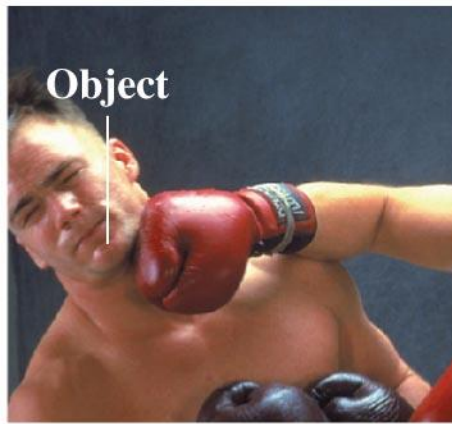
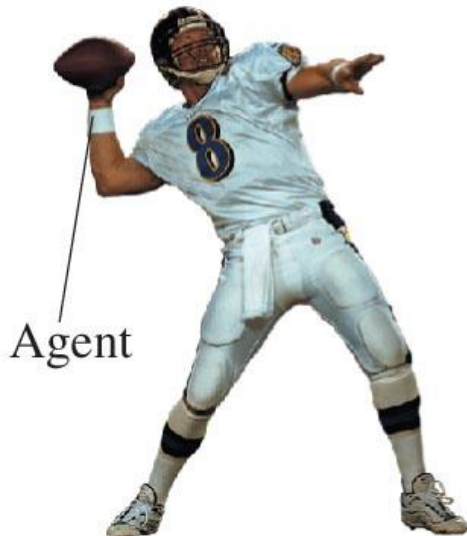


# What is a Force

- A force is a push or a pull on an object.
- A force requires an agent. Something does the pushing or pulling.



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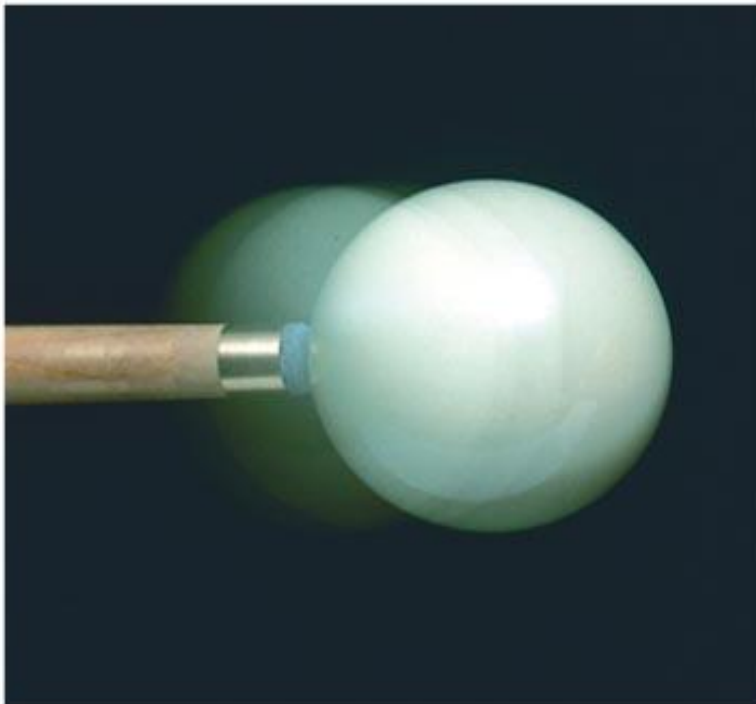


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# What is a Force

- A force is a push or a pull on an object.
- A force requires an agent. Something does the pushing or pulling.
- A force is a vector. (magnitude and direction.)



# Magnitude and Direction

Magnitude is the amount.

**Speed:** the amount is the rate

**Displacement:** the amount is the distance

**Force:** the amount is the strength of the  
push/pull

Speed = 100 mi/hr North

Which part of this is the magnitude?

- A. 100
- B. 100 mi/hr
- C. North
- D. 100 mi/hr North
- E. None of the above

Speed = 100 mi/hr North

Which part of this is the magnitude?

A. 100

**B. 100 mi/hr**

C. North

D. 100 mi/hr North

E. None of the above

Speed = 100 mi/hr North

Which part of this is the direction?

- A. 100
- B. 100 mi/hr
- C. North
- D. 100 mi/hr North
- E. None of the above

Speed = 100 mi/hr North

Which part of this is the direction?

- A. 100
- B. 100 mi/hr
- C. North**
- D. 100 mi/hr North
- E. None of the above

**Velocity:** Speed with Direction

Newton's first law

An object at rest remains at rest

An object in motion remains in motion in a straight  
line

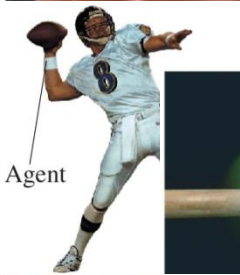
= ....uniform motion at constant velocity



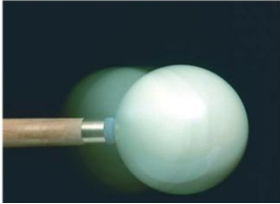
**Natural motion is  
Uniform motion**



Object



Agent



# What is a Force

- A force is a push or a pull on an object.

A force requires an agent.

Something does the pushing or pulling.

A force is a vector. (magnitude and direction.)

