Pinto Phase I – Research and Planning – Due Date: Midte

1. Identify the “Big” concept to be covered by the engineering design challenge.

Codes and Coasters:

Students will design a scale model of a roller coaster given specific design constraints

Students will draw code for an Ozobot coding robot using color coding to allow the Ozobots to successfully navigate their roller coaster design.

Students will analyze angles and forces necessary for the Ozobot to navigate the specific course they design and build.

2. Research appropriate learning standards associated with the topic.

NGSS

Science and Engineering Practices -

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.

MS-ETS1-4 Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.

MS-PS2-2 - Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.

Crosscutting Concepts -

MS-ETS-S1-1 All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.

MS-ETS1-1 The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.

Disciplinary Core Ideas -

MS-ETS1-1A - The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.

Common Core State Standards:

CCSS.MATH.CONTENT.7.G.B.6

Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

3. Identify and discuss the different types of problem solving and declarative/procedural knowledge needed.

Types of problems to be solved:
Rule Using Problem - In coding the Ozobot, students will need to learn the language that Ozobot is able to read. In the case of beginning coding, the simple language of color is all that is needed to program the robot to accomplish a prescribed task. Students will learn the sequence of colors that cause Ozobot to do a certain task and will need to draw lines that the robot can see and follow.

Design Problem - Students will be challenged to design a small roller coaster from scratch using recycled materials. This is a very unstructured, ill-defined problem. They have multiple ways of solving the problem and there is a variety of materials available to them to use.

Trouble shooting problems - students will encounter many obstacles in their design and code. They must be able to systematically determine why the code or design has failed and which piece of code or coaster that must be fixed.

Declarative knowledge needed:

- What is a roller coaster
- How much of an angle Ozobot is able to manage
- How to speak the color code to program Ozobot
- How to build using paper, cardboard, tape and glue
- What a theme for a major roller coaster would entail
- How to program Ozobot to do turns, accelerate, navigate corners and do special moves
- The relationship between force, mass and acceleration

Procedural knowledge:

Problem is vague, ill-defined and unstructured

4. Explore objectives and ancillary concepts/content covered by the project.

In this challenge, students will combine all 4 STEM disciplines to create their own roller coaster for a coding robot to navigate. Mathematics: Students will need to analyze angles as they build their roller coaster in order for the robot to be able to ascend and descend multiple levels and navigate turns. Science: Students will evaluate the best surface to use to reduce friction and allow Ozobot to complete the course. They will also analyze the force necessary to ascend a hill without using too much force to go off the track. Technology: This is an introduction to basic coding that students will then be able to build upon in later units. Engineering: The design of the roller coaster must be constructed to accomplish several major tasks and withstand the weight and movement of the Ozobot robot. The roller coaster will be constructed out of recycled and household materials.

5. Identify possible activities.

Engage: Day 1:

Watch Virtual Roller coaster ride at https://youtu.be/Q3z2AsJzR-Q. Have students discuss what makes a great roller coaster .

Create a list of the top three features that make a great roller coaster

In partners, have students explore the relationship between mass, speed, friction and gravity using https://www.funderstanding.com/educators/coaster/ and PHET Interactive Simulation “Energy Skate Park”.

Explore: (Day 2-8)

(2 days) Students will work through Ozobot task cards (included in Ozobot Classroom Kit when purchasing Ozobots) to learn color coding. Students will work in pairs to complete the task cards.

(5 days) Using the Engineering Design Process, students will construct roller coasters using recycled materials such as tape, cardboard, paper, etc. Each student will receive the handout “Codes and Coasters Student challenge” for specific constraints.

Explain: (Day 9) Students will present their roller coasters to the class. Each group must explain why they chose their particular design, the materials they used and how they were able to overcome the force and coding challenges to complete their course.

Evaluate: (Day 9)

Students will complete a self-evaluation form based on their teamwork, how they used the Engineering Design Process to overcome each part of the challenge and their overall design.

Students will participate in a gallery walk to observe and peer-evaluate all designs in the class. Each roller coaster will receive a scale score from 1-5 in the following categories: Theme, Exciting features, Interesting code, Overall impressions.

Elaborate: (Day 10) Students will use what they have learned about Color coding with Ozobot to begin blocky coding by playing coding games on https://games.ozoblockly.com/. Students will be able to complete the Shape Tracer game by programming Ozobot to follow a simple shape course by assembling block codes to accomplish specific tasks.

6. Select the best activity for your classroom.

I'm very excited to try this with my STEM class. I have approximately 25 7th grade students in class all chosen for their advanced interest and ability in science. The class meets two days per week for 50 minutes. Based on my lesson planning this challenge will take approximately 5 weeks under these limited time conditions. I plan to begin the challenge early in October and finish by Thanksgiving break. I hope to be able to showcase the students coasters at a parent night in December.