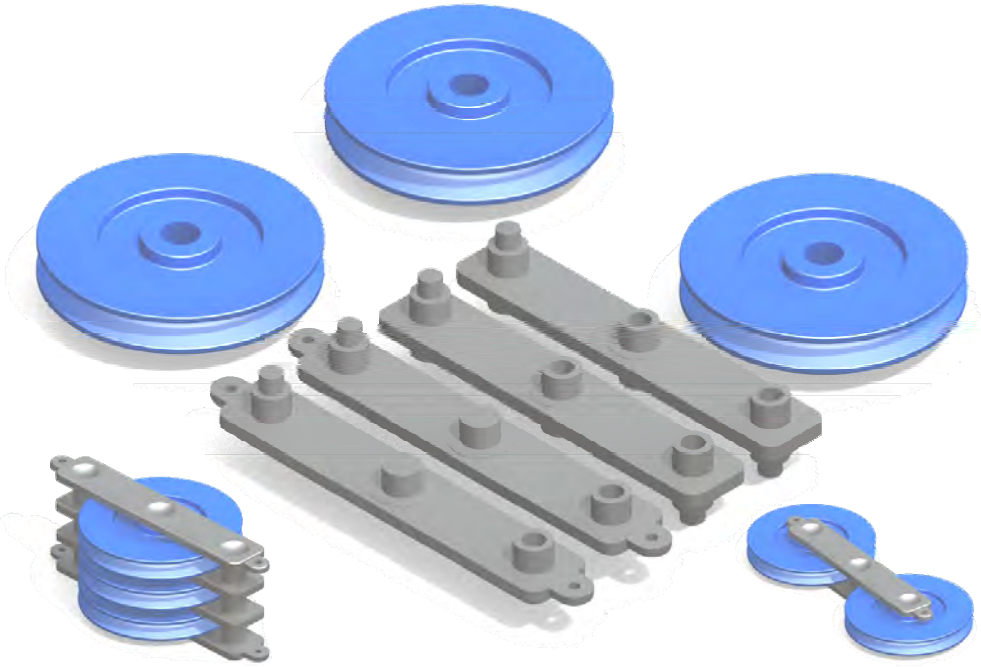
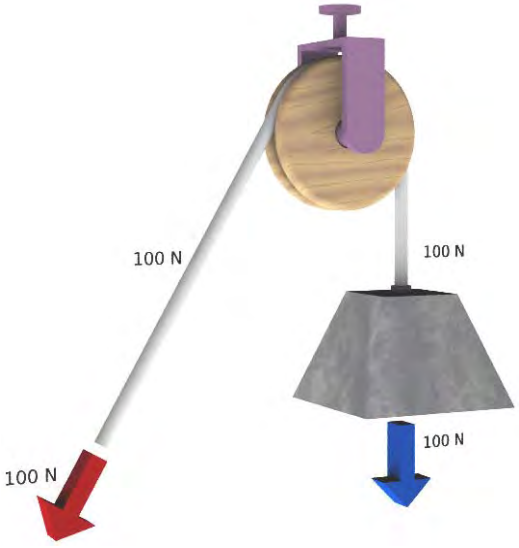
611-1050 (40-260) and 611-1055 (40-265) Build a Pulley



Introduction: Pulleys have been in use since before the time of Archimedes. They are a simple machine, and when arranged in the proper configuration, can impart a significant mechanical advantage. A legend states that Archimedes moved an entire warship using nothing but his own strength and a setup of complex pulleys.

