LEARNING TARGETS

NJ Student Learning Standards:

- 8.2.12.E.1 Demonstrate an understanding of the problem-solving capacity of computers in our world.
- 8.2.12.E.2 Analyze the relationships between internal and external computer components
- 8.2.12.E.3 Use a programming language to solve problems or accomplish a task (e.g. robotic functions, website designs, applications, and games)
- 8.2.12.E.4 Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

21st Century Life and Career Skills:

- 9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.
- 9.3.ST.6 Demonstrate technical skills needed in a chosen STEM field.

Interdisciplinary Connections and Standards:

- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:

- RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Unit Understandings:

Students will understand that...

- Functions are essential in higher level programming, both in Karel and in JavaScript (and beyond)
- Parameters are values sent to a function when called in order to allow the function to perform some action or computation based on the value of those parameters
- Functions with return values are useful in certain scenarios, and are sometimes preferred to functions without return values

Unit Essential Questions:

- Why do we use functions in JavaScript?
- What is the advantage to creating a function in computer programming?
- When would we use a function with a return value over a function without a return value, and vice versa?

Knowledge and Skills:

Students will know.....

- How to define and call a function in JavaScript
- What a parameter is
- What a return value is, and how it is used
- Why functions are essential to programming

Students will be able to ...

- Define and call functions in JavaScript
- Create programs that use functions, both with and without return values

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly “understand”?

- CodeHS.com lesson exercises
- Class participation
- Class discussion
- End of Unit Assessment
 - Students will take a test for the unit in which they will have to identify terminology, as well as the key concepts of the unit. Students will also be given a program to solve using programming and explain their thought process for the solution code.

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

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- Individualized student to teacher code demonstrations

RESOURCES

Teacher Resources:

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- Teacher designed worksheets
- CodeHS.com lesson exercises and videos

Equipment Needed:

- Classroom computers

UNIT 5 OVERVIEW

Content Area: Exploring Computer Science

Unit Title: Animation and Games

Target Course/Grade Level: 9-12

Unit Summary: In this unit, students will learn basic animation functions and create simple yet satisfying computer games from scratch. Students will learn how to use the timer function, mouse events, and keyboard events to create interactive computer games in JavaScript. The unit culminates in a Final Project to create the classic game Breakout. Students will work together in groups of 2-3 to build each part of the Breakout game, and come together at the end to put each piece together in one full program.

Approximate Length of Unit: 8 weeks

LEARNING TARGETS

NJ Student Learning Standards:

- 8.2.12.E.1 Demonstrate an understanding of the problem-solving capacity of computers in our world.
- 8.2.12.E.2 Analyze the relationships between internal and external computer components
- 8.2.12.E.3 Use a programming language to solve problems or accomplish a task (e.g. robotic functions, website designs, applications, and games)
- 8.2.12.E.4 Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

21st Century Life and Career Skills:

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Interdisciplinary Connections and Standards:

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- RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Unit Understandings:

Students will understand that...

- JavaScript can be used to create animations and computer games
- Computer games are highly complex computer programs that involve high level functions and problem solving
- Creating computer games is challenging, and requires adaptive and novel approaches in order to make the game work both correctly and run smoothly

Unit Essential Questions:

- What is the goal in creating a computer game?
- How does one approach making a game mechanic work, and work well?
- How are tasks to be divided when creating a large, complex program such as a computer game?
- What is troubleshooting, debugging, and pseudocode, and why is it used/important?
- How do people develop, test and debug programs?

Knowledge and Skills:

Students will know.....

- How to program using Events (e.g. clicking a mouse, hitting “enter” on the keyboard)
- How to use timers and randomizers to make certain features of a game work
- What debugging is, and how to go about debugging
- What pseudocode is, and how it is used
- Computer games are complex, multi-faceted programs that involve unique approaches to problems
- Project programming is highly involved and requires many different skill-sets

Students will be able to ...

- Use timers to create animations
- Use mouse events to allow user interactions in a program/game
- Use keyboard events to allow user interactions in a program/game
- Create the game Breakout by working in a group and dividing up the various aspects of the game, where each student works on a part of the game, and then combines all of the work into one final program

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly “understand”?

- CodeHS.com lesson exercises
- Class participation
- Class discussion
- End of Unit Assessment
 - Students will take a test for the unit in which they will have to identify terminology, as well as the key concepts of the unit. Students will also be given a program to solve using programming and explain their thought process for the solution code.

Learning Activities:

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<i>RESOURCES</i>

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Equipment Needed:

- Classroom computers