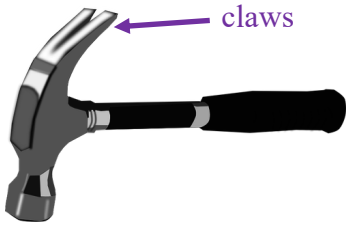
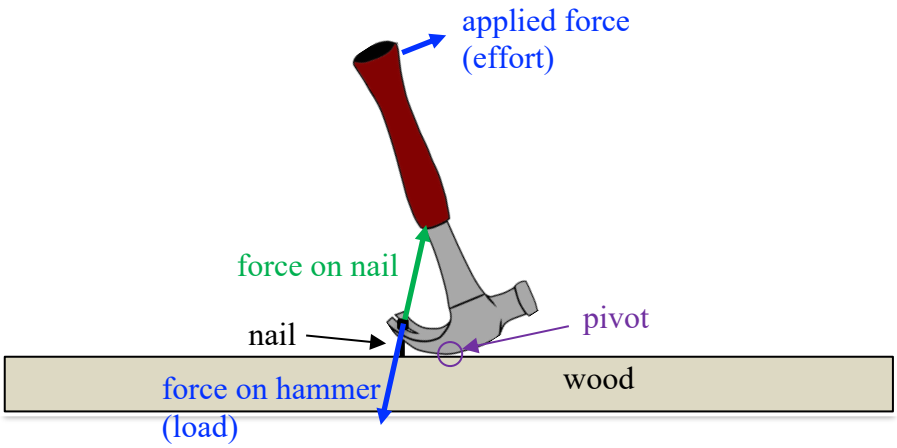
5.4.3 Levers

videos

Levers are devices for increasing force. They are called 'force multipliers'. One example is the claw hammer.



A claw hammer has two claws on the back which can be used to remove nails from a piece of wood.



A force is applied to the top of the hammer handle. The hammer rotates around the pivot (where it is in contact with the wood). This transmits a force to the nail. The force on the nail is greater than the applied force. Note that the force of the nail <u>on the hammer</u> (load) is equal in size and opposite in direction to the force of the hammer <u>on the nail</u>.

(1) Why is a hammer needed to remove the nail?

The force on the nail is greater than the applied force because of the 'principle of moments'. This states that:

$$the\ sum\ of\ clockwise\ moments = the\ sum\ of\ anticlockwise\ moments$$

(2) What force is attempting to turn the hammer clockwise around the pivot?

(3) What force is resisting this turning effect (i.e. producing an anticlockwise moment)?

A moment is the turning effect of a force.

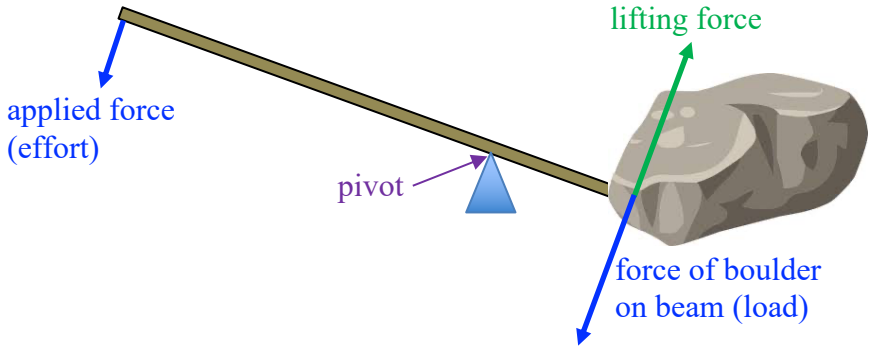
$$moment = force \times perpendicular\ distance\ to\ pivot$$

(4) What unit are moments measured in? (Hint: look at the equation to see what units are multiplied together.)

(5) A force of 320N is applied to the top of the handle at a (perpendicular) distance of 0.30m from the pivot. Calculate the clockwise moment.

(6) The nail is at a (perpendicular) distance of 0.030m from the pivot. Using the principle of moments, calculate the force of the hammer claws on the nail. (Hint: The clockwise and anticlockwise moments are equal in size.)

Consider the following situation:



A lever is being used to lift a boulder.

(7) Why is the lifting force greater than the applied force?

(8) What could be done to achieve a greater lifting force? Explain.

(9) Which end of the beam moves furthest? The end where the force is applied or the end lifting the boulder?

Recall that:

$$work\ done = force \times distance\ moved\ in\ the\ direction\ of\ the\ force$$

(10) Explain why, even though the force is magnified (for levers), you don't get more work out than you put in. (Hint: Look at the equation for work done, and consider the distance moved by the applied effort force and the load force.)