

# Engineering Discoveries: Simple Machines Combo



# Building Basics

## Building Basics with Rokenbok

The following tips will be helpful when using the Rokenbok Student Design and Engineering System.

### Connecting/Separating ROK Blocks:

ROK Blocks use a friction-fit, pyramid and opening system to connect. Simply press pyramids into openings to connect.

To separate blocks, pull apart.

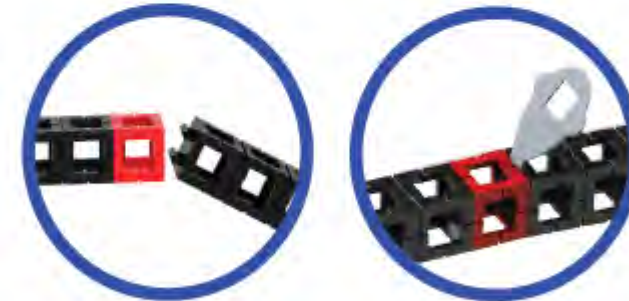


Pyramids or connectors

### Connecting/Separating Rokenbok Components

Smaller Rokenbok components use a tab and opening system to connect. Angle one tab into the opening, and then snap into place.

To separate, insert key into the engineered slot and twist.



### Snapping Across Openings

The tabs on Rokenbok components can also be snapped across openings to provide structural support to a design. This will also allow certain designs to function correctly.



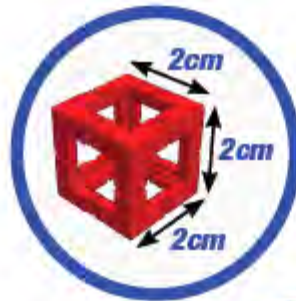
### **Attaching String:**

*In some instances, string may be needed in a design. Lay string across opening. Snap any Rokenbok component with tabs or pyramids into opening. Make sure tabs run perpendicular to string for a tight hold.*

### **Measuring:**

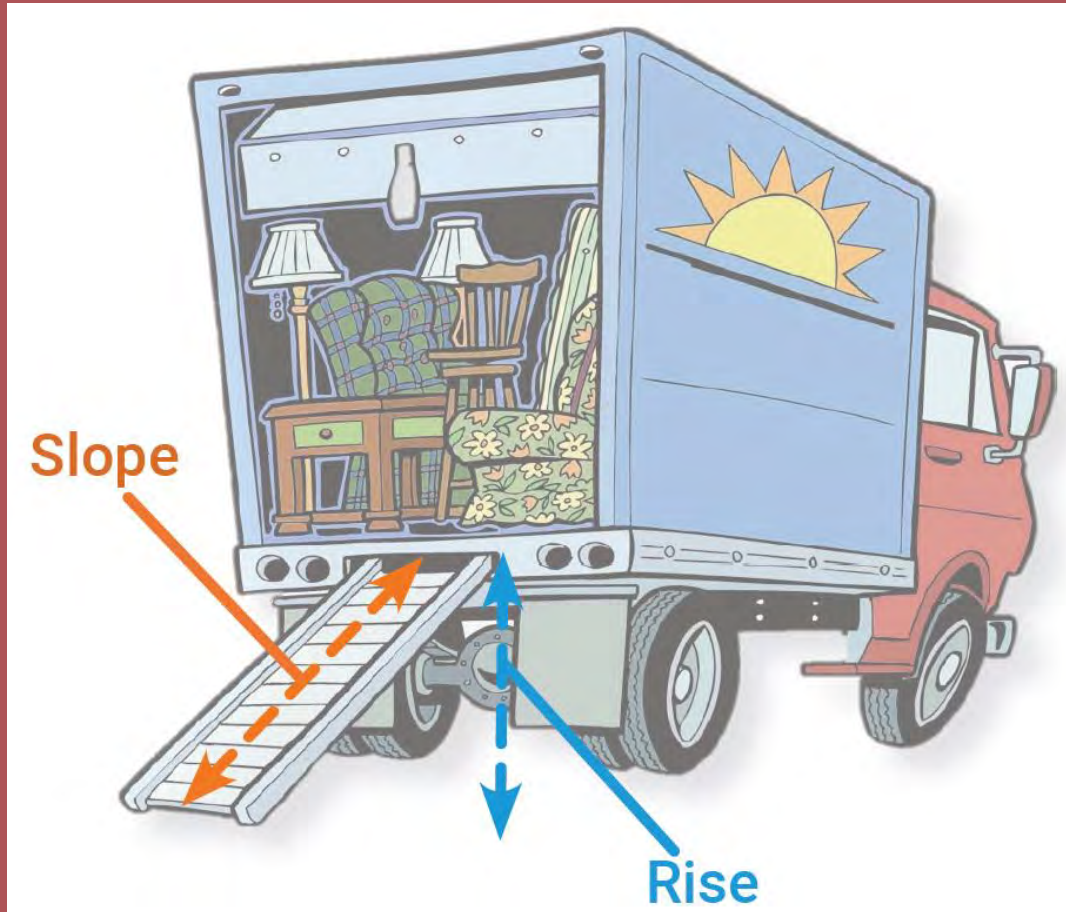
*The outside dimensions of each Rokenbok connector block is  $2\text{cm}^3$ . This means the length, depth, and height are all the same.*

