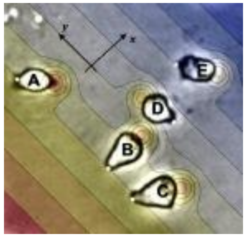
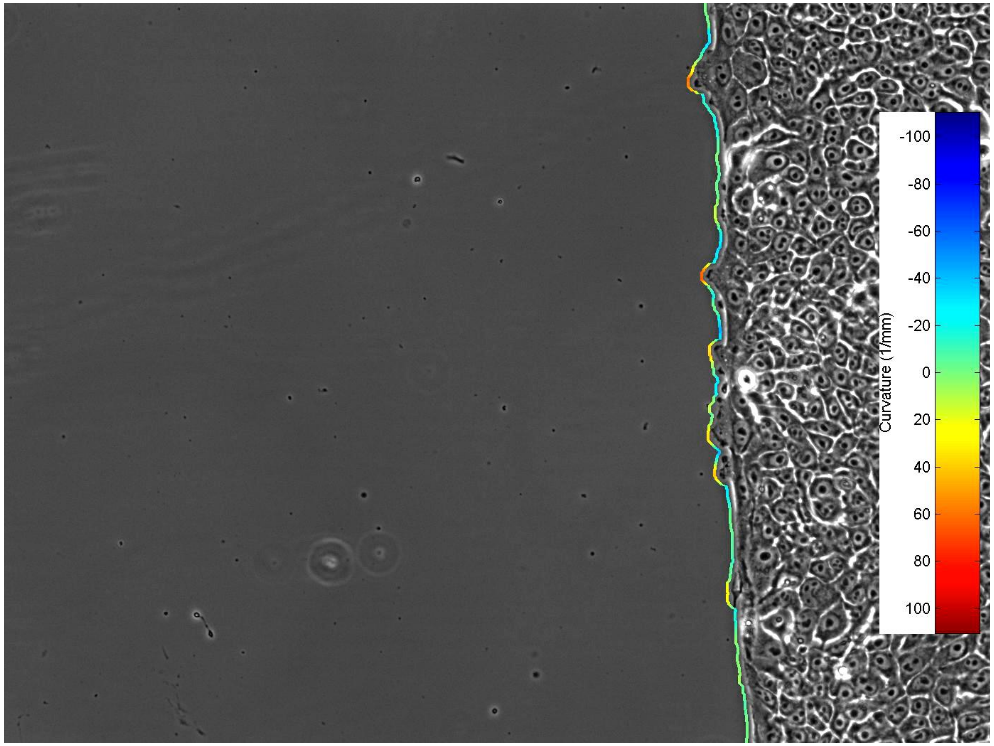
Physics 131- Fundamentals of Physics for Biologists I



Professor: Wolfgang Losert
wlosert@umd.edu

Pink Floyd



Wound healing, Rachel Lee (Losert Lab)

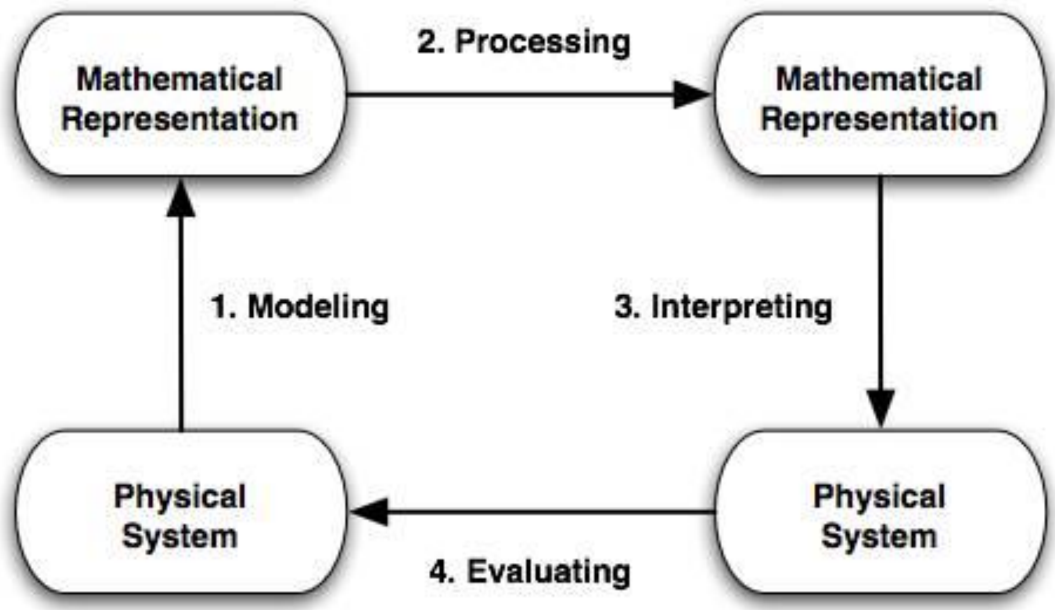
Kinematics and Dynamics

- Kinematics: Describing motion (Chapter 3)
  - Acceleration
- Dynamics: What causes motion
  - Forces and Newton's laws (Chapter 4)

