

Name: \_\_\_\_\_

Unit 1: Force & Motion

NOTES: 2.07

### FOCUS: Simple Machines

**ESSENTIAL QUESTION:** Can you explain what a machine is and how machines make work easier?

#### What do we already know?

- A force is a push or pull applied to an object that causes that object to change its shape or velocity.
- Work is done on an object when the applied force causes displacement, or movement in the same direction as the force.
- Work is calculated by multiplying force times distance.

$$W = F \times D$$

#### What is a Machine?

- A machine is... a device that makes work easier or more efficient

- A machine does **not**:

- Create energy (Remember the *Law of Conservation of Energy*)
- Do work on its own.
- multiply the amount of work put into it.



- A machine does:

- use the energy put into it to do work on an object.
- Put out the same amount of work put into it.

#### How do Machines Make Work Easier or More Effective?

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- Machines can make work easier in 3 ways:

- 1) By changing the amount of force you must exert.
- 2) By changing the distance over which you must exert your force.
- 3) By changing the direction in which you must exert your force.



What makes one machine more effective than another machine?

- You can figure out how useful or effective a machine is by comparing the amount of force you must put into the machine to the amount of force you get out of the machine.

- o input force:  
The force you put into a machine

▪ Example: you turning a can opener



- o Output force: The force the machine puts on an object

▪ Example: the blade cutting into the can

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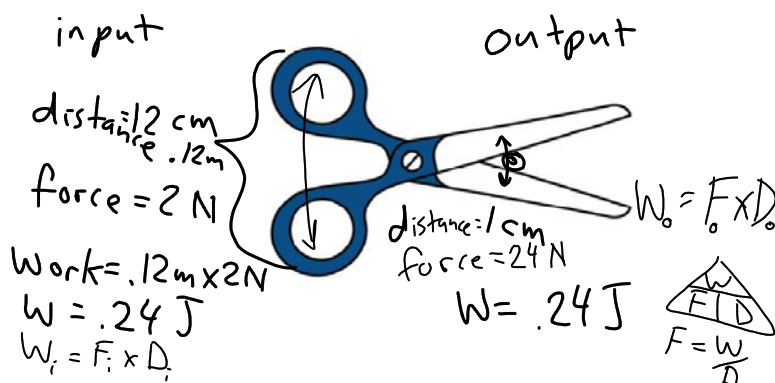
- This information can help you figure out how much work the machine is doing:

o Input work: The work you put into a machine

$$\text{INPUT WORK} = \text{input force} \times \text{input distance}$$

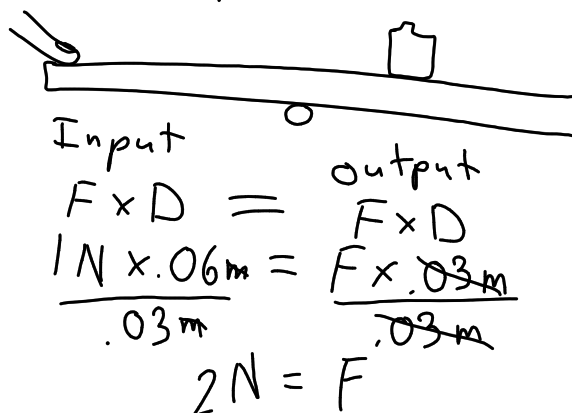
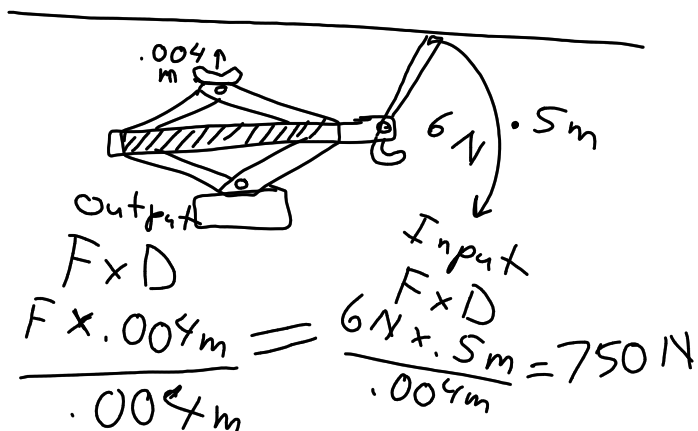
o output work: The work the machine does on an object

$$\text{OUTPUT WORK} =$$



\*\*\*In ALL machines, Input Work = Output Work!

