CHAPTER 8 WORK AND MACHINES

PAGE 210

7th Physical Science

November

8.1 WORK

- How efficient is my hand in moving the book?

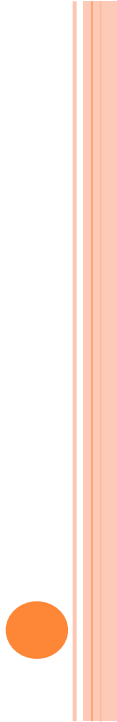- Work =

    force x distance

  - SI unit:

        Joule = Newton x meter

  - Meaning:

    How effective was the force in moving the object?
    - 1) the force must be along the line of motion
    - 2) the object must change position

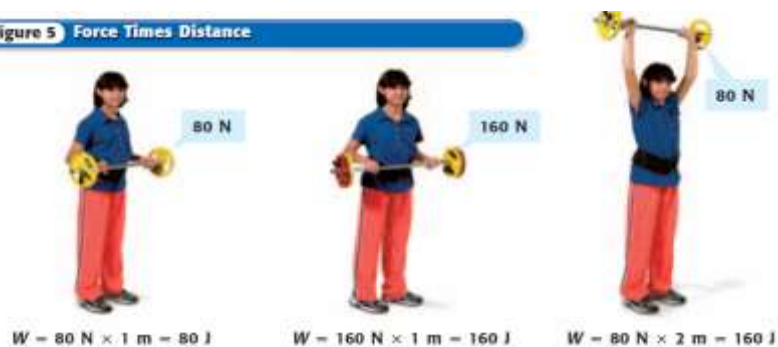 - Draw a picture with F, D, W calculated.

8.1 WORK

o Pg. 211. Work or no work?

Example	Direction of force	Direction of motion	Doing work?

8.1 WORK

o How to calculate work.

Figure 5 Force Times Distance

$W = 80 \text{ N} \times 1 \text{ m} = 80 \text{ J}$ $W = 160 \text{ N} \times 1 \text{ m} = 160 \text{ J}$ $W = 80 \text{ N} \times 2 \text{ m} = 160 \text{ J}$

o Go to Page 5. Answer #1~9.

8.1 WORK

- Worksheet Pg. 5 # 10 ~ 12
  Idea: Who does more work?
  Why?
  How do you test it?

$$W = F_1 \times d_1 = F_2 \times d_2$$
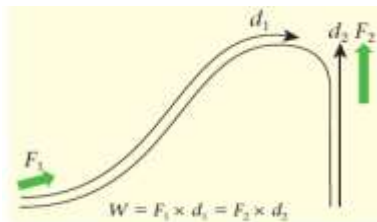
8.1 WORK

- Worksheet Pg. 5 # 10 ~ 12
  Idea: Who does more work?
  Why?
  How do you test it?

8.1 POWER

o Power =

How fast work is done

Equation:

P = work/time

SI unit:

Watt = Joule/second

Draw a power picture: Wait until I give you directions.

8.1 POWER

o Pg. 214

MATH FOCUS

More Power to You A stage manager at a play raises the curtain by doing 5,976 J of work on the curtain in 12 s. What is the power output of the stage manager?

Step 1: Write the equation for power.

$$P = \frac{W}{t}$$

Step 2: Replace W and t with work and time.

$$P = \frac{5,976\ J}{12\ s} = 498\ W$$

Now It's Your Turn

1. If it takes you 10 s to do 150 J of work on a box to move it up a ramp, what is your power output?
2. A light bulb is on for 12 s, and during that time it uses 1,200 J of electrical energy. What is the wattage (power) of the light bulb?

8.1 POWER

o Visualize Power: Worksheet Pg. 4

8.1 POWER

o Worksheet: Power Picture.
  Actually show me how you would exert a power of
  Then draw a picture on your word chart.

