Readington Township Public Schools

Innovation & Design Grade 6

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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.

STUDENT OUTCOMES (Linked to the 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

Standard

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.

Strand

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

8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.
8.1.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.
8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results
8.1.8.A.5 Create a database query, sort and create a report and describe the process, and explain the report results.

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.***

8.1.8.C.1 Collaborate to develop and publish work that provides perspectives on a global problem for discussions with learners from other countries.

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

8.1.8.D.1 Understand and model appropriate online behaviors related to cyber safety, cyber bullying, cyber security, and cyber ethics including appropriate use of social media.
8.1.8.D.2 Demonstrate the application of appropriate citations to digital content.
8.1.8.D.3 Demonstrate an understanding of fair use and Creative Commons to intellectual property.
8.1.8.D.4 Assess the credibility and accuracy of digital content.
8.1.8.D.5 Understand appropriate uses for social media and the negative consequences of misuse.

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

8.1.8.E.1 Effectively use a variety of search tools and filters in professional public databases to find information to solve a real world problem.

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.***

8.1.8.F.1 Explore a local issue, by using digital tools to collect and analyze data to identify a solution and make an informed decision.

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.

Strand

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

8.2.8.A.1 Research a product that was designed for a specific demand and identify how the product has changed to meet new demands (i.e. telephone for communication smart phone for mobility needs).

8.2.8.A.2 Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system.

8.2.8.A.3 Investigate a malfunction in any part of a system and identify its impacts.

8.2.8.A.4 Redesign an existing product that impacts the environment to lessen its impact(s) on the environment.

8.2.8.A.5 Describe how resources such as material, energy, information, time, tools, people, and capital contribute to a technological product or system.

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

8.2.8.B.1 Evaluate the history and impact of sustainability on the development of a designed product or system over time and present results to peers.

8.2.8.B.2 Identify the desired and undesired consequences from the use of a product or system.

8.2.8.B.3 Research and analyze the ethical issues of a product or system on the environment and report findings for review by peers and /or experts.

8.2.8.B.4 Research examples of how humans can devise technologies to reduce the negative consequences of other technologies and present your findings.

8.2.8.B.5 Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries and societies.

8.2.8.B.6 Compare and contrast the different types of intellectual property including copyrights, patents, and trademarks.

8.2.8.B.7 Analyze the historical impact of waste and demonstrate how a product is upcycled, reused or remanufactured into a new product.

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

8.2.8.C.1 Explain how different teams/groups can contribute to the overall design of a product.

8.2.8.C.2 Explain the need for optimization in a design process.

8.2.8.C.3 Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.

8.2.8.C.4 Identify the steps in the design process that would be used to solve a designated problem.

8.2.8.C.5 Explain the interdependence of a subsystem that operates as part of a system.
Create a technical sketch of a product with materials and measurements labeled.

8.2.8.C.6 Collaborate to examine a malfunctioning system and identify the step-by-step process used to troubleshoot, evaluate and test options to repair the product, presenting the better solution.

8.2.8.C.7 Collaborate with peers and experts in the field to research and develop a product using the design process, data analysis and trends, and maintain a design log with annotated sketches to record the developmental cycle.

8.2.8.C.8 Develop a proposal for a chosen solution that include models (physical, graphical or mathematical) to communicate the solution to peers.

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.***

8.2.8.D.1 Design and create a product that addresses a real world problem using a design process under specific constraints.

8.2.8.D.2 Identify the design constraints and trade-offs involved in designing a prototype(e.g., how the prototype might fail and how it might be improved) by completing a design problem and reporting results in a multimedia presentation, design portfolio or engineering notebook.

8.2.8.D.3 Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.

8.2.8.D.4 Research and publish the steps for using and maintaining a product or system and incorporate diagrams or images throughout to enhance user comprehension.

8.2.8.D.5 Explain the impact of resource selection and the production process in the development of a common or technological product or system.

8.2.8.D.6 Identify and explain how the resources and processes used in the production of a current technological product can be modified to have a more positive impact on the environment.

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

8.2.8.E.1 Identify ways computers are used that have had an impact across the range of human activity and within different careers where they are used.

8.2.8.E.2 Demonstrate an understanding of the relationship between hardware and software.

8.2.8.E.3 Develop an algorithm to solve an assigned problem using a specified set of commands and use peer review to critique the solution.

8.2.8.E.4 Use appropriate terms in conversation (e.g., programming, language, data, RAM, ROM, Boolean logic terms).