<u>Off topic (don't ask these thi</u>
<u>the reading assignments), b</u>
<u>questions:</u>

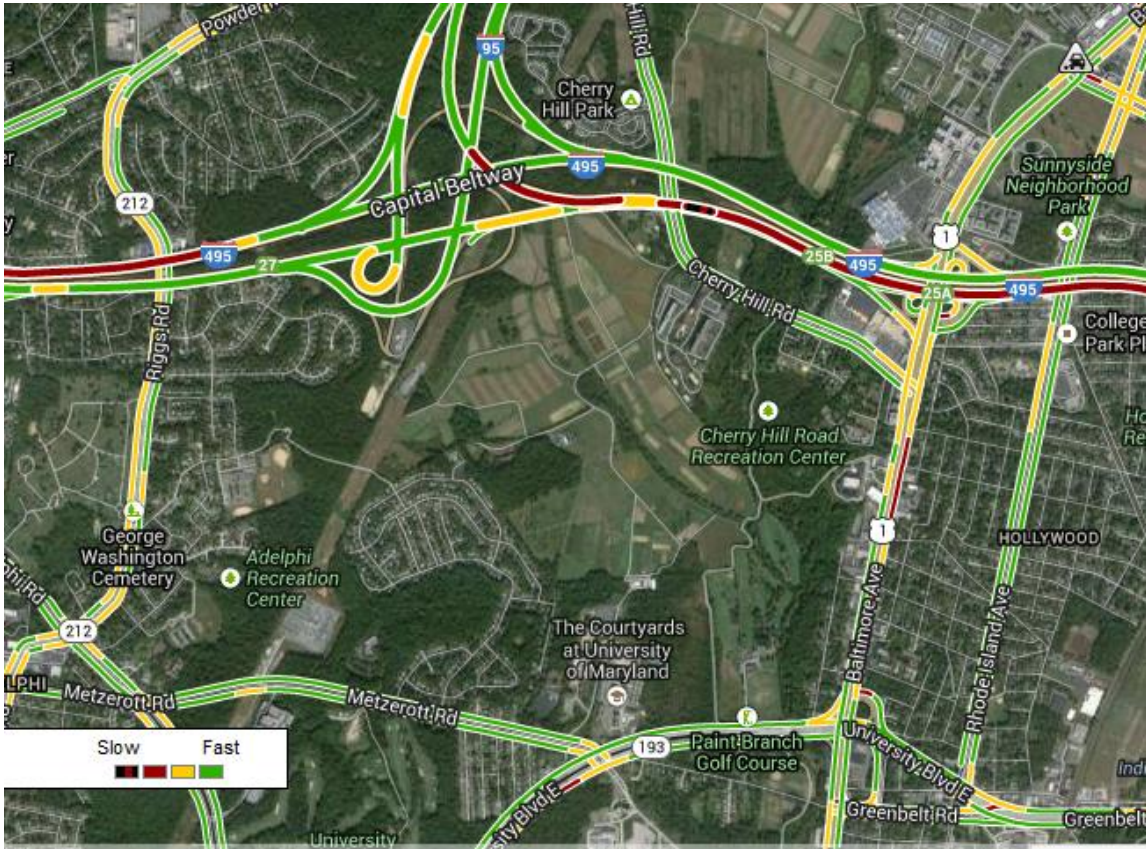
Will we learn the equations associated with each basic c of newtons theory of motion

Are definitions going to be o exams?



From this figure you can learn something about the motion of cars. **The color in the figure indicates**

1. Position
2. Velocity
3. Speed
4. Speed and Velocity
5. Position and Speed
6. Position and Velocity
7. Neither, it's an xy graph
8. What's the difference speed/velocity?



