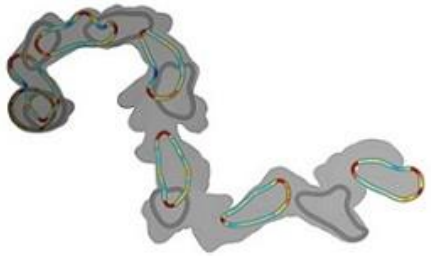
Physics 131- Fundamentals of Physics for Biologists I



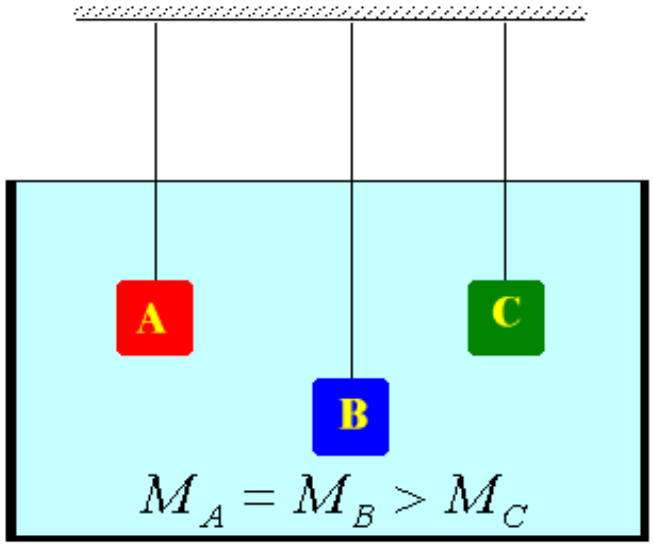
Math: Dot Product

Work –Energy Theorem

Potential Energy

Quiz

Average: 7.3

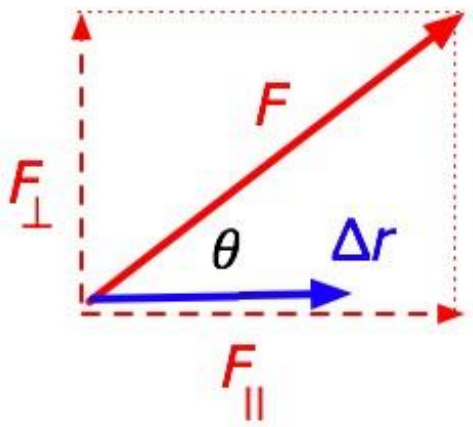


Two hoses, one of 20-mm diameter, 1 meter in length, the other of 15-mm diameter and also 1 meter in length are connected one behind the other to a faucet.

Work in another direction: The dot product

- Suppose we are moving along a line, but the force we are interested in in pointed in another direction?

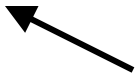
- Only the part of the force in the direction of the motion counts to change the speed (energy).



$$\text{Work} = F_{\parallel}\,\Delta r = F\cos\theta\,\Delta r \equiv \vec{F}\cdot\Delta\vec{r}$$

Each row in the following table pairs a force vector with a corresponding displacement resulting in work *W* being done.

In which of these rows is the work done zero?

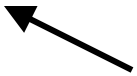
	$\vec{F}$	$D\vec{r}$
1.		
2.		
3.		
4.		
5.		

6. None of the above

Whiteboard, TA & LA

Each row in the following table pairs a force vector with a corresponding displacement resulting in work *W* being done.

In which of these rows is the work done positive?

	$\vec{F}$	$D\vec{r}$
1.		
2.		
3.		
4.		
5.		

