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

NJSLS -Technology

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

A. Technology Operations and Concepts: *Students demonstrate a sound understanding of technology concepts, systems, and operations.*

Understand and use technology systems.

8.1.5.A.1 Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.

Select and use applications effectively and productively.

8.1.5.A.2 Format a document using a word processing application to enhance text and include graphics, symbols and/ or pictures.
8.1.5.A.3 Use a graphic organizer to organize information about problem or issue.
8.1.5.A.4 Graph data using a spreadsheet, analyze and produce a report that explains the analysis of the data.
8.1.5.A.5 Create and use a database to answer basic questions.
8.1.5.A.6 Export data from a database into a spreadsheet; analyze and produce a report that explains the analysis of the data.

C. Communication and Collaboration: *Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.*

8.1.P.C.1 Collaborate with peers by participating in interactive digital games or activities.
8.1.2.C.1 Engage in a variety of developmentally appropriate learning activities with students in other classes, schools, or countries using various media formats such as online collaborative tools, and social media.
8.1.5.C.1Engage in online discussions with learners of other cultures to investigate a worldwide issue from multiple perspectives and sources, evaluate findings and present possible solutions, using digital tools and online resources for all steps.
8.1.8.C.1Collaborate to develop and publish work that provides perspectives on a global problem for discussions with learners from other countries.
8.1.12.C.1 Develop an innovative solution to a real-world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.

D. Digital Citizenship: *Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.*

Advocate and practice safe, legal, and responsible use of information and technology.

8.1.5.D.1 Understand the need for and use of copyrights.

8.1.5.D.2 Analyze the resource citations in online materials for proper use.

Demonstrate personal responsibility for lifelong learning.

8.1.5.D.3 Demonstrate an understanding of the need to practice cyber safety, cyber security, and cyber ethics when using technologies and social media.

Exhibit leadership for digital citizenship.

8.1.5.D.4 Understand digital citizenship and demonstrate an understanding of the personal consequences of inappropriate use of technology and social media.

E: Research and Information Fluency: *Students apply digital tools to gather, evaluate, and use information.*

8.1.5.E.1 Use digital tools to research and evaluate the accuracy of, relevance to, and appropriateness of using print and non-print electronic information sources to complete a variety of tasks.

F: Critical thinking, problem-solving, and decision-making: *Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.*

8.1.5.F.1 Apply digital tools to collect, organize, and analyze data that support a scientific finding.

8.2 Technology Education, Engineering, Design, and Computational Thinking

Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

A. The Nature of Technology: Creativity and Innovation *Technology systems impact every aspect of the world in which we live.*

The characteristics and scope of technology

8.2.5.A.1 Compare and contrast how products made in nature differ from products that are human made in how they are produced and used.

8.2.5.A.2 Investigate and present factors that influence the development and function of a product and a system.

The core concepts of technology.

8.2.5.A.3 Investigate and present factors that influence the development and function of products and systems, e.g., resources, criteria, and constraints.

The relationships among technologies and the connections between technology and other fields of study.

8.2.5.A.4 Compare and contrast how technologies have changed over time due to human needs and economic, political and/or cultural influences.

8.2.5.A.5Identify how improvement in the understanding of materials science impacts technologies.

B. Technology and Society: *Knowledge and understanding of human, cultural and societal values are fundamental when designing technological systems and products in the global society*

The role of society in the development and use of technology.

8.2.5.B.4 Research technologies that have changed due to society's changing needs and wants

8.2.5.B.5 Explain the purpose of intellectual property law.

The influence of technology on history.

8.2.5.B.6 Compare and discuss how technologies have influenced history in the past century

C. Design: *The design process is a systematic approach to solving problems.*

The attributes of design

8.2.5.C.1 Collaborate with peers to illustrate components of a designed system

8.2.5.C.2 Explain how specifications and limitations can be used to direct a product's development

8.2.5.C.3 Research how design modifications have led to new products.

The application of engineering design.

8.2.5.C.4 Collaborate and brainstorm with peers to solve a problem evaluating all solutions to provide the best results with supporting sketches or models

8.2.5.C.5 Explain the functions of a system and subsystems

The role of troubleshooting, research and development, invention and innovation and experimentation in problem-solving.

8.2.5.C.6 Examine a malfunctioning tool and identify the process to troubleshoot and present options to repair the tool

8.2.5.C.7 Work with peers to redesign an existing product for a different purpose.

D. Abilities for a Technological World: *The designed world is the product of a design process that provides the means to convert resources into products and systems.*

Apply the design process.

8.2.5.D.1 Identify and collect information about a problem that can be solved by technology, generate ideas to solve the problem and identify constraints and trade-offs to be considered.

8.2.5.D.2 Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design process to evaluate potential solutions.

Use and maintain technological products and systems.

8.2.5.D.3 Follow step by step directions to assemble a product or solve a problem

8.2.5.D.4 Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved.

8.2.5.D.5 Describe how resources such as material, energy, information, time, tools, people and capital are used in products or systems.

Assess the impact of products and systems.

8.2.5.D.6 Explain the positive and negative effect of products and systems on humans, other species, and the environment, and when the product or system should be used.

8.2.5.D.7 Explain the impact that resources such as energy and materials used in a process to produce products or system have on the environment.

E. Computational Thinking: Programming: *Computational thinking builds and enhances problem-solving, allowing students to move beyond using knowledge to creating knowledge.*

Computational thinking and computer programming as tools used in design and engineering.

8.2.5.E.1 Identify how computer programming impacts our everyday lives.

8.2.5.E.2 Demonstrate an understanding of how a computer takes input of data, processes, and stores the data through a series of commands, and outputs information

8.2.5.E.3 Using a simple, visual programming language, create a program using loops, events, and procedures to generate specific output.

8.2.5.E.4 Use appropriate terms in conversation (e.g., algorithm, program, debug, loop, events, procedures, memory, storage, processing, software, coding, procedure, and data).

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 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 (10 days)
- Learn the steps in the Engineering Design Process
- Follow the steps in the Engineering Design Process

Unit 2 Innovations (10 days)
- Follow the steps in the Engineering Design Process
- Anthropometrics
- Patents

Unit 3 Communication (10 days)
- Intellectual Property Law (trademark / copyright)
- Market Research

Unit 4 Coding (7 days)
- Procedures
- Program Coding
- Program debugging

Unit 5 Simple Machines (5 days)
- Simple machine names
- Simple machine identification

GRADE 5

Unit 1 Engineered Materials (10 days)
- Buoyancy and Durability
- Engineered Materials
- Manufactured Materials

Unit 2 Chain Reactions (10 days)
- Chain Reaction Properties
- Rube Goldberg
- Rube Goldberg Machine

Unit 3 Coding (5 days)
- Procedures

- Program Coding
- Program Debugging

Unit 4 Reusable Materials (6 days)

- Recycled Materials
- Force & Friction