Sixth Grade Curriculum

Theme: Advanced Technology, Environmental Engineering, and Mathematical Concepts
Duration: 3 Months (Approximately 12 weeks)

Curriculum Overview

- **Unit 1: Advanced Scratch Programming** (Weeks 1–4)
- **Unit 2: Environmental Engineering Projects** (Weeks 5–8)
- **Unit 3: Introductory Algebra and Geometry** (Weeks 9–12)

Unit 1: Advanced Scratch Programming

Duration: 4 Weeks

Unit Objectives

- Utilize advanced programming concepts such as variables, loops, conditional statements, and lists.
- Develop complex projects in **Scratch**, including interactive games and simulations.
- Understand debugging and troubleshooting techniques.
- Enhance problem-solving and logical thinking skills.
- Encourage creativity and self-expression through coding.

Week 1: Review and Introduction to Advanced Concepts

Lesson 1: Scratch Refresher and Review

- **Duration**: 60 minutes
- **Activities**:
  - **Review Session**:
    - Revisit basic **Scratch** interface elements and simple coding blocks.
  - **Mini Project**:
    - Create a simple animation or story to refresh skills.
  - **Discussion**:
    - Share experiences and previous projects.
- **Assessment**:
  - Completion of the mini project.

○ Demonstrated understanding of basic concepts.

Lesson 2: Introducing Variables and Data Types

- **Duration**: 60 minutes
- **Activities**:
  - **Explanation**:
    - Define variables and their importance in programming.
    - Discuss data types (numbers, strings).
  - **Practice**:
    - Create a program that uses variables to track scores or points.
  - **Hands-On Activity**:
    - Experiment with changing variable values and observing outcomes.
- **Assessment**:
  - Correct implementation of variables.
  - Ability to explain how variables function within a program.

Lesson 3: Utilizing Operators

- **Duration**: 60 minutes
- **Activities**:
  - **Introduction**:
    - Explore arithmetic and logical operators.
  - **Coding Exercise**:
    - Program calculations using operators (e.g., calculators, counters).
  - **Problem-Solving**:
    - Use operators to solve mathematical challenges within Scratch.
- **Assessment**:
  - Proper use of operators in code.
  - Accuracy in mathematical computations.

Lesson 4: Working with Lists (Arrays)

- **Duration**: 60 minutes
- **Activities**:
  - **Concept Explanation**:
    - Introduce lists as a way to store multiple items.
  - **Application**:
    - Create a program that manages a list (e.g., shopping list, high scores).
  - **Interactive Activity**:
    - Manipulate list items (add, delete, search).
- **Assessment**:
  - Successful creation and management of lists.
  - Understanding of list operations.

Week 2: Advanced Control Structures and Custom Blocks

Lesson 5: Deep Dive into Loops and Conditionals

- **Duration**: 60 minutes
- **Activities**:
    - **In-Depth Exploration**:
        - Discuss "repeat until," "forever," "if-else," and nested loops.
    - **Coding Activity**:
        - Program a sprite to perform complex tasks using loops and conditionals.
    - **Challenge**:
        - Create patterns or sequences that require nested loops.
- **Assessment**:
    - Effective use of advanced loops and conditionals.
    - Problem-solving demonstrated in coding challenges.

Lesson 6: Creating Custom Blocks (Functions)

- **Duration**: 60 minutes
- **Activities**:
    - **Explanation**:
        - Define custom blocks and their benefits (code reuse, simplification).
    - **Practice**:
        - Develop custom blocks for repetitive tasks in a program.
    - **Application**:
        - Use custom blocks in a project to enhance functionality.
- **Assessment**:
    - Creation of effective custom blocks.
    - Understanding of parameters and inputs.

Lesson 7: Introduction to Event Handling

- **Duration**: 60 minutes
- **Activities**:
    - **Concept Introduction**:
        - Discuss how events can trigger code (keyboard, mouse clicks).
    - **Interactive Coding**:
        - Create interactive programs that respond to user inputs.
    - **Game Development**:
        - Begin designing an interactive game that uses multiple event handlers.
- **Assessment**:
    - Implementation of event-driven programming.
    - Responsiveness of programs to user actions.

Lesson 8: Debugging Strategies

- **Duration**: 60 minutes
- **Activities**:
  - **Discussion**:
    - Common programming errors and how to identify them.
  - **Debugging Practice**:
    - Provide students with buggy code to fix.
  - **Collaboration**:
    - Pair programming to troubleshoot issues.
- **Assessment**:
  - Ability to identify and correct errors.
  - Demonstrated patience and logical reasoning.