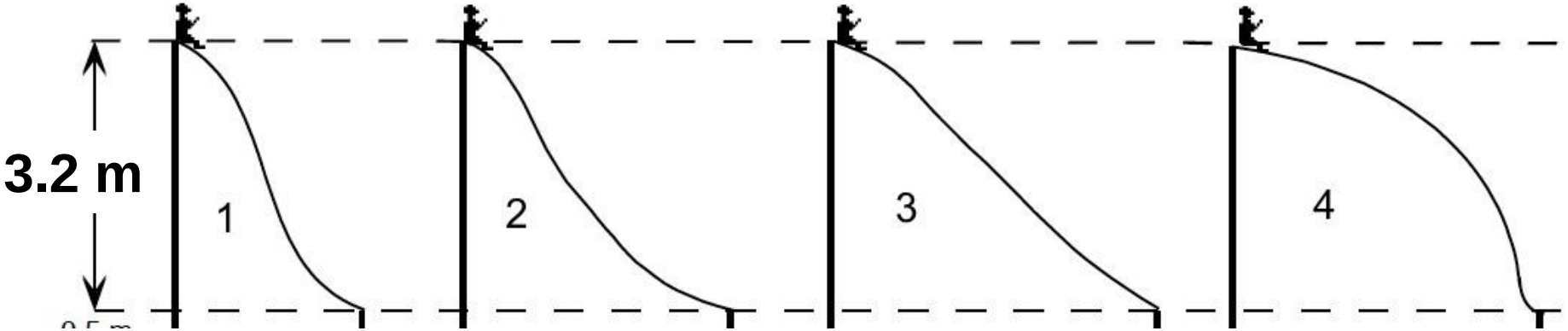
6. None of the above

Whiteboard, TA & LA

Foothold ideas: Kinetic Energy and Work

- Newton's laws tell us how velocity changes. The Work-Energy theorem tells us how speed (independent of direction) changes.
- Kinetic energy = $\frac{1}{2}mv^2$
- Work done by a force = $F_x \Delta x$ or $F_{||} \Delta r$ (part of force parallel to displacement)
- Work-energy theorem: $\Delta(\frac{1}{2}mv^2) = F_{||}^{net} \Delta r$

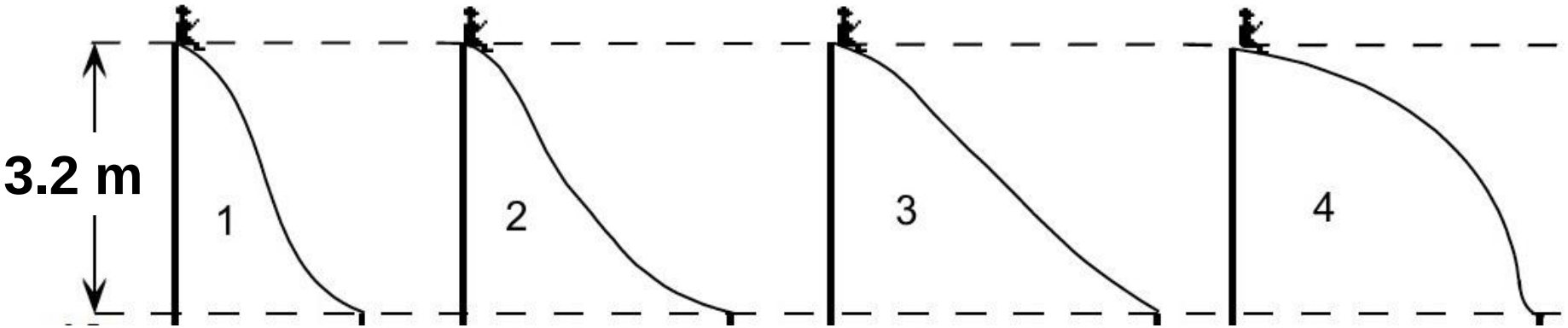
A young child wants to select one of the (frictionless) playground slides illustrated below to give her the greatest possible speed when she reaches the bottom of the slide. Which should she choose?



1. 1
2. 2
3. 3
4. 4
5. **It doesn't matter. It would be the same for each.**

Whiteboard, TA & LA

If the child starts from rest at the top of the slide, calculate the velocity of the child at the bottom of the slide

