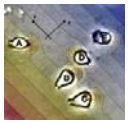
Physics 131- Fundamentals of Physics for Biologists I



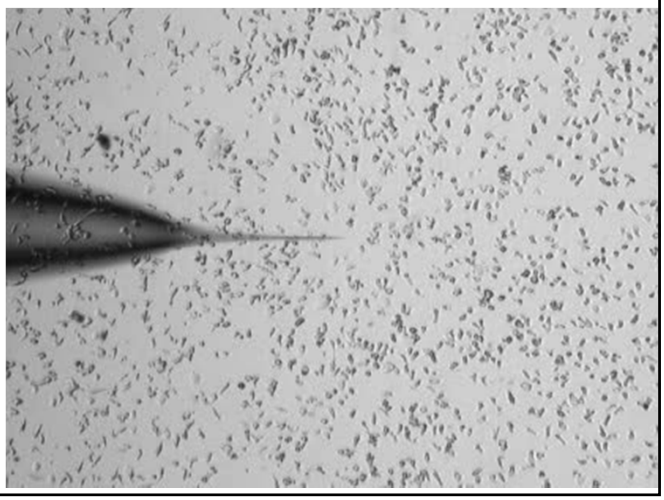
Professor: Wolfgang Losert wlosert@umd.edu

9/26/2012

-How can we describe motion (Kinematics)

- What is responsible for motion (Dynamics)

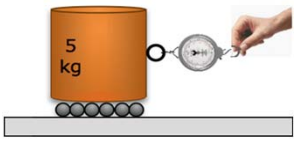
Movie of the Day
Chemically guided motion



Outline

- Exam next week Fri
- Forces
  - Gravitational Force
  - Spring force
  - Normal force
  - Resistive forces
    - » Friction force
    - » Viscous force
    - » Drag force

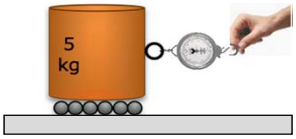
System Schema



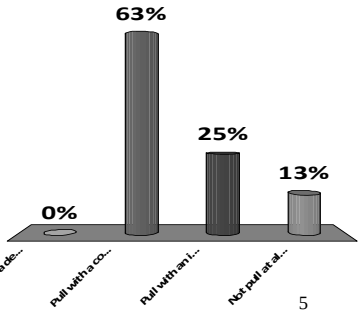
Newton's Laws: Version 1.0

- Newton 0:
  - An object responds to the forces it feels when it feels them.
- Newton 1:
  - An object that feels a net force of 0 keeps moving with the same velocity (which may = 0).
- Newton 2:
  - An object that is acted upon by other objects changes its velocity according to the rule $\vec{a}_A = \vec{F}_A^{net} / m_A$
- Newton 3:
  - When two objects interact the forces they exert on each other are equal and opposite. $\vec{F}_{A\to B}^{type} = -\vec{F}_{B\to A}^{type}$

You are pulling the block along a table
To ensure that the block speeds up at a constant rate you need to



1. Pull with a decreasing force.
2. Pull with a constant force.
3. Pull with an increasing force.
4. Not pull at all.



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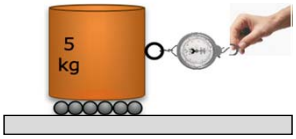
You are pulling the block along a table
To move the block at constant speed



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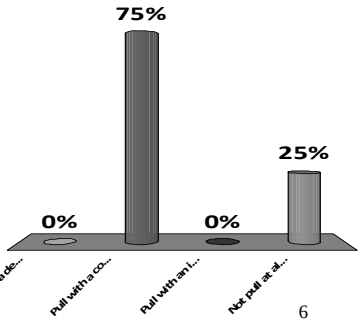

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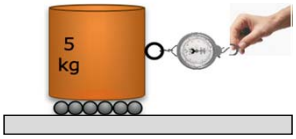
You are pulling the block along a table To move the block at constant speed



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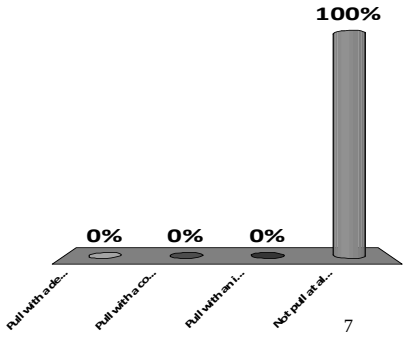
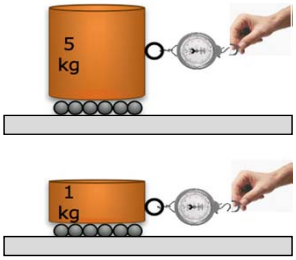
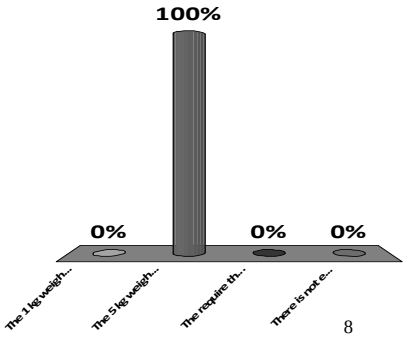


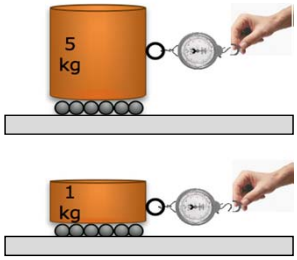
You are pulling two blocks along a table with equal acceleration. Which one requires a larger force?



