



# Bed of Nails

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Most physics teachers have seen a bed of nails (or at least a picture or video of one), and the physics of how they work is a straightforward application of  $P = \frac{F}{A}$ . This document is concerned with the specifics of constructing a bed of nails and demonstrating its use.

## Construction

Most of the neat, tidy beds of nails that are used in science museums and by physics professors who have huge classes and an army of teaching assistants were made by painstakingly pre-drilling a hole for each nail, and filling each hole with a gutter spike (large and very long nails that hold rain gutters onto houses). However, the much faster, easier option, which I chose when I built mine, is to just use a nail gun.

My bed of nails is 24" × 72", with the nails spaced every 3/4". I built it at the Salem, MA Home Depot. They have a small build-on-premises workshop where you can purchase materials and borrow tools to make your project in the store. I purchased a 4' × 8' sheet of 1/2" plywood and had an associate cut it into two 2' × 6' pieces. I used a ruler and pencil to draw lines every 3/4" on one of the sheets of plywood.

I purchased a box of 2 1/4" coil nails and used a compressed air nail gun to drive them into the plywood. One box contains 12 coils of 300 nails; I used 11 of the 12 coils, which means the bed contains approximately 3 300 nails.



I nailed the nails through one of the sheets of plywood, and then screwed the second sheet of plywood onto the back of it so the nails would not push through. The entire construction process took about three hours, of which one hour was spent measuring and drawing the lines, and two hours was spent using the nail gun.

## Lessons Learned

I was glad to have used hearing protection—this is a must if you are using a nail gun for two hours. I should have brought a pencil sharpener—I had to sharpen the pencil several times during the marking process!

If I were to build another bed of nails, I would make it 18" wide, because 24" turned out to be a little too wide for people to put one hand on the floor on either side of the bed. This makes it more difficult for students to get onto and off of it.

## Demonstration/Use

To get onto the bed of nails, place one hand on the floor next to the bed and rotate yourself into a sitting position. You should end up with your buttocks and thighs on the nails, while still allowing room for your back when you lie down. The goal is to place as much of your body on the bed as you can all at once. Do **not** put your hands on the nails! The pressure will be more than enough to puncture your skin. It is essential that students understand this before trying the demonstration themselves.

*Before you lie down, make sure there is something on the bed to protect your head from the nails! (A physics book works well.)* The back of your head is curved and rigid, and the nails can puncture your scalp if you put the full weight of your head onto them. You will want an assistant ready to place the book, so that it will be under your head when you lie down.

Once you are sitting comfortably and you have a “cushion” ready for your head, lie back onto the nails slowly and carefully. You can use a hand on the floor next to the bed to steady yourself as you lie down, but be mindful of where *both* of your hands are as you do this. As with rock climbing, it is always safer for the person on the bed of nails to be 100% in control of his/her own motion. Resist the temptation to physically help someone onto or off of the bed.



ELL students in particular can be used to doing things without fully understanding the instructions. It is important to take extra precautions with ELL students to be sure that they fully understand the dangers and how to do the demonstration safely before taking part. *If you are not confident that any student, ELL or not, understands exactly how to get onto and off of the bed of nails safely, do not allow the student to lie on the nail bed!*

Some bed of nails demonstrations involve placing a second nail bed and a cinder block on top of the subject, and breaking the cinder block with a sledge hammer. Rather than trust my students to be able to do this safely, I place a cardboard box on my chest and have a student drop a heavy text book into the box from a height of about 6 feet. (Many students find this to be the most upsetting part!)