Pool Noodle Roller Coaster - Lesson Plan

Stage 1 – Desired Results
Essential Questions: How can the time and distance traveled of an object be used to find the object's speed? How does the height of a starting point of an object affect that object's speed?
Lesson Objectives: The students will design, create, and improve a roller coaster using pools noodles that will be tested with a marble. The students will define various vocabulary words related to energy. The students will calculate the speed of the marble that passes through the roller coaster. The students will construct a scatterplot to display the data of the entire class.
Standards: T&E Education ● 3.6.7.C: Explain physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, marketing, research and design. ● 3.7.7.B: Use appropriate instruments and apparatus to study materials. ● 3.7.7.E: Explain basic computer communications systems. Science Education ● 3.2.7.A: Explain and apply scientific and technological knowledge. ● 3.2.7.B: Apply process knowledge to make and interpret observations. ● 3.2.7.C: Identify and use the elements of scientific inquiry to solve problems. ● 3.2.7.D: Know and use the technological design process to solve problems. ● 3.4.7.C: Identify and explain the principles of force and motion Mathematics Education ● CC.2.1.7.E.1: Apply and extend previous understandings of operations with fractions to operations with rational numbers. ● CC.2.2.7.B.1: Apply properties of operations to generate equivalent expressions. ● CC.2.2.7.B.3: Model and solve real-world and mathematical problems by using and connecting numerical algebraic, and/or graphical representations. Computer Science ● 1A-IC-17: Work respectfully and responsibly with others online. ● 1A-IC-18: Keep login information private, and log off of devices appropriately. CEW ● 13.1.5.H: Connect personal interests and abilities and academic strengths to personal career options. ● 13.2.5.A: Apply appropriate speaking and listening techniques used in conversation. ● 13.2.5.E: Apply to daily activities, the essential workplace skills.

Stage 2 – Assessment

Assessments:

- Informal Formative Assessments throughout unit
  - Classroom observations, questioning
- Formal assessments on:
  - Calculation of speed using time and distance
  - Creation of scatter plot displaying data of classmates
  - Peer Evaluations
- Individual Course Summative Assessments
  - Product created following the criterion and constraints provided for the construction of a rollercoaster
- Performance Tasks
  - Research of rollercoasters documentation
  - Sketch of roller coasters during brainstorming process
  - Product created following the criterion and constraints provided for the constructions of a rollercoaster
  - Analysis and organization of data collected
  - Reflection of learning throughout lesson

Stage 3 – Learning Plan

Materials

Pencil, calculator, stopwatch, marble, wooden skewers, masking tape, 3 pool noodle halves (cut long ways) per pair of students, Roller Coaster Packet, Roller Coaster PowerPoint, Roller Coaster Scatter Plot Rubric, Internet Access

Introduction and Motivation

1. Begin the lesson by bringing up the idea of roller coasters. Ask the class some of the following questions:
   a. What is your favorite roller coaster and where is it located? What makes that rollercoaster your favorite?
   b. What are some aspects of roller coasters that you like/dislike? Explain.
   c. How does a roller coaster continually travel a path without stopping and getting "stuck?"
   d. What are some of the components that are added to the tracks of roller coasters to either help the roller coaster speed up or slow down?
2. Introduce students to the task at hand.
   a. The students will be using three pool noodles, cut in half long ways, to construct a roller coaster track. This track must include at least two loops for the marble to pass through. The only supplies in addition to the pool noodles that will be available to use is masking tape and wooden skewers. The goal is to create a track that the marble passes through successfully from start to finish.

Procedures and Content Presentation

Prior to beginning the lesson, be sure to cut all pool noodles in half, long ways, to open up the marble track

1. Using the Roller Coaster presentation, begin discussing the various "Key Words" associated with this task. Make sure students understand how each of the words are related to their task
    a. **Gravitational Potential Energy:** Energy that an object possesses because of its height. For instance, at the top of the first "hill" of a roller coaster, the car's energy is mostly gravitational potential energy.
    b. **Kinetic Energy:** Energy an object has because of its motion. On a roller coaster, after the car has begun traveling down a hill, it's kinetic energy increases, allowing the car to continue to travel until all kinetic energy is lost or kinetic energy is gained again.
    c. **Speed:** To calculate the speed of the marble, students will need to divide the distance of the track by the time it took the marble to complete the track and its entirety.
    d. **Average Speed:** Since students will be calculating the speed several times for the same track, it is important to be able to determine the average speed of the marble. This is done by adding up all of the speeds for that specific height and dividing by however many how many trials were ran.
2. Provide students time to conduct their own research. Using the table provided in the student packet, students should research 8 roller coasters, their locations, top speed, and top height. Once all research has been conducted, students may share one or two of the roller coasters that they found with the class. Encourage students to find roller coasters that are not common in the area. This should take no more than 5-10 minutes.
3. Students will begin the brainstorming process. During this time students will be working on their own. Students should sketch a few designs they would like to try to build as well the components of their ideas. This should take no more than 5-10 minutes.
4. After the brainstorming process has finished, students should begin collaborating with a partner. This is when students will discuss their designs with each other to determine which design they feel would be the best to create. Once a final design has been discussed and agreed upon by all members, students should complete their final sketch for their design in the space provided in the students packet.
5. Students may then begin constructing their design only using masking tape and wooden skewers. Before constructing the rollercoaster, students need to measure the distance from one end of the track to the other end and record that distance in the table provided for #7 in the student packet. This information will be used later. During this time, students should test their marble throughout the construction process to ensure that their marble travels successfully along the track. Students should use the table provided to record any issue that occurred along the way and how those issues were resolved. This process should continue until their marble travels successfully along a track that contains at least two loops.
6. Now that the track has been deemed successful, students must begin collecting data. Students should measure the distance from the ground to the starting height of their track for data organizational purposes. With a partner, students should time how long it takes for the marble to

travel from the beginning of the track until the end. Students record this time in the table provided and repeat this process four additional times. Once the marble has been timed five times, students now move the beginning of the track to a different height. Here, students measure again, the distance from the ground to the starting height of their track. Students will time their marble five more times and record the data in the table. Students should complete his process one more time, with a third, different starting height. When all trials are completed, students should have a total of three different starting heights with five recorded times for each height.

7. On their own, students will calculate the speed of their marble for each trial. Students can calculate the speed by taking the distance, in inches, and divide it by the time, in seconds. Students need to record this speed in the table.
8. Using the calculated speeds, students will now calculate the average speed for each starting height. Using the five speeds for height #1, students will find the sum and then divide by 5. Students should repeat this process for all starting points.
9. Once the average heights have been collected, students will now share their information with their classmates. All students should collect data from each group. The data is to be organized in the table provided in the student packet by first the starting height and then the average speed for that starting height.
10. Students will create a scatter plot with the data collected from the class. Students must remember to label the x-axis (starting height), y-axis (average speed), and the graph. Students must also choose an appropriate count by number for both the x and y axis. That count by number should be consistent throughout the axis and labeled. Students must carefully place a point to represent each of the data points collected by the class. The graph should be neat and organized.
11. Now that all data has been collected and organized, students will reflect on the results of the rollercoasters. Students should respond to the reflection questions that are provided using complete sentences and explaining when necessary. Once all students have finished, these questions may be discussed with the class.
12. Students must complete the peer review in Google Forms to evaluate their group members.

Summary and Closure

Students will be summarizing the lesson by answering the reflection questions posed at the end of the Roller Coaster Packet.