

SIMPLE MACHINES

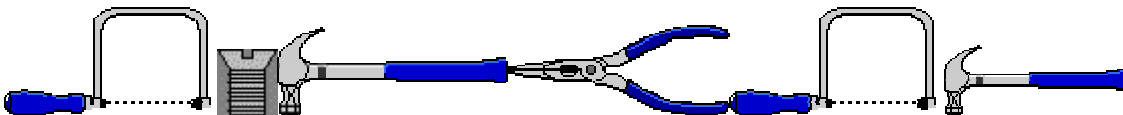
Simple machines are "simple" because most have only one moving part. Some are so simple that they don't have any moving parts!

When you put simple machines together, you get a complex machine, like a lawn mower, or a car.

Remember, a machine is any device that makes work easier. In science, "work" means making something move.

It's important to know that when you use a simple machine, you're actually doing the same amount of work — it just seems easier.

A simple machine reduces the amount of effort needed to move something, but you wind up moving it a greater distance to accomplish the same amount of work. So **remember**, there's a **trade-off** of energy when using simple machines.



Background Information: Simple Machines

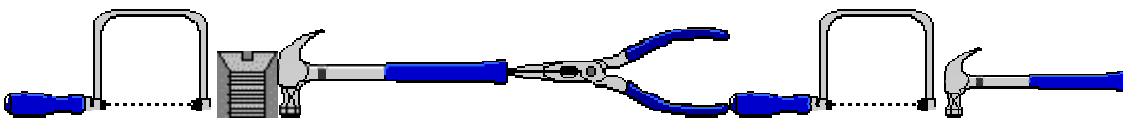
What is a simple machine? Well, the purpose of a machine, whether simple or complex, is to accomplish work more easily by somehow transforming energy or motion.

To put it another way, machines help you get a job done with less effort. Simple machines:

1. Help us do *work more easily*.
2. Can make *the force* you put into a machine *greater*.
3. Can *change the direction* of the force you put in.
4. Can *increase the speed* of the force.

All simple machines appear to give you "free energy," because in using them your effort is reduced. The truth is that in using a simple machine you actually do the same amount of work, it just seems easier.

Remember, there's always a "**trade-off**" of effort with simple machines.



INCLINED PLANE

An inclined plane is a simple machine with no moving parts.

An inclined plane is a flat surface with one end higher than the other end.

An inclined plane is a straight slanted surface.

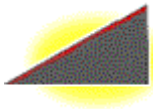
An inclined plane lets us raise heavy things without having to lift them straight up.



The Inclined Plane:

The inclined plane is the simplest of simple machines because to make it work, nothing moves. YOU move!

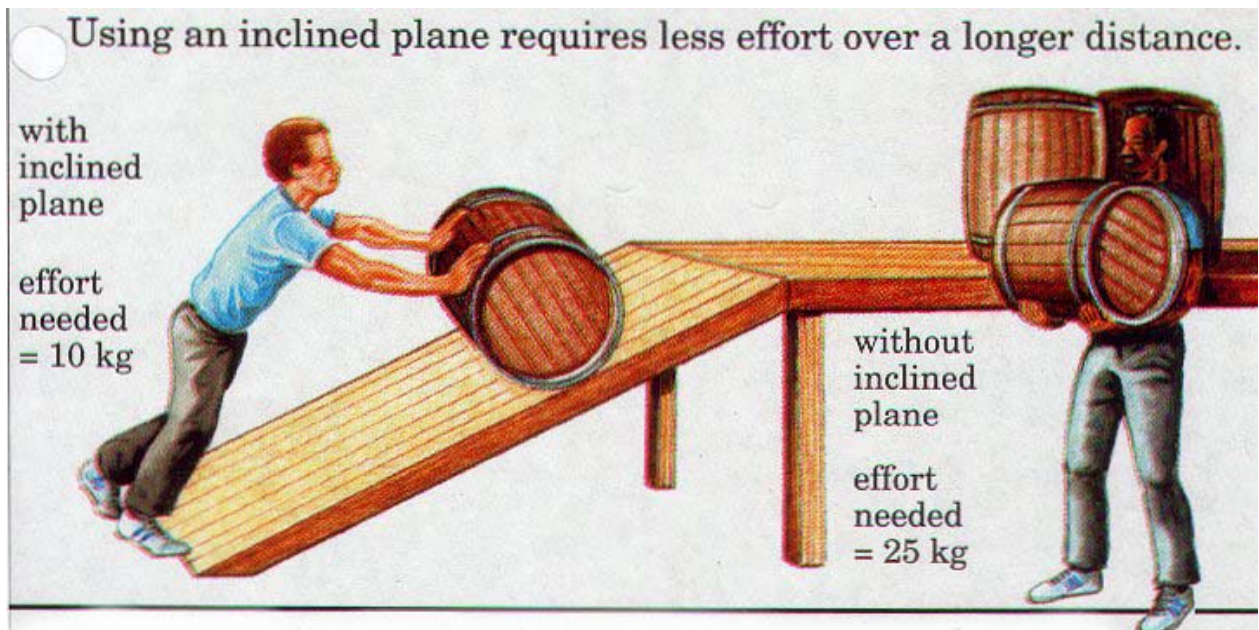
Some examples are the driveway leading to your school, a staircase, or a ramp.



