

Bed of Nails

<https://www.youtube.com/embed/cWZ-puu1keM>

Materials

- Two blast shields
- Bed and blanket of nails
- Wooden foot and back supports
- Wood leg coverings (x2)
- Thick gloves for sleeper (x2)
- Goggles for the sleeper
- Sweatshirt for the sleeper
- Sledgehammer
- Metal cinder block holders (x2)
- Plastic tarp
- One cinderblock for each performance
- One backup cinderblock per 3 performances

Safety Precautions

Science Theatre demonstrators must keep the safety of themselves and their audience in mind at all times. All Science Theatre demonstrators must have read through the Safety Training page. The ST Safety Box with first aid kit, fire extinguisher, etc. should always be available to demonstrators. Always wear safety gloves, glasses, and a labcoat if handling chemicals; always perform potentially dangerous demonstrations at a safe distance from the audience; and always keep a very close eye on any volunteers you call from the audience. Safety is extremely important for this demonstration. If you have an audience member stand on the paper cups, hold their hand to steady their balance and instruct them to step on and off slowly. Ensure proper body support for participant in bed. Between the box, the wooden coverings, the gloves, and the goggles; the sleeper's entire body

should be covered before the cinder block is put down. Keep crowd at a safe distance and behind blast shields. Make sure to tell people not to try this at home! Never invite an audience member to lie on the bed of nails.

Preparation

Make sure the presenter who will be using the sledgehammer has practiced breaking the cinder block so they know how much force to use. Use as little as possible for the safety of the sleeper! Set up the blast shields between where the bed of nails will be and the audience, although you may choose to keep the bed of nails hidden at first for effect. Lay down the tarp behind the blastshield, where you will put the bed.

Demonstration

For young audiences, you may want to introduce the bed of nails with a simple demonstration of pressure. Have an audience member step on one paper cup to demonstrate applying a force to a small surface area. Next, setup an array of at least 36 paper cups and place one of the black wooden leg covers on top of them. Invite another audience member to slowly and carefully step onto the board and stand there. Make sure they step onto the middle of the board, not an edge. The larger surface area of the array of paper cups should sustain their weight.

Next prepare the bed of nails. First get out the bed itself (the bed is the one without the extra wood edge on the base, which are handles) and show it to the audience. Lay the bed of nails down on the tarp. Set up the yellow wooden headrest and footrest.

Before lying down, the sleeper should take the following safety precautions. They may seem like more than is necessary, but safety is extremely important for this demonstration.

- Wear googles
- Wear thick gloves
- Wear sweatshirt

When the sleeper is ready to lie down, follow this procedure:

- Have the sleeper slowly lie down on the bed of nails, place head in headrest, and place feet in footrest.
- Another demonstrator should then slowly hand the sleeper the blanket of nails and the sleeper should lower it onto his/her chest and hold it securely by its handles (the extra wood at the edge of the base).
- The other demonstrator should place the two black wooden pieces to cover the sleeper's legs.
- The other demonstrator should use the large black box to cover the sleeper's head and neck.
- The two metal rods should be placed in the center on top of the blanket of nails and the cinder block placed on top of it. Don't leave the cinder block on the sleeper's chest for too long - it's heavy!
- Have the audience count down for you and then break the brick with the sledgehammer. This doesn't take all that much force - make sure you have practiced beforehand! This is helpful so that the sleeper is aware of the timing of the hit.

What to Say

The bed of nails portion of the demonstration can be performed with a little humor, for young audiences. It might go something like this:

Sleeper: ...yawn...

Performer: Are you tired?

Sleeper: Yes, we've done so many demonstrations today. I'm ready to go to bed.

Performer: Well, you're very lucky, because I've brought a bed with me... put on your pajamas (sweatshirt)... here it is, a bed of nails!

Sleeper: A bed of nails? I'm not going to sleep on that, it would hurt!

Performer: No, it won't hurt at all! Back me up, guys, can you explain why it won't hurt?

Make sure the audience can explain the relationship between pressure and surface area

Sleeper: Ok, I guess it doesn't sound that bad. Yah, it doesn't hurt at all! But I'm still cold.
Performer: Well, you're even more lucky to have a friend like me, because I've also brought a blanket of 1000 nails! I know your hands are cold, too, so I've also brought these gloves. I even have a mask (black box) to shut out the light for you.

After all the safety equipment is on, the sleeper can snore loudly

Performer: Ok, he/she's asleep. Now we can try a little experiment. Since he/she's such a good friend of mine and because we're professionally trained scientists, I can try putting a cinder block on top of him. This cinder block is heavy and applies a lot of force, but you all know that it won't create very much pressure because of the large surface area of all the nails. Look, he's still sleeping! I can try applying even more force with a sledgehammer!

Now help the sleeper get off the bed.

Performer: How was your nap?

Sleeper: Great, but I had a strange dream that I was being stepped on by an elephant. Of course, it didn't hurt very much!

Why This Works

Several physics principles are involved here. The force from any one nail is reduced by spreading the weight over many nails. The inertia of the blocks partially protects the person below from the force of impact. The smashing of the blocks absorbs much of the energy of the blow. If there were only one nail, the entire force created by the weight of the body would be distributed over the very small area presented by the tip of the one nail. In this case, the force per unit area, that is, the ratio of the force to the area, would be very great (because the area is small) and would likely result in piercing of the skin, and injury.