

AMAZING FEETS

Teaching Guidelines

Subject: Science

Topics: The Nature of Science and Technology (Experimentation), Physics

Grades: 5 - 12

Concepts:

- Friction

Knowledge and Skills:

- Can create a chart for the collection of experimental results
- Can present experimental results clearly in written form.
- Can design an experiment which compares behavior or characteristics of classes of objects or subjects
- Knows that the amount of friction between two surfaces depends on the amount of pressure which pushes on surface against another
- Knows the units in which force is measured

Materials: Spring scale, weights, pulley, dowel, 10 different tennis shoes

Procedure: This project should be done by students in teams of two or three.

You will need several different kinds of tennis shoes for each team (which you may wish to ask students to bring in). (Each team should have three or four shoes to test which have very different types of soles.) You will also need equipment which students can use to measure friction force—see below.

Distribute the handout and discuss it. Ensure that students understand the assignment.

As their first step the teams will need to determine a way of measuring how much force is required to make a shoe slide along a ground. You may wish work this out in class discussion or leave it to the teams.

A spring scale is perhaps the best way to measure the force, but other techniques might be used—for example, putting the shoe on a table and tying to it a weight which hangs over the end of the table (ideally over a pulley or a dowel), and determining how much weight is required to make the shoe move.

Students should quickly observe that they will need to put some sort of weight on the shoe to hold it down against the surface. You will also want to guide them to the discovery that the amount of force necessary to get the shoe to start sliding (the friction) depends on the amount of weight which is placed on the shoe, so that weight will need to be standardized for the various shoes being tested.

For less advanced students, you may want to ask students to find which of several shoes seems to have the greatest resistance to sliding, and to compare the soles of all of the high-friction shoes to see if they can see why.

For older or more advanced students, you may wish to have them quantitatively investigate the relationship between the amount of force required to overcome static friction and the amount of weight on the shoe, and possibly also to investigate dynamic versus static friction.

Once all results are in you may wish to have a discussion regarding the reliability of this test—do students think it is accurate, and why or why not. Ask them how they might find out if the test is accurate, and help them to realize that one way to do so is to repeat the tests and see if they get the same results.

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Feets

To: Research Department
From: Research Director

Our next new product, as some of you know, is supposed to be an athletic shoe that we will name "the Ground Gripper".

The only problem is that we haven't yet figured out how to make this new shoe.

We're planning to buy some sophisticated testing equipment soon to help us in the design of the shoe, but in the meantime I'd like to get ahead of the game and get the research going on a shoestring budget.

Here's my idea: let's gather up a bunch of existing athletic shoes and do some sort of quick test to compare their ability to grip the ground. We can then pick the best four or five of those and look at the soles to see what they have in common

I need you to work out a testing procedure that allows us to compare different shoes. Basically we want to see how hard it is to slide the shoe along the ground on a smooth surface.

Of course the important thing about a test is that it is reliable. To accomplish this you minimize the possible sources of error and make sure that the test can be repeated exactly on different shoes.

Besides the results themselves, I need a clear written explanation of how the test was done, with diagrams or pictures.

I need this fast, so please don't waste a lot of time with it. Just do it.

Thanks for your support,

Archie