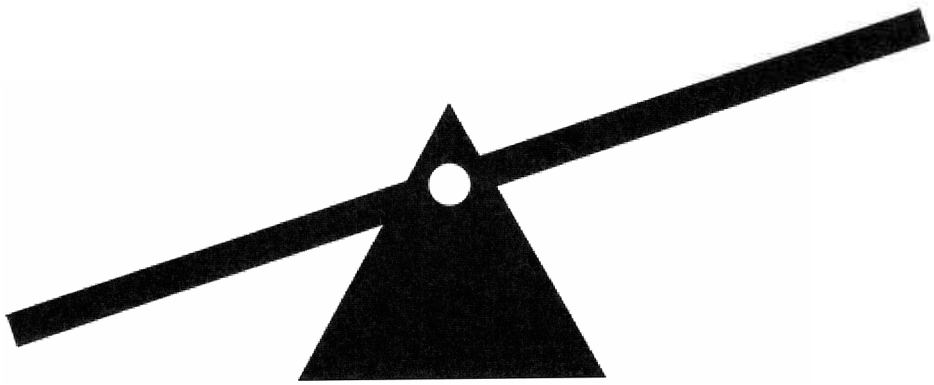
SIMPLE MACHINES



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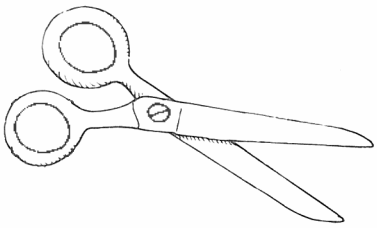
Simple Machines

A **simple machine** is one that requires only the force of a human to perform work. There are six types. From these types, the elements of all other machines are composed. Use the terms in the word box to label the illustrations. Some terms are used more than once.

lever	wheel and axle	pulley
inclined plane	wedge	screw



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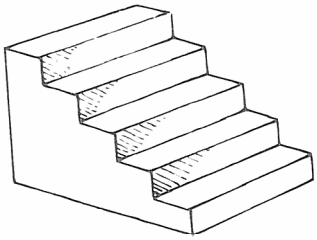

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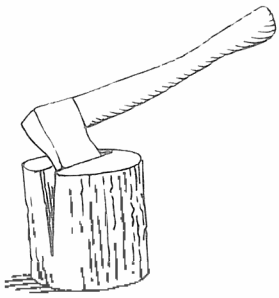

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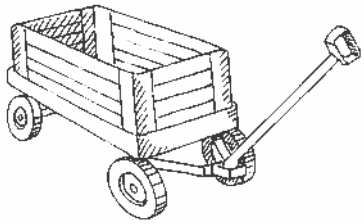

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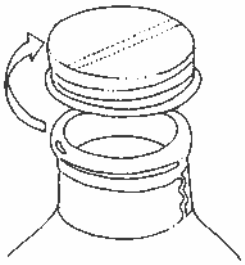

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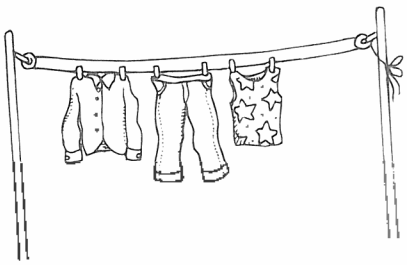

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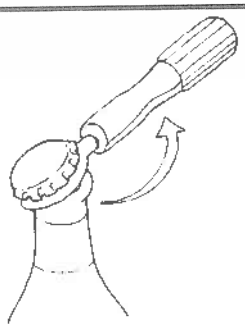

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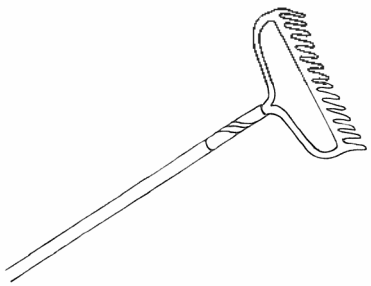

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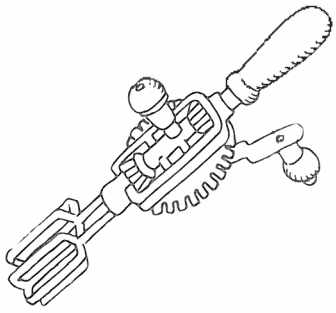

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Name _____ Date _____

Functions of Simple Machines

Simple machines are simple tools used to make work easier. Match each term in the word box to its description.