*To determine the size of a Rokenbok build in cm, simply count the number of openings and multiply by two. Repeat this process for length, depth and height.*



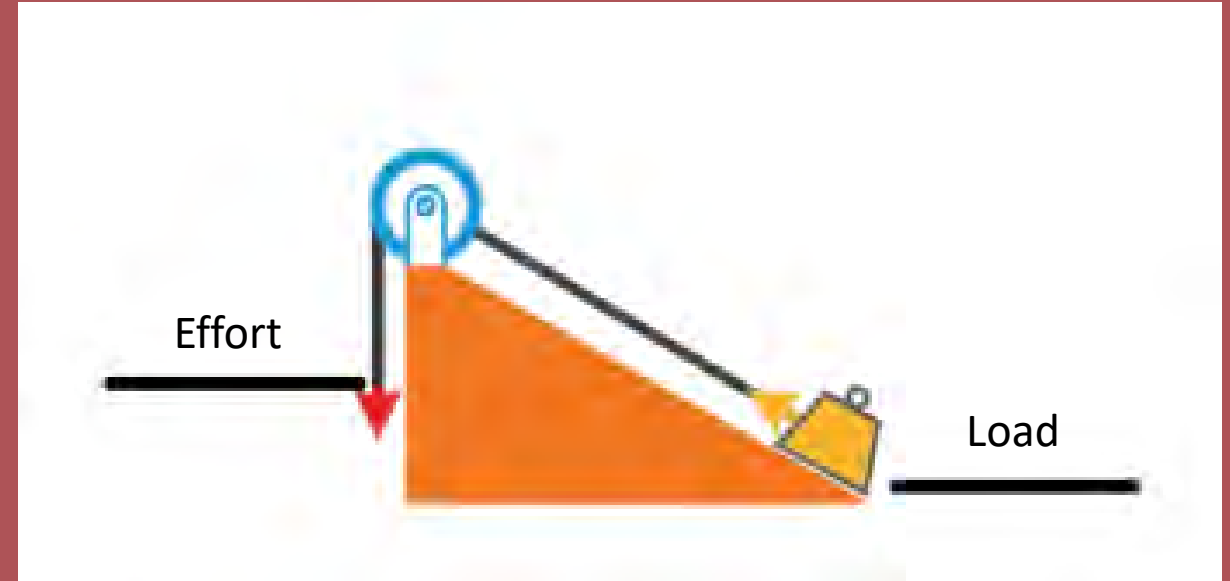
# The Inclined Plane

An inclined plane is a flat supporting surface tilted at an angle, with one end higher than the other. There are two elements in an inclined plane: the **slope** and the **rise**. In the example to the right, the slope (incline) is represented by the ramp. It is used to load and unload the furniture in the truck. The rise is the amount of increase from the horizontal surface (the ground in this case) to the top of the slope.



## Purpose

An inclined plane is used to make work easier by **creating mechanical advantage**.



Slides



Skate Ramp



Wheelchair Ramp



Entry Ramp



Ski Slope

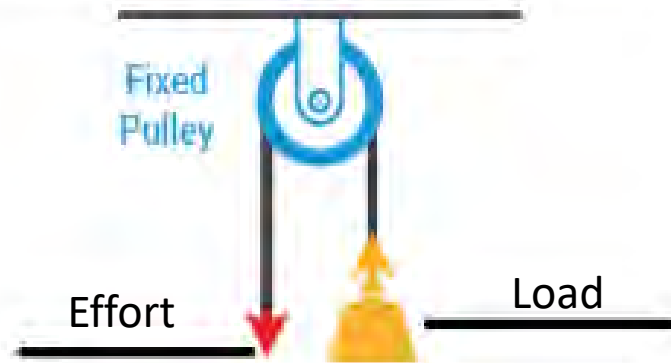


# The Pulley

A **pulley** is a simple machine that consists of a **wheel** and **axle** with a groove cut into the edge of the wheel to accept a **cable**. The pulley allows the cable to be attached to a load and transfers the downward pull of the cable to raise the load.



## Single Fixed Pulley



## Purposes

Pulleys can be used to **redirect motion** or to reduce the amount of effort needed to raise a load by creating **mechanical advantage**.

**Block & Tackle**



**Water Well**



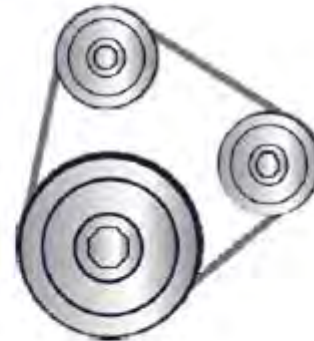
**Crane Truck**



**Flag Pole**



**Belt Pulleys**



# The Lever

A lever is a simple machine that consists of a **rigid beam (lever arm)** that pivots on a **fulcrum**. It is used to **redirect motion, create mechanical advantage** to make work easier, or **increase output speed** to make a load move faster.