Lifting a box is much easier if you slide the box up an inclined plane.

Remember the trade-off:

The way an inclined plane works is that to save effort, you must move things a greater distance. If you compare the length of a ladder to that of a staircase going to the same height, you'll find the ladder is much shorter. But it takes more effort to climb a ladder than to walk up the stairs.



Examples of Inclined Planes



Can you name all the inclined planes?

roller coaster	dump truck	unloading ramp	hill
parking ramp	car ramps	ladders	stairs

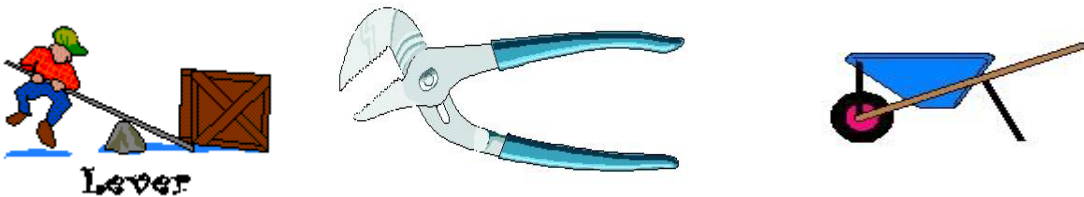
LEVERS

A lever is a simple machine made with a bar or rod.

A lever is a stiff rod that moves or rotates around a pivot point called a fulcrum. By changing the position of the fulcrum, you can gain extra power with less effort.

A lever changes your effort into more power; you can use a lever to lift objects.

A lever helps to change the motion of an object; you can use a lever to move objects.



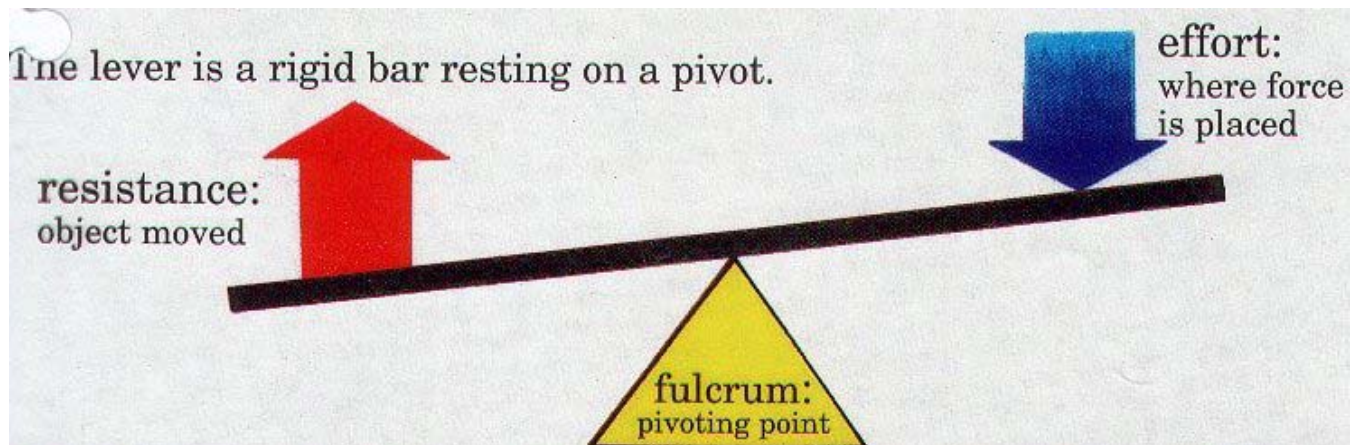
The Lever

Levers are probably the most common simple machine because just about anything that has a handle on it has a lever attached.



Lifting a nail out of a board is much easier if you use a hammer (a lever).