force	work	distance	lever	inclined plane
wedge	pulley	screw	gear	wheel and axle

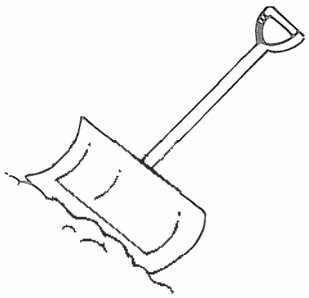
1. _____ This is the product of the force or effort needed to move a load multiplied by the distance it was moved.
2. _____ This is a simple inclined-plane type machine that consists of a spirally threaded cylindrical rod that engages with a similarly threaded hole.
3. _____ This is a small wheel with a grooved rim through which a rope or chains run. It changes the direction of a pulling force and combinations of these simple machines increase the force applied for lifting an object.
4. _____ This is a toothed wheel that engages another toothed mechanism in order to change the speed or direction of transmitted motion.
5. _____ This is the gap or measurement between two locations.
6. _____ This is a class of rotating machines or devices in which effort applied to one part produces a useful movement at another part. They are used for moving or lifting loads.
7. _____ This is an influence that produces a change in an object.
8. _____ This simple machine is a rigid bar that pivots on a fulcrum to move or lift a load.
9. _____ This is a combination of two inclined planes that is itself moved with force to cut apart or separate an object.
10. _____ This simple machine is a slope or ramp that is used to lift a load. It trades distance for force.

Name _____ Date _____

Identifying Parts as Simple Machines

Many of the tools we use every day are based on simple machines. Some tools even have more than one simple machine that makes them work. For example, scissors open and close as a lever but cut through material as a wedge. Use the terms in the word box to label the illustrations. Some illustrations may have more than one term that applies.

lever	wheel and axle	pulley
inclined plane	wedge	screw



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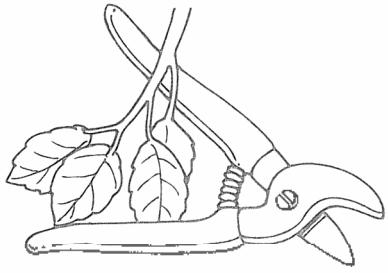

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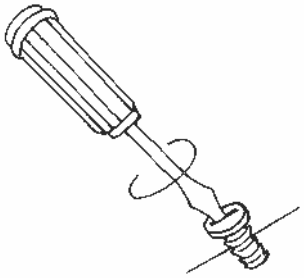

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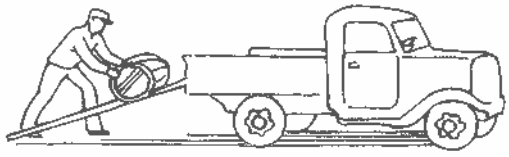

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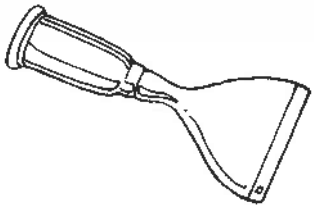

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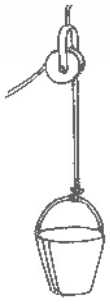

