

Physics Invention Sequences Users' Guide: Velocity

VELOCITY INVENTION SEQUENCE

Includes: *popping index (time rate), fastness index(speed), and slide steepness (slope)*

Teacher Notes: Even students who have taken a lot of math often do not have a conceptual understanding of a unit rate. These exercises help develop that concept and prime students for understanding time rates of change in kinematics.

Levels: This sequence is appropriate for all levels, from middle school physical science through calculus-based physics. Middle school students find the slide steepness challenging, so we usually use just popcorn and fastness indices with them.

Sequencing: Popcorn and fastness should be done together; slide steepness is especially appropriate if the subsequent curriculum includes the position vs time graphs.

Popcorn Popping Index

An *index* is a number that helps people compare things.

- *Miles per gallon* is an index of how well a car uses gas.
- *Batting average* is an index of how well a baseball player hits.
- *Grades* are an index of how well students perform on a test.

We want you to invent a procedure for computing an index that helps make comparisons.

A. Popping Index

Three companies make popcorn. They use different types of corn so the popping is fast or slow. Invent a procedure for computing a “popping index” to let consumers know how fast each brand pops.

Rules for the Index:

1. The same brand of popcorn pops at the same speed. So a brand of popcorn only gets a single popping index.
2. You have to use the same procedure for each brand to find its index.
3. A big index value should mean that the popcorn pops faster. A small index value should mean that the popcorn pops slower.

Hot Pops Index: _____

20 seconds 30 seconds 50 seconds Done!

Hip Hop Popping Corn Index: _____

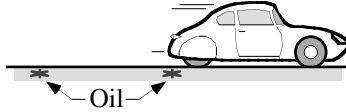
6 seconds 12 seconds 20 seconds Done!

Poppomatic Popcorn Index: _____

8 seconds 12 seconds 16 seconds Done!