Rigid Beam (Lever Arm)

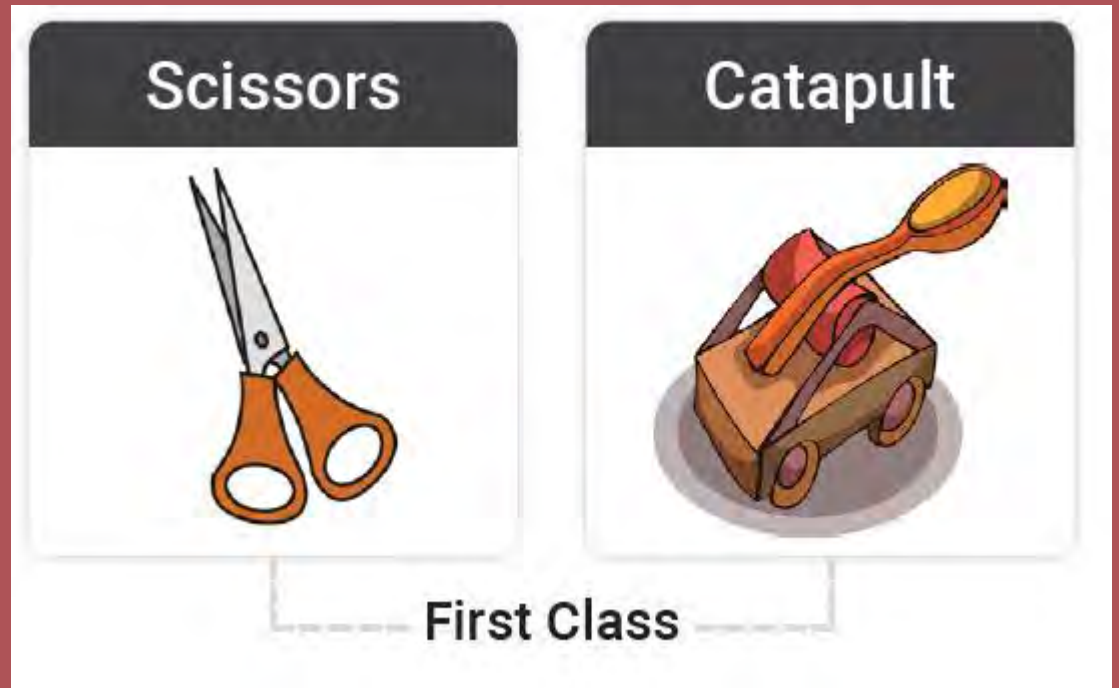
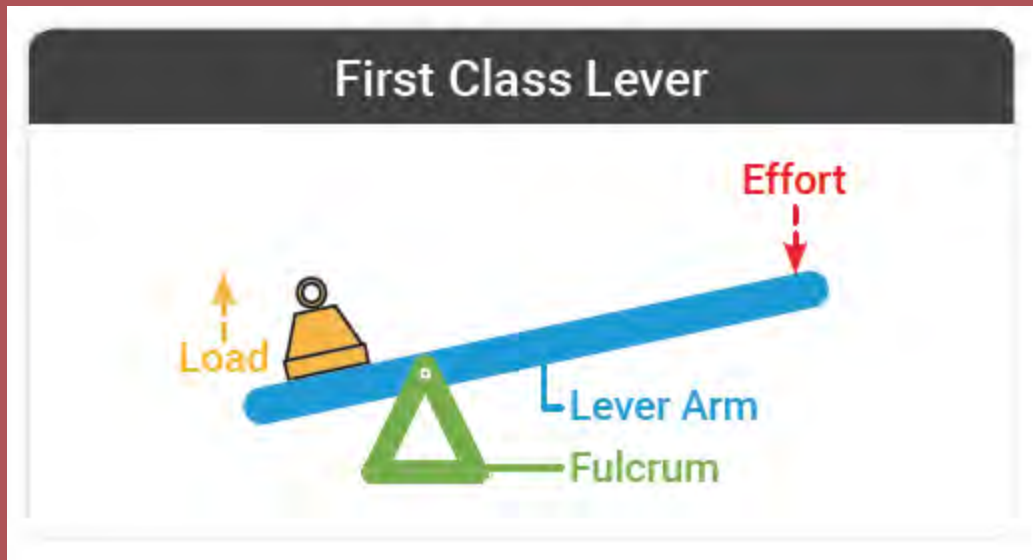


## Types of Levers

There are three types of levers, according to where the **load** and **effort** are located in respect to the **fulcrum**.

