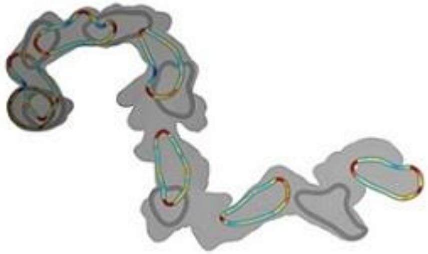
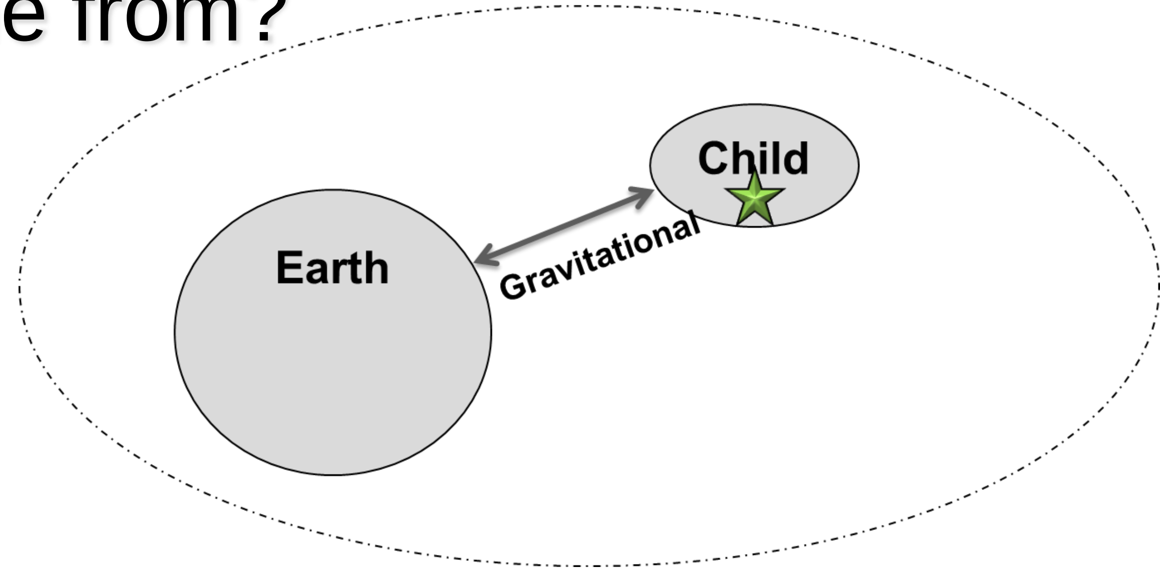
Physics 131- Fundamentals of Physics for Biologists I



Work –Energy Theorem

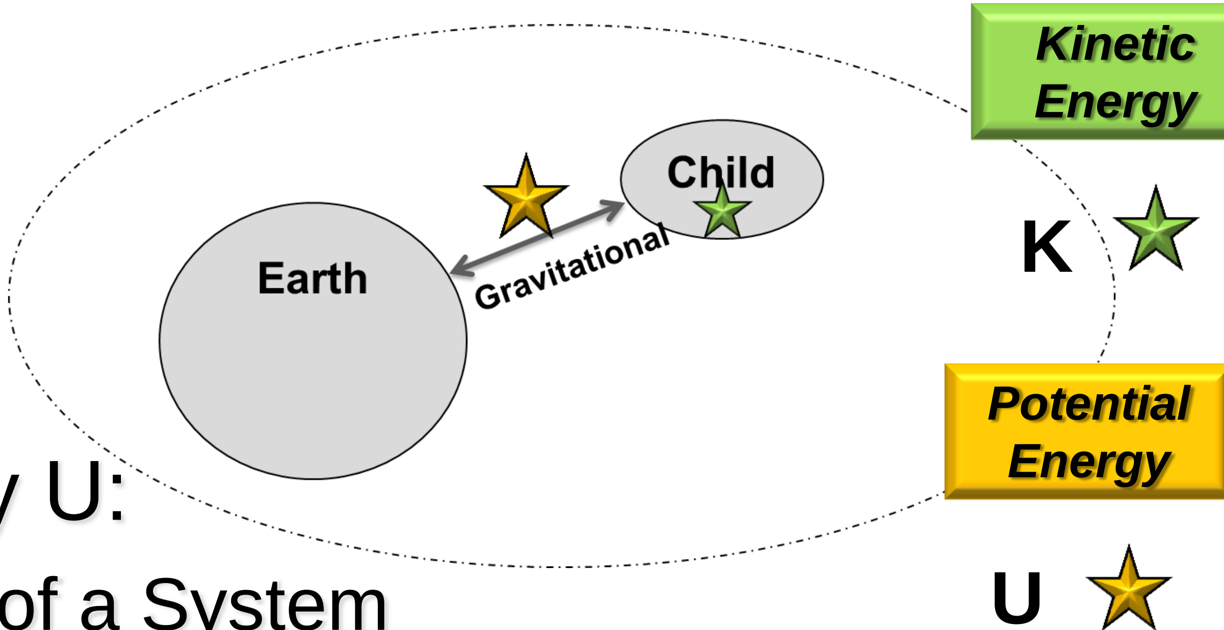
Potential Energy

Where does kinetic energy of the child come from?



