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## Chapter 9

9-1

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### Work

- $\text{Work} = \text{force} \times \text{distance}$
- $\text{work} = \text{mass} \times \text{acceleration} \times \text{distance}$

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## Machine

- device that helps you do work
- by changing the size of a force or
- by changing the direction of a force

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## Power

- =work / time
- =force x distance / time
- =force x speed

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## joules

- SI unit of work=joules
- joule = the work required to raise a one newton weight by one meter

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# Watt

- SI unit of power = watt
- joules / second = watt

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# Right!



TO SLIDE 10



TO LAST SLIDE VIEWED

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# Wrong!



To Next Slide



To Last Slide Viewed

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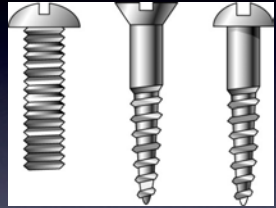
<http://outdoors.webshots.com/photo/1152826792056079647YpBpQL>



- Lever
- Wedge
- Screw
- Inclined Plane
- Pulley
- Wheel & Axle



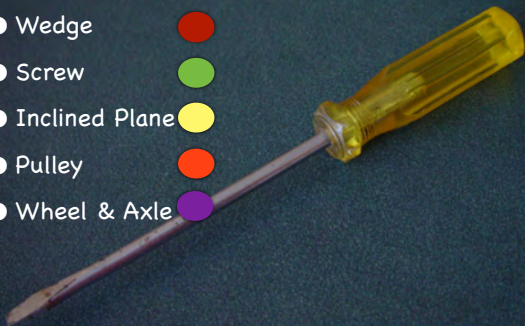
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- Lever
- Wedge
- Screw
- Inclined Plane
- Pulley
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- Lever
- Wedge
- Screw
- Inclined Plane
- Pulley
- Wheel & Axle



<http://www.thepurposeoftheladder.com/>



- Lever ●
- Wedge ●
- Screw ●
- Inclined Plane ●
- Pulley ●
- Wheel & Axle ●

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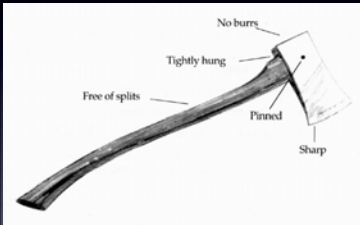
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[http://www.oxford.gov.uk/oxfordgovuk/images/oxfordgovuk\\_oxfordgovuk.pdf](http://www.oxford.gov.uk/oxfordgovuk/images/oxfordgovuk_oxfordgovuk.pdf)



- Lever ●
- Wedge ●
- Screw ●
- Inclined Plane ●
- Pulley ●
- Wheel & Axle ●

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- Lever ●
- Wedge ●
- Screw ●
- Inclined Plane ●
- Pulley ●
- Wheel & Axle ●

[http://www.oxford.gov.uk/oxfordgovuk/images/oxfordgovuk\\_oxfordgovuk.pdf](http://www.oxford.gov.uk/oxfordgovuk/images/oxfordgovuk_oxfordgovuk.pdf)

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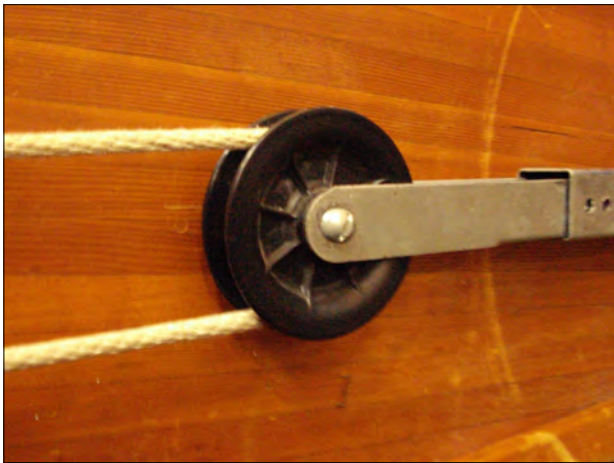
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## By the way

- As we start talking about machines, I mean simple machines, not things with engines

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## Section 9-2

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## Increasing the Distance Decreases the Force

- Increasing the distance you move decreases the force necessary
- Large force with a short distance
- OR:
- Small force with long distance
- Can openers

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## Machines change force

- Machine changes the size of a force by either:
- Multiplying Force or
- Multiplying Distance
- No Machine Can Do Both

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## Mechanical Advantage

- = Force Output / Force Input (x100%)?
- Machines make work easier by changing the amount of force, distance, direction or speed
- Some machines multiply distance instead of force
- Friction causes no machine to be 100% efficient

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## Section 9-3

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## The 6 Types of Simple Machines