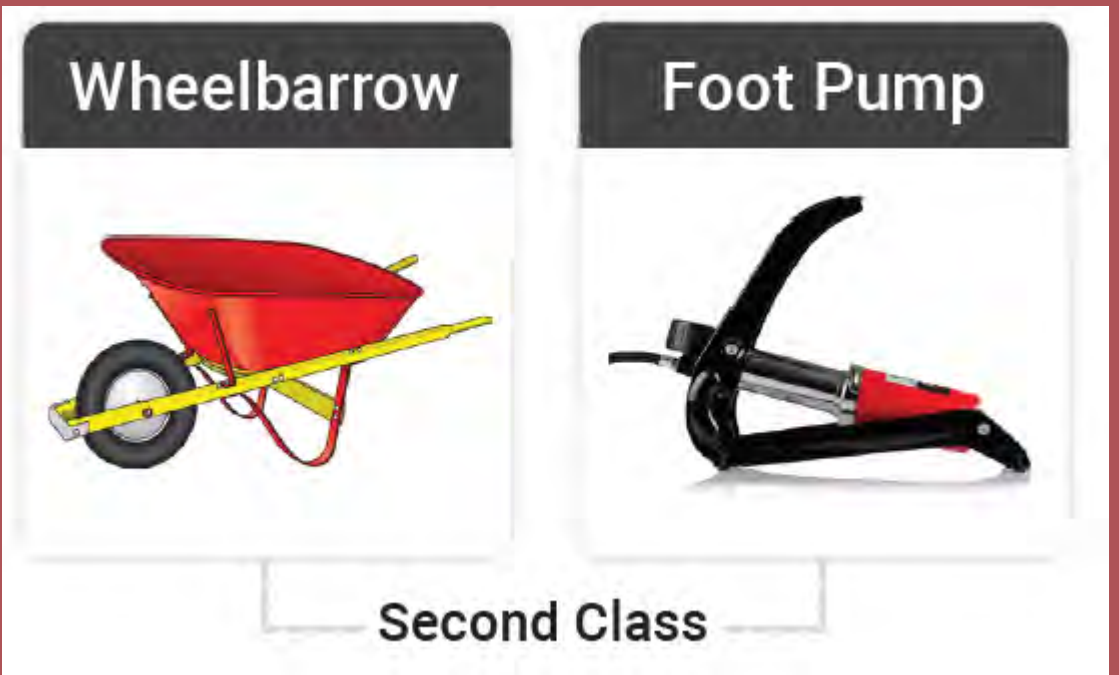
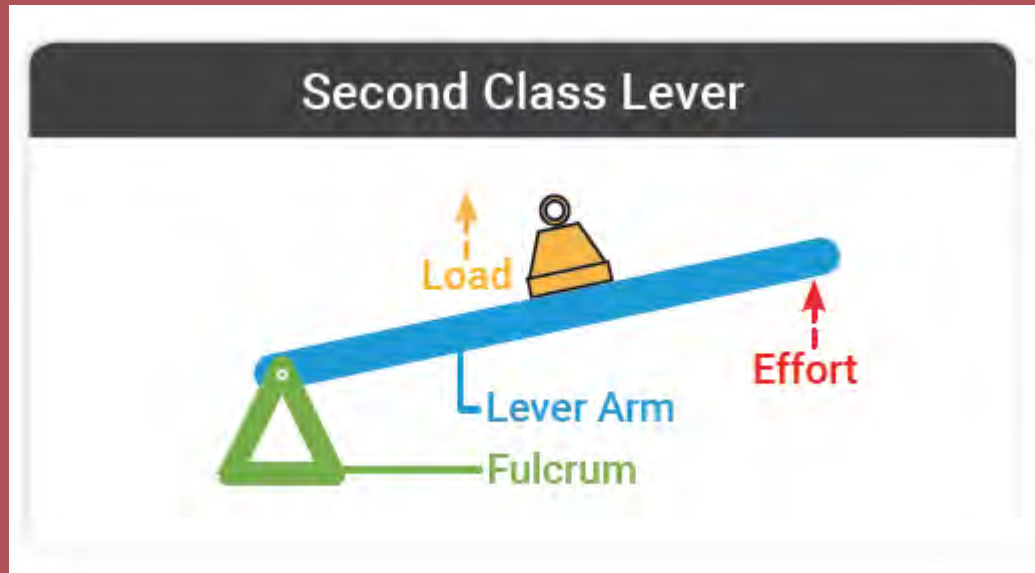
## First Class Lever

In a first class lever, the **fulcrum** is located between the **effort** and the **load**. A first class lever can be used to reduce the amount of effort needed to raise a load by placing the fulcrum closer to the load, or to increase output speed by placing the fulcrum closer to the effort.