1. Potential energy of the earth
2. Potential energy of the child
3. **Another source**

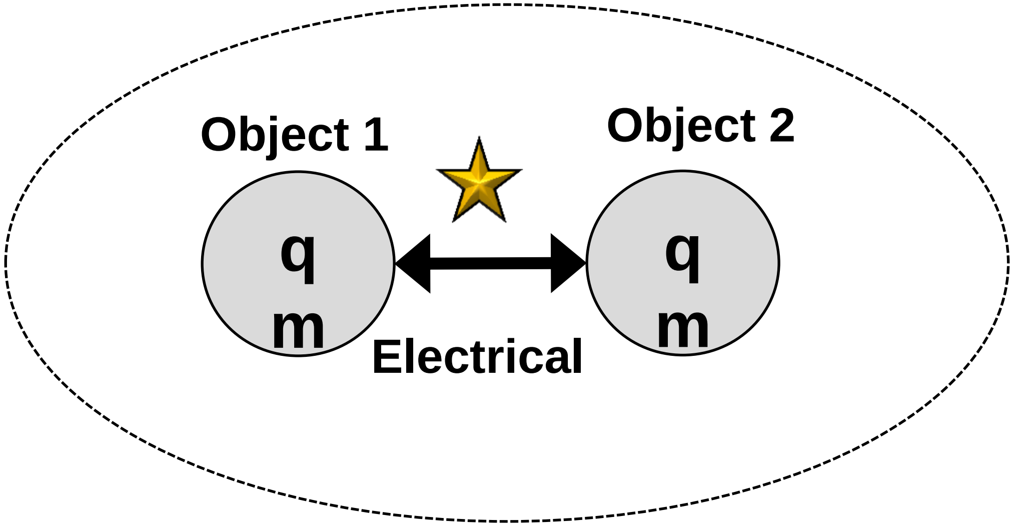
Foothold Principle: Potential Energy



Potential energy U:

- Internal energy of a System
- Related to interactions (forces) within the System
- Can turn into kinetic energy (or other energy) when the objects in the system move
- **Stored in INTERACTION (line between objects)**

Lets look at electrical force moving objects



“Initial”: t_1

Objects at rest

Potential energy U 

Where does the potential energy go when the charges move apart?