RATIONAL

Unit 1 Solar Ray Catchers

Solar powered vehicles have been developed and used for the last several decades, although they are not currently a practical form of transportation due to their inefficiency and expensive cost of production. However, in the future, they can play a part in reducing our reliance on fossil fuels. In Innovation and Design, students will use the Engineering and Design Process to build a solar car that is able to travel down a track as fast as possible and carry a payload, or empty soda can. They will study gear ratios and try to find one that will provide maximum speed, and optimal power. Students will re-design and modify their original idea to increase the speed and/ or power of their solar car. The goal of racing a car powered by a photovoltaic cell with a 12 oz aluminum can on board will be an exciting and challenging task.

Unit 2 Energy Efficient 3D House

Buildings account for about half of all of the energy consumed in the US. Today, architects are using computer-aided design software, like Google SketchUp to accelerate the design process and generate exceptional drawings in the context of a modest budget. This program allows clients to visualize green features such as solar panels, sustainable landscaping and building materials that will serve to produce a more sustainable world. Similar to real-world architects, students will use SketchUp to design a 3D energy efficient house drawn to scale. Students will research solar radiation, as well as photovoltaic cells and how they convert the sun's rays into electrical energy. With Google SketchUp, Google Earth and the Google 3D Warehouse, students can create contemporary eco-friendly homes and become even more inspired and educated about reducing their own ecological footprint.

ENDURING UNDERSTANDINGS

Students will:

- Select and use applications effectively and productively.
- Apply existing knowledge to generate new ideas, products, or processes.
- Communicate information and ideas to multiple audiences using a variety of media and formats.
- Contribute to project teams to produce original works or solve problems.
- Advocate and practice safe, legal, and responsible use of information and technology.
- Plan and manage activities to develop a solution or complete a project.
- Understand the relationships among technologies and the connections between technology and other fields of study.
- Understand the application of engineering design.
- The role of troubleshooting, research and development, invention and innovation and experimentation in problem-solving.
- Apply the design process.

ESSENTIAL QUESTIONS

Unit 1 Solar Ray Catchers

- What is the purpose of soldering and how is it done?
- What gear ratio will allow the ray catcher to move at the greatest speed?
- How does weight affect the speed of a vehicle on various terrain?

Unit 2 Energy Efficient 3D House

- What are square feet and how is it calculated?
- What is passive solar heating?
- In what cardinal direction should a building be facing to harness optimal energy from the Sun?

STRATEGIES

- Groups Discussions
- Teacher Presentation
- Student Projects
- Interactive SMARTBoard Lessons
- Tutorials
- Online Practice using lesson specific websites
- Multimedia Presentations

EVALUATION

Assessments may include but are not limited to:

- Teacher Observations
- Class Participations
- Class Discussions
- Class Assignments
- Homework Assignments
- Student Notebooks
- Student Projects

REQUIRED RESOURCES

- Computer with internet connection
- Solar Ray Catcher Kit from Pitsco

SCOPE AND SEQUENCE

Unit 1 Solar Ray Catchers (25 days)

- English System of Measurement lesson. (1 day)
- Overview of the project. Construct a car that can travel in a straight path and travel as fast as possible. (1 day)
- Study gears and understand the difference between a power ratio and a speed ratio. (2 days)
- Construct the car.
    - Draw, measure, cut, sand, and hot glue the axle assembly and motor to chassis. (2 days)
    - Solder the double A battery holder. (1 day)
    - Test and evaluate the car. (1 day)
    - Redesign and modify (2 days)
    - Complete the speed and voltage data sheet. (2 days)
- Determine an angle that will allow a solar panel to collect the most direct sunlight. (1-2 days)
    - Interpret this by looking at the solar panels shadow in addition to using a multimeter and measuring the DC voltage.
- Calculate the speed of their car by using multiple units of measurement. (1 day)
    - Human dimensions(i.e. what is a pace)

- English system of measurement (ie. feet per second to miles per hour)

Unit 2 Energy Efficient 3D House (15 days)

- Identify how many square feet are in their house and understand how that number is calculated. (1 day)
- Build a three-dimensional home to scale by inputting length, width and height dimensions. (2 days)
- Apply the appropriate material to their home that will make it as energy efficient as possible. (1 day)
- Determine where south will be located and then place as many windows as possible to collect passive solar energy. (1 day)
- Identify, design and place an additional item that will make their house greener. (garden, clothesline, water retention barrel) (1 day)
- Design and place a minimum of 1 additional item on the exterior or their home to scale. (shed, table and chairs, swing set)