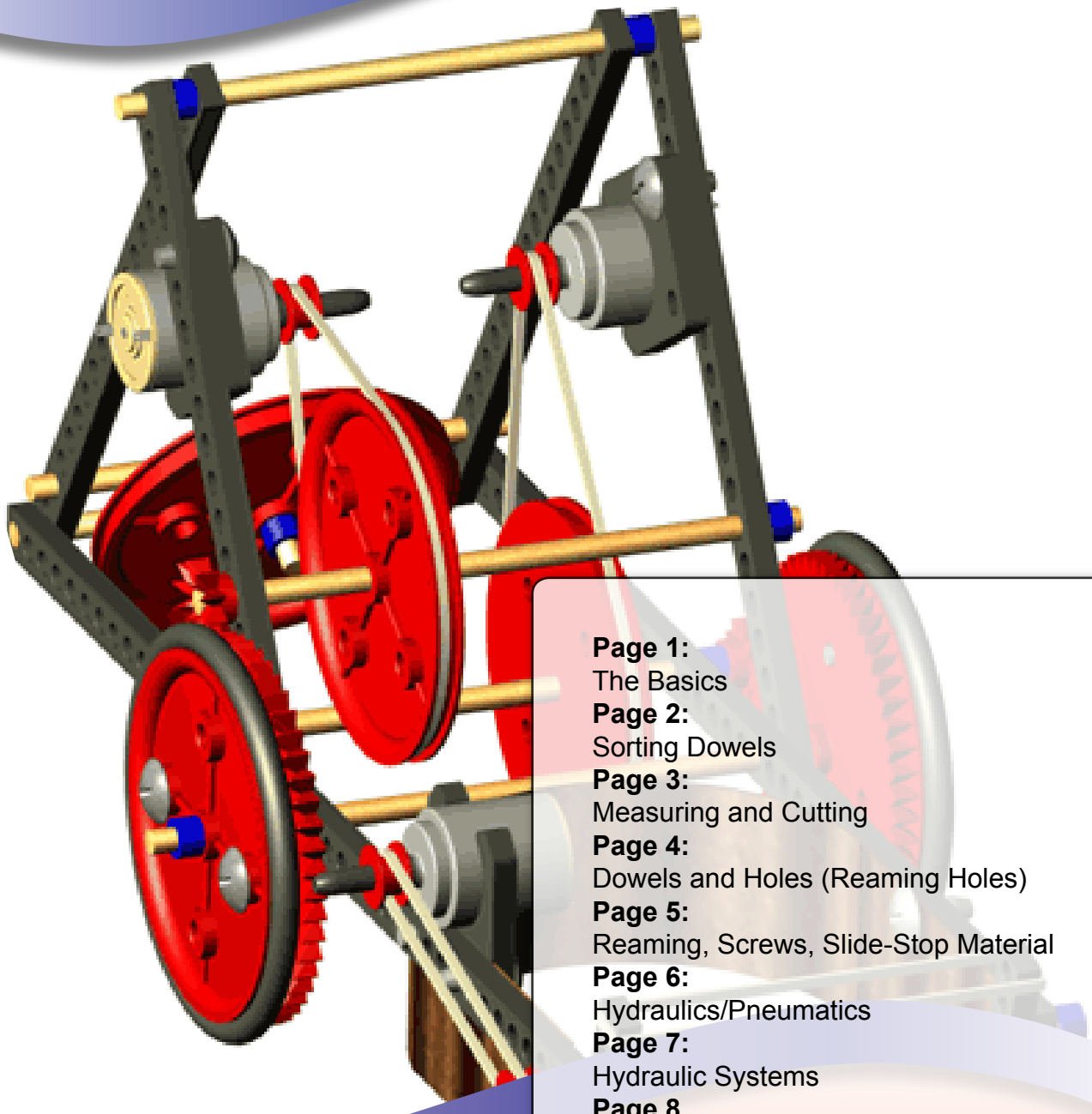
Easy Engineering™ Guide

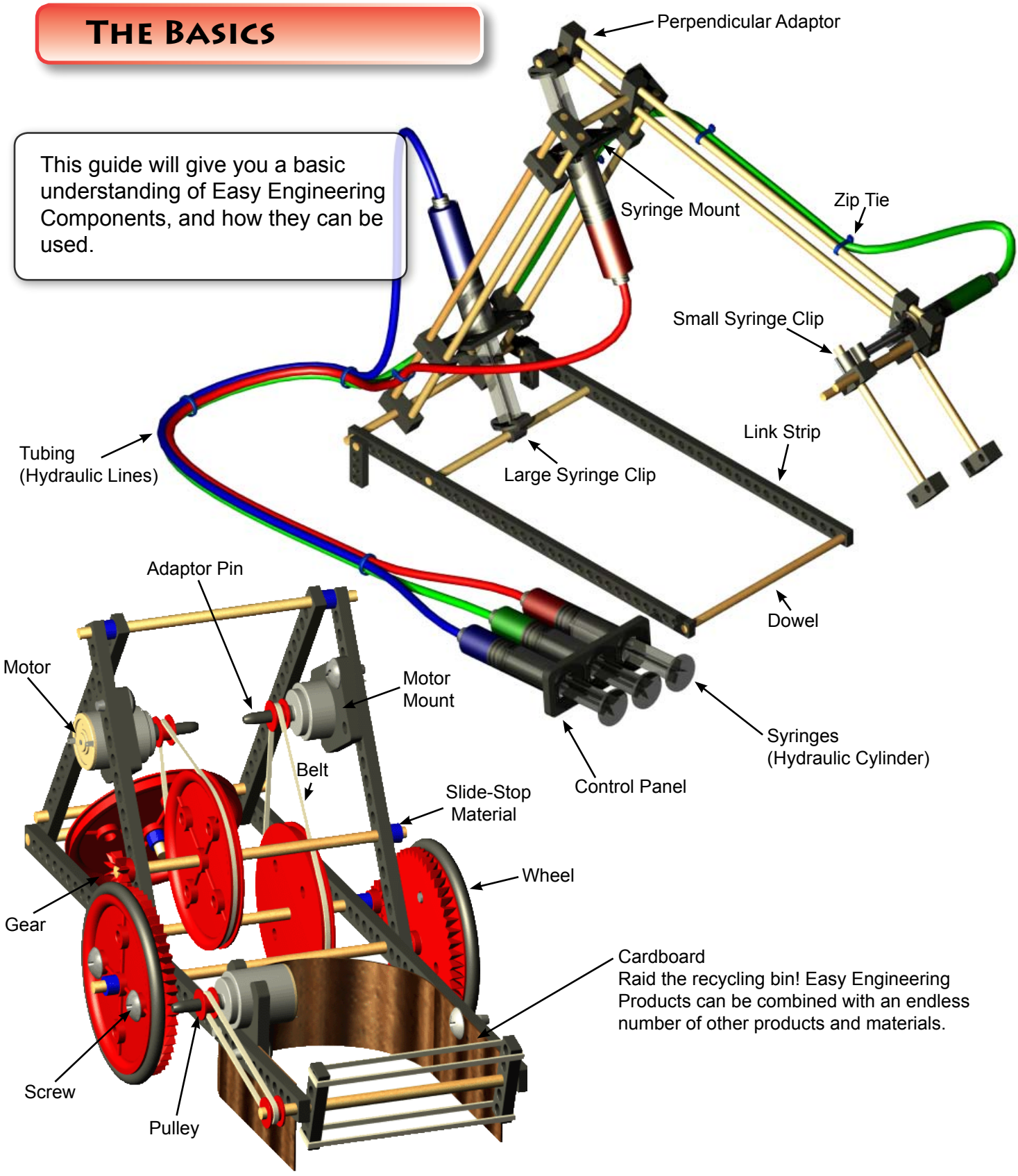
TeacherGeek.com™



Unleash Your Creativity!

THE BASICS

This guide will give you a basic understanding of Easy Engineering Components, and how they can be used.



WHY EASY ENGINEERING?

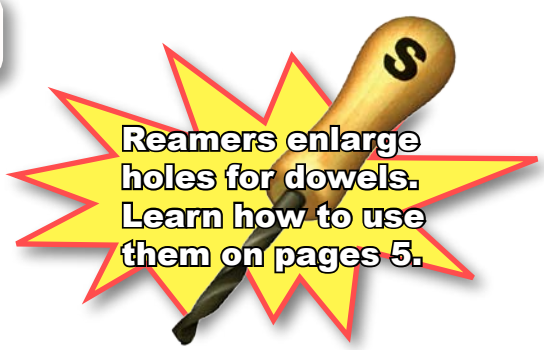
Because, in design and engineering, there is never one right answer…
TeacherGeek Easy Engineering™ Series products are designed to encourage innovation and alternative designs. We encourage you to use the Easy Engineering™ Components to create your own brilliant solutions.

