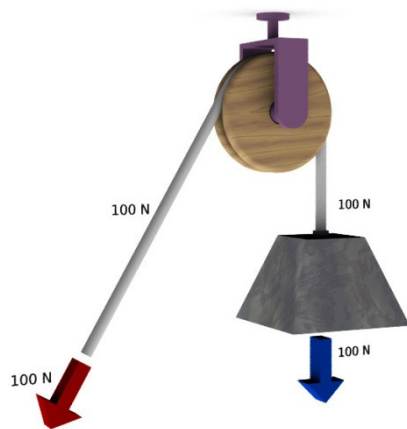
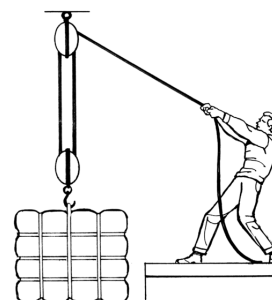


10 New Technology: The Pulley-Block 3

A simple machine consisting essentially of a wheel with a grooved rim in which a pulled rope or chain can run to change the direction of the pull and thereby lift a load.



Two or more pulleys together are called a block and tackle.



Modern Day Pulley

Archimedes probably was born in the seaport city of Syracuse, (278 B.C. – 212 B.C.) a Greek colony on the island of Sicily. He was the son of an astronomer and may have been related to Hieron, King of Syracuse. Archimedes studied in Alexandria at the school established by Euclid and then settled in his native city.

To the Greeks of this time, mathematics was considered one of the fine arts - something without practical application but pleasing to the challenges of thinking. Archimedes did not record the many mechanical inventions that were requested by King Hieron or those he simply made for his own amusement.

Fact and Fancy

The many stories that are told of Archimedes are the prototype of the absentminded-professor stories. A famous one tells how Archimedes uncovered a fraud attempted on Hieron. The King ordered a golden crown and gave the goldsmith the exact amount of gold needed. The goldsmith delivered a crown of the required weight, but Hieron suspected that some silver had been used instead of gold. He asked Archimedes to consider the matter. Archimedes was pondering the problem while he was getting into a bathtub full of water. He noticed that the amount of water overflowing the tub was proportional to the amount of his body that was being immersed. This gave him an idea for solving the problem of the crown. Because he was so excited, he ran through the streets repeatedly shouting "Eureka, eureka!" (I have discovered it!)

There are several ways Archimedes may have determined the amount of silver in the crown. He would have first taken two equal weights of gold and silver and compared their weights when immersed in water. Next, he would have compared the weight of the crown and an equal weight of pure silver in water in the same way. The difference between these two comparisons would indicate that the crown was not pure gold.

On another occasion Archimedes told Hieron that with a given force he could move any given weight. Archimedes had investigated properties of the lever and pulley. It is on the basis of these that he is said to have asserted, "Give me a place to stand and I can move the earth." Hieron, amazed at this, asked for some physical demonstration. In the harbor was a new ship which the combined strength of all the Syracusans could not launch. Archimedes used a mechanical device that enabled him, standing some distance away, to move the ship. The device may have been a simple compound pulley or a machine.

Hieron saw that Archimedes had a most inventive mind in such practical matters as constructing mechanical aids. At this time one use for such inventions was in the military field. Hieron persuaded Archimedes to construct machines for possible use in warfare, both defensive and offensive.

A Time of War

Plutarch, in his biography of the Roman general Marcellus, described the following incident. After the death of Hieron, Marcellus attacked Syracuse. The original instruments of warfare made at Hieron's request were put to use. "The Syracusans were struck dumb with fear, thinking that nothing could stop the Roman violence and power. But Archimedes began to work his engines and hurled against the land forces all sorts of missiles and huge masses of stones, which came down with incredible noise and speed. Nothing at all could defend them from the Syracusans' weights which knocked down in heaps those who stood in the way and threw the troops into disorder.

Furthermore, beams were suddenly thrown over the ships from the walls, and some of the ships were sent to the bottom by means of weights fixed to the beams and plunging down from above. Others were drawn up by iron claws, or crane-like beaks, attached to the front of the ship and were plunged down on their sterns, or were twisted round and turned about by means of ropes within the city, and dashed against the cliffs. ... Often there was the fearful sight of a ship lifted out of the sea into mid-air and whirled about as it hung there, until the men had been thrown out and shot in all directions, when it would fall empty upon the walls or slip from the grip that had held it."

Marcellus, according to Plutarch, gave up trying to take the city by force and relied on a siege. The city surrendered after 8 months. Marcellus gave orders that the Syracusan citizens were not to be killed, taken as slaves, or mistreated. But some Roman soldier did kill Archimedes. There are different accounts of his death. One version is that Archimedes, now 75 years old, was alone and so absorbed in examining a diagram that he was unaware of the capture of the city. A soldier ordered him to go to Marcellus, but Archimedes would not leave until he had worked out his problem to the end. The soldier was so enraged, he killed Archimedes.

Another version is that Archimedes was bringing Marcellus a box of his mathematical instruments, such as sundials, spheres, and angles adjusted to the apparent size of the sun, when he was killed by soldiers who thought he was carrying valuables in the box.