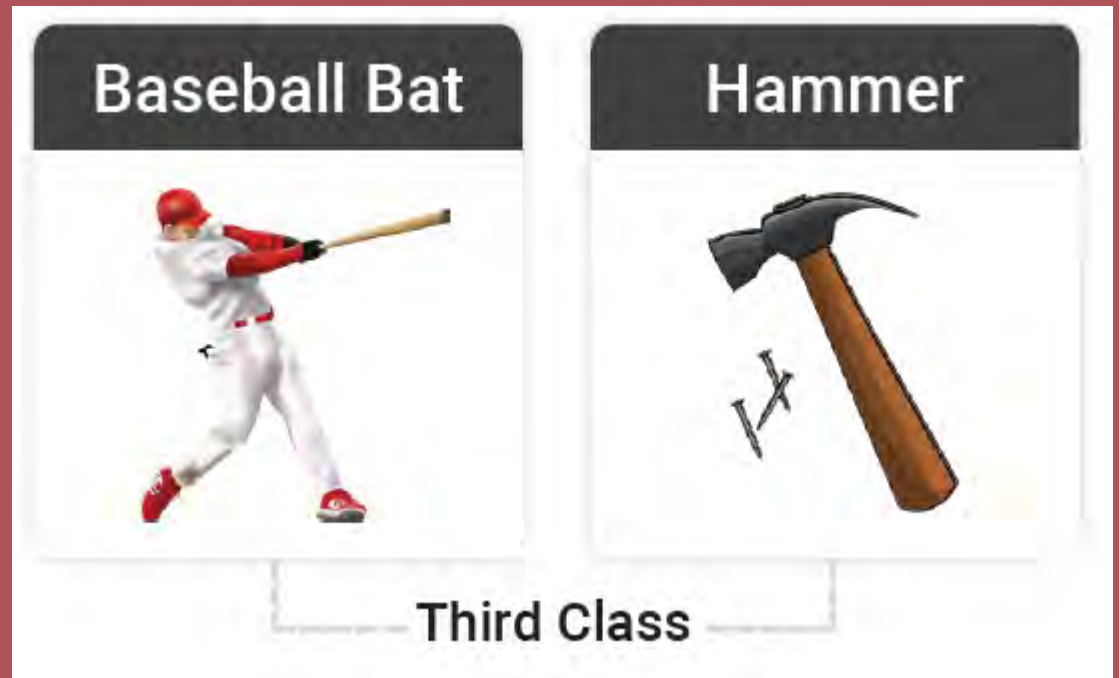
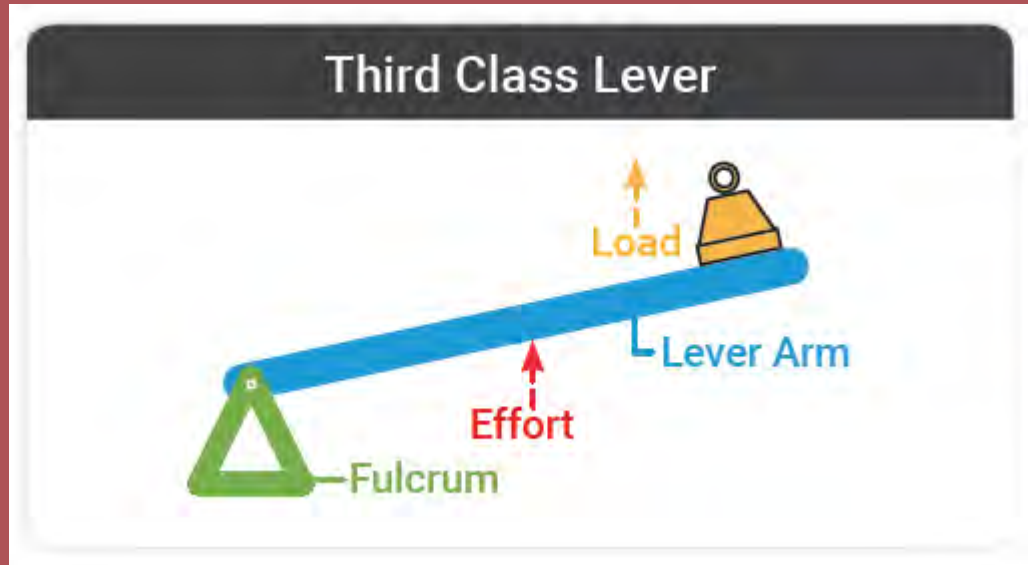
## Second Class Lever

In a second class lever, the **load** is located between the **effort** and the **fulcrum**. The amount of effort needed to raise a load is reduced as the load is placed closer to the fulcrum. A second class lever does not change the direction of motion because the effort and the load move in the same direction.



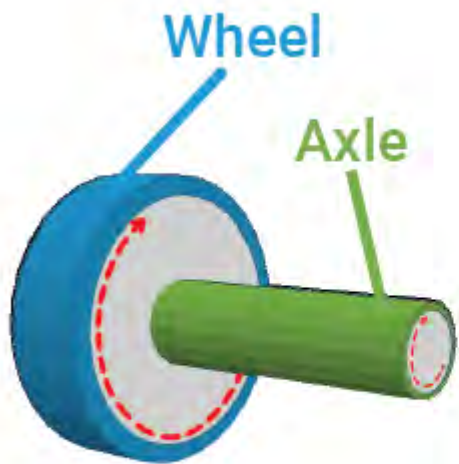
## Third Class Lever

In a third class lever, the **effort** is applied between the **load** and the **fulcrum**. The amount of effort needed to raise the load is reduced as the effort is applied closer to the load. A third class lever is primarily used to increase output speed, which increases as the effort is applied closer to the fulcrum.