Levers	Inclined Planes
Lever	Inclined Plane
Pulley	Screw
Wheel & Axle	Wedge

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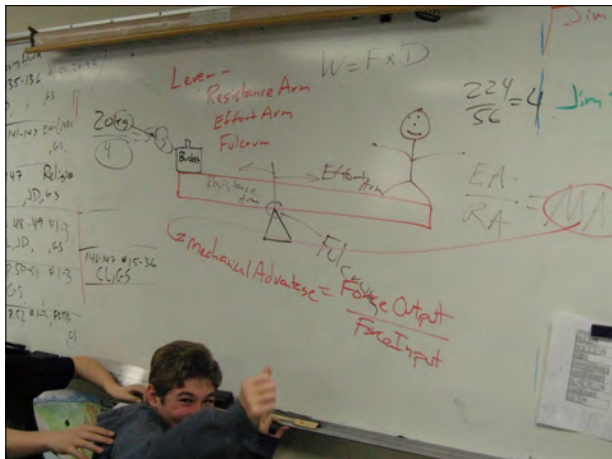
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## Levers

- Effort Arm: Part you push on
- Resistance Arm: Part that pushes object
- Fulcrum: Pivot Point

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## Levers:

- 1st Class: Fulcrum in the Middle (Scissors)
- 2nd Class: Resistance Arm in the Middle (Wheelbarrow)
- 3rd Class: Effort Arm in the Middle (Swinging a Tennis Racket)

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## Inclined Plane

- Flat sloping surface

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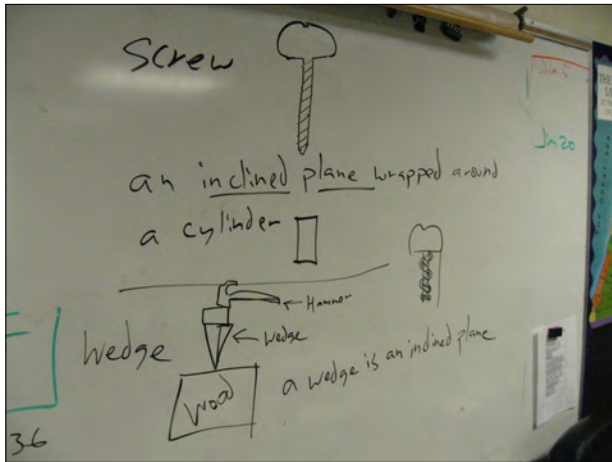
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## Screw

- An inclined plane wrapped around a cylinder
- Screw on jar lids, water faucets, automobile jacks

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## Wedge

- An inclined plane which is used to push objects apart
- Ax, Knives, Saw, Razors, Cutting Tools, Nails

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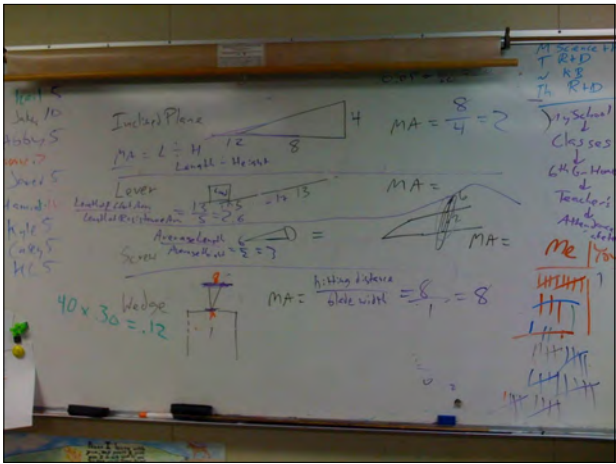
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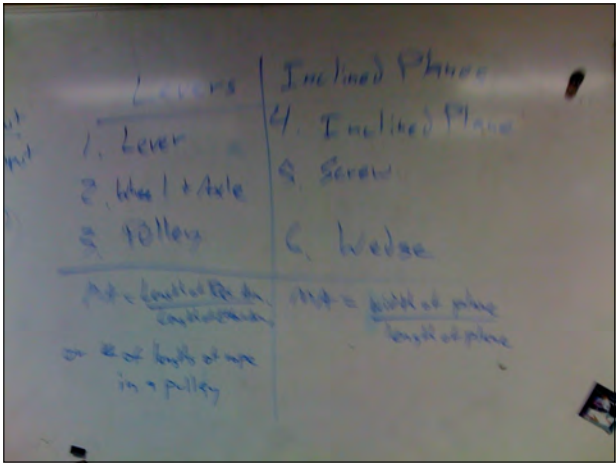
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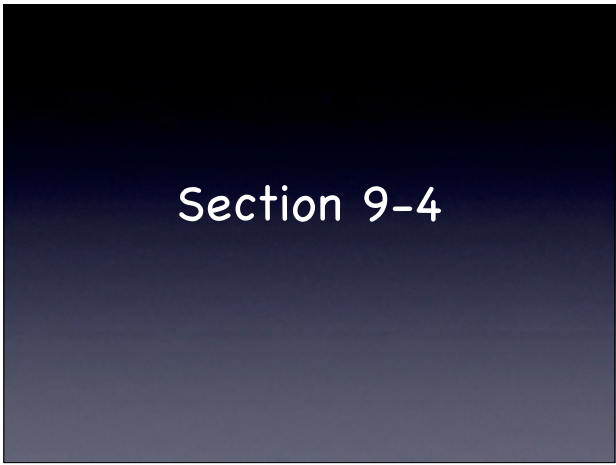
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# Compound Machines

