When you have completed this activity, go to Status Check.

Physical Science A Unit 1

Student Activity: Mathematical Expression: Force

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Name _____ **Date** _____

Objective

In this activity, you will apply the relationship of area, pressure, and force to determine a missing quantity in a mathematic expression given the two remaining terms.

Activities

Using your knowledge of how to calculate pressure, answer the questions that follow.

Recall from the lesson on properties of matter that the equation for pressure is:

force (N) = pressure (Pa) x area (m^2)

Force is measured in Newtons (N), pressure is usually measured in Pascals (Pa), and area is measured in meters squared (m^2). Suppose a large box of heavy books has an area of 2 m^2 and applies 10 Pa of pressure to the table it is resting on. To calculate the force that it exerts on the table:

force = pressure x area

force = 10 Pa x 2 m^2

force = 20 N

Now suppose a different box with an area of 0.5 m^2 exerts a force of 20N. The amount of pressure it applies to the table will be much different than before. To calculate pressure, rearrange the equation:

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

$$\text{pressure} = \frac{20\ \text{N}}{0.5\ \text{m}^2}$$

pressure = 40 Pa

Notice that if you needed to calculate the area of an object, given the force and pressure applied by the object, the equation would be:

$$\text{area} = \frac{\text{force}}{\text{pressure}}$$

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1. **A.** Women usually wear a lot of different kinds of shoes, some with flat bottoms and some with high heels. Suppose Stylin' Sue exerts a downward force of 490 N on the ground. Sue likes to wear flat-bottomed shoes with an area of 0.08 m^2 and a pair of high heels that have a heel with an area of 0.01 m^2. Calculate the pressure that she exerts on both types of shoes.

   B. Suppose Stylin' Sue and her friends all went to the school dance in high heels. The dance is held in the gym that just had new wooden floors installed. Given your calculations, why were Stylin' Sue and her friends asked to take their shoes off before entering the gym?

2. Cars in auto shops are raised up using hydraulic lifts that are controlled by large cylinders of different sizes that are connected by a chamber that holds fluid. Suppose a car sitting on a hydraulic lift exerts a downward force of 2,000 N on a piston with an area of 0.3m^2. Calculate the pressure that the car exerts on the piston. Suppose the same amount of pressure is required to raise the car. How much force is needed to exert the same amount of pressure on a different piston with an area 0.05 m^2? Explain why the two pistons require such a different amount of pressure to exert the same amount of force.

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3. Imagine that two large cargo trucks need to cross a bridge. The first truck is 30 m long and 3.2 m wide. The second truck is 35 m long and 2.8 m wide. The cargo in the first truck exerts a force of 54,000 N, and the cargo in the second truck exerts a force of 38,000 N. Suppose that the bridge is weak and can only withstand 450 Pa of pressure. What can you conclude about the safety of each truck crossing the bridge?

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