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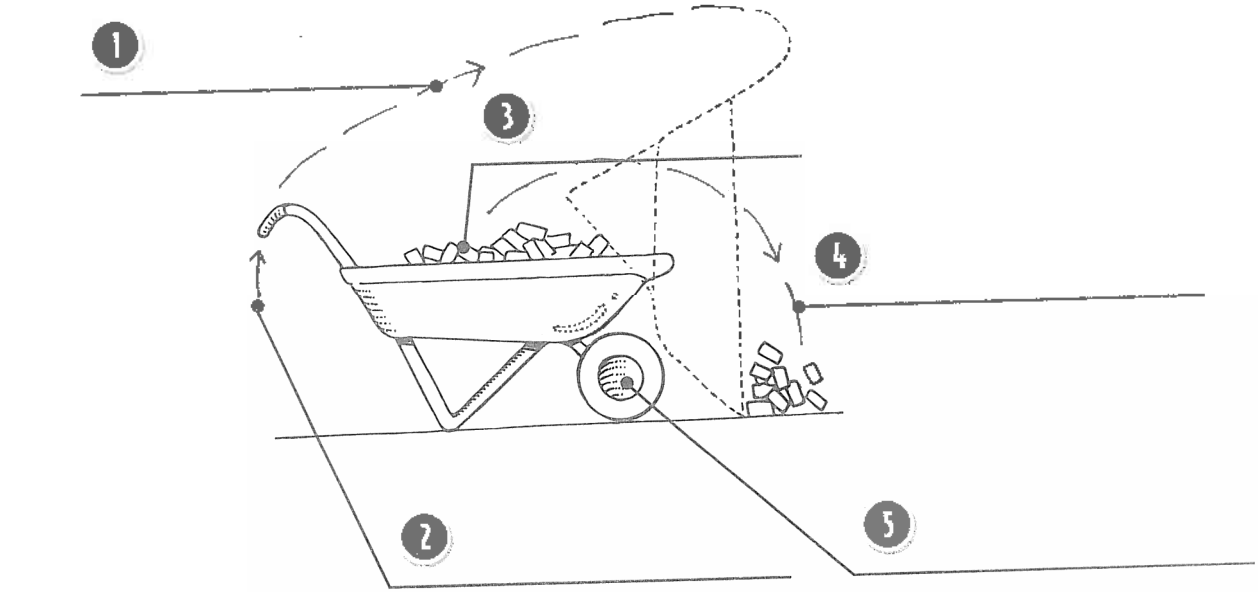
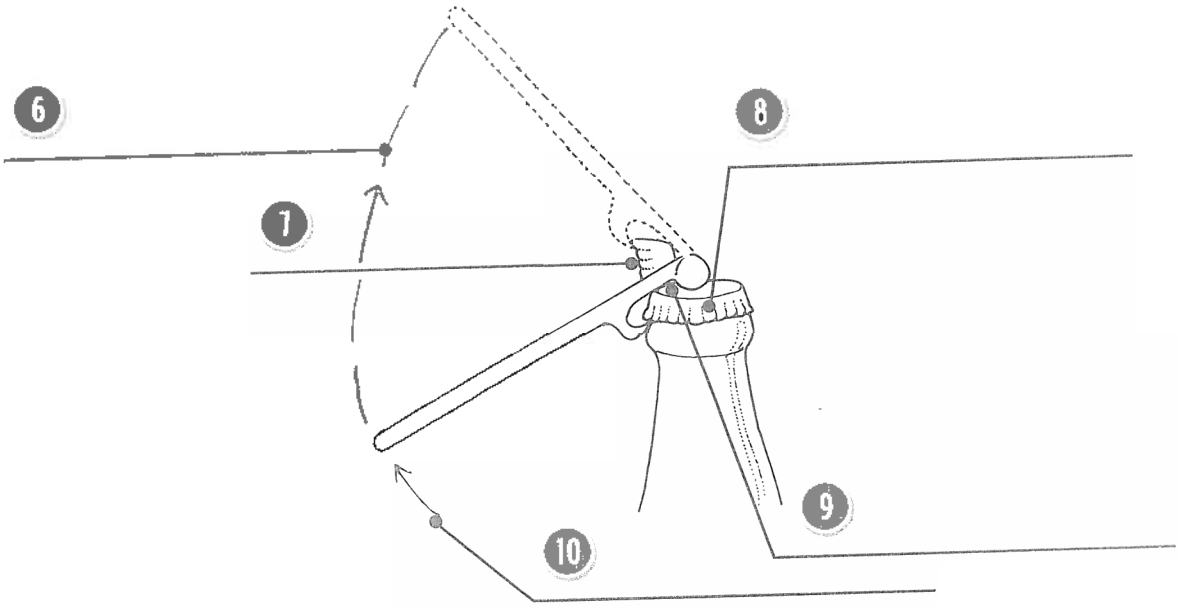
Name _____ Date _____

Levers at Work

The lever is a simple machine. It is a stiff bar that pivots on a point called a fulcrum. The bar moves but the fulcrum does not. With a lever, a load is lifted a certain distance when you apply force for another distance. Use the terms in the word box to label the illustrations. Some terms are used more than once.

distance you use	distance lever uses	force
load	fulcrum	





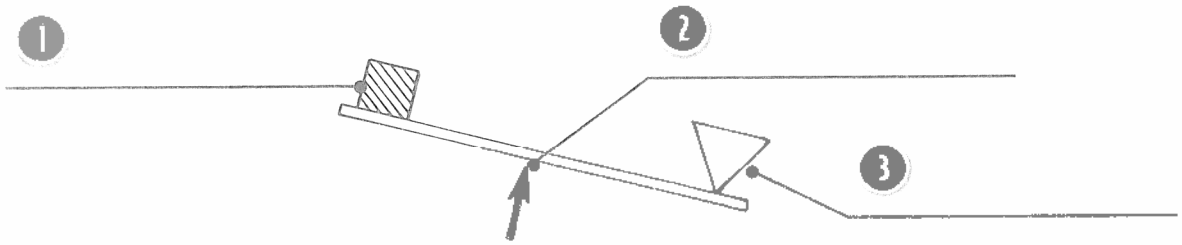
Name _____ Date _____

Three Classes of Levers

Levers come in three basic classes. They each have a **fulcrum** or pivot point. Each lever has a **force** put into the lever called an **effort** or input force. Each lever also has a force, called the **load**, which is the object being moved. The type of lever is determined by where the effort and load are placed in relation to the fulcrum. Use the terms in the word box to label each class of lever and the diagrams. Some terms are used more than once.

