CURRICULUM FOR EXPLORING COMPUTER SCIENCE

GRADES 9 - 12
This curriculum is part of the Educational Program of Studies of the Rahway Public Schools.

ACKNOWLEDGMENTS

Frank G. Mauriello, Interim Assistant Superintendent for Curriculum and Instruction
Dr. Kevin Robinson, Program Supervisor of STEM

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

John Marks

Christine H. Salcito, Interim Superintendent of Schools

Subject/Course Title: Exploring Computer Science
Date of Board Adoptions: June 30, 2015
Grades 9-12
RAHWAY PUBLIC SCHOOLS CURRICULUM

UNIT OVERVIEW

Content Area: Computer Science

Unit Title: Human Computer Interaction

Target Course/Grade Level: 9-12

Unit Summary:
In this unit students are introduced to the concepts of computer and computing while investigating the major components of computers and the suitability of these components for particular applications. Students will experiment with internet search techniques, explore a variety of websites and web applications and discuss issues of privacy and security. Fundamental notions of Human Computer Interaction (HCI) and ergonomics are introduced. Students will learn that “intelligent” machine behavior is not “magic” but is based on algorithms applied to useful representations of information, including large data sets. Students will learn the characteristics that make certain tasks easy or difficult for computers, and how these differ from those that humans characteristically find easy or difficult. Students will gain an appreciation for the many ways in which computing-enabled innovation have had an impact on society, as well as for the many different fields in which they are used. Connections among social, economical and cultural contexts will be discussed.

Approximate Length of Unit: 40 days

Primary interdisciplinary connections: Science, Business, Social Studies, Language Arts, Family/Consumer Science

LEARNING TARGETS

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Unit Understandings:

*Students will understand that...*

- Computers can be defined in a broad sense, and computing is a process that goes beyond electronic input/output.
- A computer requires several hardware components to function properly.
- The world wide web has a near infinite number of uses, and websites may or may not be trustworthy.
- Big data has had a huge impact on society, and computers can be used to turn that data into very powerful and accurate analysis.
- All computers require a very specific set of instructions in order to function in the intended way.
- Machines are only as intelligent as they are programmed to be by humans.

Unit Essential Questions:

- What are computers and what do they do?
- How are computers used to help solve problems in the real world?
- What can a computer understand? How does a human interact with a computer, and vice versa?

Knowledge and Skills:

- **Vocabulary**
  - Computer/computing
  - Web 2.0
  - Program (as it relates to Computer Science (CS))
  - Artificial Intelligence (AI)

*Students will be able to...*

- Analyze the characteristics of hardware components to determine the applications for which they can be used.
- Use appropriate tools and methods to execute Internet searches which yield requested data.
- Evaluate the results of web searches and the reliability of information found on the Internet.
- Explain the differences between tasks that can and cannot be accomplished with a computer.
- Analyze the effects of computing on society within economic, social, and cultural contexts.
- Communicate legal and ethical concerns raised by computing innovation.
- Explain the implications of communication as data exchange.
EVIDENCE OF LEARNING

Assessment:
What evidence will be collected and deemed acceptable to show that students truly “understand”?
- Daily student work.
- Daily homework.
- Long term projects.

Learning Activities
What differentiated learning experiences and instruction will enable all students to achieve the desired results?
- Cooperative learning opportunities.
- Journaling of ideas.

RESOURCES

Teacher Resources:
- Exploring Computer Science Curriculum.
- Teacher developed worksheets and activities.
- Access to CS Unplugged Activities online.

Equipment Needed:
- Laptop/Desktop Computers for all students.
- Internet access for all students.
Content Area: Computer Science

Unit Title: Problem Solving

Target Course/Grade Level: 9-12

Unit Summary:
This unit provides students with opportunities to become “computational thinkers” by applying a variety of problem-solving techniques as they create solutions to problems that are situated in a variety of contexts. The range of contexts motivates the need for students to think abstractly and apply known algorithms where appropriate, but also create new algorithms. Analysis of various solutions and algorithms will highlight problems that are not easily solved by computer and for which there are no known solutions. This unit also focuses on the connections between mathematics and computer science. Students will be introduced to selected topics in discrete mathematics including Boolean logic, functions, graphs and the binary number system. Students are also introduced to searching and sorting algorithms and graphs.

Approximate Length of Unit: 40 days

Primary interdisciplinary connections: Science, Mathematics, Business, Social Studies, Language Arts, Family/Consumer Science

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Unit Understandings:

*Students will understand that…*

- Most of their daily routines consist of algorithms, or prescribed, step-by-step instructions.
- Big problems can often be broken down into smaller problems, which are usually more manageable.
- There is a strong connection between mathematics and computer science.
- There are often many ways to solve a problem, and some ways are better than others.

Unit Essential Questions:

- What is an algorithm and how is it used?
- What are the connections between Mathematics and Computer Science?
- What are the societal impacts of computing?

Knowledge and Skills:

- **Vocabulary** –
  - Algorithm
  - Abstraction
  - Binary
  - Minimal Spanning Tree

*Students will be able to…*

- Name and explain the steps they use in solving a problem.
- Solve a problem by applying appropriate problem-solving techniques.
- Express a solution using standard design tools.
- Determine if a given algorithm successfully solves a stated problem.
- Create algorithms that meet specified objectives.
- Explain the connections between binary numbers and computers.
- Summarize the behavior of an algorithm.
- Compare the tradeoffs between different algorithms for solving the same problem.
- Explain the characteristics of problems that cannot be solved by an algorithm.

