STEM Scholars

Radius: STEM Readiness

Curriculum Guide

**Recommended Grade Level:** 9-12 | **Total Lessons:** 16 (10-20 minutes each) | **Total Time:** 6-8 hours

**Subject Fit:** CTE | **Standards Alignment:** Common Career Technical Core, Common Core State Standards (Practices)

Radius is a digital learning platform designed to spark student interest in future STEM careers and provide students with the educational foundation they need to pursue STEM careers. The course immerses middle and high school students in a stimulated learning environment where they assume a secret agent identity and are responsible for delivering a package to the President. Along the way, students will learn and apply math skills to solve real-world challenges, such as repairing a bridge using linear equations and decoding encrypted messages.

**Course Structure**

Throughout the course, students will develop an online learning journal using HTML, detailing what they have learned. The students’ amassed online journals comprise an ePortfolio, the final deliverable at the end of the course (and the “package” they deliver to the President). The ePortfolio also contains relevant information such as tailored STEM careers that are of interest to the student and digital achievement badges earned throughout the platform.

Upon completing each module, students are assessed in their new skill areas and exposed to a variety of potential career opportunities that leverage the lessons the student has just learned. Each module contains:

- Explanation/learning of new concepts
- Hands-on activity to reinforce the new concepts
- Matching/recognition activity
- Presentation of relevant STEM careers

**Lesson 1** Understanding Binary Numbers

**Lesson 3** Rational and Irrational Numbers

**Lesson 4** Linear Equations, Functions, and Graphs

**Lesson 6** Ratios, Rate and Unit Conversions

**Lesson 7** Circuits and Paths
Detailed Course Outline

Mission 1: Introduction to Binary Numbers

Overview: Students are welcomed to the world of radius and design their secret agent avatar for use during the course.

Learning Objectives:

○ Compare and contrast place value systems of numeration
○ Use point and click selection functions
○ Identify basic STEM vocabulary in selected domains

Performance-based Activities:

○ Design a custom secret agent avatar

Career Cards:

○ Webpage Designer
○ Animator/Illustrator
○ Blogger

Mission 2: Working with Binary Numbers

Overview: Students convert numbers between base 10 and base 2 and perform binary addition and multiplication.

Learning Objectives:

○ Understand binary numbers and how to manipulate them and apply them to real world scenarios
○ Compare and contrast place value systems of numeration
○ Write code to automate conversion of decimal and binary numbers

Performance-Based Activities:

○ Apply knowledge of binary numbers to plan a truck convoy and determine the minimum number of trucks required to carry different cargo weights
○ Generate code to automate conversion of decimal and binary numbers

Career Cards:

○ Capacity Planning Specialist
○ Data Center Manager
○ Game Developer

Mission 3: Rational and Irrational Numbers & Estimation

Overview: Students distinguish rational numbers from irrational numbers and practice estimation and determining measurement error.
Performance-Based Activities:

- Identify rational and irrational numbers and estimate rational approximations of irrational numbers
- Define and identify errors in measurement including absolute error, relative error, and percentage error
- Create code to automate finding the value of an irrational number to a specified accuracy

Interactive Activities:

- Calculate irrational number approximations to determine the length of the new steel beams needed to fix a broken bridge
- Generate code to approximate irrational numbers

Career Cards:

- Civil Engineer
- Math Teacher
- Marine Architect

Mission 4: Linear Equations, Functions & Graphs

Overview: Students learn about linear equations and apply linear equations to solve real world problems.

Learning Objectives:

- Analyze and solve linear equations with one variable and multiple variables
- Graph linear equations on a coordinate plane
- Interpret slope-intercept form of a linear equation

Performance-Based Activities:

- Solve linear equations to determine how many feet of surfacing is needed to patch up the gap in the broken bridge.
- Generate code to automate and solve linear equations in form $y = mx + b$

Career Cards:

- Supply Expeditor
- Carpenter
- Architect

Mission 5: HTML Part 1

Overview: Students learn key terms related to computer networks and are introduced to HTML tags, which they must apply for the first time in their online Agent Report.

Learning Objectives:

- Recall and apply HTML tag conventions and best design practices for web-page display
- Construct interface design for basic readability (color/font/size) for avoiding cognitive overload
- Compare and contrast HTML and programming language
Performance-Based Activities:

- Produce HTML to design the first phase of the Agent Report

Career Cards:

- Social Network Designer
- eCommerce Analyse
- Webpage Manager

Mission 6: Ratios, Rational Numbers, Rates & Unit Conversion

Overview: Students learn about different types of unit measurements and how to perform conversions.

Learning Objectives:

- Discover the relationships between ratios, rational numbers and unit rates
- Evaluate functions that involve rational numbers, ratios, proportions and unit rates
- Perform unit conversion and dimensional analysis (going from one set of units to another) using code

Performance-Based Activities:

- Match answers with different units of measurement to the appropriate problems
- Generate code to automate conversions between different units of measurement

Career Cards:

- Data Scientist
- Aerospace Engineer
- Chef

Mission 7: Circuits and Paths

Overview: Students are introduced to basic network models, circuits and paths and discover how they relate to STEM in the real-world.

