Readington Township Public Schools

Innovation & Design Grade 8

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OVERVIEW

This unit offers many new and unusual concepts and challenges to 8th graders as they design an aerodynamic dragster and race it down a level track. The goal of this unit is to provide a platform for students to apply concepts learned in physics and math in a real world setting. Students will also learn new skills and techniques used in the design process. Students will use 21st Century Skills such as compromise and collaboration to carry out various tasks throughout the project.

Students will also complete a unit where they will take an idea from brainstorming to sketching, then to building a computer programmed robot which will complete multiple tasks. Using robots in education will help students grasp STEM concepts while emphasizing ingenuity, teamwork, and problem-solving skills. Students will design real-life apparatuses and use imagination, reason, and investigative skills to meet challenges that faced our nation in the 19th century all while learning essential science, technology, engineering, and math concepts.

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, an 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 includes 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 CO2 Dragsters

One of the most important considerations automobile engineers focus on when designing a vehicle is aerodynamics. The more aerodynamic a vehicle is, the better the car will move through the air. Students will learn and relate concepts from physics and math to a "real world" situation.

Students also use the engineering design process to learn about the relationship between friction, drag, and weight. Students must complete all design phases to build a successful dragster, and follow the specifications or limitations provided by the instructor. They will collaborate in groups to design a dragster that will have a low drag when placed in a wind tunnel and a high speed when raced on a track. Since the construction of the vehicle is not a linear process, revisions are encouraged and expected; this helps students realize the importance of analyzing and modifying a design to achieve success. Testing and analyzing the results are a key component in any technology or science lesson. Students will be able to discover the strengths and weaknesses in their design by measuring their dragsters weight, aerodynamic resistance, and rolling friction.

Unit 2 Robotics

The students' objective is to develop, build, and program a working robot to complete predesigned tasks on a course. Students will use various materials such as brackets, mounts, tubing, hubs, servos, motors, wheels, gears, batteries, connectors, and drive trains. Students will be working collaboratively to construct a working robot capable of moving, pushing, pulling and picking up an object. The robots will compete with others built in the class according to prearranged guidelines.

The robotics-based challenge, although a competition, will be designed as a "game" with a very practical goal. Students will work in teams to create the best robotics solution possible to complete the challenge. Students must use their brains and their hands to compete and find ways to design, build, and program robots from a standard set of parts. Teams will propose and test the theory, prototype examples, and program their robots. Joint teamwork, group problem solving, as well as the ability to meet deadlines, are all hallmarks of successful teams.

ENDURING UNDERSTANDINGS

Unit 1 CO2 Dragsters

- The intention of design is to construct something that functionally works and has a pleasant appearance.
- Craftsmanship relates being aware of limitations and paying attention to detail during the construction of a product. Craftsmanship influences how a car looks as well as how well it functions.
- Examining the effects the shape of a car has on drag can lead to improved aerodynamic design.
- Aerodynamics is the study of how solid objects replace fluid air and other gasses. Cars and airplanes must be designed with rounded edges to reduce wind drag and increase efficiency.
- To understand how to achieve the speed you must explore the relationship between force, mass, and acceleration.
- Any task no matter how complex, simple, or basic must be done in an ordered sequence.

Unit 2 Robotics

- Achieving success with programing requires testing and modifying.
- Understand the limitations of sensors and how they acquire information from the external world.
- Imagination, reason, and investigative skills have always been necessary for meeting challenges.
- Learning of science, technology, engineering, and math concepts can be integrated.

ESSENTIAL QUESTIONS

CO2 Dragsters

- What are the components of design (functionality & aesthetics) and why are they important to keep in mind as you are making a product?
- What is craftsmanship, what is its purpose and how does it affect the design of a car?
- How is drag determined, and how can it be reduced?
- What is aerodynamics, and how does it affect a vehicle in motion?
- How do you achieve speed? How do forces (inertia, thrust, friction) play a role on a vehicle?

Robotics

- What are robots and how can they be useful?
- What place do robots serve in our world?
- How can autonomous robots be designed to perform manual and repetitive tasks, at home and in the workforce?
- Why are flowcharts essential in robotic engineering and programming?

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

- Basswood Dragster Blanks
- Pitsco Free Hand Foam Cutter
- Wind Tunnel
- Fog Maestro wind flow visualization
- Roll test ramp
- Race system
- Lego Mindstorms Education EV3 kit
- EV3 Programming software
- Ozobots

SCOPE AND SEQUENCE

CO2 Dragsters- (25 days)

- Engineering Design Process lesson (1-2 days)
- Physics Illustrator Car activity (2 days)
- Introduction, notes, and experiments (3 days)
- Group planning preparation (2 days)
- Architects design sketch (2 days)
- Prototype construction (2 days)
- Cutting dragster blank (4 days)
- Writing and shooting commercial for sponsor(2-3 days)
- Sanding dragster (1-2 days)
- Painting dragster (2 days)
- Testing dragster- wheel spin, wheel alignment, weight, wind tunnel (1-2 days)
- Racing dragster (1-2 days)
- Evaluation and Conclusion (1 day)

Robotics (20 days)

- Introduction to Westward Expansion(2 days)
- Introduction to Robots(1-2 days)
- Exploration with Ozobots (2 days)
- Basic chassis construction(1-2 days)
- Programming and experimenting extensions sensors (4 days)
    - Rotation
    - Ultrasonic
    - Color/light
    - Gyro
    - Touch
- Group planning and preparation(1-2 days)
- Completion of Challenge(3-4 days)
- Evaluation and Conclusion(1 day)