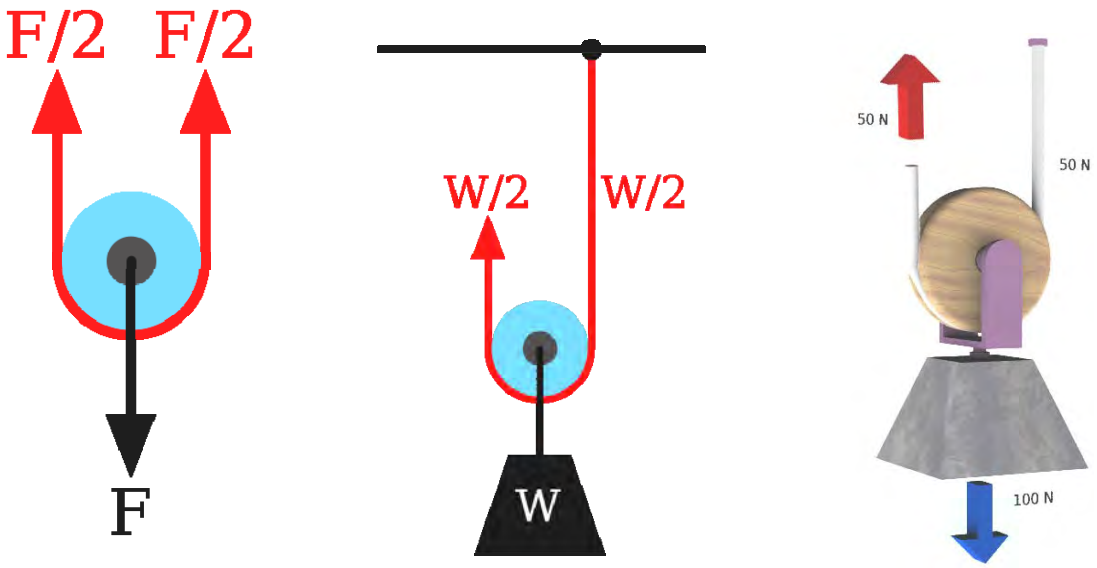
Simply put, pulleys magnify force according to the number of pulleys. Consider a weight being lifted directly by a single rope (see diagram to the right). The rope will endure a certain tension, equal to the weight.



If two ropes lift the same weight, the tension in each rope will be half (i.e. the force on the rope). If three ropes are used, the tension will be one third on each rope. Thus, if each of the three ropes has an equal force applied to it, the weight will experience three times this force and the weight will be lifted faster with less effort (tension) required by each rope.

Pulleys are a way in which one rope can be used to mimic many ropes. The part of a pulley that the rope passes through is called a sheave. Multiple sheaves cause the rope to travel a longer distance, because it must change direction several times and double back on itself. Thus, the amount of work being done does not change, but the distance over which it occurs is greatly increased and there are then multiple points at which the force is divided over.

Below are diagrams of three ways to look at the most basic separation of forces using one pulley. Each diagram shows the same concept, and in each case the ends of the rope are carrying half the weight of the block (or half of the force).



Description: As noted above, the part of the pulley the cable travels through is called a sheave, and the housing is called a block or flange. The sheave is essentially a wheel with a groove in it to hold the rope on.

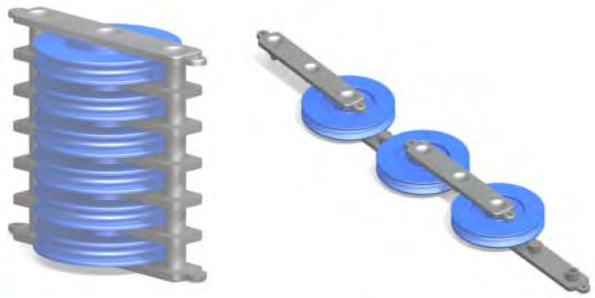
Our set contains three sheaves, and four pieces of a block. These pieces snap together and have pins molded into them to hold the sheaves on. There are two end pieces and two middles.

To use your pulley set, decide on how many pulleys you wish to construct. You can have a single, double, or triple sheave pulley. For a single you need only use the two end blocks. For a double you will need one of the middle pieces, and both of the middle pieces are needed for a triple.

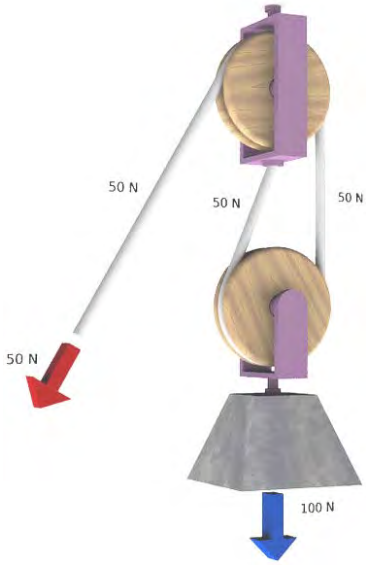
You will notice that the blocks are set up so that they have pins and receivers that fit together. These are offset from each other so that the pieces are easily interchangeable.

