**Phabulous Physics *Rollercoaster Derby*** Science/Math, Grade 4

Global Objective: LWDTAT … work with a group to solve a series of problems based on Newton’s Laws, balancing factors of inertia, acceleration, momentum, friction, and gravity.

Overview: Students will work with a group to build a rollercoaster to meet specific parameters, using materials provided.

Content

* Newton’s Laws of Motion
* Energy Transformation
* Measurement: scale, height, angles
* Use of the Scientific Method

Specific Learning Objectives

* LWDTAT … explain Newton’s Laws of Motion and how these laws pertain to moving objects.
* LWDTAT … define inertia, momentum, and gravity.
* LWDTAT … demonstrate how acceleration varies relative to the height of a falling object.
* LWDAT … use measurement of height and angles to describe components of a system.
* LWDTAT … manipulate components of a system to balance kinetic energy and momentum with inertia and friction.

Materials

* Foam pipe insulation tubes, cut to half-round strips (4-6 pieces per team; total length 16’ – 24’)
* Marble
* Masking tape, Scissors
* Meter sticks (also, optional protractors, to measure angles in track layout)
* Paper tubes (as from paper towel rolls)

Process: Teacher will introduce the content by having students sit in a circle on the floor and roll a marble across the space between them. Students will be encouraged to closely observe and describe the marble’s motion; the teacher will support their understanding by providing appropriate vocabulary terms and phrases to describe their observations.

* *Newton’s first law: A body in motion tends to stay in motion unless acted on by an outside force.*
* *Newton’s second law: In the presence of a net force, an object experiences an acceleration.*
* *Newton’s third law: For every force, there is an equal and opposite force*.
* Friction - The movement of the marble will be varied by rolling across carpet.
* Gravity, Potential energy– The marble will be released a few inches above the floor (energy is seen in motion but is not directed) and then by releasing it from an inclined track (a short piece of pipe insulation with one end elevated).

The students will then be organized into groups to explore the motion of the marble along increasing lengths of track (4’, 8’ 12’ etc.). Most students are surprised as the movement becomes more controlled once distance is increased, and can be guided to describe this in terms of the use of expenditure of energy.

Competition (optional) – The teacher may choose to present this project as a competition between groups to have their marbles travel the greatest length of track possible while ceasing motion prior to exit.

NJCCCS (2011): 5.1 Discovery and Inquiry; 5.4 Systems; 5.7 Physics

Outcome: Students will build a rollercoaster track of specified length that will allow a marble to roll the entire length of the path, ceasing motion prior to exiting the track.

Expectations for students’ performance

* Participation – Students stay on-task, contribute ideas and hands-on involvement, cooperate with team, and handle both success and frustration appropriately.
* Mastery of Concepts – Students explain why their rollercoaster does or does not work, using appropriate terms and references.
* Final Product – Rollercoaster track designed to specified parameters and constructed to function as intended.