If you want to lift a heavy person on the opposite side of a see-saw, and you put the fulcrum in the middle, you won't have a chance. But if you slide the fulcrum closer to the heavy person, it will be easier to lift.



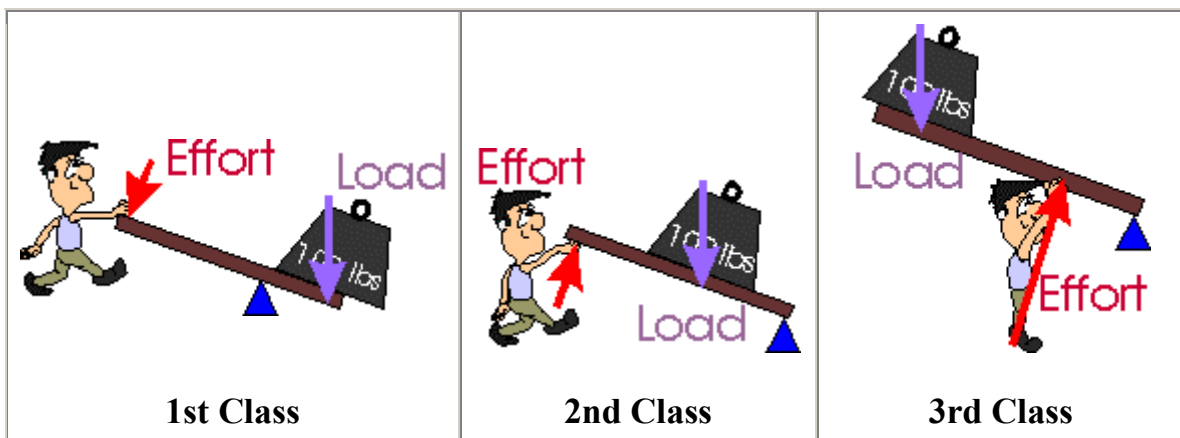
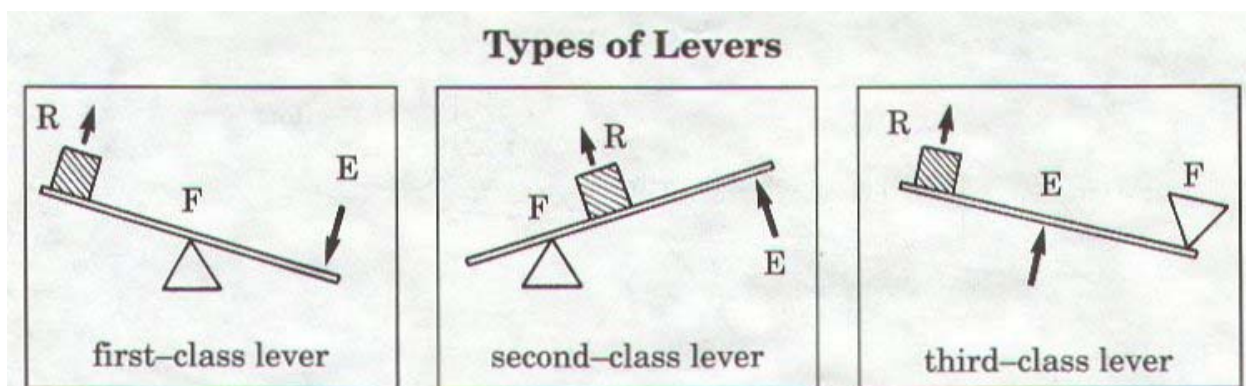
Remember the trade-off!

To get this helping hand, your side of the see-saw is much longer (and higher off the ground), so you have to move it a much greater distance to get the lift.

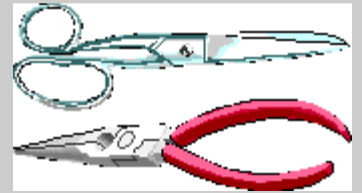
More Levers:

The point on which the lever moves is called the fulcrum. By changing the position of the fulcrum, you can gain extra power with less effort.

Some examples are a see-saw, teeter totter, oar, rake, hoe, bat, pick, fork, screw driver, snow shovel, hammer, bottle opener, light switch, pancake turner, stapler, crowbar, scissors, car jack.