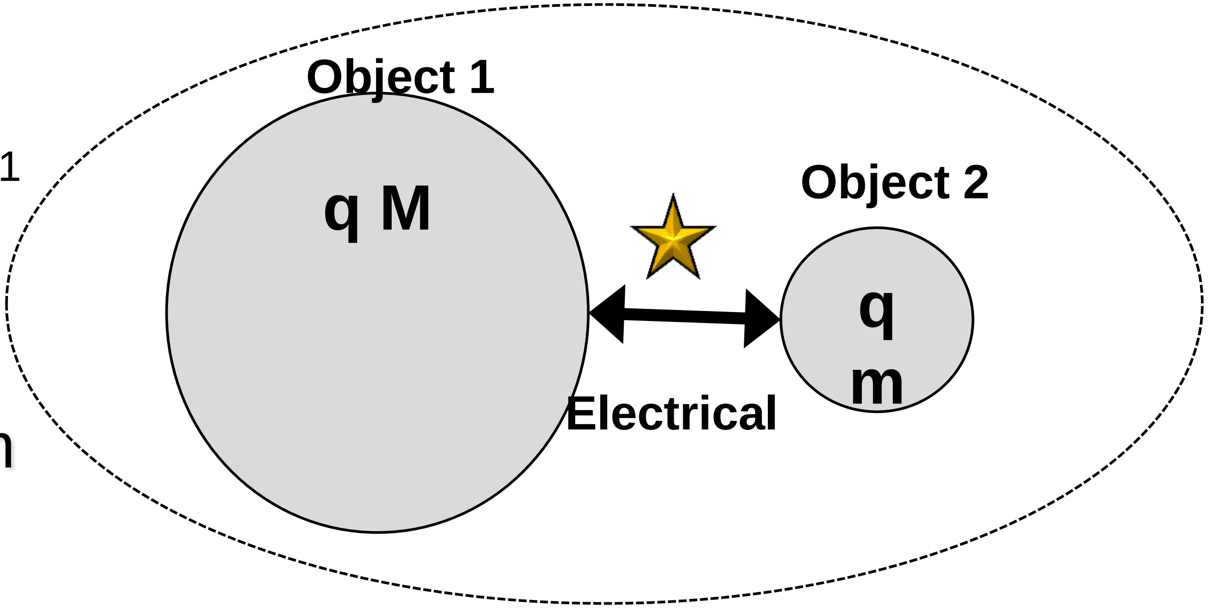
Kinetic energy of BOTH objects

Whiteboard, TA & LA

Now lets make object 1 1000 times heavier

“Initial”: t_1

M=1000m

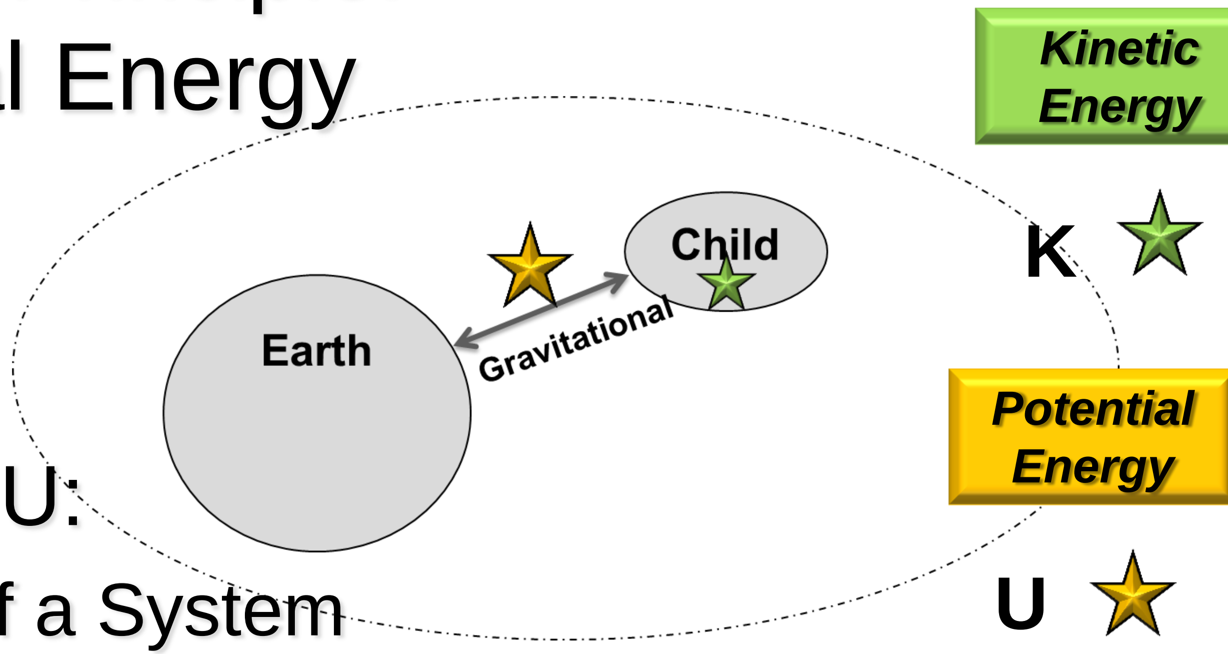


Does object 2 get more kinetic energy?

Object 2 gets 1000 times more kinetic energy than object 1

Whiteboard, TA & LA

Foothold Principle: Potential Energy



Potential energy U:

- Internal energy of a System
- Related to interactions (forces) within the System
- Can turn into kinetic energy (or other energy) when the objects in the system move
- Stored in INTERACTION (line between objects)
- **The object that moves more gets/supplies more of the potential energy!**

Potential Energy

- For some internal forces the force only depends on distance between the objects. Then the work done can be written as

$$\vec{F}_{12} \bullet \Delta \vec{r}_2 + \vec{F}_{21} \bullet \Delta \vec{r}_1 = -\Delta U_{12}$$

U is called a *potential energy* of the interaction between objects 1 and 2.

