The Newton Car

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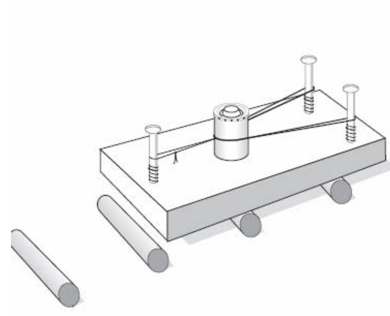
Abstract
I will be using Newton's Laws of motion as the basis for my project. The project will begin with several days of introduction and lessons on Newton's Laws. Students in the Physical Science class where I am student teaching will be participating in the lessons and culminating activity. In addition to learning about Newton's Laws, the students will also be dealing with variables and controlling them during the activity portion. Students will be working in groups of 2 or 3 to complete the activity, "The Newton Car," from the NASA's Rocket Guide. This activity allows students to see links between a mass thrown from a car and the amount of forward acceleration it produces in the car.

Lesson
The basis for this activity came from the "Newton Car" lesson contained in NASA's Rocket Educator Guide. First, one needs to construct the "car" shown to the right. This will be the setup used for the different trials in the activity. Students need to load their film canister with objects that will add some weight to the film canister.



To load the slingshot, use lightweight string and rubber bands. The rubber band loops around the two screws and the string holds the rubber band(s) in a stretched position until the trails are ready to begin. The track can be made out of round pencils, or wooden dowels. This allows the car to move without much resistance from friction. When a group is ready for their trial one person will cut the string with scissor. This must be done quickly so that the scissors do not interfere with the motion of the car.

Each trial will test 1 through 3 rubber bands for a canister's mass, and then the students will change the mass. They will observe how the change in mass (either more or less) will affect the distance their car travels. Students then record the distance their car traveled down the track and use this information for graphs.

Objectives
- To see the effect of mass on acceleration as given in Newton's Second Law
- To explain the role of Newton's Third Law in the propulsion of the car

Alignment

Grade Nine Physical Science Benchmark D: *Explain the movement of objects by applying Newton's three laws of motion*.

Grade Nine Physical Science: *Forces and Motion* indicators #23 and 24.

Underlying Theory
This lesson lends itself to a constructivist approach to learning. In this approach, the best teacher is student experience. Students can construct new knowledge right alongside previously gained knowledge through experiencing new situations that may require application of known information. The teacher acts as a facilitator to help the students get the most out of their experiences as they relate to course content.

The students gain background information on Newton's laws and forces, before they work with the cars. This provides a basis and framework for new knowledge to be gained during the activity. The activity allows the students to interact with the material and to draw connections between the hands-on experience and the content. The activity is then the culminating part of the unit on motion and forces, which allows students to solidify concepts in their minds. They can apply what they know to making their car go further, while exploring the effects the variables have on the activity.

Student Engagement

The content knowledge at the beginning of this unit was much more passive for the students than the activity. The activity is a very hands-on approach, where the responsibility for success rests solely on the students. The students are very much involved since they want to get their car to go the furthest down the track.

Resources

Each group needs a wood block with screws already placed in it to create the slingshot on the top of the block. The screws should be in the shape of a skinny isosceles triangle. Rubber bands serve as the stretch element of the slingshot. The screws we used had to be bought, but the blocks were salvaged scraps from the shop class down the hall. The blocks do not need to be a particular size, but it is ideal to have a rectangular shape.

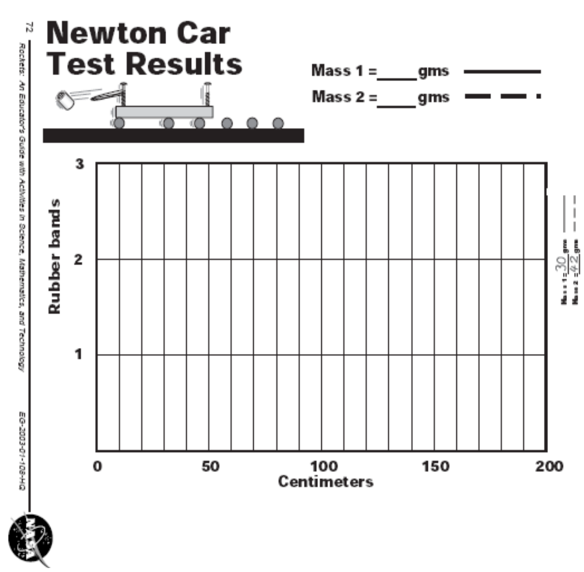
Each group received a film canister to which weight could be added. The students used metal washers or small steel spheres for weights, but many types of objects could be used. The track was made out of 10-12 pencils laid out so that the car can roll across the pencils when it is propelled forward. It is also ideal to attach the stretched rubber band to the back screw with lightweight string. The string needs to be strong enough to hold up to three stretched rubber bands, but it should be easy enough to cut quickly with scissors through it. Students will then need a meter stick or ruler to determine the distance their car traveled.

Results

It took some finesse to get a good distance out of a car, but all groups produced a result. The groups which had the best results used a canister weight somewhere between 30 and 75 grams. If the canister is lighter, it will thrown from the car very quickly and not cause the car to have much acceleration time. If the canister is heavier, the rubber band(s) cannot throw the canister very quickly, if at all, so there is little acceleration of the car. If the trials were performed correctly, groups saw that adding a rubber band increased the distance the car would travel.

Assessment

The students graph the results that they are able to achieve. They graph the distance the car traveled vs. the number of rubber bands used for that trial. I looked to see if their data was plotted correctly and if they got a greater distance for each additional rubber band. The students also wrote down responses as to how this activity demonstrated Newton's second and third laws. They also noted what effect the mass of the canister had on the distance their car traveled.



Conclusion

The project allowed students to have a concrete example of Newton's Second and Third Laws. After graphing results the students could directly see a relationship between the mass of the canister and the distance it could propel a car. The students enjoyed the hands-on approach and the friendly competition that arose.