Because, your first idea is rarely your best…
TeacherGeek Easy Engineering™ Series products are designed to be redesigned; they allow you to quickly change and evolve your designs.

Because, possibilities are endless…
TeacherGeek Easy Engineering™ Components can be easily combined with other materials and products (Raid the recycling bin, wood, metal, broken toys, etc.).

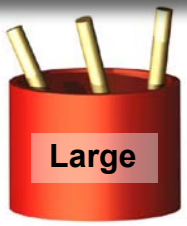
SORTING DOWELS

Dowels vary in diameter because they are a natural material. We have provided you with extra dowels to make up for dowels which may be too large or too small to use.



HOW CAN YOU USE SMALL AND LARGE DOWELS?

Small dowels can be used with a little hot-glue or in places where you don't care about the fit.



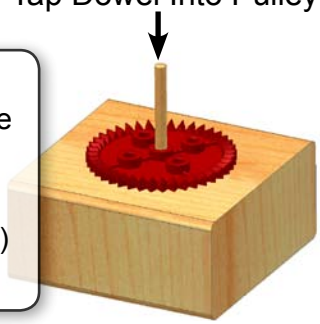
Large dowels can be used for everything other than loose fits. You will need to use a reamer to enlarge a hole to fit a large dowel.

TIP: GETTING DOWELS INTO HOLES

Cut a square section of a 2x4 stud (lumber) . Drill a 1/2" (~13mm) hole in the middle of the section.

Place components on the block so that their hole is over the hole in the block.

Dowels can then be easily tapped with a (hammer or block) into the component.



Measuring

Length (mm)	# of Holes Past
7.5	1
15	2
22.5	3
30	4
37.5	5
45	6
52.5	7
60	8
67.5	9
75	10
82.5	11
90	12
97.5	13
105	14
112.5	15
120	16
127.5	17
135	18
142.5	19
150	20
157.5	21
165	22
172.5	23
180	24
187.5	25
195	26
202.5	27
210	28
217.5	29
225	30
232.5	31
240	32
247.5	33
255	34
262.5	35
270	36
277.5	37
285	38
292.5	39
300	40

*Not to Scale

Metric dimensions can be calculated by counting Link-Strip holes.

Metric

Download and print out your own Easy Engineering Ruler: http://www.teachergeek.org/ruler.pdf

It will make measuring link strips, dowels and wood strips incredibly easy.

Cutting

Easy Cutters are the best way to cut Easy Engineering Components

Jig saws, band saws and miter boxes can also be used to cut Easy Engineering™ Components

Cut Link-Strips between holes.

Wear safety glasses when using easy engineering tools.

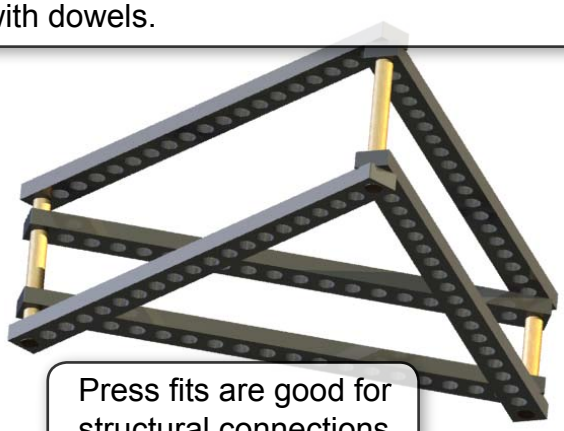
Keep fingers away from the easy cutter blade.

Wood Strips

Like working with wood? TeacherGeek Wood Strips are designed to be used with Easy Engineering™ Components. They make bridge building a snap.

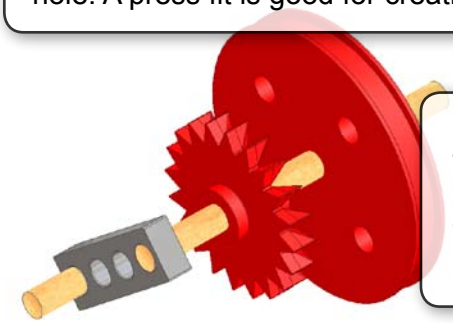
Dowels and Holes

Easy Engineering Components come with holes that are the perfect size for a press fit with dowels.



Press fits are good for structural connections.

A press fit is one where the dowel is fixed and not able to rotate or slide once it's in the component hole. A press fit is good for creating rigid structures.