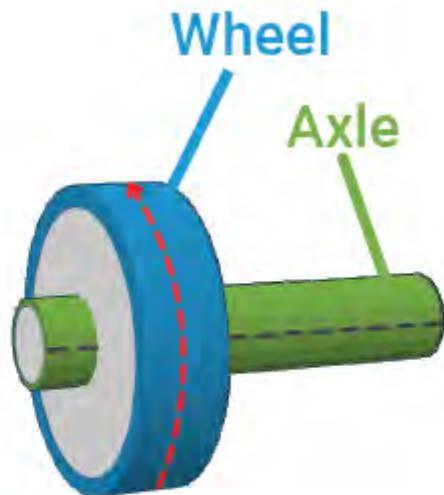


# The Wheel & Axle

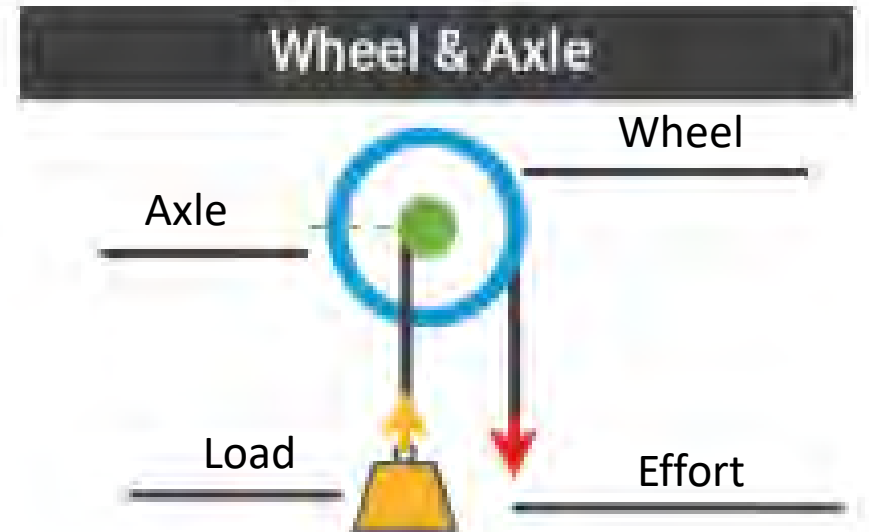
A wheel & axle is a simple machine that consists of a **wheel** that is connected to a smaller wheel, which is referred to as an **axle**. The axle can be fixed to the center of a wheel, or it can be placed through the center of a wheel, allowing the wheel to rotate freely around the axle.



Fixed/Connected



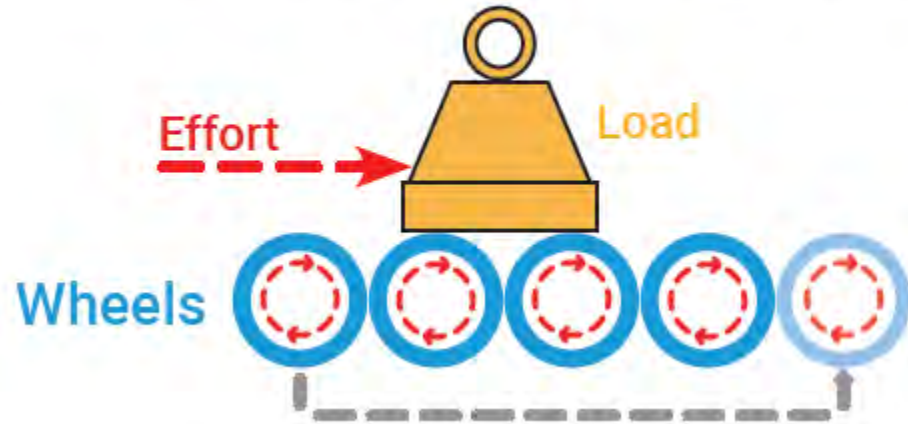
Free Spinning



## Purpose

A wheel & axle can be used to make work easier by **reducing friction** or by **creating mechanical advantage**.