- Two or more simple machines put together to do work
- Ax = Wedge + Lever
- Scissors = Wedge + Lever
- Bicycle = Levers + Wheel & Axle

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# Compound Machines

- "Within a compound machine, the output force of one simple machine becomes the input force of another simple machine." — p336

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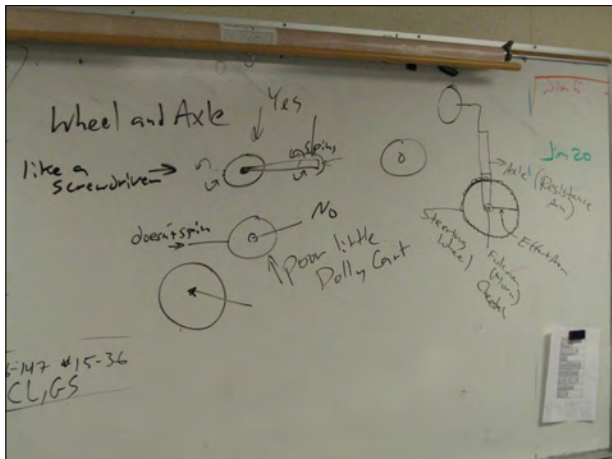
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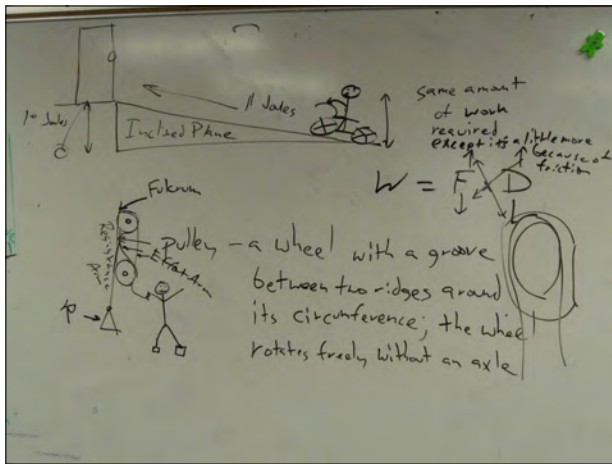
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## Wheel and Axle

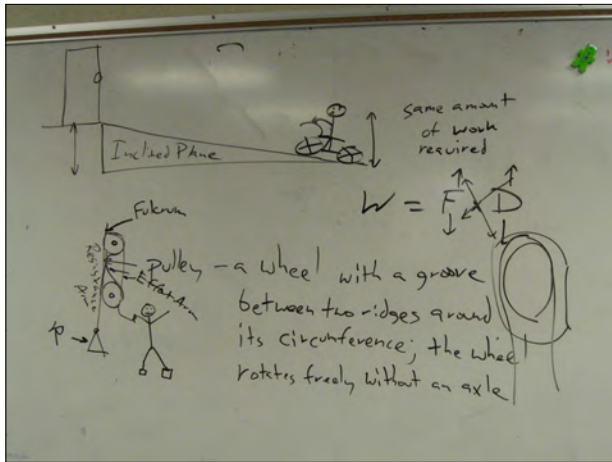
- A Lever connected to a shaft
- Wheel does not spin on the axle
- Doorknobs, radio knobs, screwdrivers, ice cream makers



## Pulleys

- A Wheel that does spin on its axle
- Fixed: only spin;  $MA = one$
- Movable: are attached to the object being lifted; are used to multiply force
- Block and Tackle: a type of movable pulley which uses large distance  $\times$  small force






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## Mechanical Advantage:



Lever

Length of Effort Arm / Length of Resistance Arm  
Effort Arm=Your Arm; Resistance Arm=Bat; Ball=Load



Wheel & Axle

Radius of Effort Arm / Radius of Resistance Arm  
EA=Handle; RA =Head; Load=Screw



Pulley

# of lengths of rope supporting the load in a pulley

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## Mechanical Advantage:



Inclined Planes

Length of Plane / Height of Plane



Wedge

Hitting Distance (what you push on) / Blade Width



Screw

The gentler the slope threads, the: 1. higher the MA, 2. the smaller the force, and 3. the greater distance.  
Length of Plane / Height of Plane

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