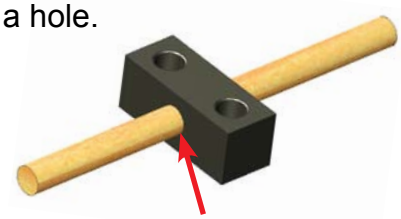
Press fits are good for gears, pulleys and levers that turn together on the same dowel (axle).

Reaming Holes

Learn how to use a reamer on page 5

Slide Fit

A Slide Reamer makes it easier to push or pull a dowel through a hole.



This hole in the perpendicular adaptor was reamed with the Slide Reamer to make it easier for it to slide to the middle of the dowel.

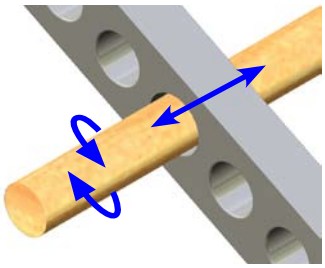
Tip: A Better Slide Fit

After reaming perpendicular adaptors with the slide reamer, slit them with the easy cutter.

Loose Fit

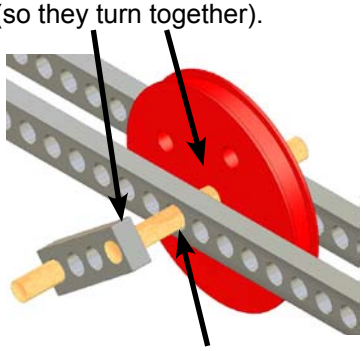
The Loose Reamer creates a hole that dowels can freely rotate in and slide through.

A loose fit is typically used to support axles, wheels and pulleys. It is also used for pivot points.

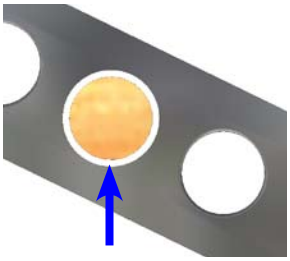


The dowel moves freely in the loose fitting hole.

The crank and pulley are press fit onto the same dowel (so they turn together).

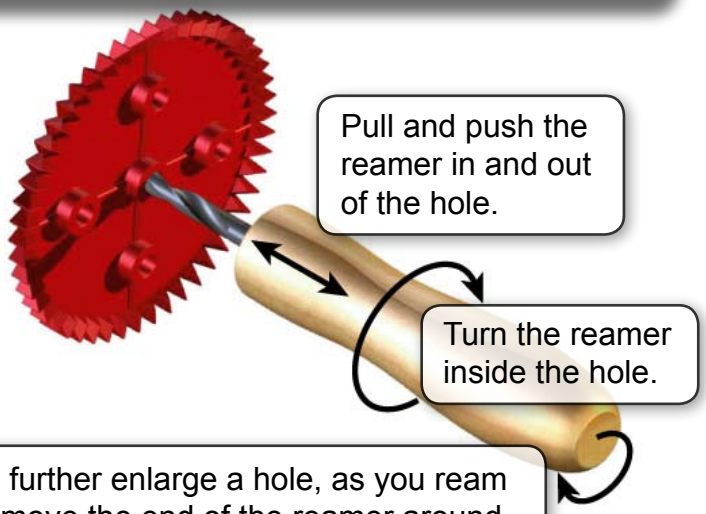


The link strip holes that the dowel needs to rotate in were reamed with the Loose Reamer.



The Loose Reamer creates a hole that is larger than the dowel.

How to Ream Holes



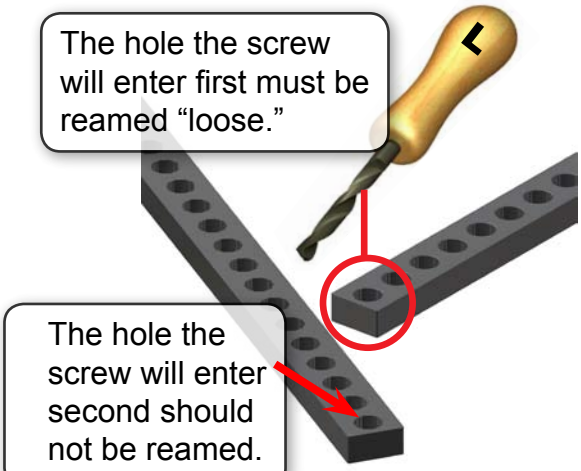
Pull and push the reamer in and out of the hole.

Turn the reamer inside the hole.

To further enlarge a hole, as you ream it, move the end of the reamer around so it is not in line with the hole.