  _3_ Watts: Table #1. Vertically

  _2_ Watts: Table #2. Horizontally

  _5_ Watts: Table #3. Vertically

  _4_ Watt : Table #4. Horizontally

8.1 POWER

- Worksheet Pg. 5.

8.1 WORK AND POWER

Homework

Page. 215 #1~9

8.2 MACHINES

- Machine =

  device that helps us <u>do work</u> by changing <u>size</u> or <u>direction</u> of force.

- Why use machines?

  Would you rather lift a piano or roll it up a slope?

  A ramp is a machine.

  A machine changes ***your*** force to a more ***useful*** force.

8.2 MACHINES

- Examples of Machines (Worksheet Pg. 5)

- A) Label the <u>input force</u>, <u>input distance</u>, <u>output force</u>, and <u>output distance</u>
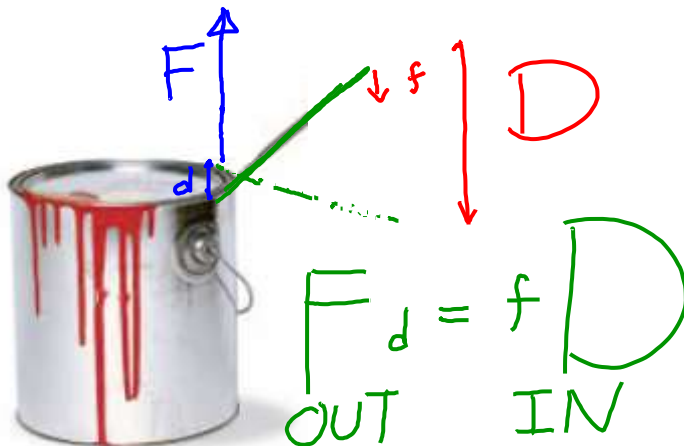- B) What does the machine change?