Week 3: Project Development

Lesson 9: Planning the Capstone Project

- **Duration**: 60 minutes
- **Activities**:
  - **Project Introduction**:
    - Outline the requirements for a complex Scratch project (game, simulation).
  - **Brainstorming Session**:
    - Generate ideas individually or in pairs.
  - **Storyboarding**:
    - Create a detailed plan, including objectives, features, and user interactions.
- **Assessment**:
  - Completeness and feasibility of the project plan.
  - Creativity and originality in ideas.

Lesson 10: Starting the Capstone Project

- **Duration**: 60 minutes
- **Activities**:
  - **Implementation**:
    - Begin coding according to the storyboard.
  - **Milestone Setting**:
    - Establish short-term goals for project completion.
  - **Instructor Support**:
    - Provide guidance and troubleshoot initial issues.
- **Assessment**:
  - Progress towards milestones.
  - Effective time management.

Lesson 11: Incorporating Advanced Features

- **Duration**: 60 minutes

- **Activities**:
  - **Feature Integration**:
    - Add advanced elements like scorekeeping, levels, timers.
  - **Use of Lists and Variables**:
    - Implement these to enhance gameplay or simulation accuracy.
  - **Peer Collaboration**:
    - Share techniques and assist classmates.
- **Assessment**:
  - Complexity and functionality of added features.
  - Collaboration and willingness to help others.

Lesson 12: Testing and Debugging

- **Duration**: 60 minutes
- **Activities**:
  - **Playtesting**:
    - Test the project thoroughly for bugs and usability issues.
  - **Feedback Collection**:
    - Receive input from peers on improvements.
  - **Iterative Refinement**:
    - Make necessary adjustments based on feedback.
- **Assessment**:
  - Responsiveness to feedback.
  - Quality of the final, polished project.

Week 4: Finalizing and Presenting Projects

Lesson 13: Preparing Presentations

- **Duration**: 60 minutes
- **Activities**:
  - **Presentation Skills**:
    - Discuss effective communication and demonstration techniques.
  - **Visual Aids**:
    - Create slides or posters to accompany the project showcase.
  - **Rehearsal**:
    - Practice presenting to small groups.
- **Assessment**:
  - Preparedness for presentation.
  - Quality of visual aids.

Lesson 14: Project Presentations

- **Duration**: 60 minutes
- **Activities**:

- ○ **Showcase Event**:
  - ■ Present projects to the class, teachers, or invited guests.
- ○ **Q&A Session**:
  - ■ Answer questions about the project and coding process.
- ● **Assessment**:
  - ○ Clarity and confidence in presentation.
  - ○ Depth of understanding demonstrated in responses.

Lesson 15: Reflection and Self-Assessment

- ● **Duration**: 60 minutes
- ● **Activities**:
  - ○ **Written Reflection**:
    - ■ Students write about their learning experience, challenges, and achievements.
  - ○ **Peer Review**:
    - ■ Provide constructive feedback to classmates.
- ● **Assessment**:
  - ○ Insightfulness of reflections.
  - ○ Thoughtfulness in peer reviews.

Lesson 16: Extension Activities (Optional)

- ● **Duration**: 60 minutes
- ● **Activities**:
  - ○ **Exploring Extensions**:
    - ■ Introduce additional Scratch extensions (e.g., text-to-speech, video sensing).
  - ○ **Creative Experimentation**:
    - ■ Encourage students to incorporate these into their projects or new mini-projects.
- ● **Assessment**:
  - ○ Exploration and integration of new features.
  - ○ Continued enthusiasm for learning.

Ongoing Assessments Throughout Unit

- ● **Coding Journals**: Regular entries documenting ideas, code snippets, and challenges.
- ● **Participation**: Active engagement in coding sessions and discussions.
- ● **Quizzes**: Periodic assessments on advanced coding concepts.

Standards Alignment

- ● **CSTA K-12 Computer Science Standards**:
  - ○ **2-AP-13**: Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs.
  - ○ **2-AP-17**: Systematically test and refine programs using a range of test cases.
- ● **ISTE Standards for Students**:

- ○ **1.5 Computational Thinker**: Students develop strategies for understanding and solving problems.