Examples of Levers



Can you name all the levers?

scissors	Hoe	crowbar	bat	clippers	stapler
fork	screwdriver	spatula	teeter-totter	rake	can opener

PULLEY

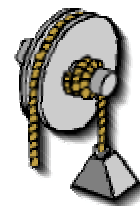
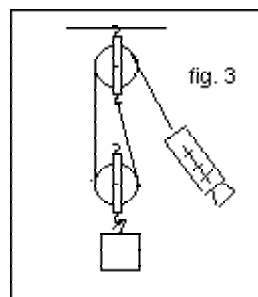
A pulley is a simple machine with 2 parts:

- (1) a wheel that turns on an axle
- (2) a rope that runs over the wheel

The wheel turns around an axle (fulcrum), and the rope or chain moves around the wheel.

A pulley works in two ways. It can change the direction of a force, or it can change the amount of force.

A pulley makes heavy objects easier to lift, or pull.



The Pulley

A pulley makes work seem easier because it changes the direction of motion to work with gravity.



It is easy to lift things up using a pulley.

Let's say you have to lift a heavy bale of hay up to the second floor of a barn. You could tie a rope to the bale of hay, stand on the second floor, and pull it straight up. The action of pulling down feels easier because you're working with the force of gravity.

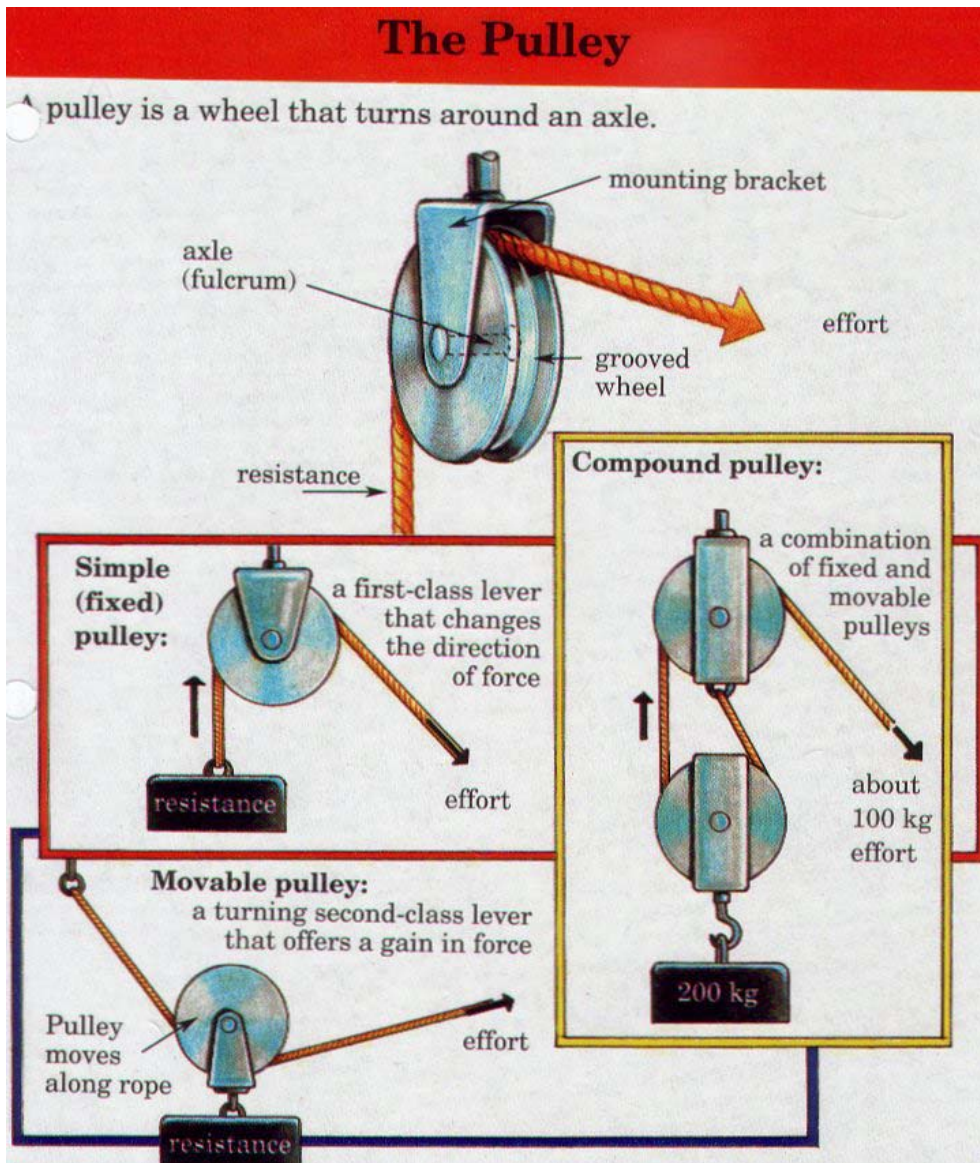
A pulley really saves effort when you have more than one pulley. By looping a rope around two, or three pulleys, you can really cut down on the effort needed to lift something.

