

Phone Book Tug

Test your strength against the laws of physics.

WHAT TO DO

Interleave a few pages between two books and easily pull them apart. Continue to add more and more interleaved pages until you can no longer separate the books, no matter how hard you pull.

WHAT'S HAPPENING?

When you slide one page across another, there is a force of friction between the two pages which resists your pull force, but it is very small. Nonetheless, every pair of pages you interleave adds the same small amount to the total frictional force, so if you interleave enough pages (and it doesn't take as many as you might think), soon the total frictional force is much greater than any two people can provide to pull them apart. This also illustrates the difference between force and pressure, which is the force per unit area. In this case the force with which the two people are pulling may be very large, but the total area of all the pages added together is also very large, so the force per pair of pages- the pressure- is actually very small, and much smaller than the pressure of the friction between each pair of pages. This also explains the amazing strength of Velcro. Each tiny "hook" would be very easy to pull out of the "fuzz" on its own, but when hundreds or even thousands are added together it becomes very difficult to separate the two sides.