# Example 1 - Reducing Friction



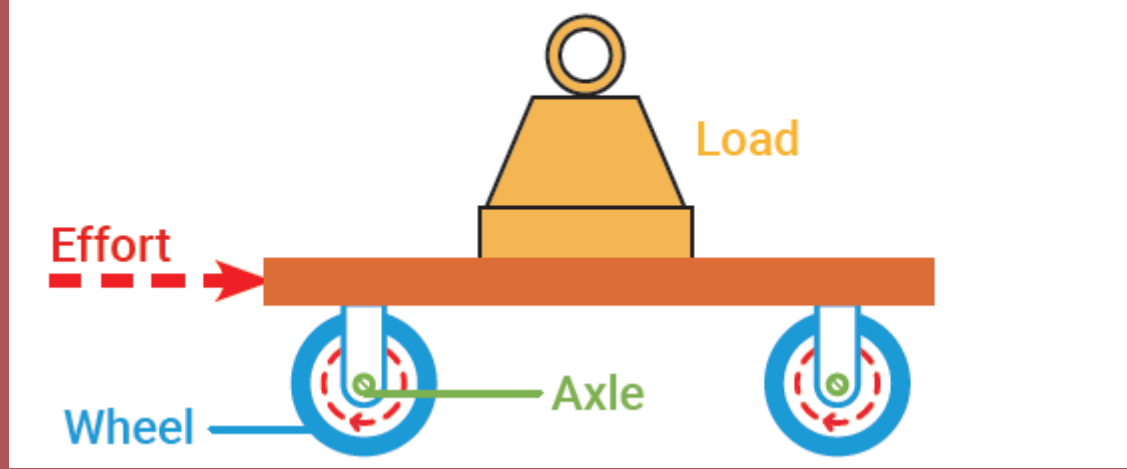
Airport security

Conveyor belt

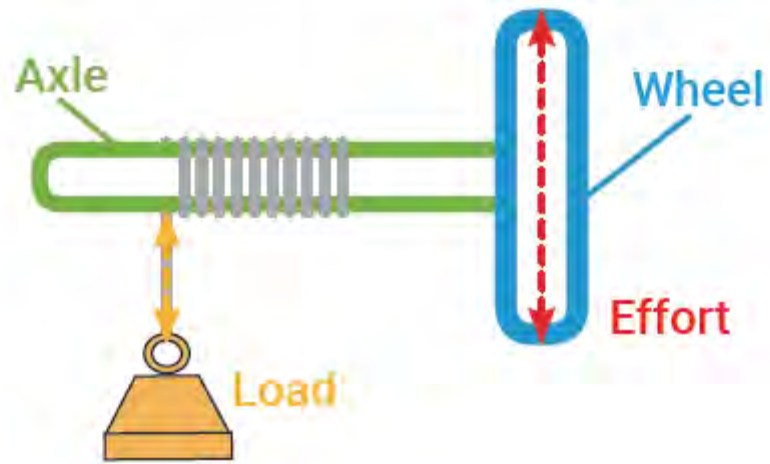


Roller slide

## Example 2 - Reducing Friction



### Example 3 - Mechanical Advantage



**Bicycle Wheel**



**Wheelbarrow**



**Steering Wheel**



**Screwdriver**



**Well**

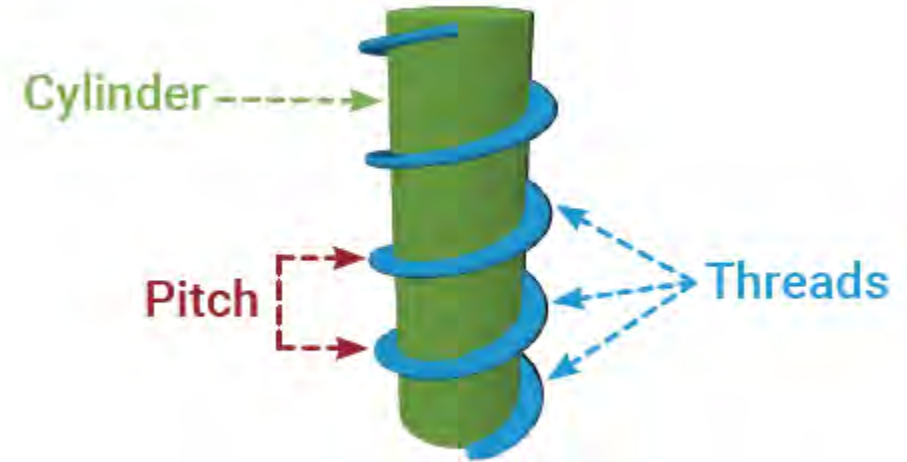


**Gears**



# The Screw

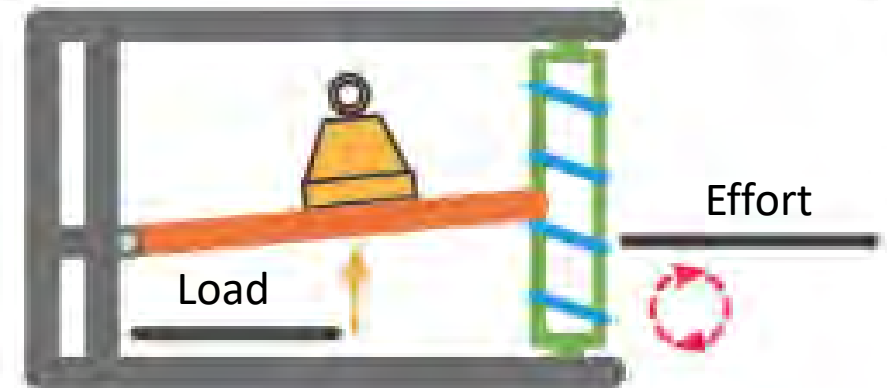
A screw is an inclined plane wrapped around a **cylinder**. The incline or ridges that wrap around the cylinder are referred to as the **threads**. The distance between the threads is referred to as the **pitch**.



## Purposes of the Screw

The screw can be used to push and pull objects, or to hold objects together. This is done by converting rotary motion (circular) into linear motion (in a straight line).

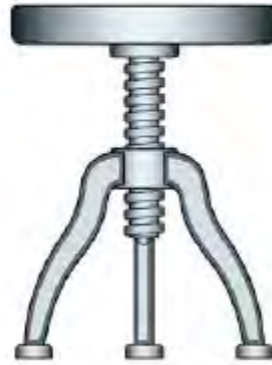
### Screw: Raising Load



**Wood Screw**



**Adjustable Stool**



**Bolt and Nut**



**Scissor Jack**



**Bench Vise**



**Drill Bit**



## The Wedge

A wedge is an inclined plane that moves. A wedge may be a **Single wedge** (one slope) or a **Double Wedge** (two slopes). A single wedge is similar to a right angle triangle and is defined by its **slope** and **rise**, relative to the base which is perpendicular to the rise. A double wedge is similar to an isosceles triangle and is defined by its **slope** and **thickness**.