Remember the Trade-off!

As you increase the number of pulleys, you also increase the distance you have to pull the rope. If you use two pulleys, it takes half the effort to lift something, but you have to pull the rope twice as far. Three pulleys will result in one-third the effort — but the distance you have to pull the rope is tripled!

Examples of pulleys: fan belt, elevators, steam shovels, flagpole, clothesline pulleys, derricks, cranes, lifts, pulleys,

gears, old-fashioned well, block and tackle, winch, wire stretchers, venetian-blinds, sail-hoist, curtain rod-line, mini-blinds, zip lines.



Examples of Pulleys



Can you name all the pulleys?

old wooden pulley	oil derrick	winch
rock climber pulleys	clothesline pulley	wishing well
steam shovel	flagpole pulley	window blinds

SCREWS

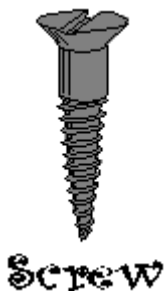
A screw is a simple machine.

A screw is an inclined plane that wraps around a shaft.

A screw helps to change a turning motion into a forward or backward motion.

A screw can help to lift objects, hold things together, or push into an object.

Examples of screws: different sizes of screws for metal or wood, drill, meat grinder, bolts, nuts, cork screw, swivel chair, jar lid, etc.



The Screw

A screw is like another simple machine: a wedge. If you look at the end of a screw, you will see a sharp point; that's the wedge!

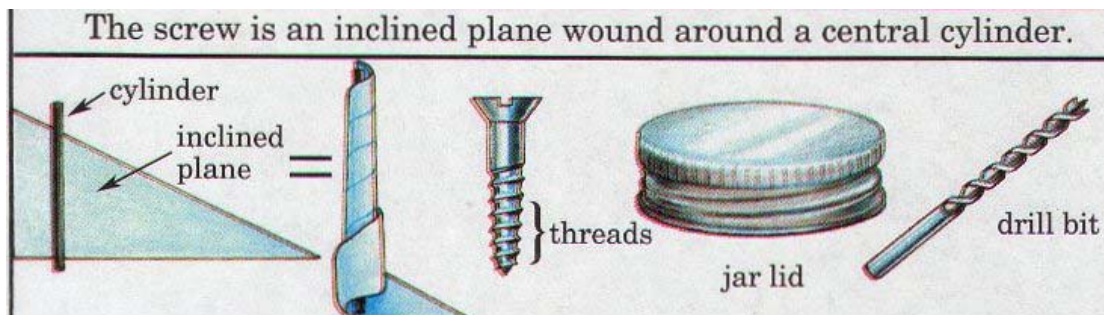


It's easy to put things together, lift objects, or push into something else if we use a screw

A screw is like the ramp — and the width of the thread is like the slope of an inclined plane. The threads on a screw are the ramp; the more far apart the thread of a screw, the harder it is to turn it.

Remember the Trade-off!

If you put in a screw with really narrow threads, you have to turn it a really long time to get it to go anywhere. Just like in a ramp, the easier the effort, the longer the distance you have to move something!



Examples of Screws



Can you name all of the screws?

WEDGES

A wedge is made of two inclined planes put together.

A wedge is an inclined plane that moves.

Wedges can be forced between two things to hold them together.

Examples of wedges include: axe, log splitter, chisel, knife, nails, doorstop, plows, tip of screwdriver, scissors, needles, pins, paper cutter, crowbar, chisel, prying tools, can opener, door wedge, etc.



The Wedge

A wedge is an inclined plane turned on its side. But instead of helping you move things to a higher level, a wedge helps you push things apart.