Screws

Screws can be used to attach two components together.

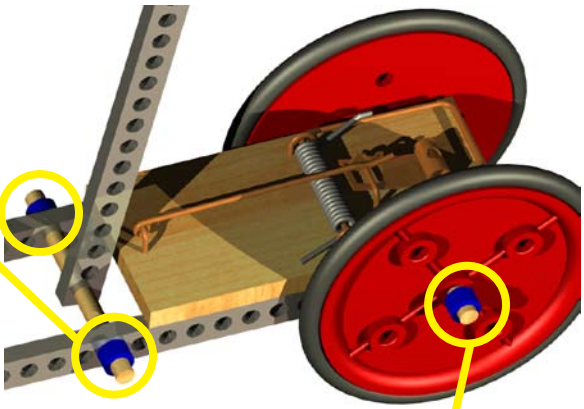


The hole the screw will enter first must be reamed "loose."

The hole the screw will enter second should not be reamed.

Slide-Stop Material

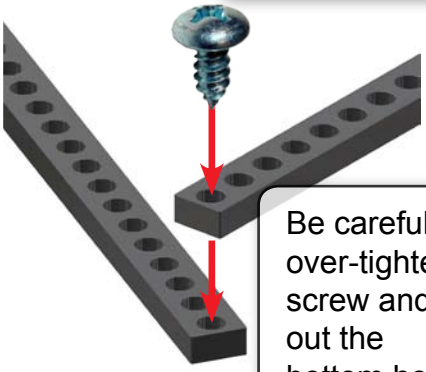
Slide-Stop Material comes in long lengths. It must be cut into 6mm (~1/4") sections before it can be used.



Slide-Stop Material keeps dowels from sliding back and forth in "loose" reamed holes.

Slide-Stop Material keeps components with "loose" reamed holes from sliding back and forth on dowels.

Turn the screw into both components.



Be careful not to over-tighten the screw and strip out the bottom hole.

Tighten the screw completely to keep components from rotating.

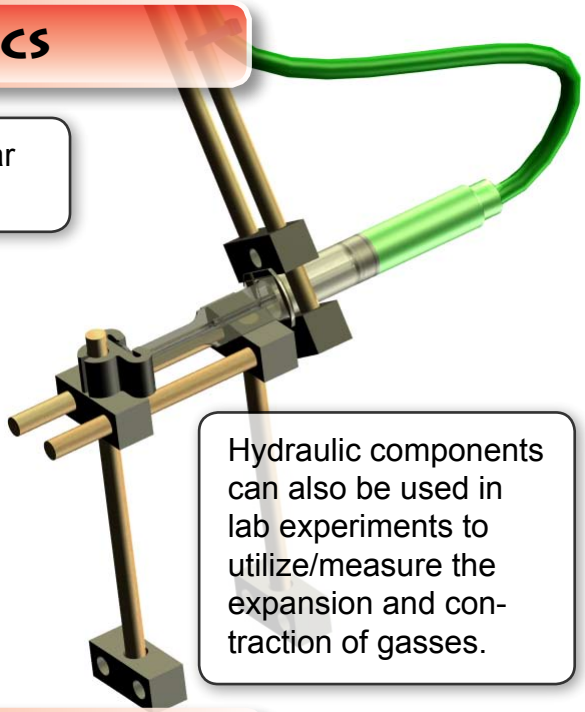
OR

Leave the screw a ¼ turn from tight to allow components to rotate/pivot.

HYDRAULICS / PNEUMATICS

Easy Engineering Syringe Clips and Mounts turn regular syringes into incredibly versatile hydraulic cylinders.

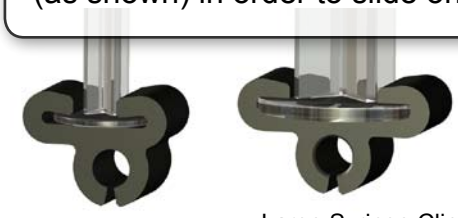
Syringe Clips and Syringe Mounts have circles on one side (as shown). Insert dowels and syringes into these components from the side with circles.



