BED OF NAILS

Name _____ Date_____

The purpose of this practical is to demonstrate the physics of pressure and the difference between pressure and force. In this experiment, force is the weight of the mass pushing down on the balloon and thus the nails. Pressure is the force per unit area.

Have you heard of people lying on a bed of nails? Suggest why these people are not punctured by the nails?

A single nail has a sharp point – any force applied to this point is being concentrated onto a small area. Therefore the force per unit area (i.e., pressure) is large for a single nail. If the same force is spread out over several nail points, the force per unit area decreases (i.e., pressure decreases). The pressure on each nail point will decrease when more nails are added to the “bed”.

What are more common applications of this relationship between pressure and surface area?

A large factor in determining success for this lesson relates to how consistent you are with inflating their balloons to about equal sizes. For this reason use the circumference string to get each inflated balloon to the same size. The pattern of the nails is another important determinant in judging the accuracy of the data. For example, six nails arranged in a sporadic pattern will pop a balloon much easier than six nails in a tight, cubic pattern.

You will be testing how changing the pattern of six nails affects how much force it takes to break a balloon. Only one variable will change – the pattern of nails. The force is measured by how far the top board has to be pushed down before the balloon breaks.

Predict what might happen when the number of nails is increased or decreased?

Which will require more force to break the balloon? If a balloon is placed on top of one nail in the centre of the 25-nail board or if a balloon is placed on top of six nails in the centre of the 25-nail board?

METHODS

Materials

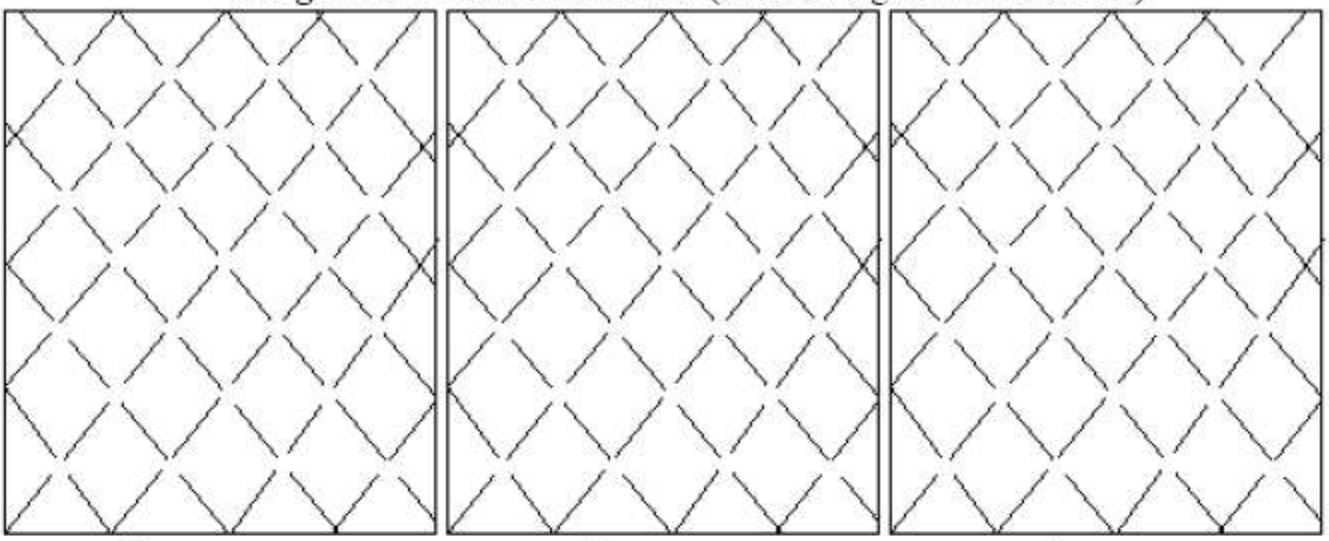
- Bed of Nail boards - Nails - Balloons
- Pieces of string to measure circumference of balloon (23 cm long)

