

Readington Township Public Schools

Innovation & Design Grades 4 & 5

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OVERVIEW

The Innovation and Design Curriculum is based on the belief that much of the ingenuity of children is untapped, unrealized potential that, when properly motivated, will lead to the next generation of technologists, innovators, designers and engineers critical to our society. Our goal is to promote Science, Technology, Engineering and Mathematics (STEM) learning, innovative thinking and creative problem-solving.

Our curriculum framework is aligned with the New Jersey Student Learning Standards for Technological Literacy as well as Engineering Design. We believe that by providing an environment that stimulates enthusiasm for learning, students will develop a conceptual understanding of scientific and mathematical principles, establish proficiency with technological systems and become creative and innovative problem solvers. We are committed to integrating technology into all content areas in a manner that is meaningful, natural, appropriate and which extends a student's learning and makes it more efficient. Our curriculum is designed to promote a problem-based course of study where students will be presented with a problem and will work to design a solution for the problem. This type of learning would be "constructivist" in nature with students actively "building" knowledge rather than passively receiving it and is based on four basic principles:

- 1) Learning by designing meaningful projects to share in the community.
- 2) Using concrete objects to build and explore the world.
- 3) Identifying powerful ideas that are both personally and epistemologically significant
- 4) Engaging in self-reflection as part of the learning process

STUDENT OUTCOME (Linked to New Jersey Student Learning Standards)

NJSLS- Science-Engineering Design

MS.ETS1.A: Defining and Delimiting Engineering Problems

MS.ETS1.B: Developing Possible Solutions

MS.ETS1.C: Optimizing the Design Solution

Computer Science and Design Thinking Practices

1. Fostering an Inclusive Computing and Design Culture
2. Collaborating Around Computing and Design
3. Recognizing and Defining Computational Problems
4. Developing and Using Abstractions
5. Creating Computational Artifacts
6. Testing and Refining Computational Artifacts
7. Communicating About Computing and Design

8.1 Computer Science

Computing Systems

8.1.5.CS.1: Model how computing devices connect to other components to form a system.

8.1.5.CS.2: Model how computer software and hardware work together as a system to accomplish tasks.

8.1.5.CS.3: Identify potential solutions for simple hardware and software problems using common troubleshooting strategies.

Networks and the Internet

8.1.5.NI.1: Develop models that successfully transmit and receive information using both wired and wireless methods.

8.1.5.NI.2: Describe physical and digital security measures for protecting sensitive personal information.

Impacts of Computing

8.1.5.IC.1: Identify computing technologies that have impacted how individuals live and work and describe the factors that influenced the changes.

8.1.5.IC.2: Identify possible ways to improve the accessibility and usability of computing technologies to address the diverse needs and wants of users.

Data & Analysis

8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.

8.1.5.DA.2: Compare the amount of storage space required for different types of data.

- 8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.
- 8.1.5.DA.4: Organize and present climate change data visually to highlight relationships or support a claim.
- 8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.

Algorithms & Programming

- 8.1.5.AP.1: Compare and refine multiple algorithms for the same task and determine which is the most appropriate.
- 8.1.5.AP.2: Create programs that use clearly named variables to store and modify data.
- 8.1.5.AP.3: Create programs that include sequences, events, loops, and conditionals.
- 8.1.5.AP.4: Break down problems into smaller, manageable sub-problems to facilitate program development.
- 8.1.5.AP.5: Modify, remix, or incorporate pieces of existing programs into one's own work to add additional features or create a new program.
- 8.1.5.AP.6: Develop programs using an iterative process, implement the program design, and test the program to ensure it works as intended.

8.2 Design Thinking

Engineering Design

- 8.2.5.ED.1: Explain the functions of a system and its subsystems.
- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
- 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task
- 8.2.5.ED.4: Explain factors that influence the development and function of products and systems (e.g., resources, criteria, desired features, constraints).
- 8.2.5.ED.5: Describe how specifications and limitations impact the engineering design process.
- 8.2.5.ED.6: Evaluate and test alternative solutions to a problem using the constraints and tradeoffs identified in the design process.