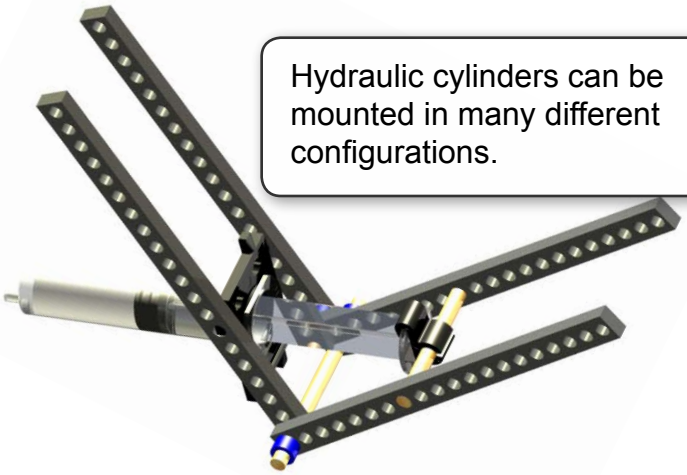
Hydraulic components can also be used in lab experiments to utilize/measure the expansion and contraction of gasses.

ASSEMBLING HYDRAULIC CYLINDERS

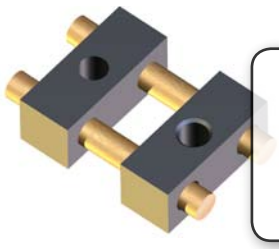
Slide the corresponding Syringe Clips onto the end of each syringe plunger. Syringe Clips must be square with the syringe plunger shaft (as shown) in order to slide on.



Small Syringe Clip Large Syringe Clip



Hydraulic cylinders can be mounted in many different configurations.



A small syringe mount can be made with 2 dowels and 2 perpendicular adaptors

TIP: FILLING HYDRAULIC SYSTEMS

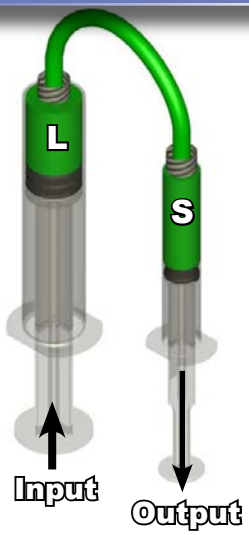
The easiest way to fill your hydraulic system is in a tub, before it is built into your mechanism. *Be careful not to get dowels wet. They will expand and lose their proper fit into holes.

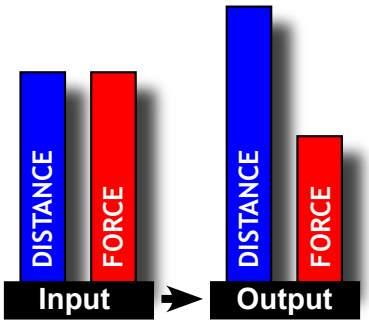
Download a tutorial on filling your hydraulic system:
http://www.teachergeek.org/hydraulics.pdf

HYDRAULIC SYSTEMS

Hydraulic systems are used to transfer energy to perform work. In this case, water is pressurized using a control syringe which causes movement in another syringe. Hydraulic mechanical advantage occurs when two different sized syringes are used.

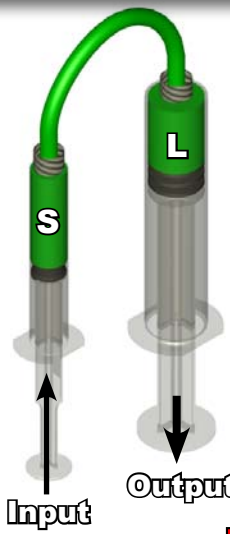
LARGE TO SMALL

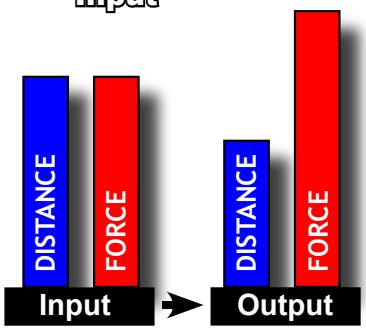




Output force will be less than the input force but the output plunger will move farther than the input plunger.

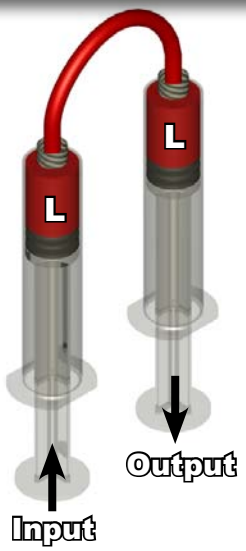
SMALL TO LARGE

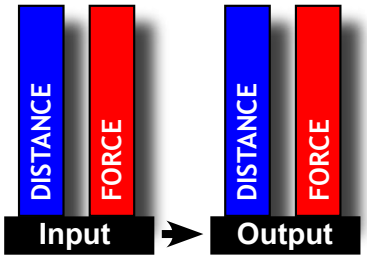




Output force will be greater than the input force but the output plunger will move less than the input plunger.