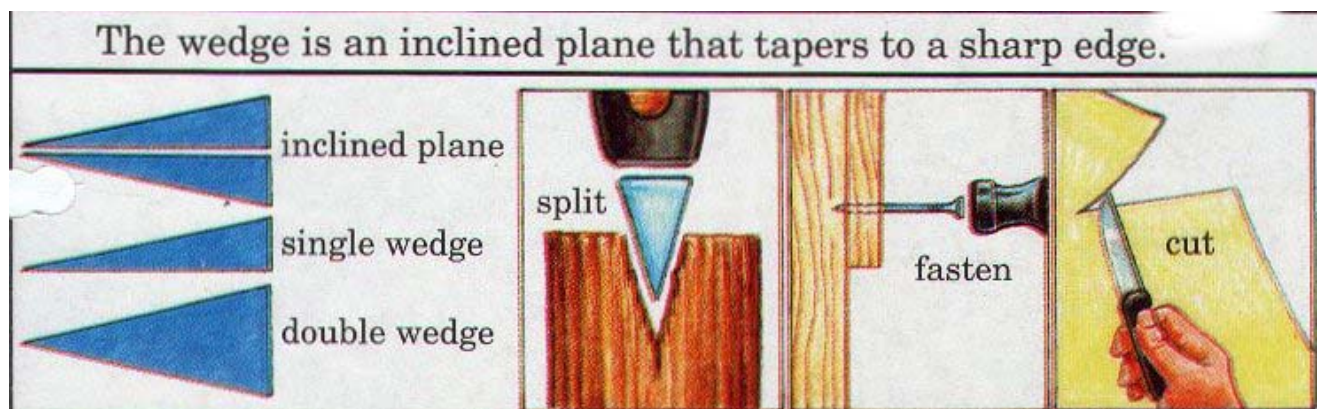


It is easier to push things apart or hold 2 things together if you use a wedge.

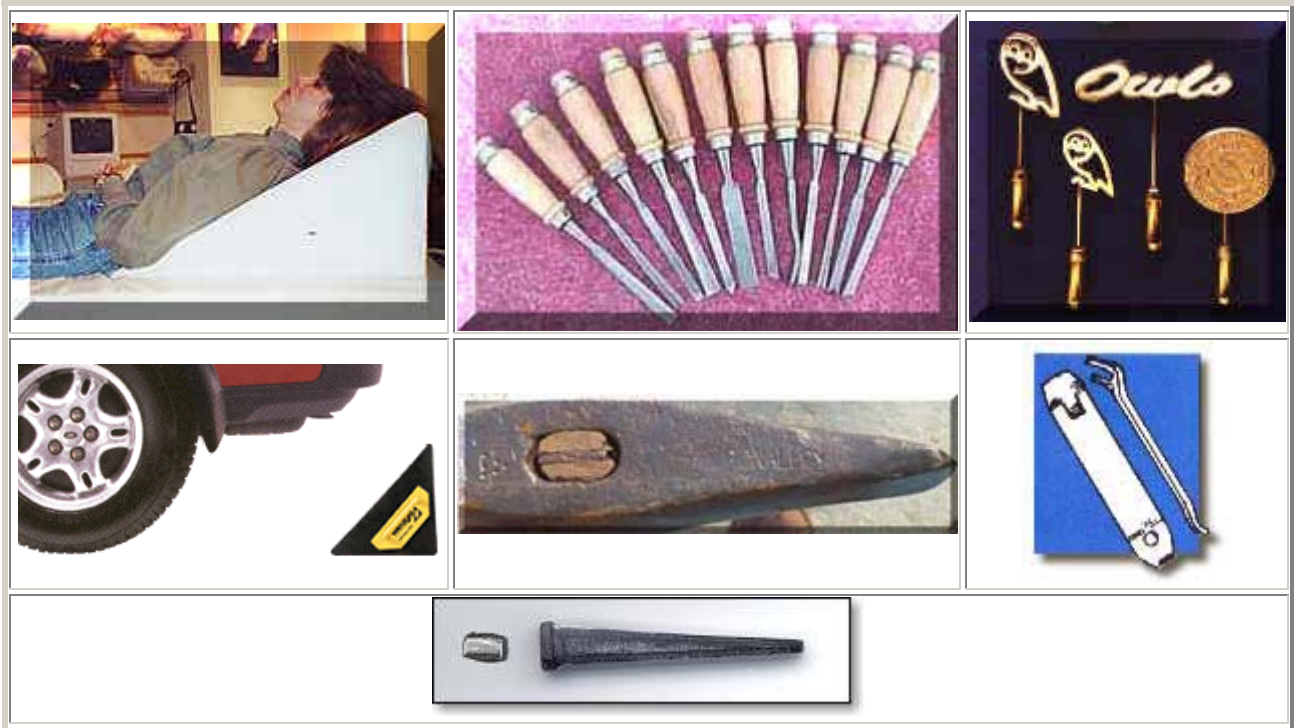
The blades of a knife or a shovel are both wedges. A wedge can also be round, like the tip of a nail, or the ends of your fork. The wedge works just like a ramp: the narrower the wedge (the sharper the point of a wedge), the easier it is to drive it in and push things apart.

Remember the Trade-off!

To split something apart really wide, you have to push the wedge a long distance.