Learning Objectives:

- Apply graph theory to determine network flow
- Identify and manipulate Euler and Hamilton paths and circuits
- Determine an optimal route through a network by assessing paths, circuits, edges, nodes and points of failure

Performance-based Activities and Assessments:

- Analyze three network graphics to determine how to map the shortest route possible while still reaching all of the necessary nodes

Career Cards:
Mission 8: Cryptography

Overview: Students are given a history of cryptography and learn how to use binary numbers to solve basic encryption and decryption problems.

Learning Objectives:
- Understand why encryption and decryption of information is important, both historically and in modern day
- Synthesize binary coding scheme to encode and decode messages
- Modify code for specific encryption and decryption algorithms using a template

Performance-Based Activities:
- Decode secret messages by applying basic decryption methods and knowledge of binary numbers.
- Modify code for a specific encryption/decryption algorithm

Career Cards:
- Cryptanalyst
- Security Expert
- Cloud Software Engineer

Mission 9: Logical Operators & True or False Statements

Overview: Students learn about logical operators, Boolean logic, truth table and logical program design.

Learning Objectives:
- Evaluate true/false statements with logical connectors and, or and not, and recall the order of logical operations
- Translate truth tables into binary code
- Understand the steps of logical program design and how you can use the true/false value of logical statements to control the flow of a program

Performance-Based Activities:
- Sort the steps of programming a solution into the correct sequencing
- Generate code to automate truth tables

Career Cards:
- Travel Agent
- Psychologist
- Nuclear Engineer
Mission 10: HTML Part 2

Overview: Students discover more common HTML tags as a continuation of Mission 5 and become versed in best practices when creating webpage visuals.

Learning Objectives:
- Construct Online Learning Journal using HTML
- Identify HTML tags as the source of controlling web-page display details
- Design for basic perceptual readability (font/color/size) and avoiding cognitive overload
- Compare and contrast HTML and programming language

Performance-Based Activities:
- Product HTML code to continue to enhance the Agent Report

Career Cards:
- Web Developer
- Creative Director
- Social Media Manager

Mission 11: Pythagorean Theorem & Distance Formula

Overview: Students are introduced to the Pythagorean Theorem and learn how to find the distance between two points on a coordinate plane using the Pythagorean Theorem and the Distance Formula.

Learning Objectives:
- Apply the Pythagorean Theorem and/or Distance Formula to solve for one side of a right triangle and find the distance between two points on a coordinate plane.

Performance-Based Activities:
- Match mathematical expressions with the corresponding images
- Generate code to automate a function template that uses the Pythagorean Theorem to find the length between two coordinate points

Career Cards:
- Optometrist
- Astronomer
- Environmental Scientist

Mission 12: Visual Displays, Trends & Scientist Notation

Overview: Students learn about scientific notation and different types of visual data displays and how to analyze them.

Learning Objectives:
List numbers in scientific notation in order from least to greatest
Identify different types of visual displays (lists, tables, bar graphs, pie charts, time series graphs, scatterplots) and how to read them
Analyze visual displays to find trends and determine if the display might be misleading

Performance-Based Activities:
- Match mathematical expressions with the corresponding images
- Generate code to automate a function template that uses the Pythagorean Theorem to find the length between two coordinate points

Career Cards:
- Computer Systems Analyst
- Aircraft Pilot
- Interior Designer

Mission 13: Probability
Overview: Students learn about probability and determining probability with diagrams and algebraic statements.

Learning Objectives:
- Solve the probability of an event and compound events by applying the rules of probability, including \( P(E) = \frac{\text{number of times the event occurs}}{\text{total number of outcomes}} \)
- Calculate the complement of \( P(E) \)
- Evaluate and make decisions under uncertainty

Performance-Based Activities:
- Analyze Venn diagrams and algebraic statements to calculate simple and compound probabilities for possible outcomes
- Modify code to create a custom tool that calculates expected value given a probability distribution.

Career Cards:
- Census Bureau Agent
- Game Designer
- Actuary

Mission 14: Pert, Project Planning & Critical Paths
Overview: Students learn how to execute Pert planning techniques and critical path analysis.

Learning Objectives:
- Create a project task table and draw a network diagram from a task table
- Identify the critical path from a network diagram
Performance-Based Activities:
- Coordinate task management and planning activities

Career Cards:
- Project Planner
- Farmer Manager
- Campaign Manager

Mission 15: Trees-Rooted, Binary, Expression

Overview: Students learn how to create and interpret network trees that represent algorithms.

Learning Objectives:
- Read and identify rooted trees, binary trees and expression trees and understand how they relate to sorting
- Find the value of expression trees
- Build expression trees from binary numbers

Performance-Based Activities:
- Match complex arithmetic expressions with their equivalent tree diagram

Career Cards:
- Payroll Clerk
- Pharmacist
- Urban Planner

Mission 16: HTML Part 3

Overview: The final mission reinforces students’ understanding of HTML tags and best design practices for webpages as they finalize their Agent Report.

Learning Objectives:
- Recall basic HTML tags with solid understanding of how tags function to control webpage display details
- Develop strong sense of user interface best practices for basic readability (color/font/size) and avoiding cognitive overload

Performance-Based Activities:
- Match types of components with examples in a webpage image
- Finalize Agent Report using HTML to format answers and design the report

Career Cards:
- User Experience Designer
- Software Developer
- Medical Coder