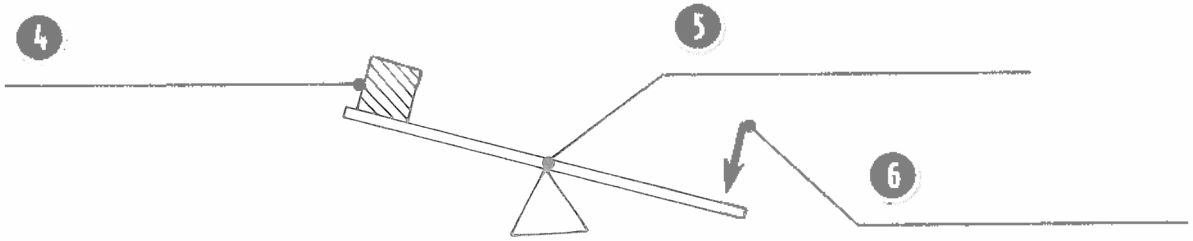
first class	second class	third class
fulcrum	load	effort

Type of Lever: _____



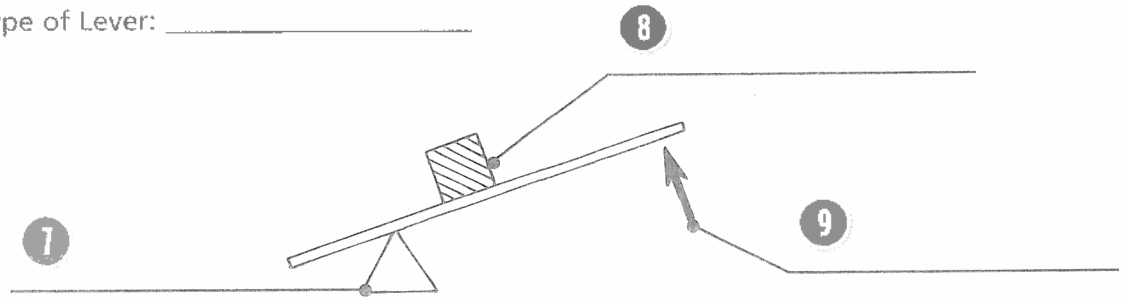
The effort and load are on the same side of the fulcrum, but the effort is closer in.

Type of Lever: _____



The fulcrum is between the effort and the load.

Type of Lever: _____



The effort and load are on the same side of the fulcrum, but the effort is farther out.

Name _____ Date _____

Classes of Levers

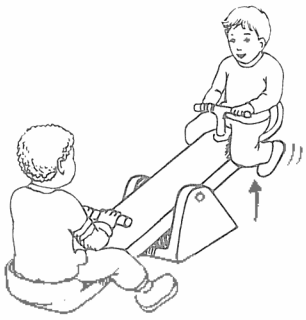
Use the terms in the word box to label each class of lever in the illustrations.

first class	second class	third class

1 _____

2 _____

3 _____



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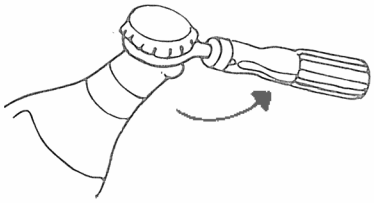

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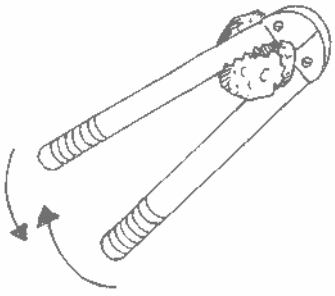

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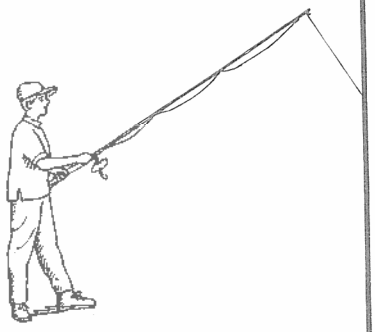

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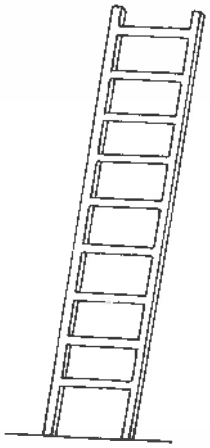
Name _____ Date _____

Inclined Planes

An **inclined plane** is a slope or ramp that does not move. Instead, it helps you move or raise things that are too heavy otherwise. With an inclined plane, you can do more work with your own force over a greater distance. Describe how the object in each illustration helps you do work more easily.



