## Potential Energy and the Work Done by Conservative Forces

| Learning Target | Description |
|---|---|
| 10.1 | I can define, analyze, and solve problems involving potential energy and the work done by conservative forces. |



| PRACTICE | LABS | TESTS |
|---|---|---|
| Problems (1-5) | Stair Power Lab due today | Unit 10 Test Thursday 2/7/19 |

## Conservative vs. Nonconservative Forces

| CONSERVATIVE FORCES | NONCONSERVATIVE FORCES |
|---|---|
| • Work is stored in the form of energy that can be released at later time.<br>• A conservative force is a force that does zero total work on any closed path.<br>• If the work done by a force in going from an arbitrary point A to an arbitrary point B is independent of the path from point A to B, the force is conservative.<br>EXAMPLES: Gravity & Springs | • Work cannot be recovered later as kinetic energy. Instead, it is converted to other forms of energy.<br>EXAMPLES:<br>Friction, Tension, Muscles |

## Potential Energy

- **Potential Energy (U):** is a storage system for energy.
- When a conservative force does an amount of work ($W_c$), the corresponding potential energy U is changed.

$$W_c = -\Delta U$$

- Gravitational Potential Energy depends on weight and height, *h*, but it is independent of horizontal position.

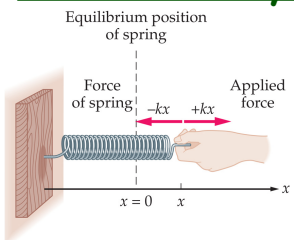
$$\Delta U_g = mg\Delta y$$

## Energy?

## Springs and Bungees

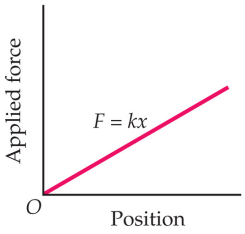
Because springs, and bungee cords, exert conservative forces, they can serve as energy storage devices.

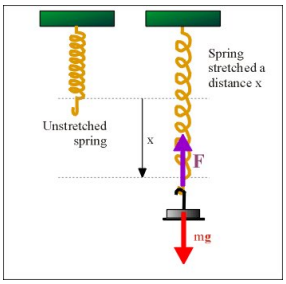
## Work Done By a Spring




**Hooke's Law**
$F = k\,x$

**Work Done by a Spring**
$W = \frac{1}{2}\,k\,x^2$




## Potential Energy for a Spring

$$U_s = \frac{1}{2}kx^2$$

## POTENTIAL IN-CLASS PROBLEMS

3. Find the potential energy of a spring with force constant $k$ = 680 N/m if it is **(a)** stretched by 5.00 cm or **(b)** compressed by 10.00 cm.

4. When a force of 120.0 N is applied to a certain spring, it causes a stretch of 2.25 cm. What is the potential energy of this spring when it is compressed by 3.50 cm?

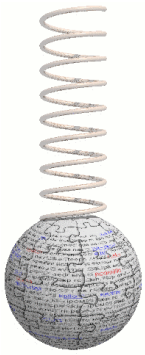
## POTENTIAL IN-CLASS PROBLEMS

3. Find the potential energy of a spring with force constant $k$ = 680 N/m if it is **(a)** stretched by 5.00 cm or **(b)** compressed by 10.00 cm. 0.05 m 0.1 m

$U_s = \frac{1}{2}kx^2$

a) 0.85 J

b) 3.4 J



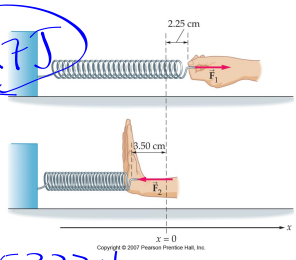
## POTENTIAL IN-CLASS PROBLEMS

4. When a force of 120.0 N is applied to a certain spring, it causes a stretch of 2.25 cm. What is the potential energy of this spring when it is compressed by 3.50 cm?

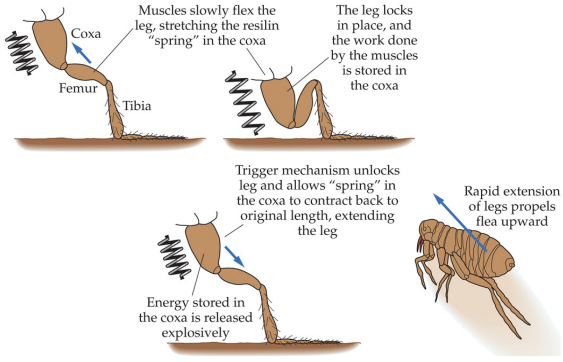
$U_s = \frac{1}{2}kx^2 = 3.27\text{ J}$

$F = kx$

$k = \frac{F}{x} = \frac{120}{0.0225} = 5333\text{ N/m}$




## Application




PRACTICE
PROBLEMS
(1-5)