SAME SIZE



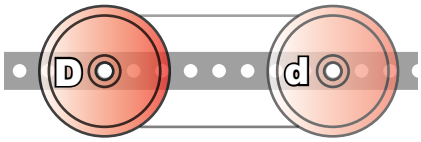


Output force will be equal to the input force and the output plunger will move the same distance as the input plunger.

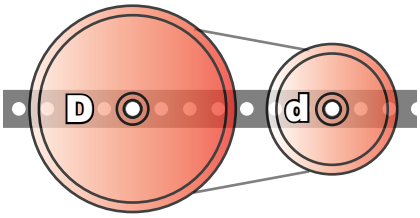
Gear and Belt Systems

Belt and Pulley Systems

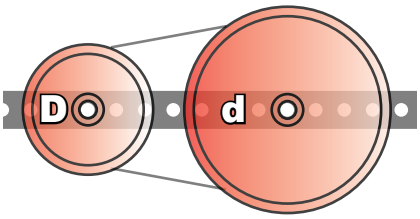
Belt and pulley systems are used to transmit rotational force (torque) between two or more points. The diagrams below show three different belt and pulley configurations.



The driven pulley (d) will have the same rotational speed and torque as the driver pulley (D).



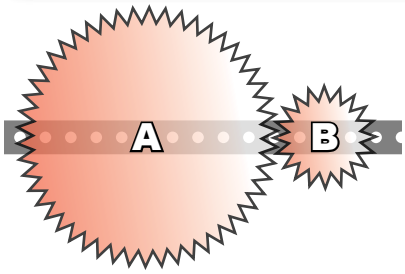
The driven pulley (d) will have a greater rotational speed and lower torque than the driver pulley (D).



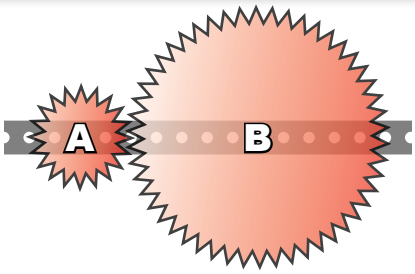
The driven pulley (d) will have a lower rotational speed but greater torque than the driver pulley (D).

Gear Systems

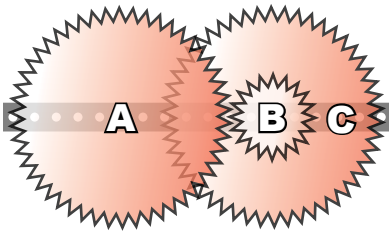
Gears can be used to change the direction, speed and the torque from input to output. The diagrams below show three possible gear train configurations.



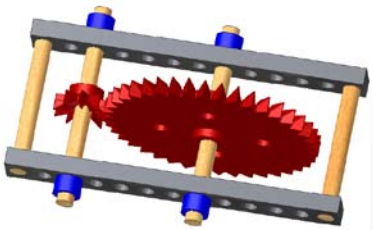
Gear B will rotate faster than Gear A. Gear A will have a higher torque than Gear B.



Gear B will rotate slower than Gear A. Gear B will have a higher torque than Gear A.



Gear B will rotate faster than Gear A. Gear C is fastened to the same axle as Gear B and will rotate at the same rate as Gear B.

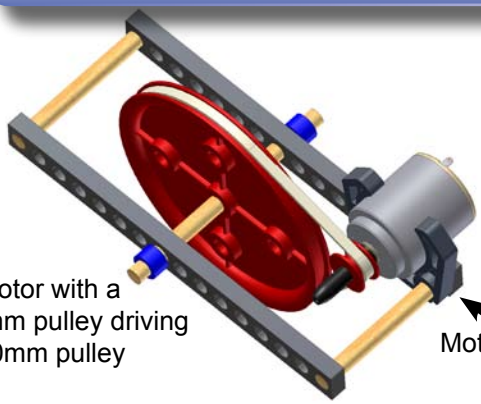


Tip: Support Your Gears and Pulleys

When a gear or pulley is on a dowel, that dowel should be supported on both ends. This example shows gears press fit onto dowels. Those dowels go into “loose” reamed holes in link strips (so they can rotate).