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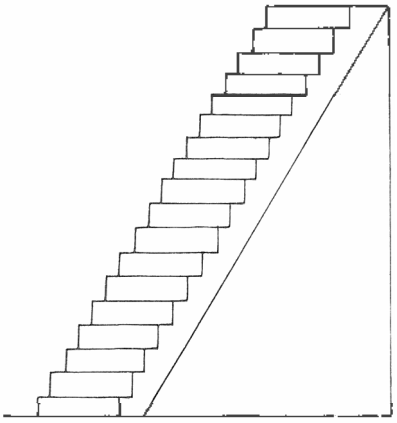

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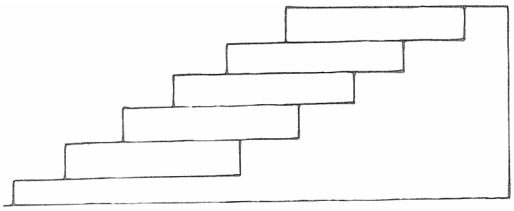

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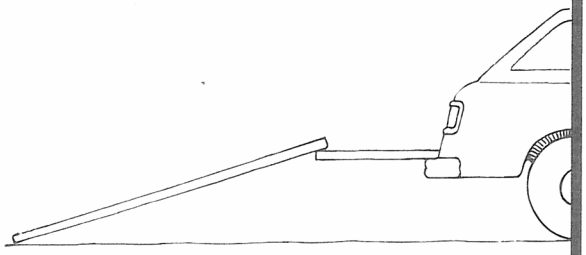

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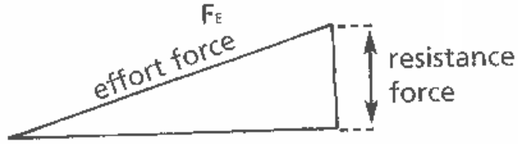
Name ______________________________ Date ______________

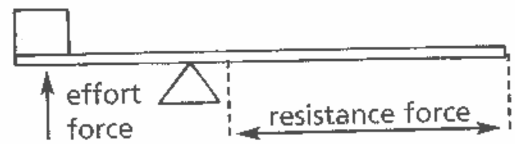
Mechanical Advantage of Inclined Planes and Levers

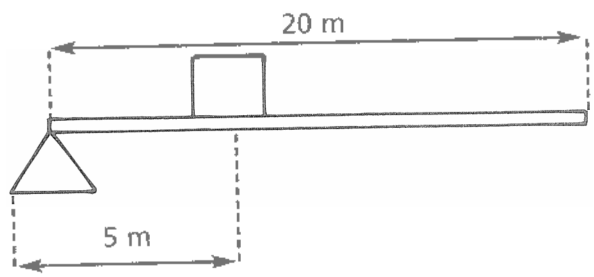
Mechanical advantage is the advantage created by a machine that enables people to do work while using less force. Use the example diagram to identify resistant force and effort force. Then use the formula to calculate the mechanical advantage for each diagram.

mechanical advantage = resistance force divided by effort force

$$MA = \frac{F_R}{F_E}$$







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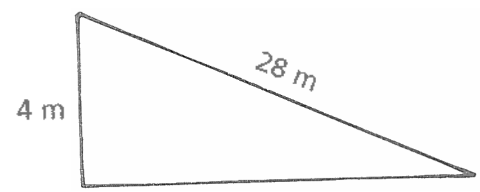

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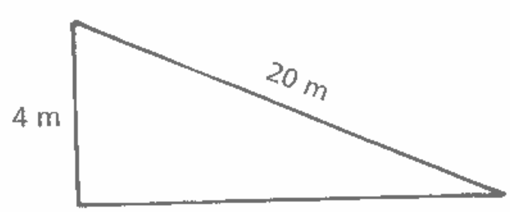

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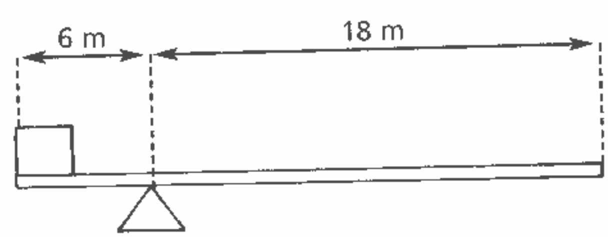