Unit 2: Environmental Engineering Projects

Duration: 4 Weeks

Unit Objectives

- Understand environmental challenges and the role of engineering in solving them.
- Apply the engineering design process to address real-world environmental issues.
- Develop research, collaboration, and presentation skills.
- Foster environmental stewardship and sustainability awareness.
- Enhance critical thinking and creativity.

Week 5: Introduction to Environmental Engineering

Lesson 1: What Is Environmental Engineering?

- **Duration**: 60 minutes
- **Activities**:
  - ○ **Interactive Presentation**:
    - ■ Discuss the role of environmental engineers.
    - ■ Explore current environmental issues (pollution, climate change).
  - ○ **Class Discussion**:
    - ■ Brainstorm ways engineering can address these issues.
- **Assessment**:
  - ○ Participation in discussions.
  - ○ Completion of a KWL chart.

Lesson 2: The Engineering Design Process

- **Duration**: 60 minutes
- **Activities**:
  - ○ **Introduction**:
    - ■ Review the steps: Ask, Imagine, Plan, Create, Test, Improve.
  - ○ **Case Studies**:
    - ■ Examine successful environmental engineering projects.
  - ○ **Group Activity**:
    - ■ Apply the design process to a simple problem.
- **Assessment**:
  - ○ Understanding of each step.

○ Engagement in group activity.

Week 6: Project Planning and Research

Lesson 3: Identifying Environmental Problems

- **Duration**: 60 minutes
- **Activities**:
  - **Research Assignment**:
    - In groups, select an environmental issue to address (e.g., waste management, water conservation).
  - **Problem Definition**:
    - Clearly define the problem and its impacts.
- **Assessment**:
  - Clarity in problem statements.
  - Depth of research.

Lesson 4: Brainstorming Solutions

- **Duration**: 60 minutes
- **Activities**:
  - **Idea Generation**:
    - Use brainstorming techniques to come up with possible solutions.
  - **Feasibility Analysis**:
    - Evaluate ideas based on criteria such as cost, effectiveness, and sustainability.
- **Assessment**:
  - Variety and originality of ideas.
  - Critical evaluation skills.

Lesson 5: Planning the Project

- **Duration**: 60 minutes
- **Activities**:
  - **Detailed Planning**:
    - Develop a plan including materials, methods, and timelines.
  - **Design Sketches**:
    - Create diagrams or prototypes of the proposed solution.
- **Assessment**:
  - Completeness and practicality of the plan.
  - Quality of design sketches.

Lesson 6: Research on Materials and Methods

- **Duration**: 60 minutes
- **Activities**:

- ○ **Materials Selection**:
  - ■ Research eco-friendly and sustainable materials.
- ○ **Methodology Development**:
  - ■ Outline procedures for creating and testing the solution.
- **Assessment**:
  - ○ Justification for material choices.
  - ○ Logical and safe methods.

Week 7: Building and Testing Prototypes

Lesson 7: Constructing Prototypes

- **Duration**: Multiple sessions totaling 180 minutes
- **Activities**:
  - ○ **Hands-On Building**:
    - ■ Begin constructing the prototype according to the plan.
  - ○ **Team Collaboration**:
    - ■ Assign roles and responsibilities within the group.
- **Assessment**:
  - ○ Progress in construction.
  - ○ Effective teamwork and communication.

Lesson 8: Testing and Data Collection

- **Duration**: 60 minutes
- **Activities**:
  - ○ **Experimentation**:
    - ■ Test the prototype under controlled conditions.
  - ○ **Data Recording**:
    - ■ Collect quantitative and qualitative data on performance.
- **Assessment**:
  - ○ Accuracy and thoroughness in data collection.
  - ○ Adherence to testing procedures.

Lesson 9: Analyzing Results and Iterating

- **Duration**: 60 minutes
- **Activities**:
  - ○ **Data Analysis**:
    - ■ Interpret the results and identify areas for improvement.
  - ○ **Iteration**:
    - ■ Modify the prototype based on findings and retest if time allows.
- **Assessment**:
  - ○ Ability to draw conclusions from data.
  - ○ Willingness to refine and improve the design.

Week 8: Finalizing Projects and Presentations

Lesson 10: Preparing Presentations

- **Duration**: 60 minutes
- **Activities**:
  - **Presentation Development**:
    - Create slides, posters, or reports summarizing the project.
  - **Practice Runs**:
    - Rehearse presentations with peers and receive feedback.
- **Assessment**:
  - Quality and clarity of presentation materials.
  - Responsiveness to feedback.