Single Wedge



Double Wedge

### Wedge: Raising Load



## Purposes of the Wedge

The wedge can be used to separate, raise, and hold objects together. When using a wedge, the amount of effort needed is reduced as the length of the slope (or slopes) is increased.

**Axe**



**Chisel**



**Nail**



**Spatula**



**Knife**



**Doorstop**



# Creative Building Challenge!

*As a team, design and build  
your own machine!*

Your machine must use  
at least 1 of the 6  
simple machines  
(It can combine more than one)

Your machine must have  
a load and an effort

## Engineering & Design Process

You will need to explain how  
your machine moves the  
load with less effort

Your machine must do a job.  
How does your machine  
help someone?  
Who would be using it?

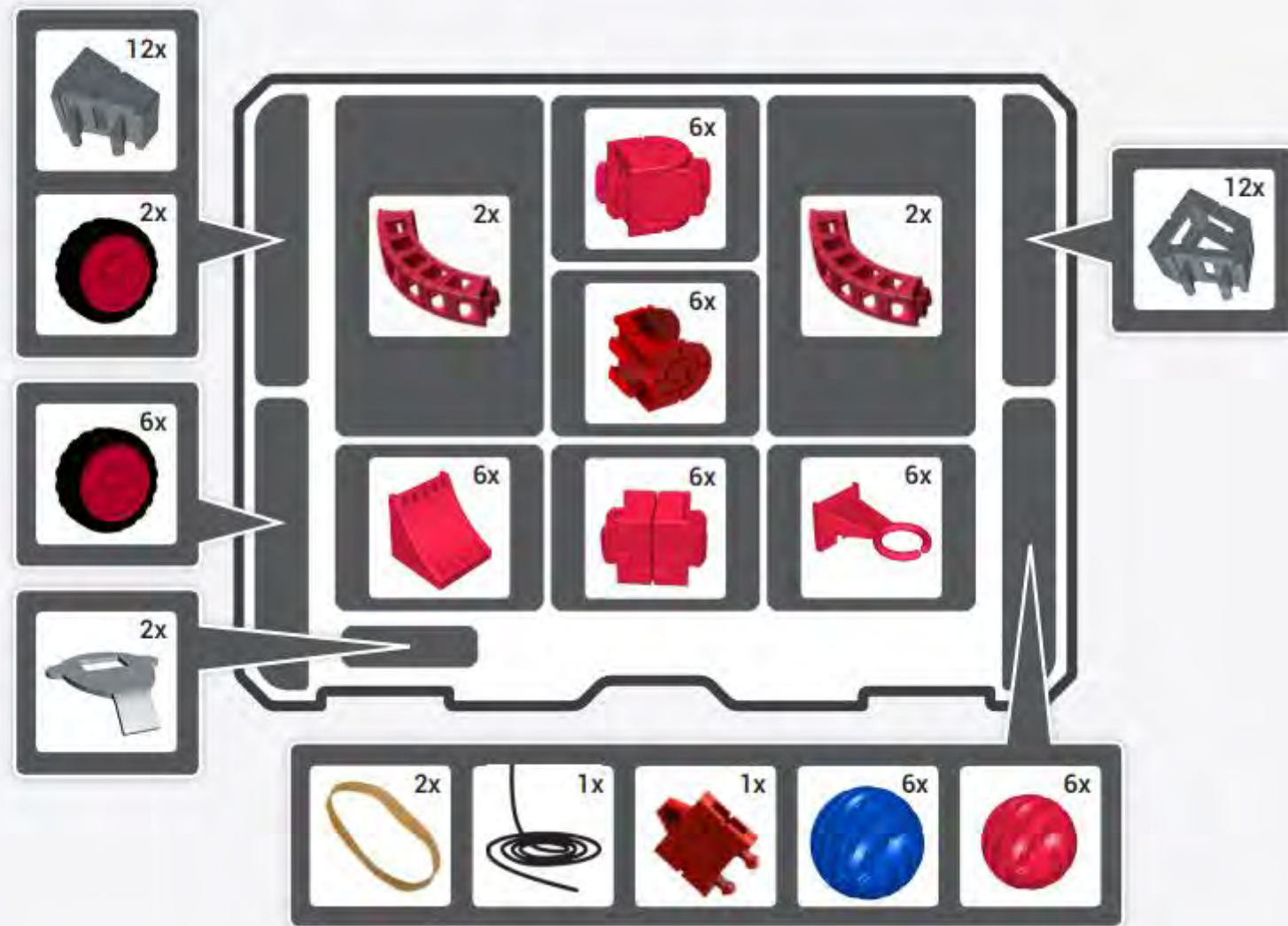
*Be prepared to  
demonstrate and  
explain your machine  
to your classmates.*

Remember that this is  
a process. Your initial idea  
may need to be modified  
or improved multiple times.



**Clean Up**

**BOTTOM OF  
MODULE**



REMOVABLE  
BINS

