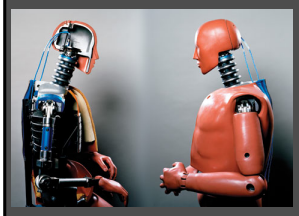
Changes in Motion



Define *force* and introduces free-body diagrams.
Analyze interactions by identifying the forces involved.
Understand many types of motion.

MCHS Honors Physics 2014-15

Force

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- A force can cause an acceleration - a force exerted on an object can change the object's velocity with respect to time.
  - » A force can cause a stationary object to move

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- A force can cause an acceleration - a force exerted on an object can change the object's velocity with respect to time.
  - » A force can also cause a moving object to change direction

The SI Unit of Force is the Newton

- The SI unit of force is the newton, named after Sir Isaac Newton.
- The newton (N) is defined as the amount of force that, when acting on a 1 kg mass, produces an acceleration of 1 m/s^2. Therefore, $1\ N = 1\ kg \times 1\ m/s^2$.

Table 1 Units of Mass, Acceleration, and Force

System	Mass	Acceleration	Force
SI	kg	m/s^2	$N = kg \cdot m/s^2$

Weight Is a Force…Mass Isn't

- The weight of an object is a measure of the magnitude of the gravitational force exerted on the object.
- Weight is the result of the interaction of an object's mass with the gravitational field of another object, such as Earth.

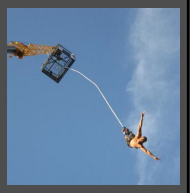
- 1/4 lb stick of margarine has a weight equivalent to a force of about 1 N

Forces Can Act Through Contact

- *Contact forces,* result from physical contact between two objects.
- Contact forces are easy to identify when you analyze a situation.

Forces Can Act At A Distance

- *Field forces* do not involve physical contact between two objects.
- Gravitational force - Whenever an object falls to Earth, the object is accelerated by Earth's gravity. Earth exerts a force on the object even when Earth is not in contact with the object.
- The attraction or repulsion between electric charges is another example of a field force

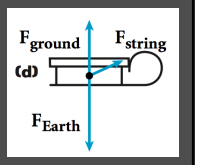


Is There Such a Thing as Contact?

- The distinction between contact forces and field forces is useful when dealing with forces that we observe at the macroscopic level.
- As we will see later, all macroscopic contact forces are actually due to microscopic field forces.
- For instance, contact forces in a collision are due to electric fields between atoms and molecules.
- In fact, every force can be categorized as one of four fundamental field forces.

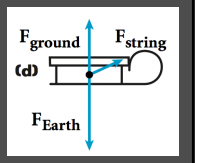
Force is a Vector

- Because the effect of a force depends on both magnitude and direction, force is a vector quantity.
- Diagrams that show force vectors as arrows are called *force diagrams*.
- The tail of an arrow is "attached" to the object on which the force is acting.



Free Body Diagrams

- A force vector points in the direction of the force.
- The vector length is proportional to the magnitude of the force.
- All forces are drawn as if they act at the center of the object, no matter where the force is applied.
- A free-body diagram is used to analyze the forces affecting the motion of an object.
- Free-body diagrams are constructed and analyzed just like other vector diagrams.



Free Body Diagrams