Gears

Gears are based on the wheel and axle. Gears have teeth on the edge of the wheel that allow one gear to turn another. A set of gears forms a compound machine in which one wheel and axle is linked to another.

Two linked gears that are the same size and have the same number of teeth will turn at the same speed. They will move in opposite directions. In order to make them move in the same direction, a third gear must be added between them. The gear that turns another gear applies the input force; the gear that is turned exerts the output force. A difference in speed between two gears—caused by a difference in size and the distance each turns through—produces a change in force.

**Mechanical Advantage of Compound Machines**

The mechanical advantage of any compound machine is equal to the product of the mechanical advantages of all the simple machines that make up the compound machine. For example, the ideal mechanical advantage of a pair of scissors would be the product of the ideal mechanical advantages of its two levers and two wedges.

The mechanical advantage of a pair of gears with different diameters can be found by counting the teeth on the gears. The mechanical advantage is the ratio of the number of teeth on the output gear to the number of teeth on the input gear. If there are more than two gears, count only the number of teeth on the first and last gears in the system. This ratio is the mechanical advantage of the whole gear system.

Compound machines typically must overcome more friction than simple machines because they tend to have many moving parts. Scissors, for example, have a lower efficiency than one lever because there is friction at the point where the two levers are connected. There is also friction between the blades of the scissors as they close.