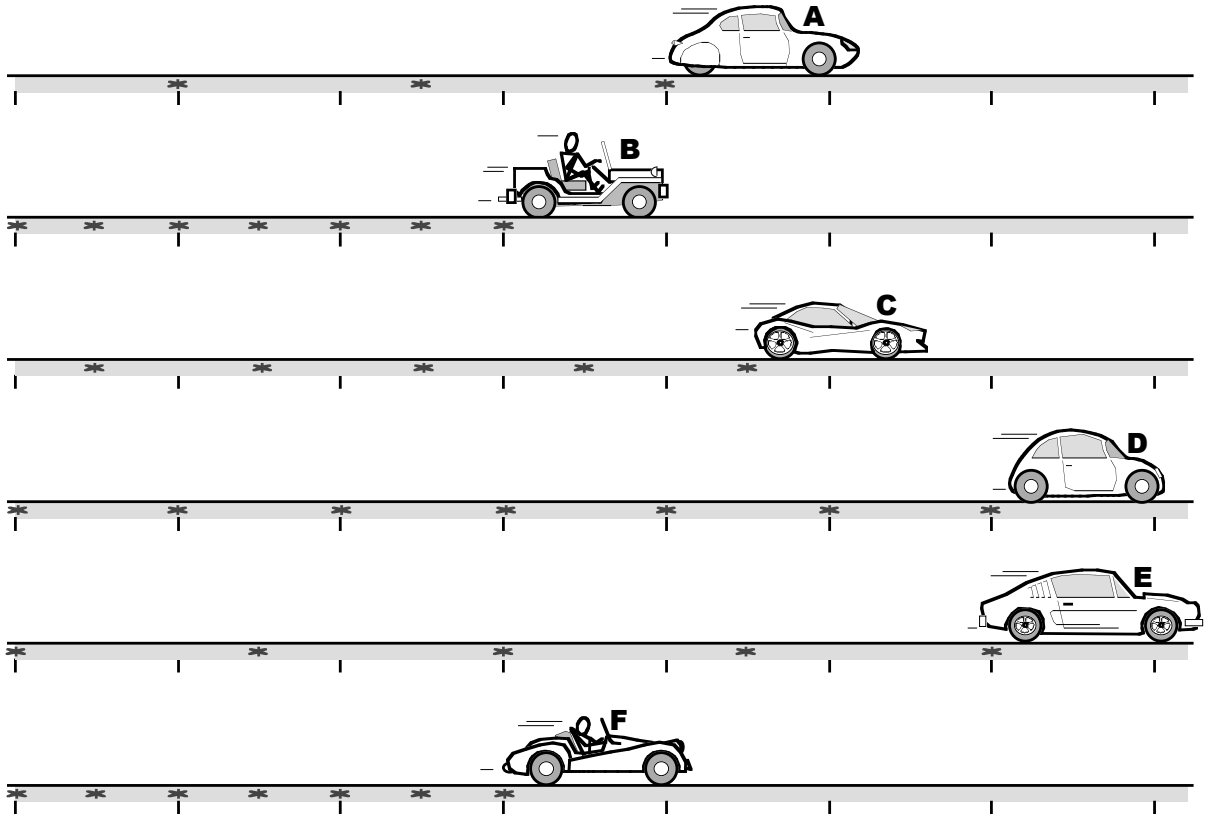
Fastness Index

Let's look at another kind of index. Your task this time is to come up with a *fastness index* for cars with dripping oil. You will see several cars, and will need to come up with one number to stand for each car's "fastness." There is no watch or clock to tell you how long each car has been traveling. However, all the cars drip oil once every second. (They are not very good cars!)



Some relevant information:

- A company makes cars that all have the same fastness.
- We will not tell you how many companies there are.
- You have to decide which cars are from the same company. They may look different! To show cars that are from the same company, draw a line connecting them.



Follow up questions

1. Which popcorn is fastest? Which car is fastest? Explain.

2. For each question below, explain your reasoning:
 - A full bowl of popcorn has 60 popped corns in it. Determine the amount of time for the fastest popcorn to fill a bowl.

 - Write an expression for the time required for the fastest car to travel B blocks.

3. Another company (“ACME”) has an index of 2.5.
 - a. Let’s say that ACME makes popcorn. Using everyday language, describe the specific information that the number 2.5 tells about this their popcorn.

 - b. Now let’s say that ACME makes cars. Using everyday language, describe the specific information that the number 2.5 tells about their car.

4. Suppose your friend is having trouble deciding whether to compute the index for Car E as $3/2 = 1.5$, or $2/3 = 0.67$. Describe one way of convincing your friend of the correct answer.

The Steepness Index

Let's try another kind of index.

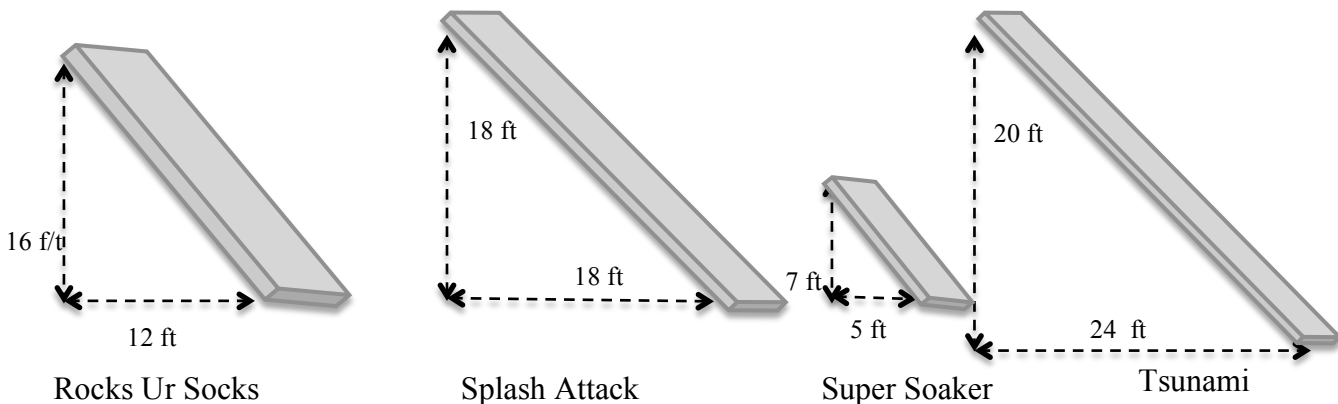
As the owner of 2-Die-4 Water Park, you are in charge of buying the slides. Most of your clients are teenagers, and they like the steepest slides they can find. You want to buy slides that will attract the most business. You are trying to choose between the slides shown below.

Invent a procedure for computing a "steepness index" so that you can buy the best slides, and prove to your customers that you have the steepest slides in town.

Rules for the Index

1. Each slide gets one steepness index because it has the same steepness all the way down.
2. You have to use the exact same procedure for each slide to find its index.
3. A big index value should mean that the slide is steep. A small index number should mean that the slide is less steep.

Find the steepness index for the following portions of these slides:



Follow up questions

1. Which slide is steepest? Give an explanation why you picked that slide.
2. Another company, "Acme," has a steepness index of 0.75. Using everyday language, describe the specific information that the number 0.75 tells about their slides.
3. Super Soaker's company also makes a different slide that has the same index as the one shown on the other page. This slide is 10 ft tall; how far does it go horizontally?