1. The 1 kg weight block
2. The 5 kg weight block
3. The require the same force.
4. There is not enough information to tell.



You are pulling two blocks along a table with constant speed (ignore friction). Which one requires a larger force?



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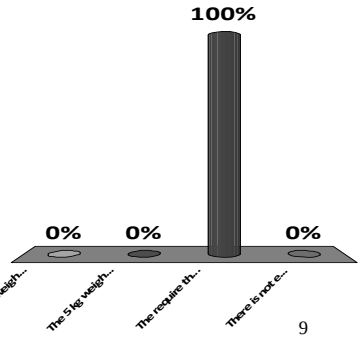


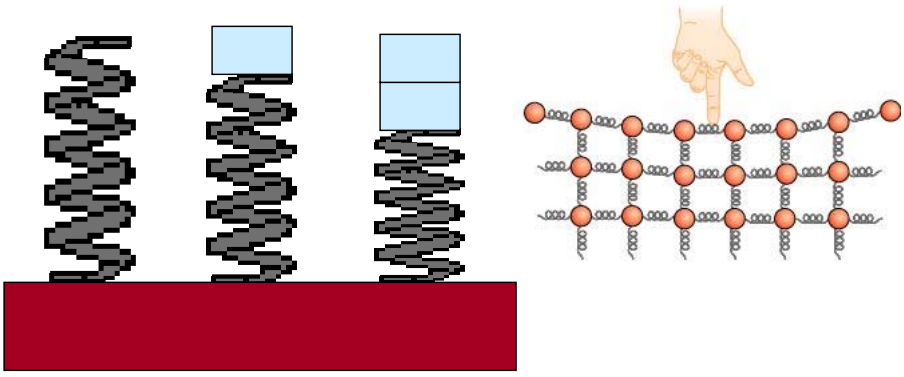
Springs

- If you pull on a spring from both sides it changes its length.

$$T = k\Delta L$$ ("ΔL" = stretch or squeeze)

- Holds for ALL objects interacting pulled by a spring!

Normal Force works like a network of very stiff springs



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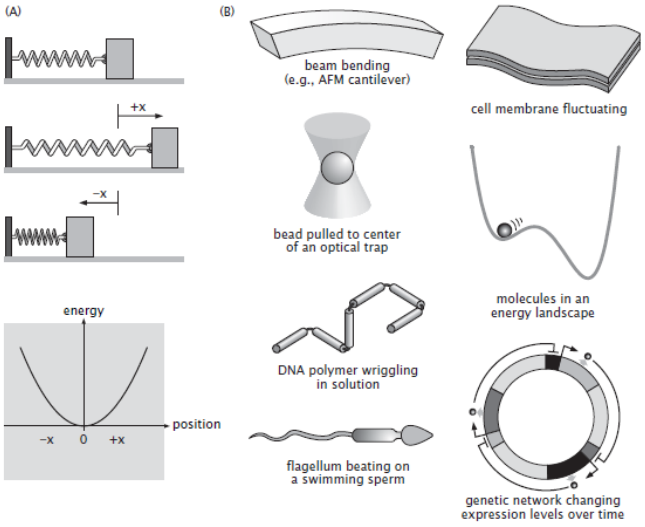
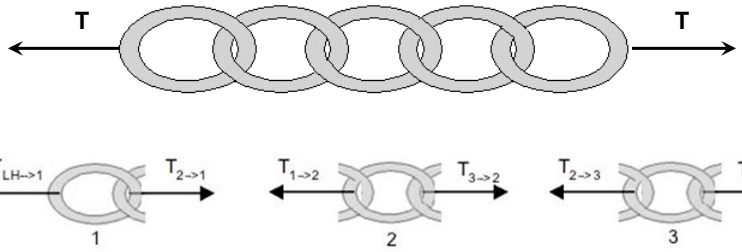
Springs in biology



From: Physical Biology of the Cell, Philips, Kondev, Therior (2009)

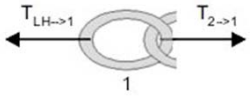
Scalar vs. Vector Tension: The Chain

- Consider a series of links of chain being pulled from opposite directions. What are the forces on each link?

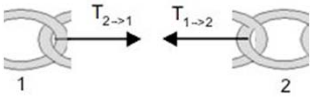


Which of the force pairs are examples of Newton's third law

A



B



1. A
2. B
3. A and B
4. neither