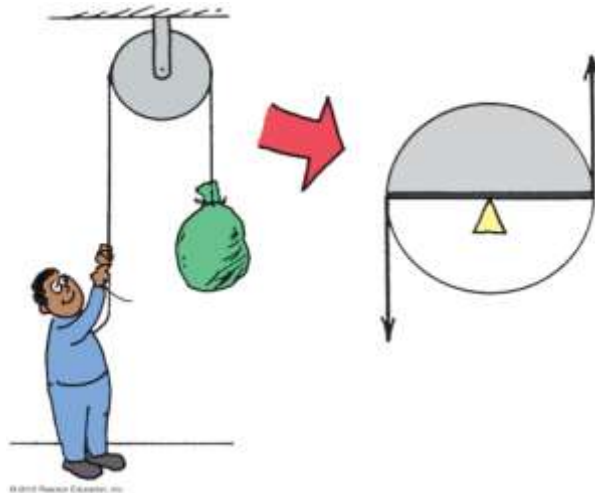## 8.2 Machines

o Lever

o Worksheet Page 2: Lever changes

8.2 Machines

o Lever

$$F_d = f D$$

OUT   IN

o Worksheet Page 2: Lever changes <u>force **STRENGTH** &
DIRECTION</u>

8.2 MACHINES

o Pulley

8.2 MACHINES
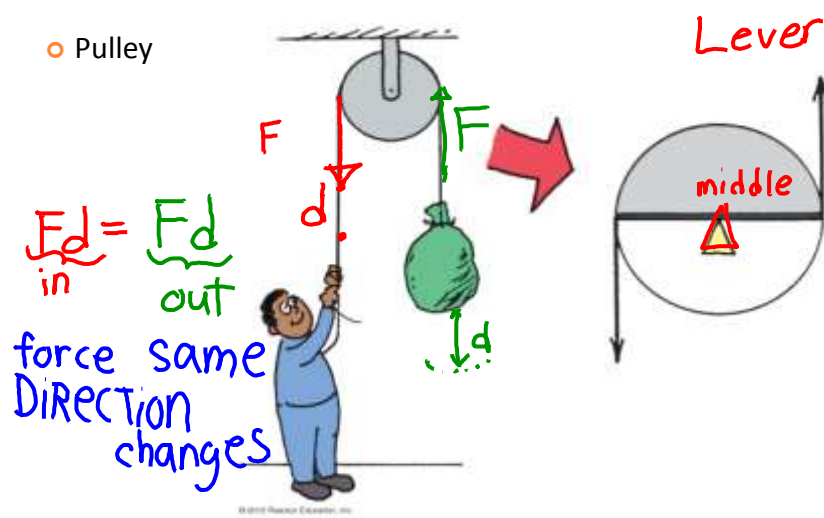
o Pulley

Lever

$$\underset{\text{in}}{Fd} = \underset{\text{out}}{Fd}$$

force same
DIRECTION
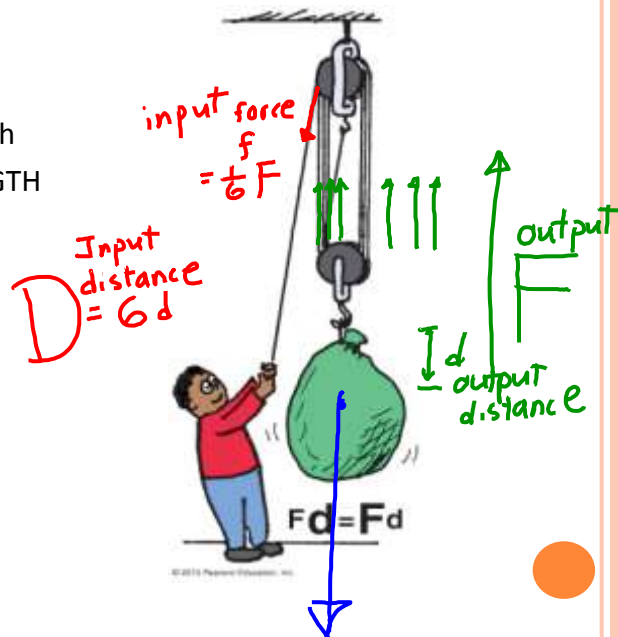changes

F

d

F

d

middle

8.2 Machines

o Pulley that changes both
  DIRECTION and STRENGTH

Fd=Fd

8.2 Machines

o Pulley that changes both
  DIRECTION and STRENGTH

input force
f
$= \frac{1}{6} F$

Input distance
$D = 6d$

output F

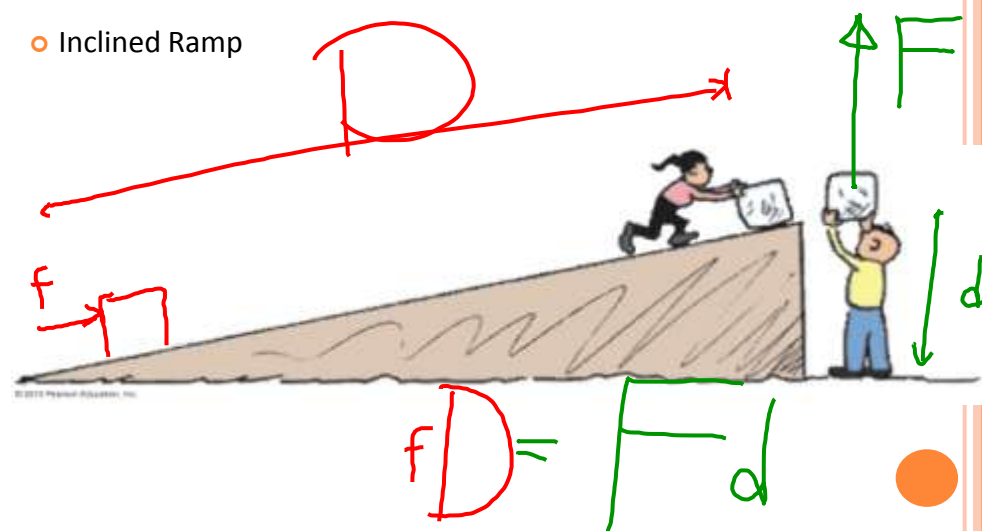$\frac{1}{d}$ output distance

Fd=Fd

10

8.2 MACHINES

- Examples of machines
- Work you put in always goes somewhere!