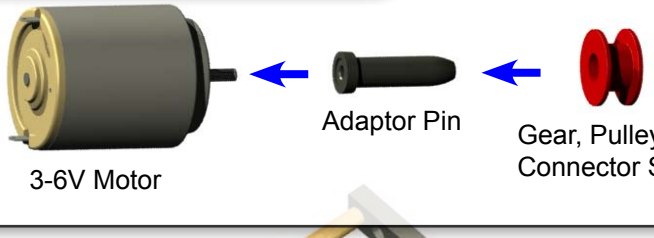
USING ELECTRIC MOTORS

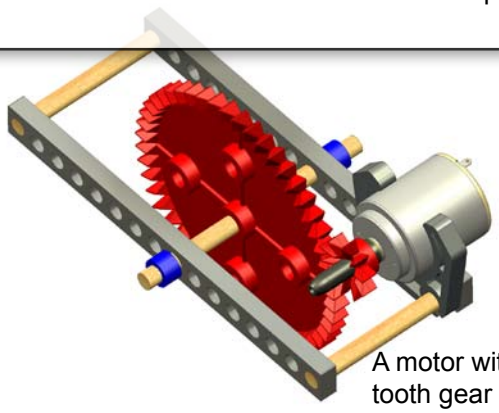
PUTTING IT TOGETHER



A motor with a 10mm pulley driving a 70mm pulley

Motor Mount





A motor with a 10 tooth gear driving a 50 tooth gear

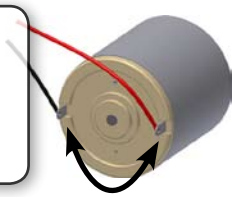
TIP FOR LOOSE PINS

If an adaptor pin will not stay on a motor shaft, try slightly crimping it with a pair of pliers.

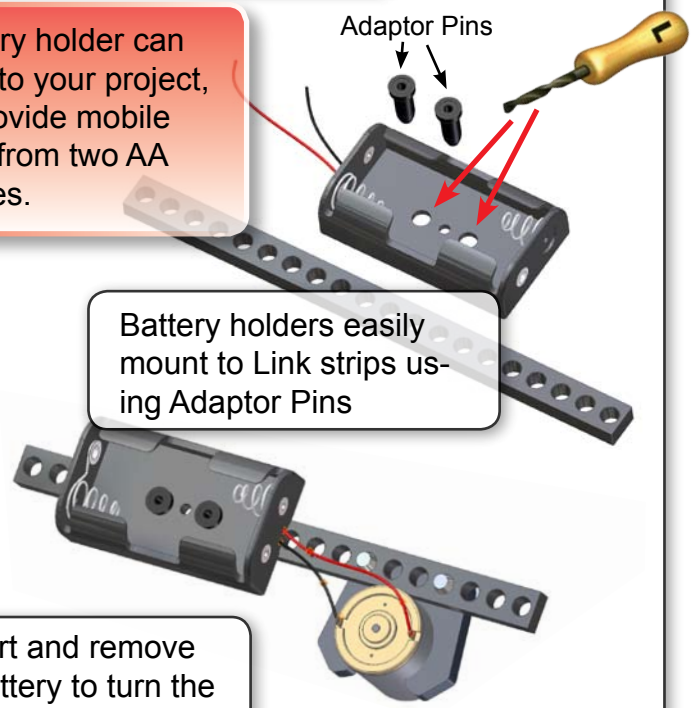
POWERING A SINGLE MOTOR

The TeacherGeek™ Single Motor Power Supply provides an endless supply of power for project motors.

Reverse the direction of a motor by swapping the wires going to the motor leads.

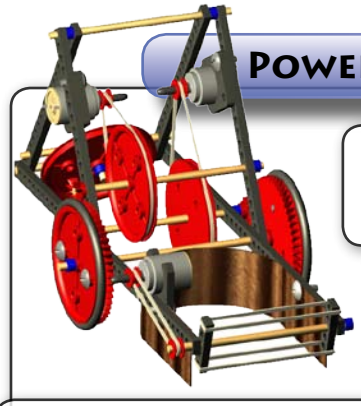


A battery holder can mount to your project, and provide mobile power from two AA batteries.



Battery holders easily mount to Link strips using Adaptor Pins

Insert and remove a battery to turn the motor on and off.



Powering Multiple Motors

The TeacherGeek Total Controller 2.0 is a rugged, fun and powerful way to control up to 4 motors.

The Total Controller Can:
Independently control 4 motors (forwards and reverse, speed, latch on)
Inverse output polarity to fix backwards wired motors
Output a total of 4 amps of power for project motors