Procedures

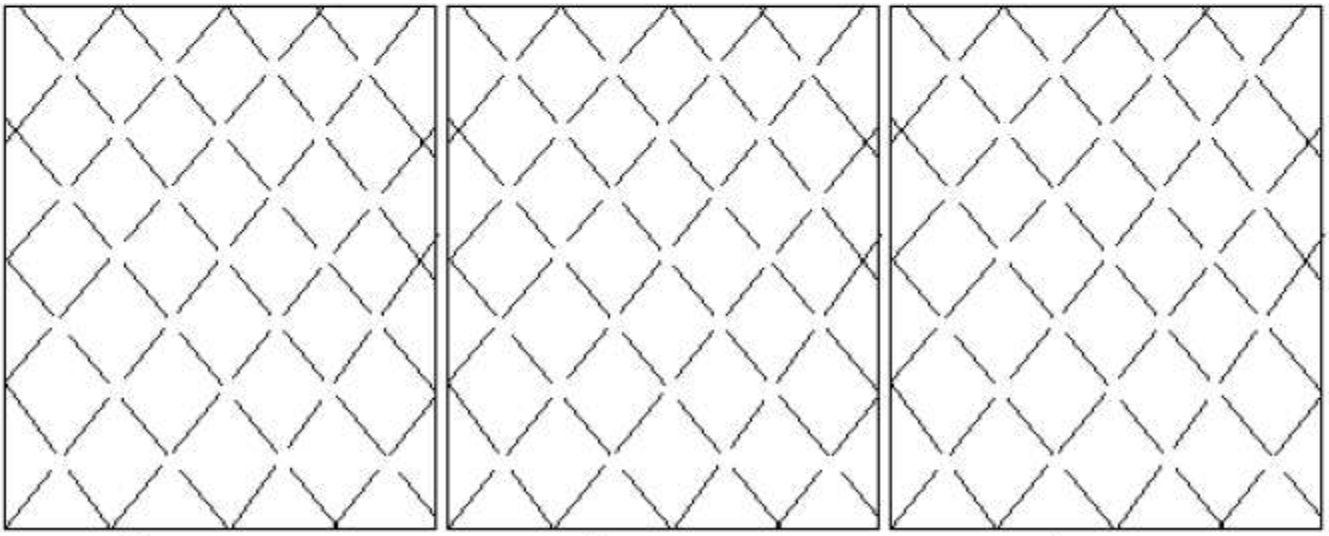
1. Place a supporting rod at each corner of the wood block labelled “Bottom.”
2. Add six nails to the block with 25 holes drilled into it, and place the block in the centre of the “Bottom” board. Try a cluster of nails for your first experiment. Draw a diagram of where you placed the nails on the worksheet.
3. Inflate a balloon to the same circumference by measuring with the circumference string.
4. Carefully rest the balloon on the nails and place the block labelled “Top” over the balloon so that the apparatus is stable, confined completely within the support rods.
5. Note the cm mark on the front dowels, and gradually push down on the top board keeping it level as you do so. Another member of the group should be watching the cm marks and note the mark reached when the balloon breaks.
6. Record the cm mark reached on the worksheet under your diagram of nail placements.
7. Repeat the experiment, changing the arrangement of the six nails in the block each time.

DATA

Diagram of Nail Placements (Reuse diagrams as needed.)



Cm reading _____ Cm reading _____ Cm reading _____



Cm reading _____ Cm reading _____ Cm reading _____

Conclusions

1. Using the data you collected, write up a 2 to 3 paragraph conclusion to describe your observations. Be sure to explain your results using scientific terms. Items to consider 1) Did the placement of the nails affect how easily the balloon would pop?, 2) What do would happen if the balloon were only partially inflated? 3) What types of nail patterns worked best for holding the most mass? 4)Which patterns held the least mass?