- Inclined Ramp

8.2 MACHINES

- Inclined Ramp

$$fD = Fd$$

8.2 MACHINES

Figure 4 Machines Change the Size and/or Direction of a Force

Input force

A nutcracker *increases* the force but applies it over a *shorter* distance.

Output force

A hammer *decreases* the force, but applies it over a *greater* distance.

Output force

Input force

A simple pulley changes the *direction* of the input force, but the size of the output force is the same as the input force.

Input force

Output force

When a screwdriver is used as a lever, it *increases* the force and *decreases* the distance over which the force is applied.

Output force

Input force

---

o Can a machine *create* work?

NO!!!

o Why not?

8.2 MACHINES

- Why can't machines create energy?

- Conservation of energy:

    Energy is never created or lost.

    If something gains energy, it must have come from somewhere that lost energy.

$$W_{in} = W_{out} + W_{wasted}$$

Work **YOU** do to machine =

    useful work done by machine + work to overcome friction.

8.2 MACHINES

- Work input =

    work **YOU** do on a machine

- Work output =
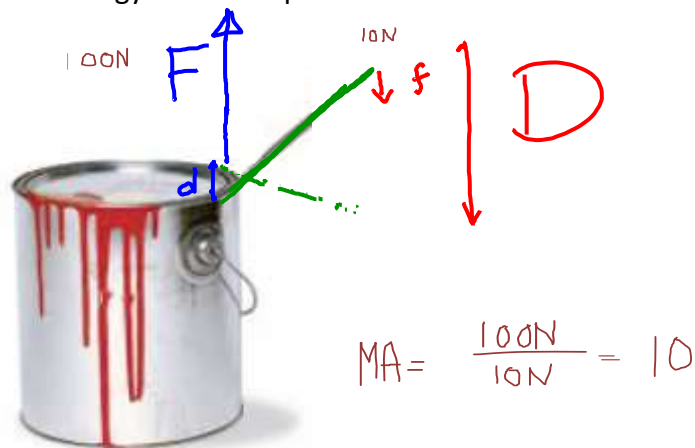
    work machine does on OBJECT

8.2 MACHINES

o Mechanical Advantage =
   how many times YOUR force gets multiplied.

MA = 10 means you pull 2 N → machine pulls 20 N

o MA = output force/ input force

8.2 MACHINES

o Mechanical Energy.   Example:

100N F ↑   10N ↓ f D

d

$$MA = \frac{100N}{10N} = 10$$

8.2 Machines

- Worksheet Pg. 5
- 1)

8.2 Machines

- Worksheet Pg. 5
- 2) If the mechanical advantage of a machine is 5, how does the output force compare to the input force?

- How does the output distance compare to the input distance?

8.2 MACHINES

- Mechanical Efficiency

  = what percent of your work is made **USEFUL**? (not wasted)

- Equation:

  ME = work output/ work input

$$W_{in} = W_{out} + W_{wasted}$$

Work **YOU** do to machine =
         useful work done by machine + work to overcome friction.

8.2 MACHINES

- Mechanical Efficiency

- ME = 100% means that machine uses ALL of your work usefully, 0% wasted.

- ME = 70% means that the machine uses 70% of your work to lift the object, with 30% wasted in friction.

8.2 MACHINES

- Did you know…
- The mechanical efficiency of a car is …

- The mechanical efficiency of a light bulb is…

8.2 MACHINES

- Worksheet Pg. 3
- 3) Can a machine have 100% efficiency? Why?

Do Homework
8.2 (Pg. 221) #3~10
On Worksheet Pg. 4

Read Section 8.3
You will do a poster in class on Monday.