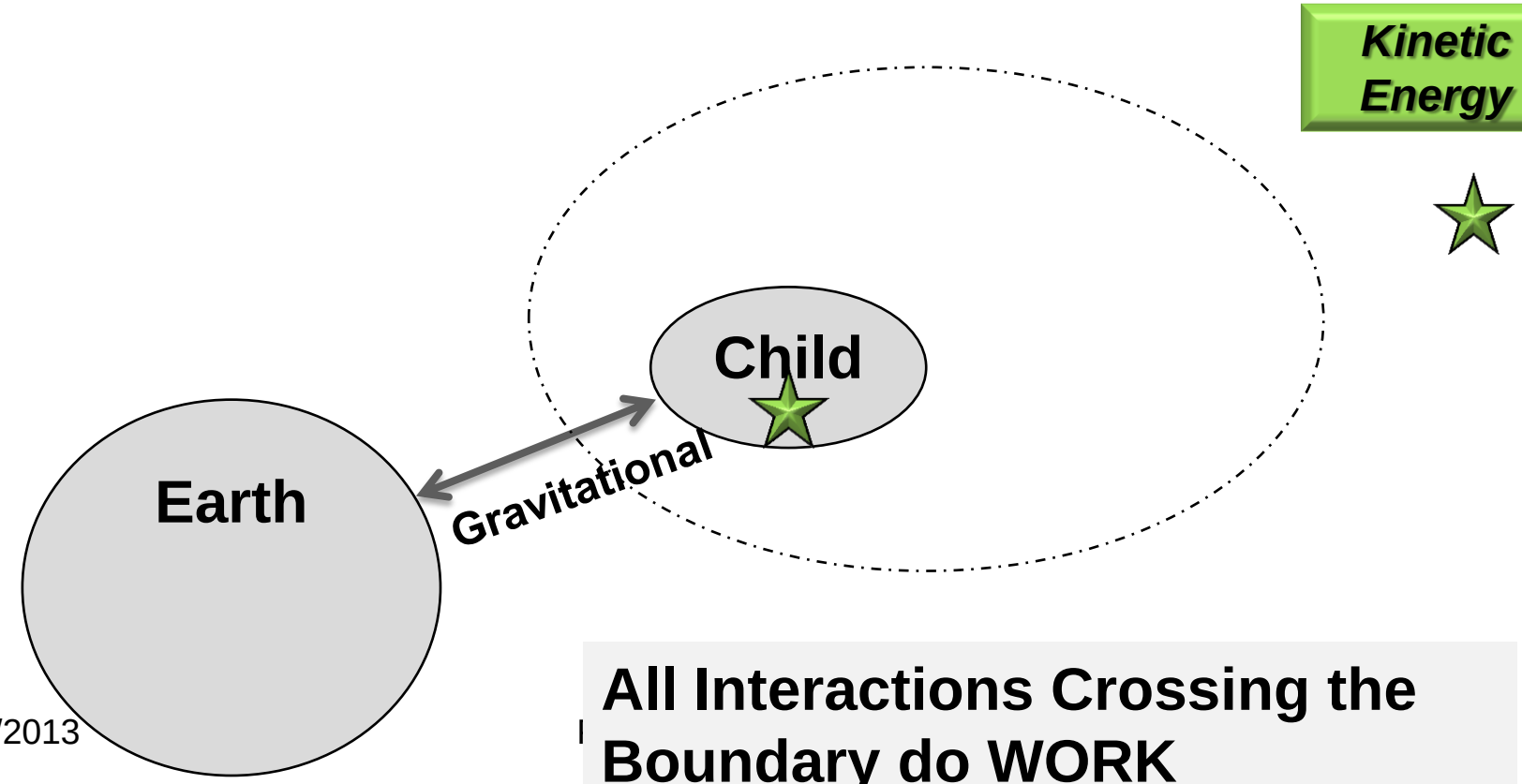


1. 16 m/s
2. 32 m/s
3. 8 m/s
4. **4 m/s**
5. Depends on the weight of the girl

Whiteboard, TA & LA

Energy Conservation

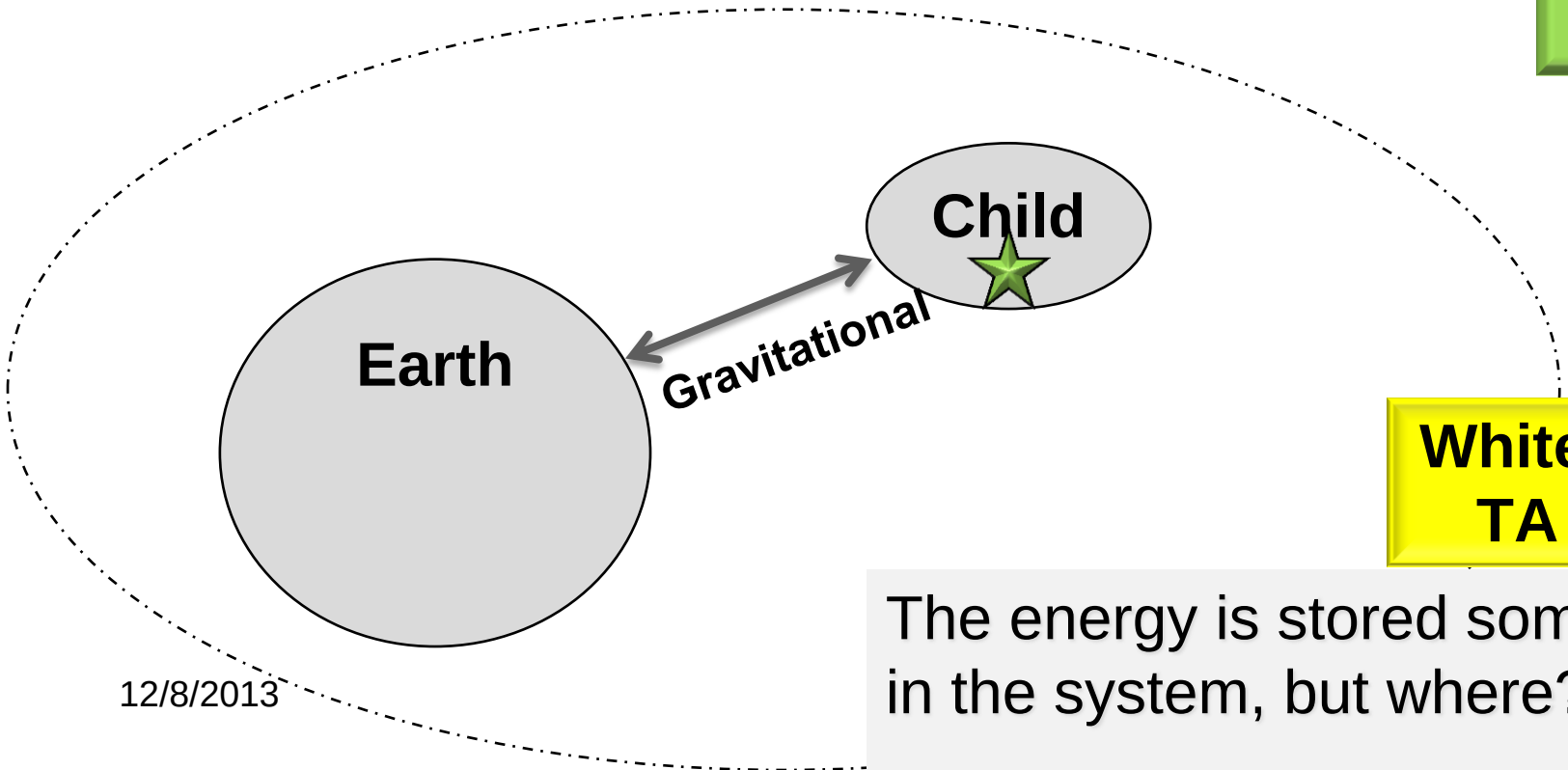
Total energy of object of interest is conserved unless external forces move the object of interest (i.e. do work on the object)



