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The Rubber Band Problem

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Description: Elementary Science Activity - Force, Friction and Inertia

Time: Approximately 30 - 40 minutes, depending on discussion

Grade: 4th through 8th

Materials: For each group of 3-4 students:

Small table with hard surface

2 text books

1 rubber band, cut once so that it can open out flat

Procedure: Group the students into groups of 3 or 4. Each group should be at separate tables. Each table should be around 4 to 6 feet long. In front of the class, show the two textbooks and the cut rubber band. The textbooks should both be at least 3/4" thick; 1" thick or more is even better. Lay one textbook down at one end of the table, put part of the rubber on top of the book so that about half of the rubber band is hanging over the edge, and then cover them both with the second book, leaving part of the rubber band sticking out.

Tell the class to watch what happens when you pull on the rubber band. Pull on the rubber band; the rubber band will pull out from between the books and snap your fingers, inflicting minor pain that you can exaggerate for your class's amusement. (Practice this beforehand to make sure that the rubber band pulls out without pulling the books forward. You may need to use a smaller rubber band or books with a larger surface area if the books can be moved across the table just by pulling on the rubber band.) Explain to the class that their assignment is to figure out a way to pull both books across the table by pulling on the rubber band. They may not push the books; they may only pull on the rubber band. The books must be kept together.

Discussion: Ideally, each group should have the same size table and the same textbooks, but if this is not possible the activity is still worth trying. 15 to 20 minutes is usually enough time for most groups to discover a solution. Tell groups that solve the problem quickly to see if they can solve it another way. I normally do not allow the students to use tape or staples, and I insist that the rubber band be between the two books rather than inside one, but you can be flexible about the rules. The more flexibility you allow the students, the more different solutions you will get, which

will make for a more interesting discussion afterwards.

There are many different solutions to the problem. I have had students stretch the rubber band across the top of the bottom book, with part of it wrapped around under the book's cover. (Technically, the rubber band is still going between the books.) I've seen students put a series of round pencils under the books so that the books roll across the table, and I've had groups tilt the table so that the books are being pulled downhill.

This challenge may be used to introduce the concepts of friction, force, and/or inertia, or it can be used to reinforce them. The key is to have a discussion after the groups have solved the problem. A good way to proceed is to have each group share their solution with the class. If you have already introduced terms like force, inertia and friction, ask the students to use them as they explain their method for getting the books to move across the table. If you have not used these terms in class yet, then you might try using questions to guide the students to the concepts and then ask if anyone knows what that phenomenon is called.

In general, to overcome the inertia of the books you need to reduce the friction between the books and the table, (which is what placing the books on pencils achieves), or increase the force exerted on the books by the rubber band, or both. Ironically, increasing the friction between the rubber band and the books allows you to increase the force that the rubber band exerts on the books, so this problem can be solved by both increasing and decreasing friction. (A good series of questions: How can we solve this problem by decreasing friction? How can we solve it by *increasing* friction?) Tilting the table also increases the force by adding the force of gravity to the force exerted by the rubber band. There may be other solutions in your class, but chances are they rely on one or both of these strategies.

This activity can then be extended to more practical applications. Teachers might suggest that their students look for and identify real world examples of the properties illustrated here. For example, students might be asked how these properties might affect the design of car brakes or how it might change one's approach to walking on a wet or icy surface. Most students, with a little reflection, should be able to come up with examples that illustrate these properties.