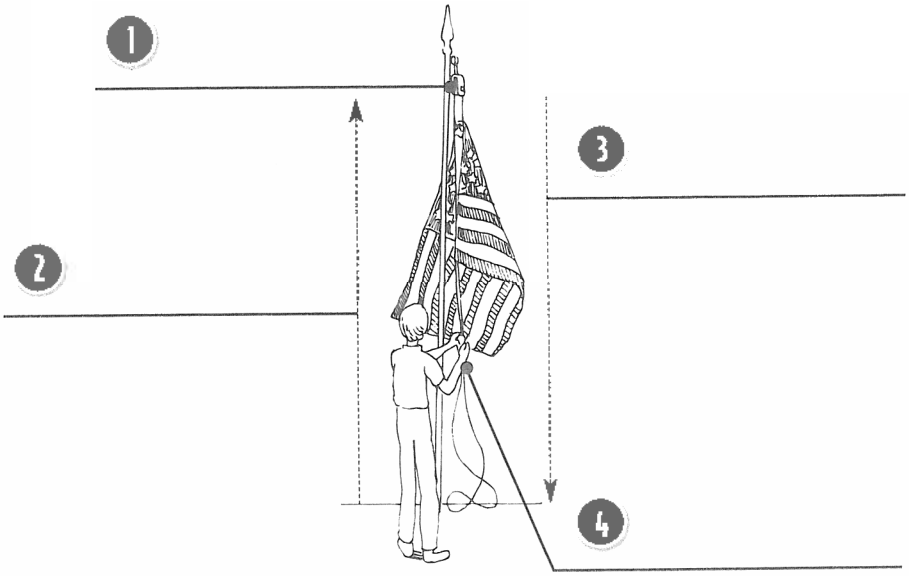
4. ______________________________

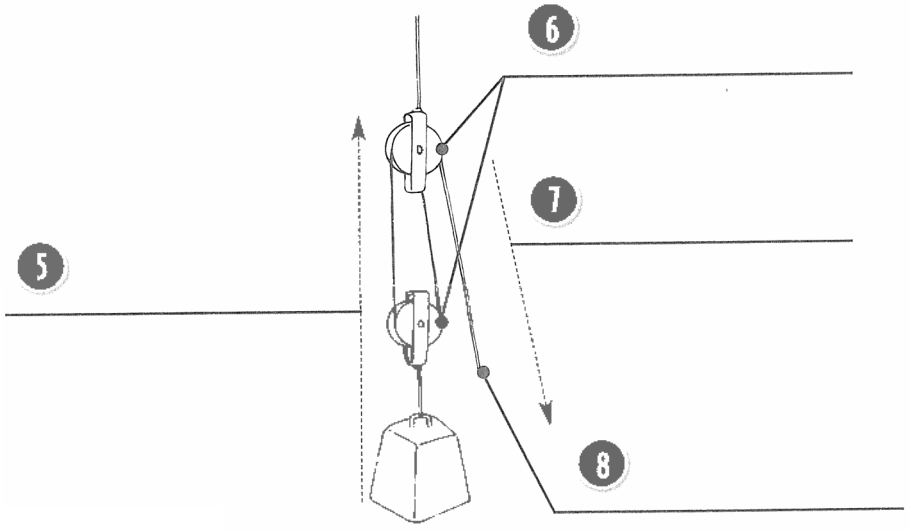
Name _____ Date _____

Pulleys

A **pulley** is a small wheel with a grooved rim that holds a rope or chain. Pulleys can be fixed or movable. Each pulley or wrap of the line allows you to trade distance for force. Use the terms in the word box to label the illustrations.

distance to move load	distance you use	force	pulley





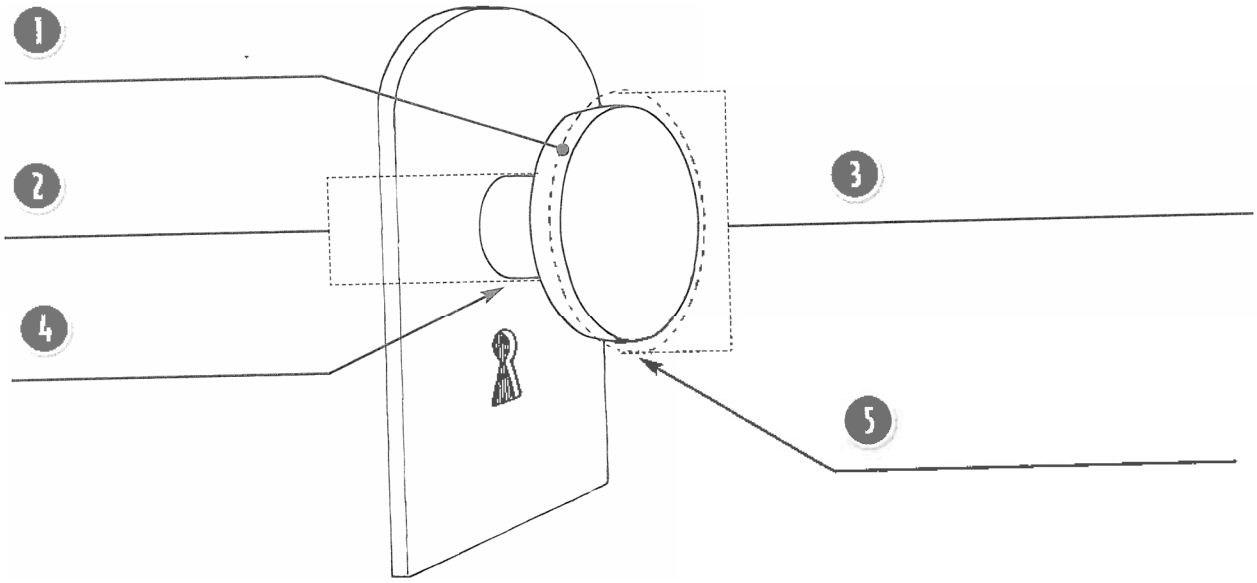
Distance used is two times more than distance moved.

