

Exploration & Formation: Roller Coaster Physics and the Forces of Motion

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School/Location: Middle School

7th Grade Science: Physics/Forces of Motion Unit

Library Context:

Flexible

Lesson in a unit

Collaboration Continuum:

Moderate

Content Topic:

Exploration or information

Formulation of ideas

Forces of motion

Estimated Lesson time:

50 minute period

Materials Needed:

One computer with internet connection per student

Poster board or large paper for each group

Permanent markers

Standards for the 21st-Century Learner Goals

Skills Indicator(s): 1.1.6, 1.1.9

Benchmark(s):

Grade 8: Evaluate, paraphrase, and summarize information in various formats.

Grade 8: Work in self-managed teams to understand concepts and to solve problems.

Dispositions Indicator(s): 3.2.2, 3.2.3

Responsibilities Indicator(s): 1.3.5

Self-Assessment Strategies Indicator(s): 1.4.2, 3.4.3,

Illinois Learning Standards

4.B.3b Design and produce reports and multimedia compositions that represent group projects.

12.C.3a Explain interactions of energy with matter including changes of state and conservation of mass and energy.

12.D.3a Explain and demonstrate how forces affect motion (e.g., action/reaction, equilibrium conditions, free-falling objects).

12.D.3b Explain the factors that affect the gravitational forces on objects (e.g., changes in mass, distance).

Scenario:

1. Using a Pathfinder, the students will explore listed websites, collaborate with group members, create a realistic roller coaster design, and explain factors that went into the design.
2. Work on improving information literacy through steps 4 (Exploration) and 5 (Formulation) from Carol Kuhlthau's information search process.

Objectives:

1. The students will be able to navigate and investigate a list of websites related to the lesson.
2. The students will be able to create a realistic roller coaster design based on their reading.
3. The students will be able to utilize the 4th and 5th steps of Kuhlthau's information search process while gathering information
4. The students will be able to explain the effects of natural forces on roller coasters.
5. The students will be able to work collaboratively and productively in a group.

Overview/Process:

(Before class, the school librarian/teacher will have created a pathfinder with relevant links)

The Teacher/School Librarian will:

1. Students will meet in the computer lab, not science classroom.
2. (As they enter the computer lab) Tell each student to sit at a computer, log on, and open a web browser (IE, Firefox, Safari, etc). **(1 minute, hopefully done before bell)**
3. (While computers are loading) Project on the screen the pathfinder with the list of rollercoaster sites to explore and briefly describe each. Explain how to get to the list. **(3-5 minutes)**
4. Give a brief overview of the lesson instructions. These instructions will also be put on a PowerPoint slide and projected at the front of the room as a reminder **(3 minutes)**
5. Walk around the room answering questions, making sure students are working efficiently

The students will:

- A. Read and investigate each roller coaster site, making note of important info related to roller coaster design and the forces of motion. **(15-20 minutes to complete)**
- B. With a small group (4-5 students), create a realistic roller coaster design on a **regular sheet** of paper. Using the info from the websites, answer these questions: *What should be the dimensions of your roller coaster (height of hills, size of loops, etc.) and why? Will your design work in the real world? How safe is your design? Will your design entertain riders? What factors go into designing a roller coaster?* **(15-20 minutes to complete)**
- C. On the back of your first design, explain in detail the factors that go into designing a roller coaster. How do these factors answer the above questions?
- D. Have the science teacher/school librarian look at your design. It must be approved.
- E. If the design is approved, get a large poster board and transfer your design along with the explanation of the factors. **(10 minutes to complete)**
- F. Posters should be completed by the end of the period. If not, teacher can allow the first five to ten minutes of the next class meeting to complete.
- G. Students will present and explain to the entire class their design during the next class meeting.

Modifications:

High-level students: write a summary of what they learned. Relate it specifically to everyday life.

Lower-level students: explore one or two websites instead of the entire list. Focus on one factor.

Looking through websites appeals to visual learners; group discussion appeals to auditory learners; designing/drawing on poster appeals to kinesthetic learners.

Final Product:

Roller coaster design on large poster board with details and an explanation of factors involved

Assessment

Product

Use a rubric to determine if the following is true:

The design is complete, neat, and organized.

The explanations are clear, concise, and based on researched information.

The students in each group successfully worked as a collaborative team.

Each group member participated in the presentation of their design (in the next class meeting).

Process

The student thoroughly investigated every website taking note of information that answers the self-questioning inquiries below.

Group members worked as a team to create a finished product.

Student self-questioning

What strategies can I use to efficiently find the information I need?

How credible is the website I am investigating?

What information from this website is most relevant to the tasks?

How can I use the information I collect to complete the tasks?

Instructional plan

Resources students will use:

Websites

Fellow students

Instruction/activities

Direct instruction:

Overview of lesson instructions and sources/materials to be used

Formation of groups of 4-5 students, trying to keep the groups even (don't put all high- or low-level students in one group)

Modeling and guided practice:

Have a basic example of a final design along with explanations available as a guide.

Show and briefly describe each website on the pathfinder list.

Examine the rough draft before allowing students to move on to the final poster.

Independent practice:

Each student will independently explore websites listed on the pathfinder.

Each student will take notes necessary to complete the tasks.

Sharing and reflecting:

Share design ideas with the group

Share the notes taken from the websites

Explain the reasoning behind the group's design decisions

Assess the quality of information and completeness of the design based on the instructions/rubric