Lesson: Kinetic and Potential Energy

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Introduction:

The mentors will start the lesson by giving a brief introduction on kinetic and potential energy with illustrations, and then give demonstrations on friction by sliding a wood block down a cardboard ramp with different materials attached to the surface. They will also introduce and explain the engineering design process. The lesson itself will involve the mentees splitting into groups and planning and building their own cardboard roller coasters. This lesson is intended to teach students about energy and its different forms, and the process of planning and building a product as a team. The demonstrations and lesson itself should show the mentees how energy exists in different forms all around us, and how it can change from one form to another. The demos should also give the mentees a simple introduction to the concept of friction and how it restricts motion.

Materials:
Group size: about 20 students

- 4 rolls of masking tape
- Cardboard
- 4 pairs of scissors
- Marbles
- Markers
- Computer Paper
- Flat pieces of plastic
- Small wood block
- Soap and water
- Sand paper

Agenda:

- Introduction to potential energy, kinetic energy, friction, and the engineering design process (5 minutes)
- Demonstrations on friction with wood block and cardboard ramp with different surfaces attached (5 minutes)
- Divide into groups, groups design structure and develop plan on construction (10 minutes)
- Groups build and test their structures (30-35 minutes)
- Each groups showcases their structure with final tests and reflects on the successes and failures of their project (10 minutes)

Before Lesson:

- Background on the engineering design process, 6 steps: 1. State the problem. 2. Generate ideas. 3. Select a solution. 4. Build the item. 5. Evaluate. 6. Present results.
- Questions:
    - What is the problem in this case?
    - How does the height of a ramp affect the speed at the bottom of it? Why is that?
    - What is friction?
    - Why do objects move faster along slippery surfaces like plastic and move slower along rough surfaces like sand paper?
    - Why is it important to assign jobs to each person in the group?

Lesson:

Part 1: Design and plan structures

- The mentees will get into groups of 4 or 5 and start planning their ramp structure.
- They will use markers to draw out their designs and will collaborate on their ideas for building the structure.
- The mentees will find a way to assign roles to each group member for building their structure.

Part 2: Execution of design

- When every group has a good idea of what their plan is, the mentors will hand out the scissors, tape, cardboard, and 1 marble to each group.
- Each mentor will oversee one group of mentees as they build their structure, and they will provide feedback on any ideas or questions the mentees have.
- The mentees will go through the sequence of building their design, testing it, and modifying it for improvements until they are finished building their ramps.

Part 3: Final evaluation

- Each group will take turns showcasing their ramps and the mentees will vote on the best design.

Goals:

- Going through the engineering design process should teach the mentees about designing and executing plans.
- The group planning activity should give the mentees exposure to the sometimes difficult process of compromising on ideas in order to include everybody's input on a project.
- Testing the marbles on their ramps should be an effective real-life demonstration of kinetic and potential energy, and it should aid their understanding of the relationship between the two.

Background on Energy and Friction:

- Energy can be in one of two states: potential or kinetic. Energy can be transferred from potential to kinetic and between objects.

Potential energy is stored energy—energy ready to go. A lawn mower filled with gasoline, a car on top of a hill, and students waiting to go home from school are all examples of potential energy. Water stored behind a dam at a hydroelectric plant has potential energy.

Most of the energy under our control is in the form of potential energy. Potential energy can be viewed as motion waiting to happen. When the motion is needed, potential energy can be changed into one of the six forms of kinetic energy.

Kinetic energy is energy at work. A lawn mower cutting grass, a car racing down a hill, and students running home from school are examples of kinetic energy. So is the light energy emitted by lamps. Even electrical energy is kinetic energy. Whenever we use energy to do work, it is in the kinetic state.

http://www.energyeducation.tx.gov/pdf/113_inv.pdf

- Friction is the force resisting the relative motion of solid surfaces, fluid layers, and/or material elements sliding against each other. When surfaces in contact move relative to each other, the friction between the two surfaces converts kinetic energy into heat. This property can have dramatic consequences, as illustrated by the use of friction created by rubbing pieces of wood together to start a fire. Kinetic energy is converted to heat whenever motion with friction occurs, for example when a viscous fluid is stirred. Another important consequence of many types of friction can be wear, which may lead to performance degradation and/or damage to components. Friction is not a fundamental force but occurs because of the electromagnetic forces between charged particles which constitute the surfaces in contact.

http://en.wikipedia.org/wiki/Friction