Lesson 11: Project Showcase

- **Duration**: 60 minutes
- **Activities**:
  - **Formal Presentations**:
    - Present projects to the class, other students, or community members.
  - **Demonstrations**:
    - Showcase prototypes and explain how they work.
- **Assessment**:
  - Effectiveness of communication.
  - Demonstrated understanding of the project.

Lesson 12: Reflection and Environmental Stewardship

- **Duration**: 60 minutes
- **Activities**:
  - **Group Reflection**:
    - Discuss what was learned and the impact of their solutions.
  - **Action Plans**:
    - Develop personal or class commitments to environmental stewardship.
- **Assessment**:
  - Depth of reflection.
  - Practicality of action plans.

Ongoing Assessments Throughout Unit

- **Project Journals**: Documenting research, designs, and reflections.
- **Participation**: Active engagement in group work and discussions.
- **Observation**: Teacher observations of collaboration and problem-solving skills.

Standards Alignment

- **NGSS MS-ETS1-1**: Define the criteria and constraints of a design problem.
- **NGSS MS-ETS1-2**: Evaluate competing design solutions.
- **NGSS MS-ESS3-3**: Apply scientific principles to design a method for monitoring and minimizing human impact.
- **CCSS.ELA-LITERACY.SL.6.4**: Present claims and findings in a focused manner.

Unit 3: Introductory Algebra and Geometry

Duration: 4 Weeks

Unit Objectives

- Understand and apply concepts of variables and algebraic expressions.
- Solve one-variable equations and inequalities.
- Explore geometric shapes, properties, and theorems.
- Develop reasoning and problem-solving skills.
- Connect mathematical concepts to real-world applications.

Week 9: Foundations of Algebra

Lesson 1: Understanding Variables and Expressions

- **Duration**: 60 minutes
- **Activities**:
  - **Interactive Lecture**:
    - Introduce variables as symbols representing numbers.
    - Explain algebraic expressions.
  - **Practice Problems**:
    - Write expressions from word phrases and vice versa.
- **Assessment**:
  - Accuracy in translating phrases to expressions.
  - Participation in class examples.

Lesson 2: Simplifying Algebraic Expressions

- **Duration**: 60 minutes
- **Activities**:
  - **Teaching Concepts**:
    - Discuss combining like terms and the distributive property.
  - **Guided Practice**:
    - Simplify given expressions step by step.
- **Assessment**:

- ○ Correct simplification of expressions.
- ○ Understanding of properties used.

Lesson 3: Solving One-Step Equations

- **Duration**: 60 minutes
- **Activities**:
  - ○ **Explanation**:
    - ■ Introduce inverse operations to isolate the variable.
  - ○ **Hands-On Activity**:
    - ■ Use balance scales to represent equations physically.
  - ○ **Independent Practice**:
    - ■ Solve equations involving addition, subtraction, multiplication, and division.
- **Assessment**:
  - ○ Accuracy in solving equations.
  - ○ Ability to check solutions.

Lesson 4: Solving Two-Step Equations

- **Duration**: 60 minutes
- **Activities**:
  - ○ **Concept Building**:
    - ■ Extend to two-step equations involving multiple operations.
  - ○ **Problem-Solving**:
    - ■ Work through examples with increasing complexity.
- **Assessment**:
  - ○ Correct solutions.
  - ○ Logical progression in solving steps.

Week 10: Exploring Inequalities and Functions

Lesson 5: Understanding Inequalities

- **Duration**: 60 minutes
- **Activities**:
  - ○ **Introduction**:
    - ■ Define inequalities and their symbols.
  - ○ **Graphing on Number Lines**:
    - ■ Represent solutions visually.
  - ○ **Practice**:
    - ■ Solve simple inequalities and graph solutions.
- **Assessment**:
  - ○ Proper graphing of inequalities.
  - ○ Correct interpretation of inequality statements.

Lesson 6: Solving Inequalities

- **Duration**: 60 minutes
- **Activities**:
  - **Instruction**:
    - Solve one-step and two-step inequalities.
  - **Application Problems**:
    - Use inequalities in real-world contexts.
- **Assessment**:
  - Accuracy in solutions.
  - Ability to apply concepts to practical situations.

Lesson 7: Introduction to Functions

- **Duration**: 60 minutes
- **Activities**:
  - **Concept Explanation**:
    - Define functions as relationships between inputs and outputs.
  - **Function Tables**:
    - Complete tables based on given rules.
  - **Graphing Functions**:
    - Plot points on coordinate planes.
- **Assessment**:
  - Correct completion of function tables.
  - Accurate graphing of functions.