A force is either a contact force or a long-range force. (i.e. gravity, magnetism)



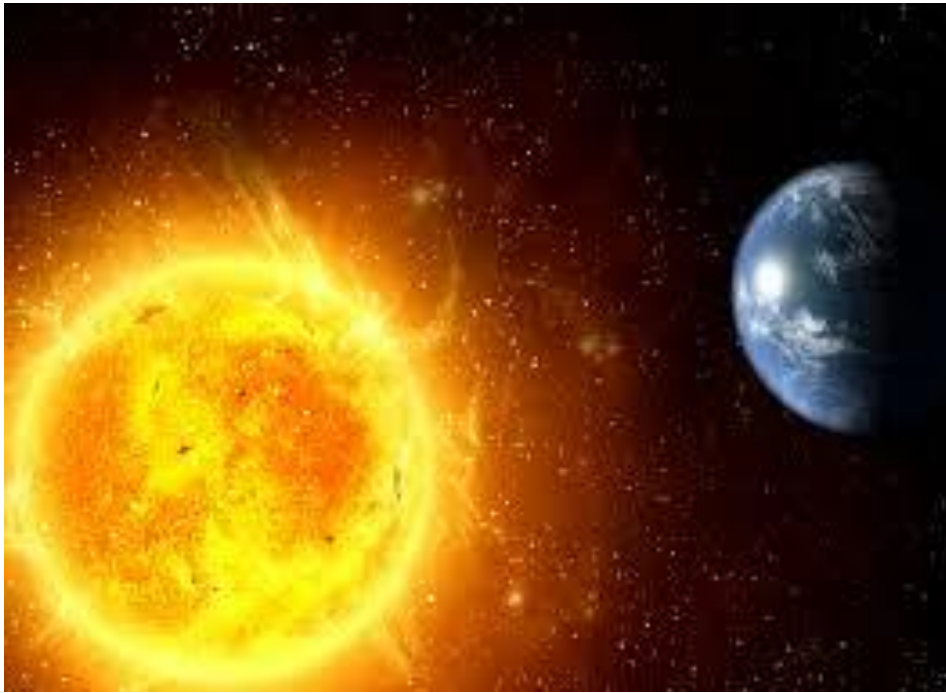
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# Gravity

- Mass attracts mass



# Gravity

- Mass attracts mass



# Gravity

- Mass attracts mass



# Gravity

- Mass attracts mass



- Is the hand throwing the ball a contact force or long range force?



- A. Contact force
- B. Long Range Force
- C. Both
- D. Neither

- Is the hand throwing the ball a contact force or long range force?



- A. Contact force**
- B. Long Range Force
- C. Both
- D. Neither



# Catalog of Forces

- Push
- Pull
- Friction
- Gravity (weight)
- Magnetism
- Electrostatic
- Spring (could be a push or a pull)

# Catalog of Forces

- Normal Force
- Drag
- Thrust

# What do forces do?

They cause acceleration

$$\text{acceleration} = \text{Force/mass}$$

Acceleration = change in speed per time

# **Cause and Effect**

**Force** is the Cause

**Acceleration** is the Effect

- After the ball is no longer touching the hand, can the boy change his mind about how hard he throws it?



A. Yes

B. No

- After the ball is no longer touching the hand, can the boy change his mind about how **hard** he throws it/pushes it? = Force



A. Yes

**B. No**



Would Dear Demi still have won if the Owner rode her? (Assume he's as skilled as the Jockey.)

- A. NO
- B. YES
- C. Maybe



**Jockey, Owner, Trainer**



Would Dear Demi still have won if the Owner rode her? (Assume he's as skilled as the Jockey.)

**A. NO**

**B. YES**

**C. Maybe**



**Jockey, Owner, Trainer**





What is the same if the Owner rides?

What is different if the Owner rides?

# Precise language

- **Force** is what the horse exerts
- **Mass** is how much stuff which tells us about **inertia**
- **Acceleration** is the result – change in speed

# What do forces do?

They cause acceleration

$$\text{acceleration} = \text{Force/mass}$$

Acceleration = change in speed per time

What if you put the same engine in a big truck and in a little car?

Which will accelerate more?

A. Car

B. Truck

C. Both the same



- Engine provides the **Force**

$$\text{acceleration} = \text{Force}/\text{mass}$$

What if you put the same engine in a big truck and in a little car?

Which will accelerate more?

**A. Car**

B. Truck

C. Both the same



# Equal forces

If you push Vin Diesel and this baby, which will accelerate more?

- A. Vin Diesel
- B. Baby
- C. Both same
- D. Not enough info



# Different mass = different acceleration

If you push Vin Diesel and this baby, which will accelerate more?

- A. Vin Diesel
- B. Baby**
- C. Both same
- D. Not enough info





# **Cause and Effect**

**Force** is the Cause

**Acceleration** is the Effect

Despite a very strong wind, a tennis player manages to hit a tennis ball with her racquet so that the ball passes over the net and lands in her opponent's court.

Consider the following forces:

1. A downward force of gravity.
2. A force by the "hit".
3. A force exerted by the air.

Which of the above forces is (are) acting on the tennis ball after it has left contact with the racquet and before it touches the ground?

- |                 |            |
|-----------------|------------|
| A. 1 only.      | C. 1 and 3 |
| B. 1 and 2.     | D. 2 and 3 |
| E. 1, 2, and 3. |            |

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| E. 1, 2, and 3. |            |

(a) Smooth snow



On smooth snow, the sled soon comes to rest.

A person is sitting on a sled moving at a constant speed. The sled hits some dry snow and begins to slow down.

If friction slows the sled, what slows the person on the sled down?

- A. Person is holding on
- B. Friction between the person and the sled
- C. A or B
- D. It's natural to slow down, nothing has to slow the person

(a) Smooth snow



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