All Interactions Crossing the Boundary do WORK

Energy Conservation for SYSTEM

Total energy of system is conserved unless external forces move object(s) within the system (i.e. do work on the object(s))

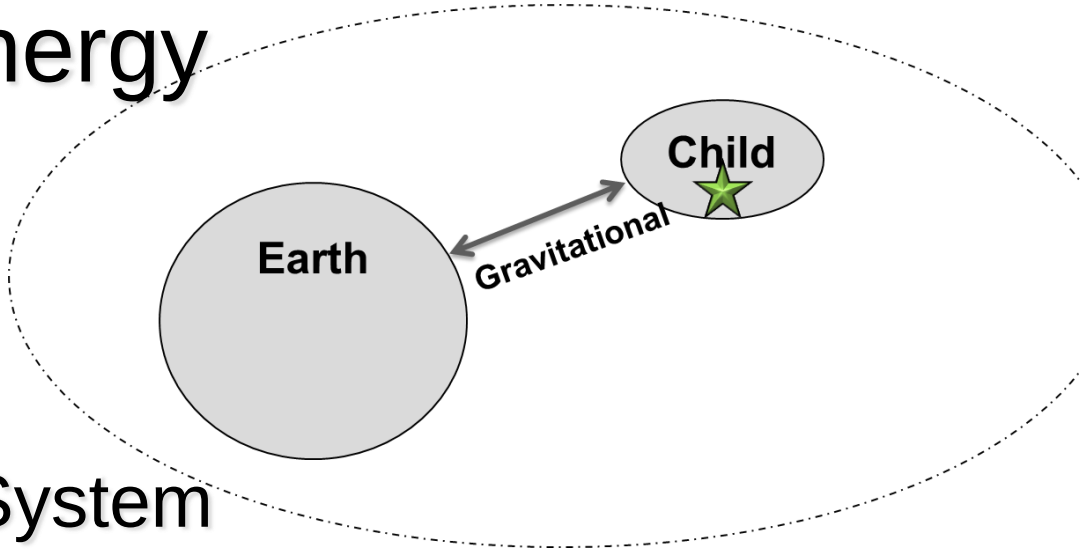


Kinetic Energy

Whiteboard, TA & LA

The energy is stored somewhere in the system, but where?