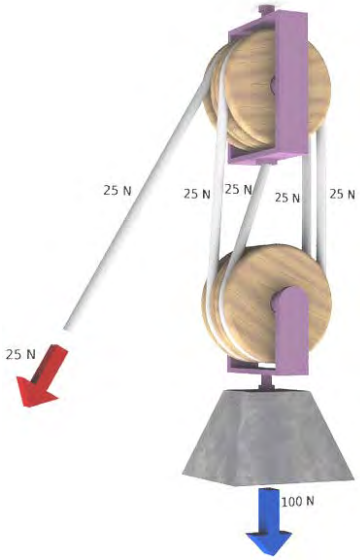
The following are images of some of the possible setups that can be obtained with this set:

By using more than one set, it is possible to set up pulleys with six, nine, twelve, or higher numbers of sheaves. While pulleys of this size will greatly decrease the force needed to lift a given mass, they require a much longer cable. In addition, friction causes the system to become increasingly inefficient with each additional sheave.

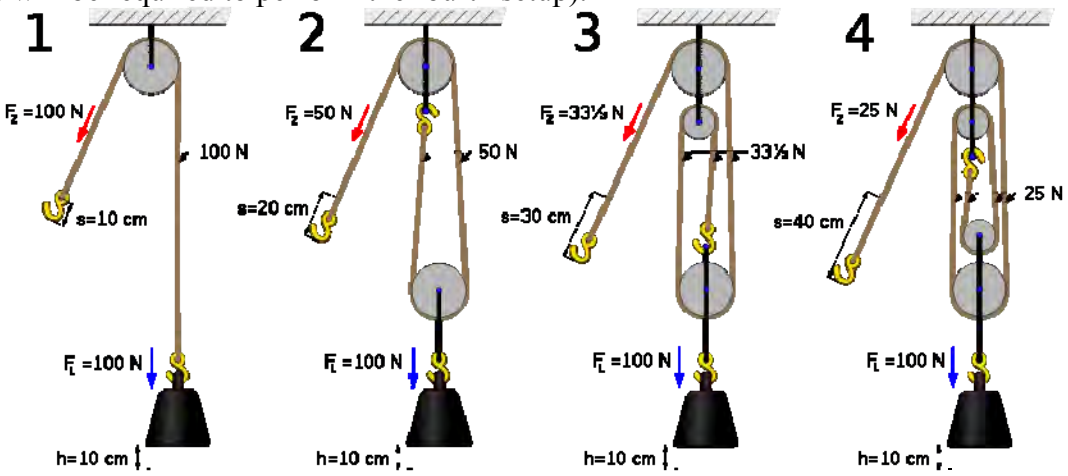


These setups (directly above and below) require two or more sets.





Experiments: There are a couple of easy ways to show how much force is required to move an object and the mechanical advantage that a pulley or pulleys will give to a system. The first would be to use a spring scale and attach this to a string and then to wind it through the pulley setups shown below in order to loft a weight (Note: two pulley kits will be required to perform the fourth setup).



If a teacher (or student) is performing these experiments, then the values for the required lift and the distances can be omitted and the students can determine these experimentally. They should record the weight of the object and then the force required to move the object the same distance. From this students will observe the mechanical advantage obtained through each pulley setup.

If a spring scale is not available, then it is recommended that a hook be fashioned out of a large paperclip or a piece of coat hanger. Then use 5-10 large nuts as the weight and have the students use various numbers of nuts on the other end of the string to show how much force is required to lift each setup and the corresponding distance required to lift each "weight" the same distance. Larger nuts (weights) will be more likely to translate to more accurate results as they help to negate the effects of friction.

Warranty and Parts:

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident,

misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

May we suggest:

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Spring Scales (611-0000 thru 611-0032): Ranging from 1N to 50N and sold either individually or in a set of seven, these high quality, color coded spring scales are fusion welded (not glued) so they are both strong and versatile.

611-1020 Double Inline Pulley: These free-running tandem pulleys have 1, 2, or 3 rigid plastic sheaves and nickel-plated steel frames with hooks on either end. Single has 50mm sheave; double has 38 and 50 mm sheaves; triple has 25, 38, and 50 mm sheaves.

611-1045 Table Top Pulley: Great for experiments needing a pulley at different heights, this pulley rotates 360°. Adjusting up to 10 cm, it locks in place with a thumbscrew and can attach to surfaces to 5 cm thick. Two-piece apparatus includes glass filled nylon molded clamp and pulley; blue sheave 2" (50 mm) diameter; stainless steel rod.