You can never get more work out of a machine than you put into it.



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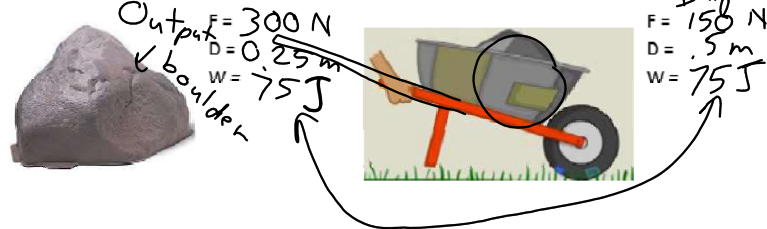
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How can you get the machine to do the work for you?

- By manipulating the input force and/or input distance you can make the machine do most of the work for you easier.
- Remember the 3 ways machines do work:
  - By changing the amount of force you must exert.
  - By changing the distance over which you must exert your force.
  - By changing the direction in which you must exert your force.

1. Changing the **AMOUNT** of force you exert: wheelbarrow



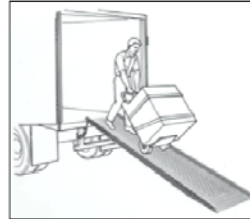
2. Changing the **DISTANCE** over which you must exert your force: Ramp

No Ramp:

$$F = 750 \text{ N}$$

$$D = 1 \text{ m}$$

$$W = 750 \text{ J}$$



Ramp:

$$F = 150 \text{ N}$$

$$D = 5 \text{ m}$$

$$W = 750 \text{ J}$$

Same

Swing Set  
no ramp

$$F = 2500 \text{ N}$$

$$D = 1 \text{ m}$$

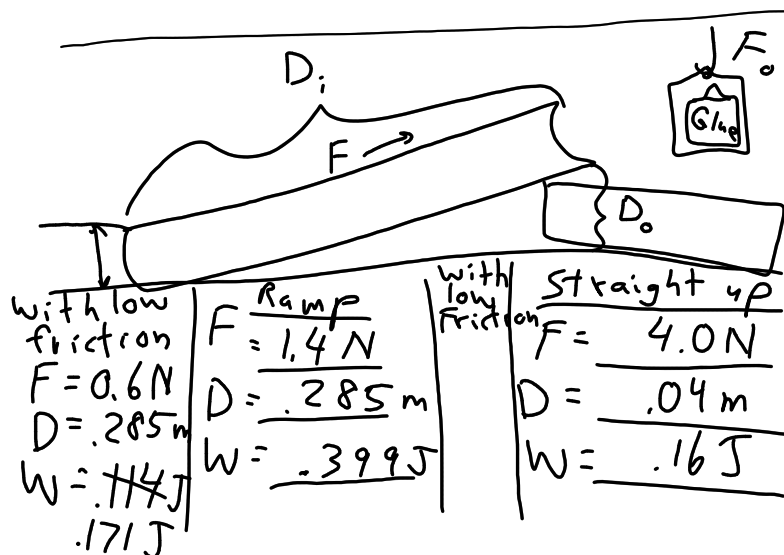
$$W = F \times D = 2500 \text{ J}$$

with Ramp

$$F = 500 \text{ N}$$

$$D = 5 \text{ m}$$

$$W = 2500 \text{ J}$$

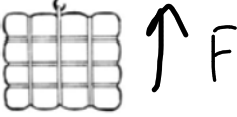
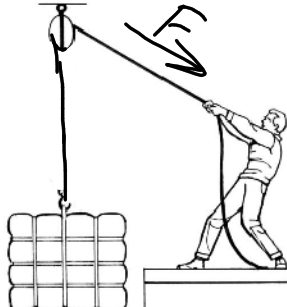


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3. Changing the **DIRECTION** in which you must exert your force: Pulley

$F = 500\text{ N}$ $D = 2\text{ m}$ $W = 1000\text{ J}$ 	 $F = 500\text{ N}$ $D = 2\text{ m}$ $W = 1000\text{ J}$
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**\*\*Remember:**

- The output work can not exceed the input work.
- A machine can not create energy. It can only use the energy that you put into the machine.
- It will make your work easier, by changing the amount, distance, and/or direction of your input force.