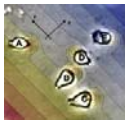
Physics 131- Fundamentals of Physics for Biologists I



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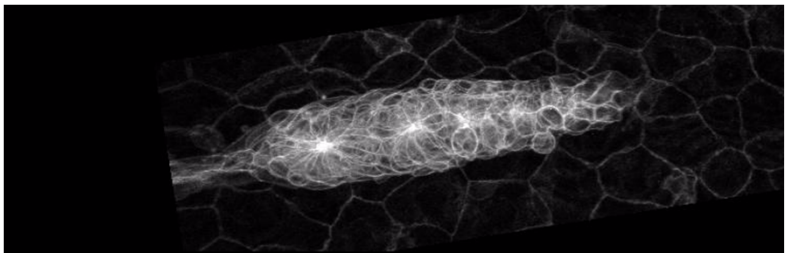
9/5/2012 - Main Topic: Motion

-Coordinates, Graphs, Vectors



Deborah Hemingway

Movie of the Day
Development of the Central Nervous System

Outline

- Recap:
  - Estimation
- **The Main Topic: Motion**
  - **Kinematics** Describing Motion:
    - » Coordinates
    - » Graphs
    - » Vectors

Useful numbers (people)

Numbers	
Number of people on the earth	~7 billion (7×10^9)
Number of people in the USA	~ 300 million (3×10^8)
Number of people in the state of Maryland	~ 5 million (5×10^6)
Number of students in a large state university	~30-40 thousand (3×10^4)

Physics 131

Useful numbers (distances)

Macro Distances	
Circumference of the earth	~24,000 miles (1000 miles/time zone at the equator)
Radius of the earth*	$2/\pi \times 10^7$ m
Distance across the USA	~3000 miles
Distance across DC	~10 miles

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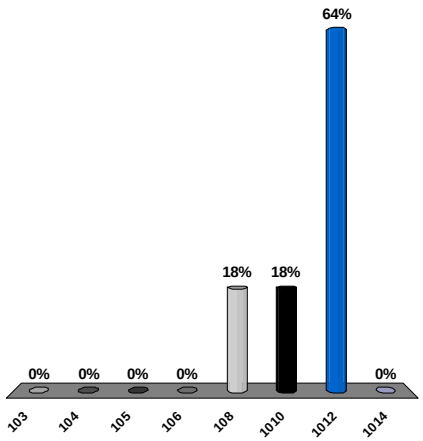
Estimate the number of cells in your body.

1. 10^3
2. 10^4
3. 10^5
4. 10^6
5. 10^8
6. 10^{10}
7. 10^{12}
8. 10^{14}



- Estimation is harder in biology problems since we may not have the knowledge of some basic numbers that can be used as a foothold for estimation

Foothold Biology Numbers

Numbers that we do NOT know from personal experience but that we need to build an "intuition" for living systems

Bio Scales	
Size of a typical animal cell	**~10-20 microns (10^{-5} m)**
Size of a bacterium, chloroplast, or mitochondrion	**~1 micron (10^{-6} m)**
Size of a medium-sized virus	**~0.1 micron (10^{-7} m)**
Thickness of a cell membrane	**~10nanometer = 0.01 micron (10^{-8} m)**

Foothold Biology Numbers

- You will learn foothold biology numbers throughout this physics class
  - Volume of a Cell
  - Speed of a living system (calculate in lab,recitation,HW)
  - Number of molecules per μm^3 in nM solution (you will calculate this in HW)
  - electrical potential of neurons

Outline

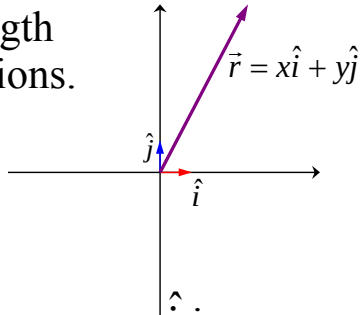
- Recap:
  - Estimation
- **The Main Topic: Motion**
  - **Kinematics:** Describing Motion
    - » Coordinates
    - » Graphs
    - » Vectors

Foothold ideas: Coordinates in space

- In order to specify the position of something we need a coordinate system.
- The coordinate system includes:
  - Picking an ***origin***
  - Picking perpendicular directions for the axes of the coordinate system
  - Choosing a ***measurement scale***
- Each point in space in then specified by
  - three numbers: the *x*, *y*, and *z* coordinates.
  - a position vector– an arrow drawn showing the displacement from the origin to that position.

Notation

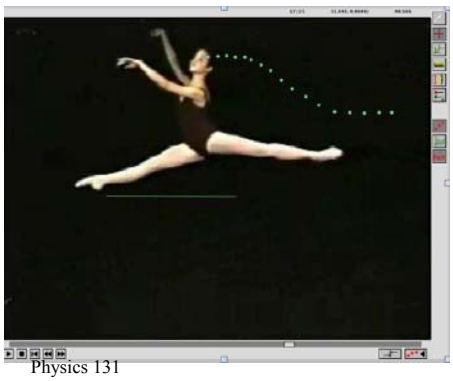
- We specify the directions we are talking about by drawing two little arrows of unit length in two perpendicular directions.
- "x" and "y" are called the coordinates and can be positive or negative.
- Note that if x is negative, it means $x\hat{i}$ is a vector pointing in the direction opposite to



Graphing Position

- Graphs for the eye vs. graphs for the mind.
- Describe where something is in terms of its coordinate at a given time.

- Choose origin
- Choose axes
- Choose scale
- Set scales on graph
- Take data from video
- Construct different graphs
- Fit the graphs with math functions



Where is t=0 on the graph?

1. At the far left
2. At the far right
3. You can't tell, there is not enough information
4. I have no clue
5. The question makes no sense