Speed: Magnitude of the Velocity (always positive)

Acceleration

- Average acceleration is defined by

$$\langle \vec{a} \rangle = \frac{\Delta \vec{v}}{\Delta t} = \frac{\text{change in velocity}}{\text{time it took to do it}}$$

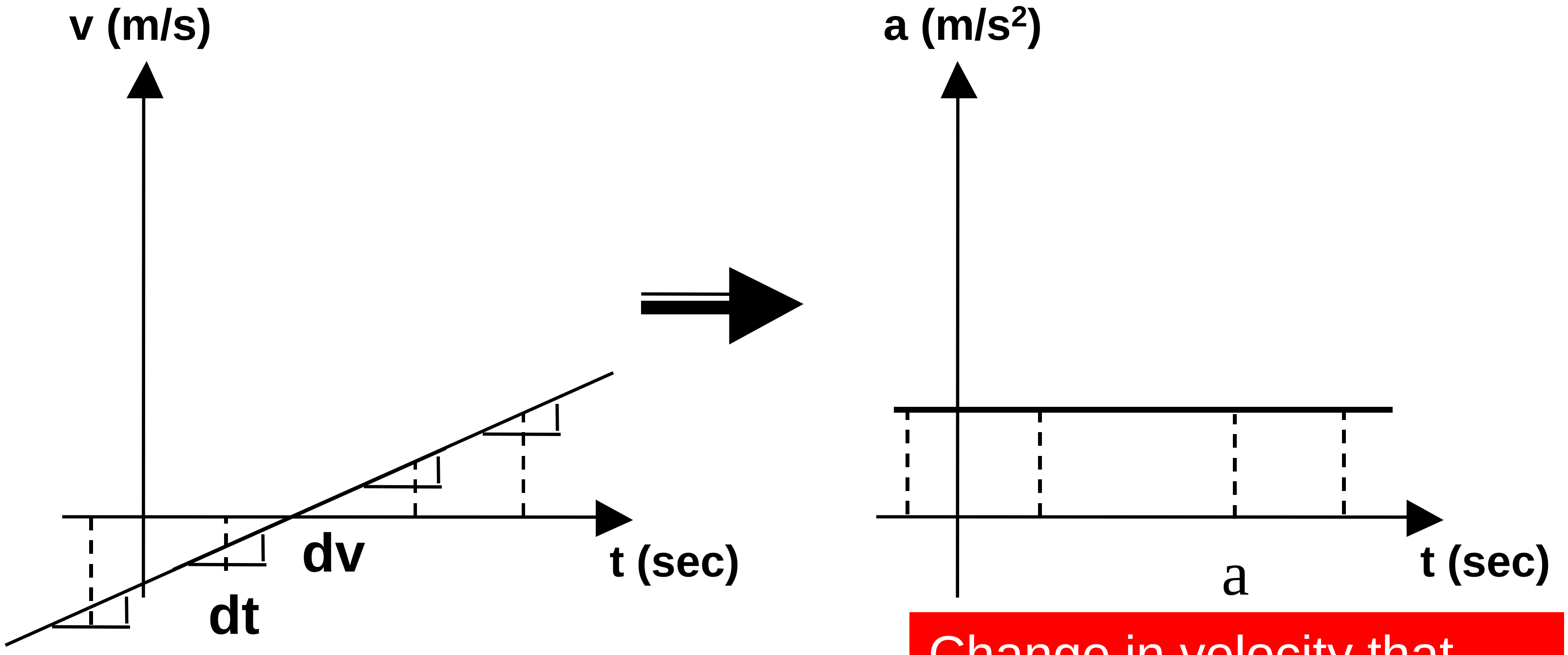
Note: an average acceleration goes with a <u>time interval</u>.

- Instantaneous acceleration is what we get when we consider a very small time interval (compared to times we care about)

$$\vec{a} = \frac{d\vec{v}}{dt}$$

Note: an instantaneous acceleration goes with a <u>specific time</u>.

When do we calculate acceleration?