Interaction of Technology and Humans

- 8.2.5.ITH.1: Explain how societal needs and wants influence the development and function of a product and a system.
- 8.2.5.ITH.2: Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have.
- 8.2.5.ITH.3: Analyze the effectiveness of a new product or system and identify the positive and/or negative consequences resulting from its use.
- 8.2.5.ITH.4: Describe a technology/tool that has made the way people live easier or has led to a new business or career.

Nature of Technology

- 8.2.5.NT.1: Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem.
- 8.2.5.NT.2: Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries, and societies.
- 8.2.5.NT.3: Redesign an existing product for a different purpose in a collaborative team.
- 8.2.5.NT.4: Identify how improvement in the understanding of materials science impacts technologies.

Effects of Technology on the Natural World

- 8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.
- 8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources.
- 8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved.
- 8.2.5.ETW.4: Explain the impact that resources, such as energy and materials used to develop technology, have on the environment.
- 8.2.5.ETW.5: Identify the impact of a specific technology on the environment and determine what can be done to increase positive effects and to reduce any negative effects, such as climate change

Ethics & Culture

- 8.2.5.EC.1: Analyze how technology has contributed to or reduced inequities in local and global communities and determine its short- and long-term effects.

9.4 Life Literacies and Key Skills

Creativity and Innovation

- 9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3, 7.1.NM.IPERS.6).
- 9.4.5.CI.2: Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue (e.g., 6.3.5.CivicsPD.3, W.5.7).
- 9.4.5.CI.3: Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity (e.g., 8.2.5.ED.2, 1.5.5.CR1a).
- 9.4.5.CI.4: Research the development process of a product and identify the role of failure as a part of the creative process (e.g., W.4.7, 8.2.5.ED.6).

Critical Thinking and Problem-solving

- 9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2).
- 9.4.5.CT.2: Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1).
- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
- 9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3)

ESSENTIAL QUESTIONS AND CONTENT

GRADE 4:

Unit 1 Engineering Design Process

- What is the Engineering Design Process?
- What are the steps in the Engineering Design Process?

Unit 2 Innovations

- What is an Innovation?
- What makes my product an Innovation?

Unit 3 Communication

- How is collaboration an important skill when working in a group?
- Why is it important to have a trademark or copyright?

Unit 4 Coding

- What are the basic fundamentals of programming?

Unit 5 Simple Machines

- What is a simple machine?
- Can you identify 6 simple machines?

GRADE 5:

Unit 1 Engineered Material

- What is the difference between engineered and natural materials?
- What is buoyancy and why must my boat be durable?

Unit 2 Chain Reactions

- What is a chain reaction?
- Who is Rube Goldberg?
- How would you describe a Rube Goldberg Machine?

Unit 3 Coding

- What are the basic fundamentals of programming?

Unit 4 Reusable Materials

- What is recycling?
- How can I recycle?
- What is necessary to create a vehicle that will travel a specific distance?

STRATEGIES

- Groups Discussions
- Teacher Presentation
- Student Projects
- Interactive SMARTBoard & Google Classroom Lessons
- Tutorials
- Online Practice using lesson specific websites

EVALUATION

Assessments may include but are not limited to:

- Teacher Observation
- Class Participation
- Class Discussions
- Class Assignments
- Student Journals
- Student Projects

REQUIRED RESOURCES

- Computer with Internet Connection
- Makey Makey Boards
- Probots

SCOPE AND SEQUENCE

GRADE 4

Unit 1 Engineering Design Process

- Learn the steps in the Engineering Design Process
- Follow the steps in the Engineering Design Process

Unit 2 Innovations

- Follow the steps in the Engineering Design Process
- Innovations & Inventions
- Patents

Unit 3 Communication

- Intellectual Property Law (trademark / copyright)
- Logos & Slogans

Unit 4 Coding

- Procedures
- Program Coding
- Program debugging

Unit 5 Simple Machines

- Simple machine names
- Simple machine identification

GRADE 5

Unit 1 Engineered Materials

- Buoyancy and Durability
- Engineered Materials
- Manufactured Materials

Unit 2 Chain Reactions

- Chain Reaction Properties
- Rube Goldberg
- Rube Goldberg Machine

Unit 3 Coding

- Procedures
- Program Coding
- Program Debugging

Unit 4 Reusable Materials

- Recycled Materials
- Force & Friction