Name _____ Date _____

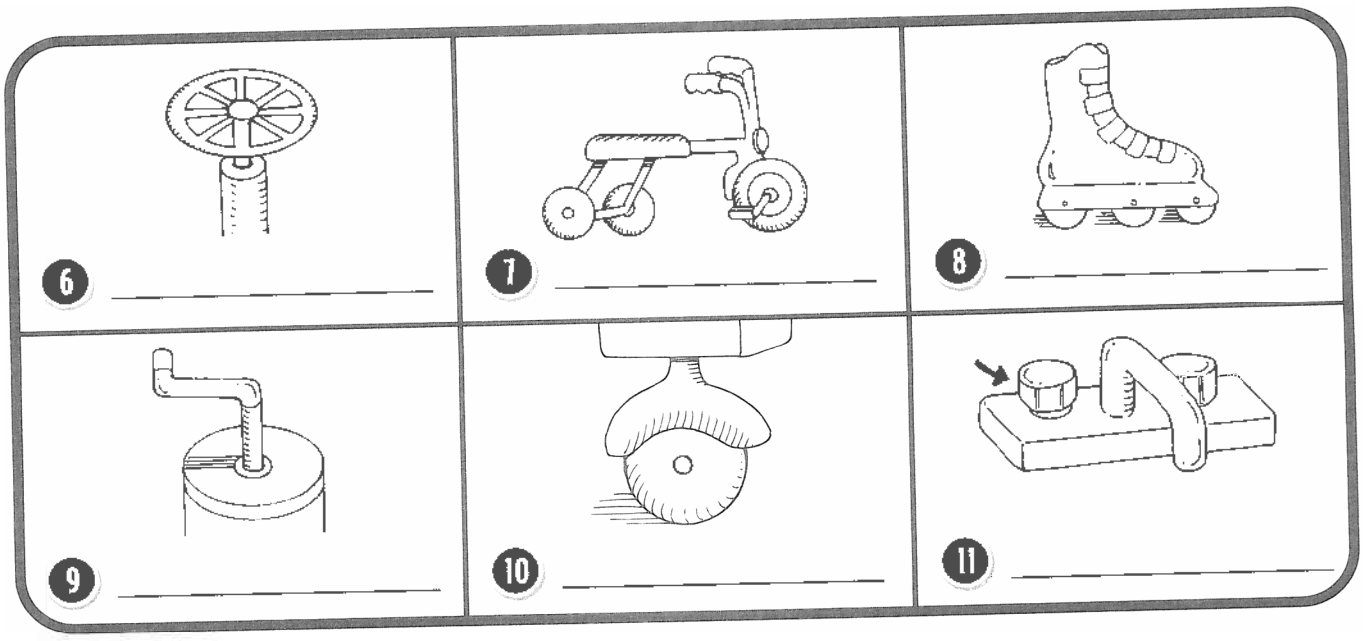
Wheels and Axles

We see wheels on things every day. However, these kinds of wheels do not always do the same kind of work as the simple machine called the wheel and axle. The purpose of some wheels is to reduce friction by allowing an object to roll instead of drag. The simple machine is made up of a small wheel attached to a larger wheel. The small wheel is the axle. It is usually a rod that turns as a larger wheel turns. Use the terms in the word box to label the diagram.

distance axle uses	force	distance you use
large wheel makes turning easier	small wheel is difficult to turn	



Write **wheel and axle** if it operates like a simple machine to increase force.
Write **reduce friction** if that is the purpose of the object in the diagram.



Name _____ Date _____

Mechanical Advantage of Pulleys, Wheels, and Axles

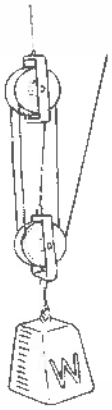
Pulleys create mechanical advantage. Wheels and axles work together to create mechanical advantage. Gears are a type of wheel and axle. Use the formula to calculate the mechanical advantage for each diagram.

Mechanical advantage for pulleys: When the length of line you pull on is equal in length to the distance you move the load, the mechanical advantage (ma) is 1. Each time you add another length to the distance you must pull, by adding another wrap around a pulley, the mechanical advantage increases by 1 more.

Mechanical advantage for wheels and axles:

$$MA = \frac{\text{radius of the wheel}}{\text{radius of the axle}}$$

1



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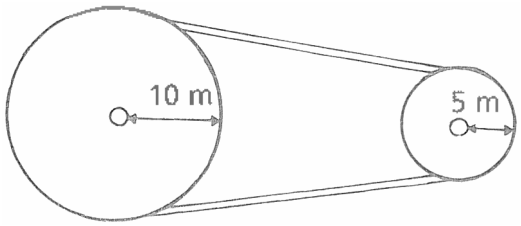

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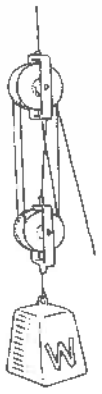