Examples of Wedges



Can you name all the wedges?

floor nail	back wedge	pins	iron wedge
paint can opener	chisels	car tire wedge	

WHEEL AND AXLE

A wheel and axle is like a pulley; it helps you move objects a distance.

A wheel and axle is also like a lever; it helps you turn things.

In this machine a wheel is locked to a central axle so that when one is turned the other must turn.

A wheel and axle changes a small motion into a bigger motion.

A wheel and axle can help us to lift, move, or turn objects.



The Wheel and Axle

A wheel and axle is really two machines in one because you can use it in **two different ways**.

The **first way** is to roll something. Wheels help you move an object across the ground because they cut down on the resistance between what you're trying to move and what your pulling it against. Since only the very bottom of the wheel touches the ground, there is less surface area (friction) to rub.

The **second way** is to turn something, like a lever does. A door-knob is a round lever: the wheel is on the outside, and the "fulcrum" is in the middle where the axle turns. Imagine if a door-knob were replaced with a little rod. It would be much harder to open the door!

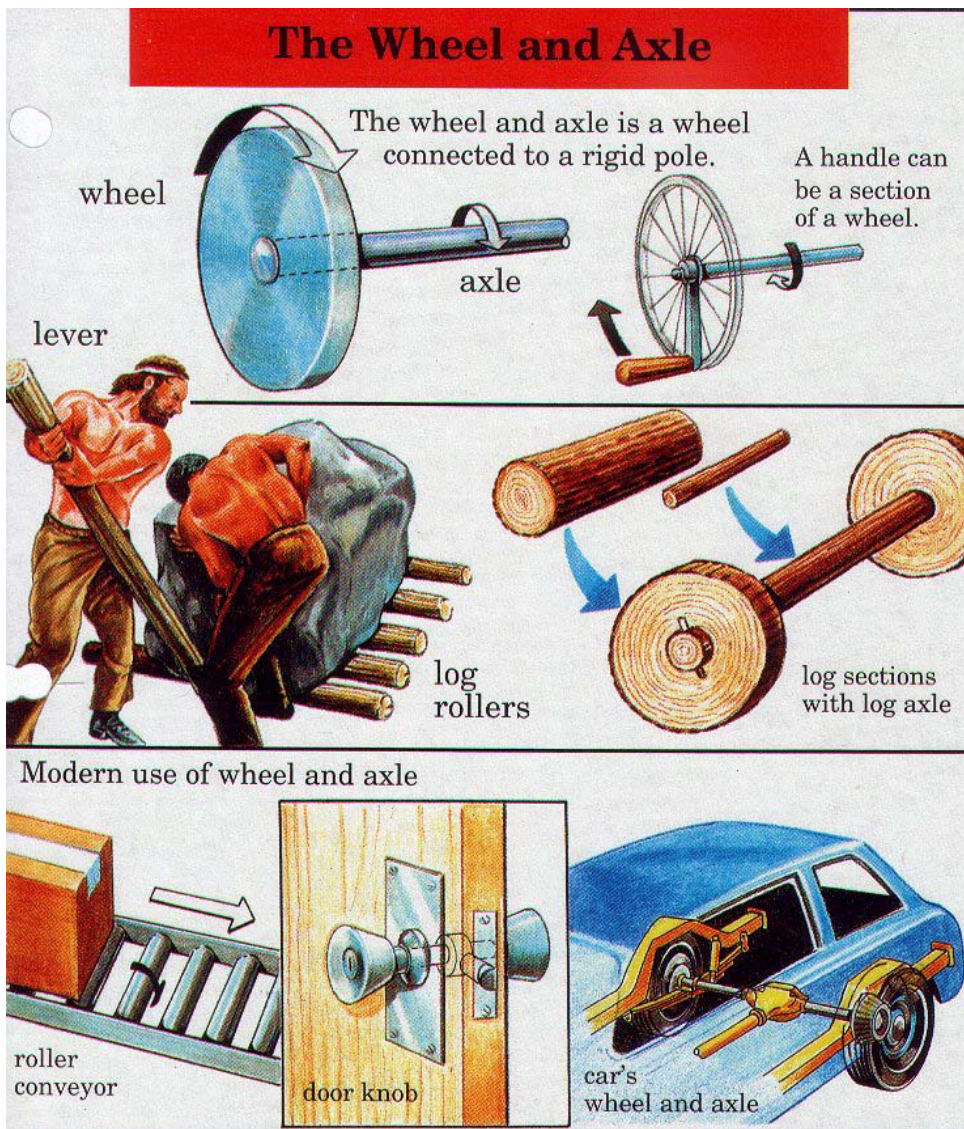


It's easier to turn, move, and lift objects using a wheel and axle.