Lesson 8: Patterns and Sequences

- **Duration**: 60 minutes
- **Activities**:
  - **Exploration**:
    - Identify arithmetic sequences and patterns.
  - **Rule Formulation**:
    - Derive formulas for nth terms.
- **Assessment**:
  - Identification of patterns.
  - Ability to express rules algebraically.

Week 11: Geometry Concepts

Lesson 9: Basic Geometric Figures

- **Duration**: 60 minutes
- **Activities**:
  - **Review**:

- - ■ Discuss points, lines, planes, angles, and their relationships.
  - ○ **Measurement**:
    - ■ Use protractors and rulers to measure angles and lengths.
- ● **Assessment**:
  - ○ Correct use of measurement tools.
  - ○ Understanding of geometric terms.

Lesson 10: Properties of Triangles and Quadrilaterals

- ● **Duration**: 60 minutes
- ● **Activities**:
  - ○ **Classification**:
    - ■ Identify types of triangles (by sides and angles) and quadrilaterals.
  - ○ **Properties Exploration**:
    - ■ Examine angle sums and side relationships.
- ● **Assessment**:
  - ○ Accurate classification.
  - ○ Application of properties to solve problems.

Lesson 11: Circles and Their Parts

- ● **Duration**: 60 minutes
- ● **Activities**:
  - ○ **Concept Introduction**:
    - ■ Define radius, diameter, circumference, and area.
  - ○ **Calculations**:
    - ■ Use formulas to find circumference and area.
- ● **Assessment**:
  - ○ Correct use of formulas.
  - ○ Precision in calculations.

Lesson 12: Coordinate Geometry

- ● **Duration**: 60 minutes
- ● **Activities**:
  - ○ **Plotting Points**:
    - ■ Practice placing points on the coordinate plane.
  - ○ **Distance and Midpoint**:
    - ■ Introduce formulas and solve problems.
- ● **Assessment**:
  - ○ Accurate plotting.
  - ○ Correct application of formulas.

Week 12: Applying Algebra and Geometry

Lesson 13: Solving Real-World Problems

- **Duration**: 60 minutes
- **Activities**:
  - **Word Problems**:
    - Apply algebraic and geometric concepts to practical scenarios.
  - **Group Work**:
    - Collaborate to solve complex problems.
- **Assessment**:
  - Logical reasoning.
  - Ability to explain solutions.

Lesson 14: Review and Practice

- **Duration**: 60 minutes
- **Activities**:
  - **Comprehensive Review**:
    - Revisit key concepts with practice exercises.
  - **Question and Answer Session**:
    - Address any lingering uncertainties.
- **Assessment**:
  - Completion of review exercises.
  - Engagement in clarifying doubts.

Lesson 15: Unit Assessment

- **Duration**: 60 minutes
- **Activities**:
  - **Written Test**:
    - Evaluate understanding through a combination of multiple-choice, short-answer, and problem-solving questions.
- **Assessment**:
  - Performance on the test.
  - Demonstrated mastery of unit objectives.

Lesson 16: Reflection and Goal Setting

- **Duration**: 60 minutes
- **Activities**:
  - **Self-Assessment**:
    - Reflect on learning progress and areas for improvement.
  - **Future Planning**:
    - Set academic goals for continued growth in mathematics.
- **Assessment**:
  - Honesty and insightfulness in reflections.

○ Specificity of goals.

Ongoing Assessments Throughout Unit

- **Homework Assignments**: Regular practice to reinforce concepts.
- **Quizzes**: Short assessments after key topics.
- **Class Participation**: Engagement in lessons and willingness to contribute.

Standards Alignment

- **Common Core State Standards for Mathematics**:
  - **6.EE.A.1–4**: Expressions and Equations.
  - **6.G.A.1–4**: Geometry.
  - **6.NS.C.8**: Solve real-world problems by graphing points.

Additional Notes for Educators

- **Differentiation**:
  - Provide additional support or enrichment activities as needed.
  - Use varied instructional methods to cater to different learning styles.
- **Integration Opportunities**:
  - Incorporate technology by using graphing calculators or geometry software.
  - Connect mathematical concepts to science and engineering units.
- **Assessment Strategies**:
  - Use formative assessments to guide instruction.
  - Offer feedback that promotes growth mindset and resilience.
- **Parental Involvement**:
  - Encourage parents to support learning at home with resources and discussions.