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**EVIDENCE OF LEARNING**

**Assessment:**

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

- Daily student work.
- Daily homework.
- Long term projects.

**Learning Activities:**

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

- Cooperative learning opportunities.
- Journaling of ideas.
Teacher Resources:
- Exploring Computer Science Curriculum.
- Teacher developed worksheets and activities.
- Access to CS Unplugged Activities online.

Equipment Needed:
- Laptop/Desktop Computers for all students.
- Internet access for all students.
UNIT OVERVIEW

Content Area: Computer Science

Unit Title: Web Design

Target Course/Grade Level: 9-12

Unit Summary:
This section prepares students to take the role of a developer by expanding their knowledge of algorithms, abstraction, and web page design and applying it to the creation of web pages and documentation for users and equipment. Students will explore issues of social responsibility in web use. They will learn to plan and code their web pages using a variety of techniques and check their sites for usability. Students learn to create user-friendly websites. Students will apply fundamental notions of Human Computer Interaction (HCI) and ergonomics.

Approximate Length of Unit: 40 days

Primary interdisciplinary connections: Science, Mathematics, Business, Social Studies, Language Arts, Family/Consumer Science

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Unit Understandings:

*Students will understand that…*

- Websites are formed through the markup language Hyper Text Markup Language (HTML) and Cascading Style Sheets (CSS).
- A well-designed website requires proper planning and testing to ensure user acceptance.
- There are many websites in existence now that makes creating websites much easier.
- Documentation while coding a website is essential: others must be able to see the thought process clearly when viewing the source code of a website.

Unit Essential Questions:

- What is Hyper Text Markup Language (HTML) and Cascading Style Sheets (CSS)? What are the differences between the two?
- What is WordPress? Why is it so powerful?
- What are the signs of a well-made website?

Knowledge and Skills:

- **Vocabulary** –
  - What You See is What you Get (WYSIWYG)
  - Hyper Text Markup Language (HTML)
  - Cascading Style Sheets (CSS)
  - Responsiveness (In the context of websites)

*Students will be able to…*

- Create web pages to address specified objectives using Hyper Text Markup Language (HTML) and Cascading Style Sheets (CSS).
- Create web pages with a practical, personal, and/or societal purpose.
- Select appropriate techniques when creating web pages.
- Use abstraction to separate style from content in web page design and development.
- Describe the use of a website with appropriate documentation.
- Use WordPress to quickly and efficiently create a robust, professional looking website.

**EVIDENCE OF LEARNING**

**Assessment:**

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

- Daily student work.
- Daily homework.
- Long term projects.

**Learning Activities:**

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

- Cooperative learning opportunities.
- Journaling of ideas.
Teacher Resources:
- Exploring Computer Science Curriculum.
- Code Academy.

Equipment Needed:
- Laptop/Desktop Computers for all students.
- Internet access for all students.
UNIT OVERVIEW

Content Area: Computer Science

Unit Title: Problem Solving

Target Course/Grade Level: 9-12

Unit Summary:
Students are introduced to some basic issues associated with program design and development. Students design algorithms and create programming solutions to a variety of computational problems using an iterative development process in Scratch. Programming problems include mathematical and logical concepts and a variety of programming constructs.

Approximate Length of Unit: 40 days

Primary interdisciplinary connections: Science, Mathematics, Business, Social Studies, Language Arts, Family/Consumer Science

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Unit Understandings:

*Students will understand that...*
- Designing a computer program requires algorithms and abstraction just as in general problem solving.
- Proper program design requires several steps, and often require the developer to go back and redesign the program several times.
- Logical programming is based in mathematics and Boolean logic.
- Programs will inevitably contain errors, and learning how and why those errors occur is a fundamental skill for computer programmers.
- Programming is very much a collaborative endeavor, as many programs are often modified by others to improve upon or use for another purpose.

Unit Essential Questions:
- What are the signs of a well-made program?
- How can programming in Scratch be used to help solve real world problems?
- What is open source code? Why is it done?

Knowledge and Skills:

- **Vocabulary** –
  - Conditionals
  - Variables
  - Remixing (As it pertains to Scratch)
  - Open Source
  - Event, Control, Logic, Motion, Sound Blocks (In Scratch)

*Students will be able to...*
- Use appropriate algorithms to solve a problem.
- Design, code, test, and execute a program that corresponds to a set of specifications.
- Select appropriate programming structures.
- Locate and correct errors in a program.
- Explain how a particular program functions.
- Justify the correctness of a program.
- Create programs with practical, personal, and/or societal intent.

**EVIDENCE OF LEARNING**

**Assessment:**

*What evidence will be collected and deemed acceptable to show that students truly “understand”?*
- Daily student work.
- Daily homework.
- Long term projects.

**Learning Activities:**

*What differentiated learning experiences and instruction will enable all students to achieve the desired results?*
- Cooperative learning opportunities.
- Journaling of ideas.
RESOURCES

Teacher Resources:
- Exploring Computer Science Curriculum
- Teacher developed worksheets and activities
- http://scratch.mit.edu/

Equipment Needed:
- Laptop/Desktop Computers for all students.
- Internet access for all students.