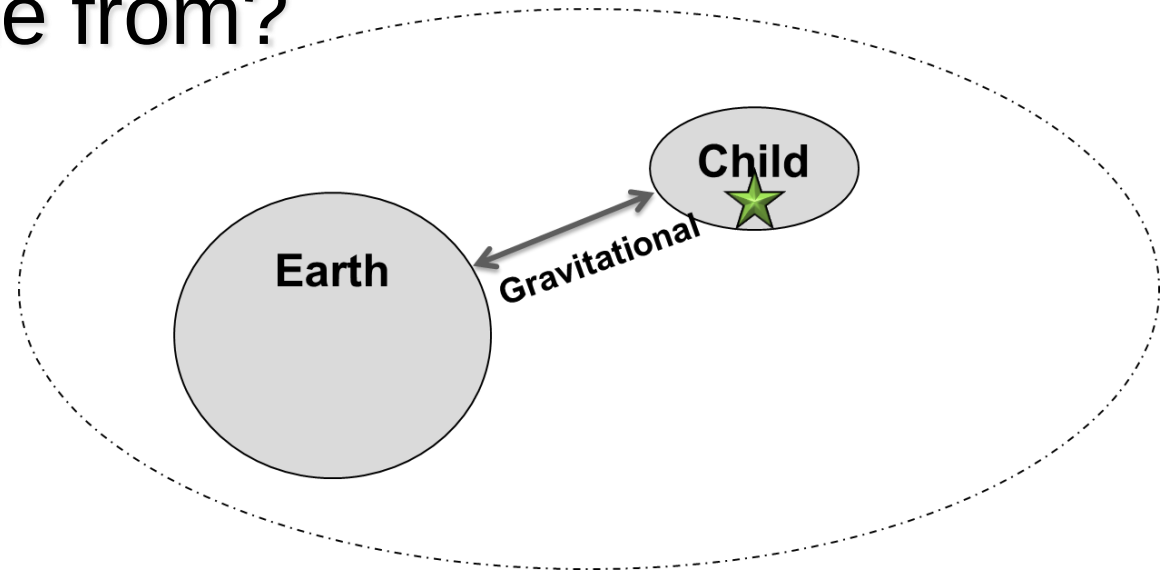
Foothold Principle: Potential Energy



Potential energy:

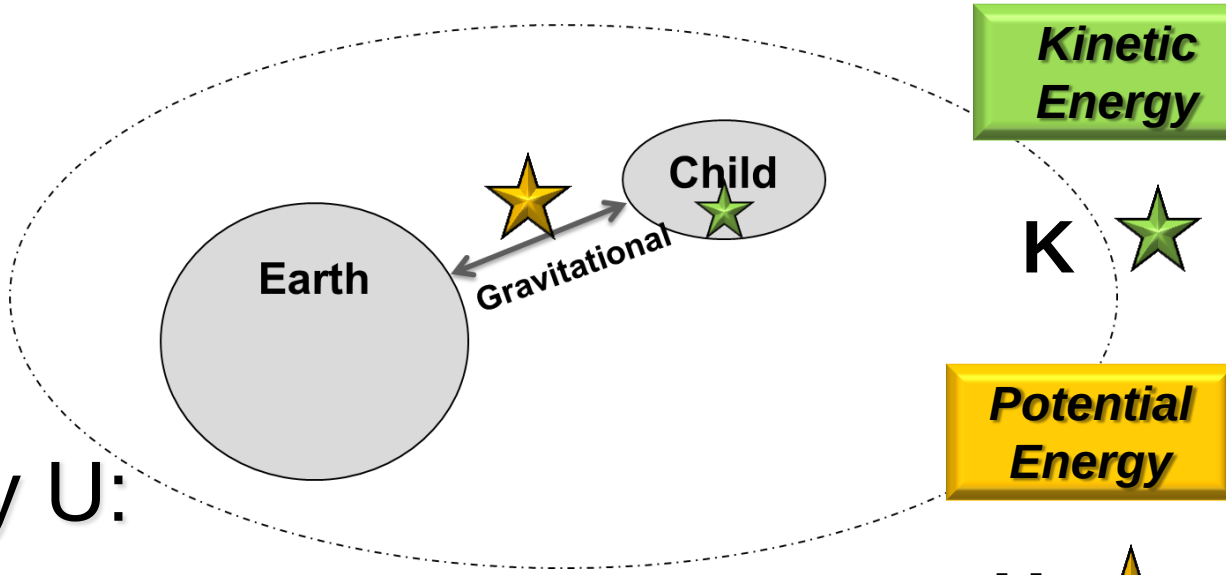
- Internal energy of a System
- Related to interactions (forces) within the System
- Can turn into kinetic energy (or other energy) when the objects in the system move

Where does kinetic energy of the child come from?



1. Potential energy of the earth
2. Potential energy of the child
3. **Another source [potential energy resides in the interaction between objects]**

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)**