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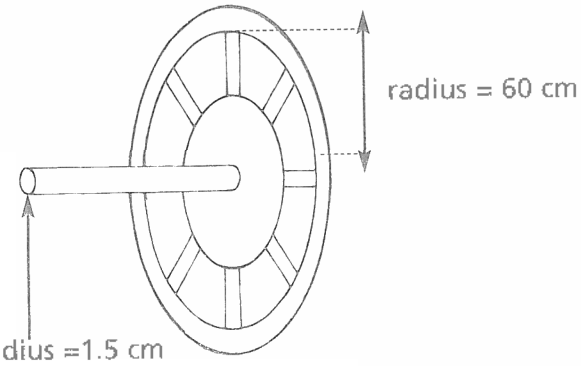

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Name _____ Date _____

Wedges

A **wedge** is made up of two inclined planes. Unlike an inclined plane which does not move, the wedge moves to do work. Wedges can be used to lift things, separate things, or tighten and attach things in place. Use the terms in the word box to label each use of a wedge.

lift	separate	tighten	attach

1. _____ A nail is a wedge. Drive the nail into a block of wood.
2. _____ A doorstop is a wedge. Prop a door open with a doorstop.
3. _____ The blades of a pruner are wedges. Cut a branch with the pruners.
4. _____ The blades on a pair of scissors are wedges. Use the scissors to cut paper.
5. _____ A piece of wood can be a wedge. A man slips a wedge under a heavy box.
6. _____ A chisel is a wedge. An artist uses a chisel to carve a statue.
7. _____ Paper staples are wedges. Use staples to hold pages together.
8. _____ An axe is a wedge. Use an axe to split a log.
9. _____ Little wedges of wood can tighten a loose chair leg. Hammer the wedges into the space where the chair leg is attached to the seat.
10. _____ Wedges of metal can secure the head of an axe. Pound the wedges into the wood where the handle joins the axe head.
11. _____ The edge of a snow shovel is a wedge. Use the shovel to push snow off your driveway.
12. _____ The blade of a knife is a wedge. Be careful as you slice a piece of cheese for a hamburger with the wedge.

Name _____ Date _____

Screws

Screws are a simple machine that is a combination of other simple machines. Match each word in the word box to its description.

inclined plane	threads	turned
wheel and axle	handle	axle
wedge	force	distance
drill	jackscrew	

1. _____ This is a variation of a screw that is designed to make holes in wood or other materials.
2. _____ A screw is one of these wrapped around a cylinder.
3. _____ With the use of a screwdriver, this is done to the screw as it enters the wood or other material.
4. _____ When you are moving the screw with a screwdriver, you are really moving it with this simple machine.
5. _____ Without the threads, a screw is basically a nail, which is an example of this.
6. _____ When driving a nail, it takes a lot of this to push apart the wood as the nail enters it.
7. _____ On a screw, the inclined plane forms these ridges in a spiral along the cylinder.
8. _____ When turning a screw, it takes less force but you use more of this as the screw enters the wood.
9. _____ This tool is a variation of a screw that allows a platform to raise and lower extremely heavy objects.
10. _____ This part of the screwdriver acts as a wheel to do the work.
11. _____ The shaft of the screwdriver and the screw itself act as one of these to do the work.

Name _____ Date _____

Classifying Simple Machines

Classify the useful items listed in the word box by the main type of simple machine.

hammer	tin snips	nut and bolt
staircase	step stool	engine gears
seesaw	halyard	window blinds
front teeth	flagpole	clothesline
bottle opener	fishing pole	door knob
windlass crank	hand drill	clamp
lightbulb	zipper	knife
playground slide	ramp	wrench and pipe

Levers	Screws	Inclined Planes
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Wedges	Pulleys	Wheel and Axles
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Name _____ Date _____

Uses for Simple Machines

Match the simple machines in the word box to the descriptions of the work that needs to be done. Some terms are used more than once

lever	pulley	wheel and axle
wedge	screw	inclined plane

1. _____ A piano needs to be moved up to a third floor apartment.
2. _____ Your sister wants to fasten a towel bar in the bathroom. You suggest one of these.
3. _____ A large boulder is in your yard. You need to move it over about 3 feet.
4. _____ You need to block a door to keep it open while you bring in groceries from the car.
5. _____ Dad needs to take your older dog to the vet. The dog can no longer jump into the car on his own and he is too heavy to lift.
6. _____ Every morning the flag needs to be raised to the top of the flagpole.
7. _____ You remember to put the lid back on the jar of mayonnaise.
8. _____ The trees have lost their leaves and you have a lot of them to collect.
9. _____ Your little sister's treehouse is 6 feet off the ground and her friends need an easier way to get up to it.
10. _____ You turn off the water to the sprinkler hose for your mom.
11. _____ Your older brother chops some firewood because it's going to be a cold night.
12. _____ While visiting an old farm, you need to draw a bucket of water up from the well.