- For gravity, $U_{gravity} = mgh$

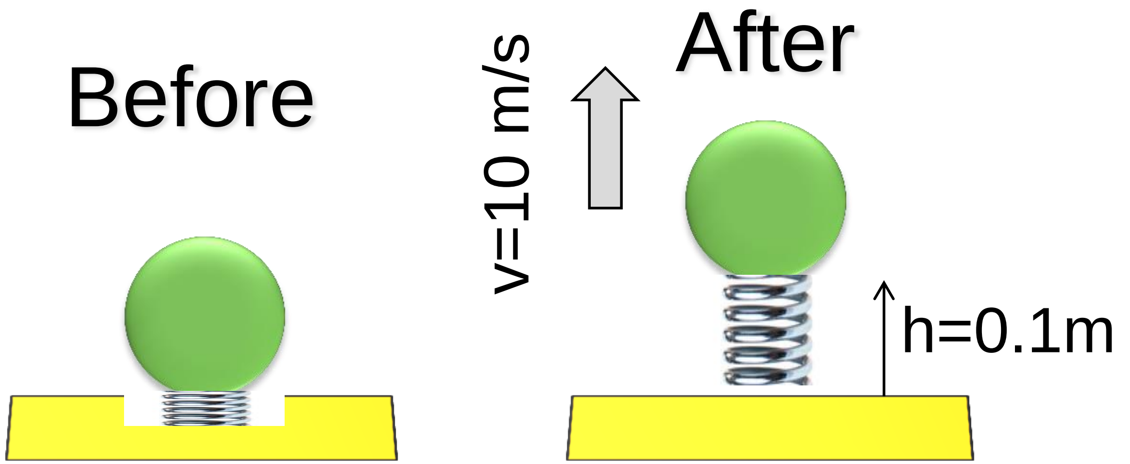
  For a spring, $U_{spring} = ½\, kx^2$

  For electric force, $U_{electric} = k_C Q_1 Q_2 / r_{12}$

A spring-loaded toy dart gun is used to shoot a dart straight up in the air, and the dart reaches a maximum height of 24 m. The same dart is shot straight up a second time from the same gun, but this time the spring is compressed only half as far before firing. How far up does the dart go this time, neglecting friction and air resistance and assuming an ideal spring?

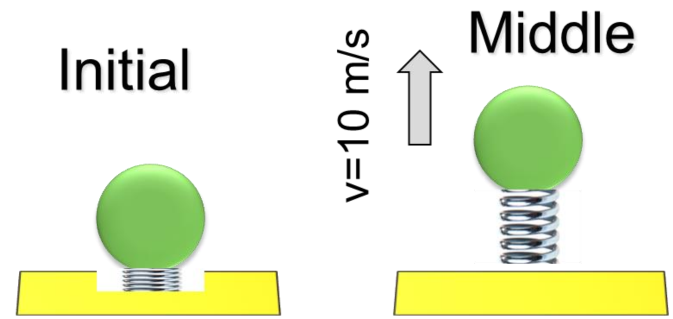
1. 96 m
2. 48 m
3. 24 m
4. 12 m
5. 6 m
6. 3 m
7. Something else

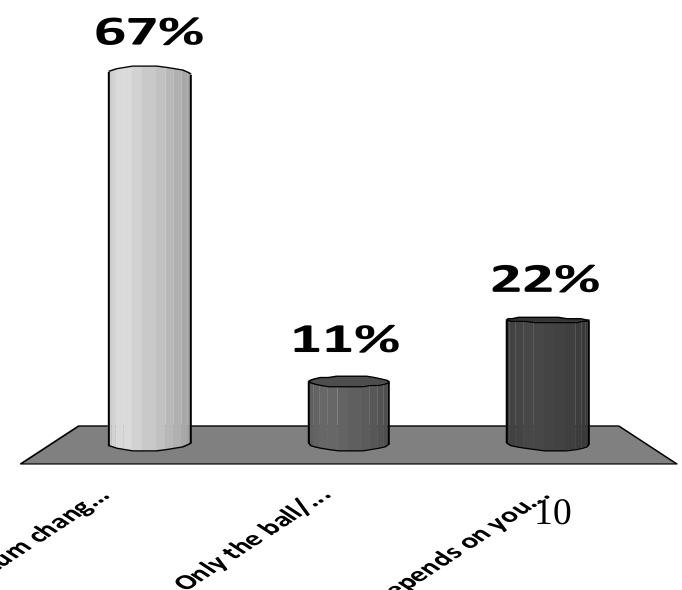
1. Draw System Schema for Before and After state
2. Identify main Energies in System Schema
3. Define a system boundary so that mechanical energy is conserved in the system



Comparing the before and after state, the spring pushes on both the ball and the earth giving them energy and momentum

1. **Momentum change of ball/spring and earth is the same**
2. Only the ball/spring changes momentum
3. Depends on your choice of system





Comparing the before and after state, the spring pushes on both the ball and the earth giving them kinetic energy and momentum

1. Kinetic Energy change of ball/spring and earth is the same
2. **Only the ball/spring changes Energy**
3. Depends on your choice of system