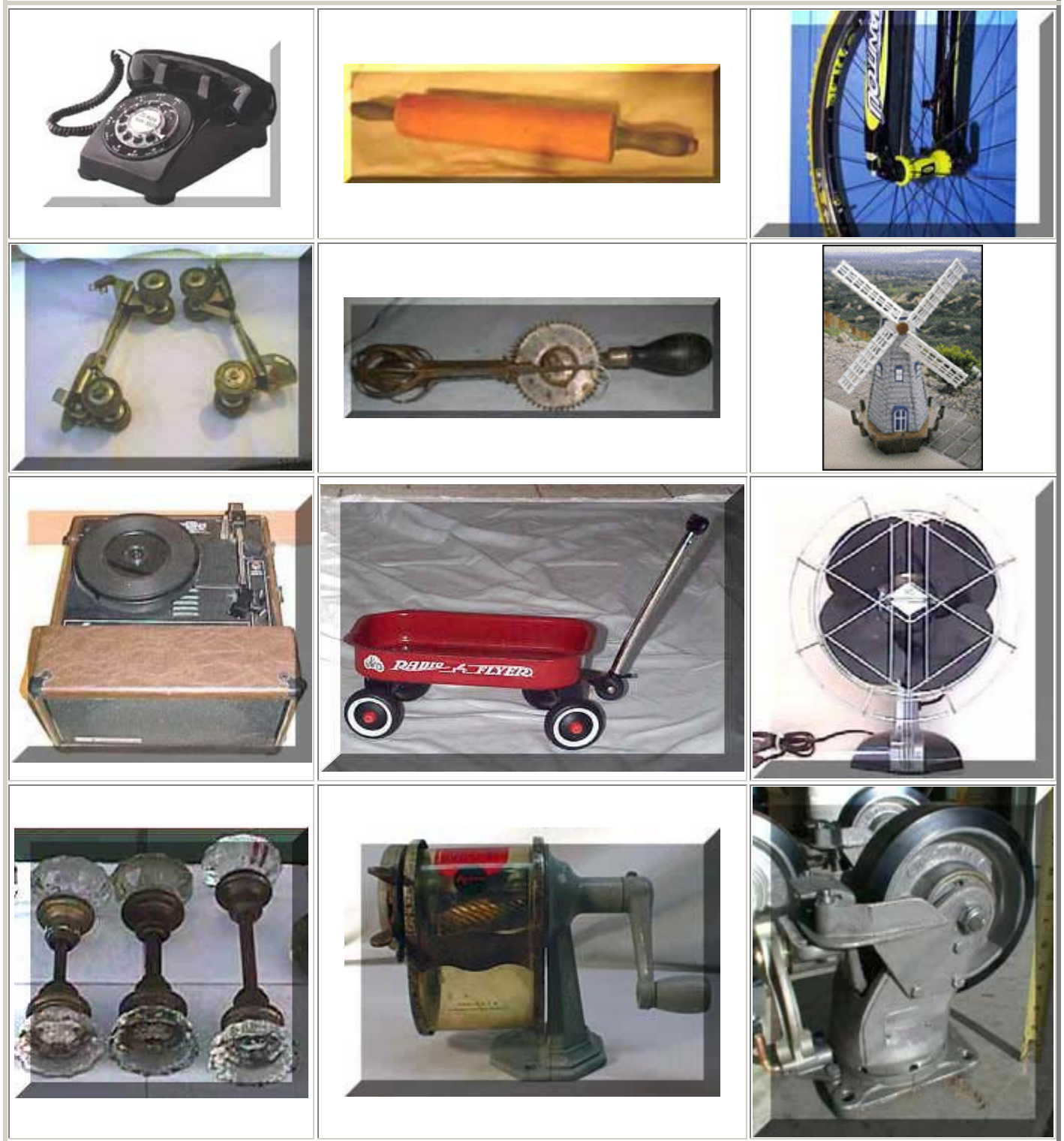
Remember the Trade-off!

The larger the wheel, the less effort you need to turn it, but you have to move the wheel a greater distance to get the same work done.

Examples of wheel and axles include roller skates, doorknobs, screwdrivers, water faucets, handle bars on a bike, airplane propellers, helicopter blades, fan blades, wheels on a car, wagon, bike, windmill, bicycle, vehicles, rolling pin, egg beater, helicopter, old-fashioned telephone dial, fishing reel, record player, tapes, pencil sharpener, bobbins, casters.



Examples of Wheel and Axles



Can you name all the wheel and axles?