"Kinetic Energy of Rolling Balls"

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I. DCPS Standards:

8.1.12 Apply simple mathematical models to problems (*e.g.* formulas such as F=ma).

8.5.1 Explain how energy is the ability to do work and is measured in Joules (J).

8.5.2 Describe kinetic energy as the energy of motion (*e.g.* a rolling ball).

II. Goals:

Students will understand that moving objects have kinetic energy.

III. Objectives:

Students will calculate the kinetic energy of a rolling ball.

Prerequisite Knowledge: Energy can roughly be described as the ability to do work. ("Work" actually has a precise definition in physics.) It is in measured in units of Joules (J), named for the English scientist James Prescott Joule. All moving objects have kinetic energy. The kinetic energy of a moving object of mass m moving with speed v is $(1/2)mv^2$. (Here we refer to just the translational kinetic energy, not the rotational kinetic energy.)

IV. Essential Questions:

How many Joules of kinetic energy are in an everyday process like rolling a small metal ball? What is the difference in kinetic energy when the ball rolls faster?

V. Materials: Measuring stick, stopwatch, rolling objects, masking tape.

VI. Differentiating Instruction: This activity should pose no problem to speakers of English.

VII. Rationale: This activity gives an estimation of the order of magnitude of the kinetic energy of an everyday process.

VIII. Activity Procedure: The students measure out the distance (given by the instructor) with the ruler or meter stick on the table. Mark the beginning and the end with a piece of tape. One student holds the stopwatch, one student records the data and another student rolls the object. A student rolls the object slowly on the table. The timer uses the watch to measure how long it took the object to go from one piece of tape to the other. This process is then repeated for a faster roll. All members of the group record the data in their lab notebooks. The (average) velocity v=distance/time. The students compute v for both rolls, then compute v^2 for both rolls. The kinetic energy is $(1/2)mv^2$. Compute for both rolls, using the mass for your object given by the instructor. Remember that energy is measured in Joules.

IX. Evaluation and Assessment: How many Joules were involved with this process? [typically between 0.05J and 0.1J] Was this more or less than you would have expected? How much more kinetic energy was in the fast roll than the slow on? Optional: How much does the kinetic energy change if you roll the same ball twice as fast? [It increases fourfold.] Students write their own statement in their lab notebooks saying what this lab has shown them.