HOW FAST DO DOMINOES FALL ?

PROBLEM PRESENTATION / EXPLORATION

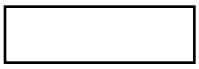
A. Most everyone has seen dominoes set up in some intricate pattern and then set off by tipping over one of them. What follows is often amazing, in that hundreds and even thousands of dominoes gracefully fall over after being hit by their neighboring dominoes. How fast does the pattern unfold? What is the maximum speed at which a row of dominoes can be made to fall when set off by a single domino toppling? The CHALLENGE of this activity is to maximize the speed at which a row of 100 dominoes falls down. Make sure that the dominoes are at least 0.2 of a domino length apart. Don't let them place the dominoes next to each other so that they touch. *A cheaper and more accessible alternative is to use a can of Lego® or Tyco® blocks. They are easier to count too if you use different colored blocks to mark every tenth block.*

B. Have students set up 100 dominoes in a straight row. Have them determine how they should be spaced to maximize the toppling speed. Are there any relationships between the average spacing distance between dominoes, the length of the domino, and the average speed at which the dominoes fall?

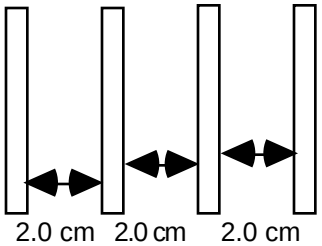
Domino Length	Ave Spacing		Row Length		Time	Ave Speed
cm	cm	Domino Lengths	cm	Domino Lengths	sec	cm/sec

CLASS RESPONSE / CONCEPT INVENTION

A. Point out that to compare results among groups investigating this problem a common unit of distance measurement must be used when referring to the average spacing between dominoes (To come up with enough dominoes to do this activity, different sets of dominoes may have to be used. Dominoes in different sets do not necessarily have the same length, therefore only dominoes from identical sets should be used in a single group. However, if the spacing is formulated in domino lengths, groups can compare their results with each other). We will use the domino length found by taking the spacing in cm and dividing by the length of the domino in cm. This gives us the spacing in domino lengths.



Domino Length = 4.0 cm



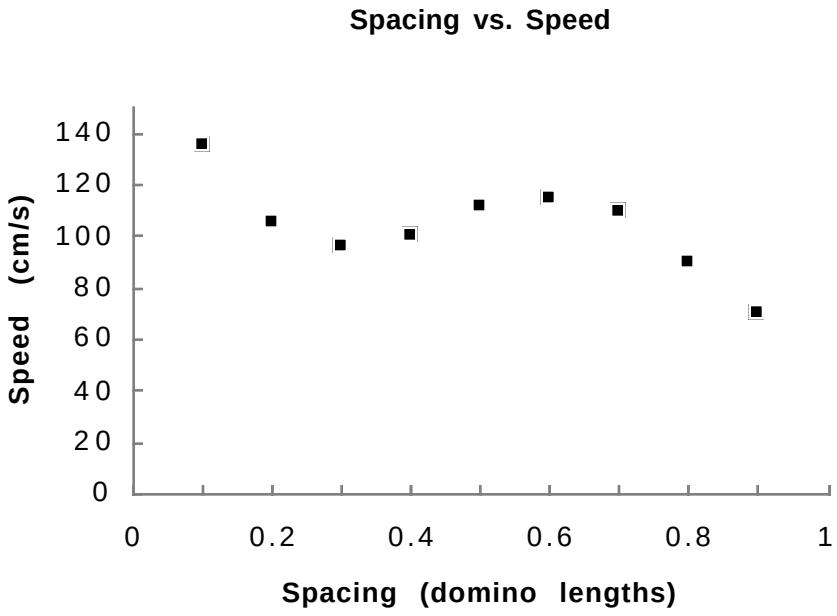
Spacing = 2.0 cm

Spacing in Domino Lengths = 2.0/4.0 = 0.5 DL

A good way to get equal spacing would be to take some adding machine tape and draw a continuous line on it. Make 100 marks at 0.3 of the domino length on this line.

Then extend the line and tape it to the table. Repeat this for additional machine tapes with 0.4, 0.5, 0.6, 0.7, etc. spacings. The dominoes can now be set up evenly by placing them next to a tape on the table.

B. The concept of average speed can be demonstrated by this activity in that the total distance of the domino row divided by the time it took to topple is the average speed of the dominoes falling. The speed at which the dominoes fall is probably not constant. Possible reasons for this are that each domino is not exactly equally spaced and that all dominoes may not be uniform, and that the surface over which the dominoes are placed may not be uniform.
   1. From the information accumulated by the various groups, construct a class graph of average speed (y axis) vs. spacing in domino lengths (x axis). At what predicted spacing would the dominoes topple with maximum average speed?
   2. Explain the shape of the graph. (Rough sketch below)



When the dominoes are close together the speed is slower because the speed of falling over is less. When the dominoes are far apart the speed is slower because it takes longer to touch the next domino.

CONCEPT EXTENSION

A. Based on the observations and relationships developed above, predict how long a string of dominoes would have to be to take 1 minute to fall? At what average speed is this row toppling?

B. At what average speed would the dominoes topple if you arranged 75 of them at a spacing of 0.3 domino lengths and 50 of them at 0.6 domino lengths? (The row consists of 125 dominoes but there are two different spacings.)

C. Since you are playing with the dominoes, why don't you have the students simulate a chain reaction.
   1. Instead of setting up the dominoes in a straight line where a domino simply hits the one in front of it, arrange the dominoes so that each domino hits two

other dominoes and in turn each of these hits two other dominoes, etc.

2. Compare the amount of time for 100 dominoes to fall down. This shows how a large number of nuclear collisions in a short time can sustain a nuclear chain reaction.