Subject: Science

Topic: Potential and Kinetic Energy, Momentum, Friction and Gravity

Date: April 4, 2009

Grade Level: 3rd-6th

Teacher: Teresa Reynolds

Time Frame: 30 minutes

Instructional Method: Inquiry

Rationale: The study of physics seeks understanding of the very forces that act upon us each day and will help students gain insight into the laws that govern the world around them. Physics expands the frontiers of our knowledge about nature and generates fundamental knowledge needed for future technological advances that will continue to drive the economy. Physics contributes to technological infrastructure as well as scientific advances and discoveries. Physics is an important element in the education of chemists, astronomers, engineers and computer scientists, as well as practitioners of other physical and biomedical sciences. Physics extends and enhances our understanding of other disciplines and improves our quality of life by providing the basic understanding necessary for developing new instrumentation and techniques for medical applications.

Goals: The students will gain practical knowledge and experience by observing the basic laws of physics in action and employing their knowledge of the laws to build their own roller coaster.

Objective: The students will be able to design a roller coaster while considering the effect of gravity, potential and kinetic energy, momentum and friction and will address problems presented by these forces in the course of their design.

The students will be able to verbally describe the concepts of potential and kinetic energy, momentum, friction, and gravity using examples from their constructed roller coaster.

SOLs: 3.1 The student will plan and conduct investigations in which

a) predictions and observations are made;
c) questions are developed to formulate hypotheses; and
j) inferences are made and conclusions are drawn.

4.2 The student will investigate and understand characteristics and interaction of moving objects. Key concepts include:

a) motion is described by an object's direction and speed;
b) forces cause changes in motion;
c) friction is a force that opposes motion; and
d) moving objects have kinetic energy.

6.2 The student will investigate and understand basic sources of energy, their origins, transformations, and uses. Key concepts include:

a) potential and kinetic energy

Materials: 2 Newton's Run Kits, marbles, masking tape, ladder, 2 yard sticks, candy or other prize, stop watch, YouTube video clip of roller coaster ride

Anticipatory Set: Ask the students if they like riding roller coasters. Invite students to share roller coaster experiences while also offering my favorite roller coaster experience. Explain that they will be competing in a contest to design their own roller coasters. Show YouTube video clip of roller coaster ride.

Procedures:
1. Remind students of my favorite roller coaster experience and introduce key terms (potential and kinetic energy, friction, momentum, and gravity)
2. Explain the contest rules and point system.
3. Divide students into two teams and provide each team with a copy of the rules and point system.
4. Explain that they will have 20 minutes to build their roller coaster going for as many points as possible.
5. Send each group to their station with one adult to monitor and assist (adults may assist with things such as climbing the ladder; not with design).
6. With 5 minutes left, each team will present their roller coaster and name one or two challenges they faced or adjustments they had to make and why they think changing what they did worked.
7. After each team presents, a "scoring run" will be performed where the marble is run down each track and the points are awarded.
8. All participants will get a small prize, with the winning group getting a little extra.

Content:
Potential Energy is stored energy; it has the potential to be converted into kinetic energy. The marble has the greatest potential energy at the top of a hill because when released, gravity will act on the marble, causing it to gain speed. The higher the marble is placed, the more potential energy it has. As the marble travels downhill and picks up speed, it loses potential energy and gains kinetic energy.

Kinetic Energy is extra energy an object has due to its motion. The greater the mass of an object, and the faster the object is moving, the more kinetic energy it has. The marble's kinetic energy is greatest at the bottom of a hill. As it slows down when going up a hill, it begins to lose kinetic energy and gains potential energy.

Friction is the force that resists or slows down motion; it acts against an object to slow it down. Without friction, all the potential energy would convert into kinetic energy and back without losing any energy. However, friction takes away some of the energy as the marble goes through the track.

Momentum is the force that allows a moving object to continue moving until something stops it; it also allows an object at rest to remain at rest until something starts it. Momentum is mass times speed, so the more massive an object, and the faster it moves, the more force is required to slow it down or stop it.

Gravity is the earth's pull; it is the force exerted on an object by another object. The force that gets the marble rolling and keeps it rolling is the Earth's gravity pulling it down.

Assessment: Teacher questions, evaluation of design using points sheet

Reflection: