Unit 2: Amusement Park Design

Content Area: **Engineering**
Course(s): **STEM**
Time Period: **Week 3**
Length: **20 Days**
Status: **Published**

Unit Overview

In this unit, students will create their own robotic amusement park. Students will begin by researching different rides at local amusement parks and selecting different rides that they would like to incorporate into their amusement park. Students will then be split off into teams to plan and design what they would like their amusement park to look like. When planning their amusement park, students must incorporate all functionalities of the "Hummingbird" device (specifically the use of motors, lights, and sensors). Everything from planning, to programming, to construction will be completed cooperatively in teams. There are certain principles that students must incorporate into their final amusement park designs. This unit will incorporate knowledge gained from the first unit, STEM 1, and computer programming.

Standards

6-8.MS-ETS1-3.ETS1.B.1	There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
SCI.MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
SCI.MS-ETS1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
TECH.8.1.8.A.CS1	Understand and use technology systems.
TECH.8.1.8.F.CS2	Plan and manage activities to develop a solution or complete a project.
TECH.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.
TECH.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.

Essential Questions

1) What characteristics make an amusement park fun and exciting?

2) How can you utilize the features of the Hummingbird to create amusment park rides?

3) How can the use of sensors be seemlessly incorporated into your amusement park designs?

Application of Knowledge: Students will know that...

- A crankshaft and piston can be used to raise/lower a ride.
- A pendulum is an object hung from a fixed point so that it can freely "swing" forward and backward.
- Centrifugal force is a force that acts outward on a body.
- Centripetal force is a force that acts on a body moving in a circular path and is directed toward the center around which the body is moving.
- It is important to have a systematic approach to programming.
- SCRATCH is a computer program used to help understand programming language.
- When creating a centripetal ride the object must be completely balanced in order to rotate correctly.

Application of Skills: Students will be able to...

- Incorporate all of their rides into their own unique theme park.
- Organize their daily progress in various journal entries.
- Research, design, create, and program an amusement park ride that represents the characteristics of a pendulum.
- Research, design, create, and program an amusement park ride that utilizes centrifugal force. (An example of this would be the "swing" ride).
- Research, design, create, and program an amusement park ride that utilizes centripetal force. (An example to this would be a carousel).
- Write programming code to accomplish a task.

Assessments

- Journal logs: Will be used for students to share anything that worked out well during the design process or anything unexpected they encountered.
- Peer scoring rubrics: Students will grade their peers as to how well they completed the required tasks.
- Pendulum rubric: Will be used by the teacher to grade student progress for creating the pendulum ride for the amusement park project.
- Centripetal force rubric: Will be used by the teacher to grade student progress for creating the carousel (or similar ride) for the amusement park project.
- Centrifugal force rubric: Will be used by the teacher to grade student progress for creating the swings (or similar ride) for the amusement park project.

Suggested Activities

- Pendulum Project: Students will create a working pendulum ride to incorporate into their amusement park project. Students will research various type of pendulum rides and will select one that they would like to create. Students will then use their programming knowledge to make this a working pendulum ride.
- Centripetal Force Project: Students will create a working amusement park ride that incorporates the concept of centripetal force. Students will research various types of amusement rides that rely on

centripetal force and will select a ride that they would like to create. Students will then utilize their programming knowledge to bring this ride to life.

- Centrifugal Force Project: Students will create a working amusement park ride that incorporates the concept of centrifugal force. Students will research various types of amusement rides that rely on centrifugal force and will select a ride that they would like to create. Students will then utilize their programming knowledge to bring this ride to life.

Activities to Differentiate Instruction

Differentiation for special education:

- General modifications may include:
  - Modifications & accommodations as listed in the student's IEP
  - Assign a peer to help keep student on task
  - Modified or reduced assignments
  - Reduce length of assignment for different mode of delivery
  - Increase one-to-one time
  - Prioritize tasks
  - Think in concrete terms and provide hands-on-tasks
  - Position student near helping peer or have quick access to teacher
  - Anticipate where needs will be

- **Content specific modifications may include:**
  - Breaking a project up into attainable goals that can be met each period.
  - Providing students with the beginning (or if necessary the full) programming language to accomplish the programming aspect of the project.
  - For certain projects, show students completed models of projects.
  - Provide students with ride ideas that would be easier to manage.

Differentiation for ELL's:

- General modifications may include:
  - Strategy groups
  - Teacher conferences
  - Graphic organizers
  - Modification plan
  - Collaboration with ELL Teacher
- **Content specific vocabulary important for ELL students to understand include:** STEM, pendulum, centripetal force, centrifugal force, crankshaft, motor, physics

Differentiation to extend learning for gifted students may include:

- For those looking for a different way to program other than SCRATCH, allow students to use Python.

- Allow students to come up with ride designs that incorporate more than one motor moving in conjunction with the other.

Integrated/Cross-Disciplinary Instruction

ELA: Practice formulating complete and grammatically correct responses for the given journal entries.

Technology: Successfully program the "Hummingbird" to bring the amusement park rides to life.

Science: Put into practice the ideas of forces (centripetal and centrifugal) into the given amusement park rides.

Resources

https://scratch.mit.edu/: (SCRATCH Programming)

Rubrics for the given amusement park rides

Youtube videos: self directed videos that can help students along in the design process

21st Century Skills

CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.