$$a(t) = \frac{dv}{dt}$$

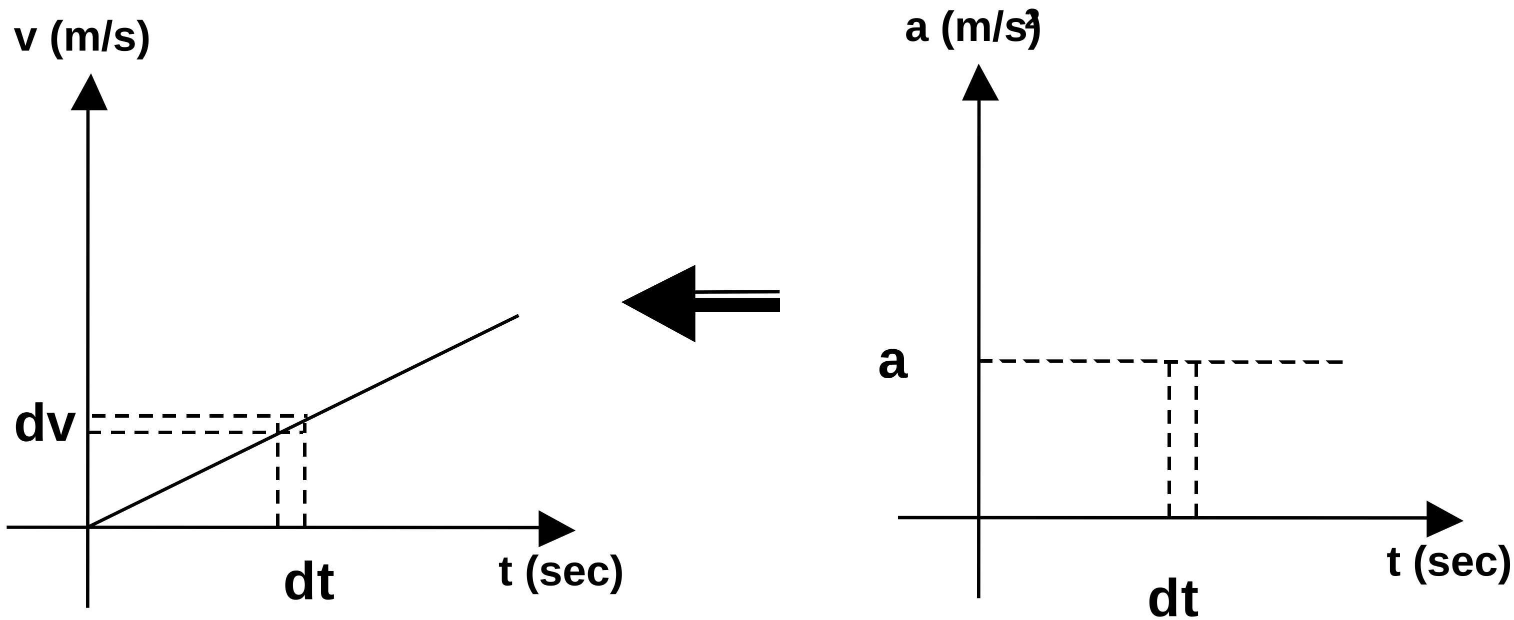
Change in velocity that takes place in the (small) time interval dt

Difference of two velocities at two (close) times

$$a(t) = \frac{v(t + \Delta t/2) - v(t - \Delta t/2)}{\Delta t}$$

When we do A x (delta)t, doesn't a velocity-like L/T dimension result?

Acceleration to velocity Predicting the future (future velocity that is)



$$dv = a(t)\,dt$$

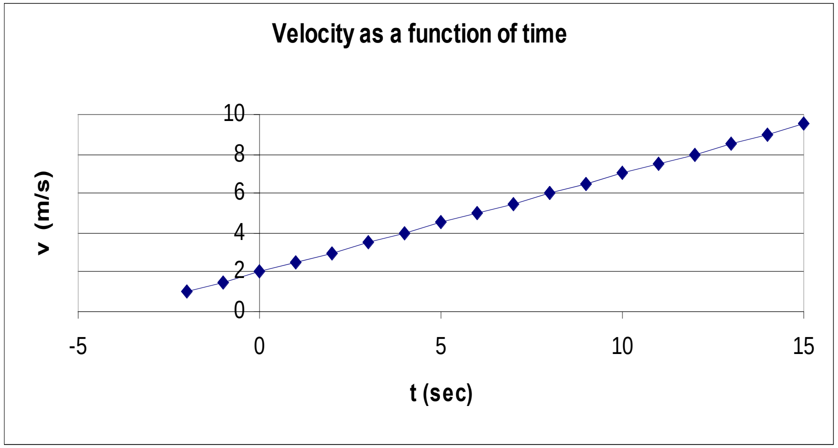
change in velocity over a small time interval

sum ("Σ") in the changes in velocity over many small time intervals

$$v = \sum dv = \int a(t)\,dt$$

Uniformly changing motion

If an object moves so that it changes its velocity by the same amount in each unit of time, we say it is in uniformly accelerated motion.



$$< \vec{a} > = \frac{\Delta \vec{v}}{\Delta t} = \vec{a}_0$$

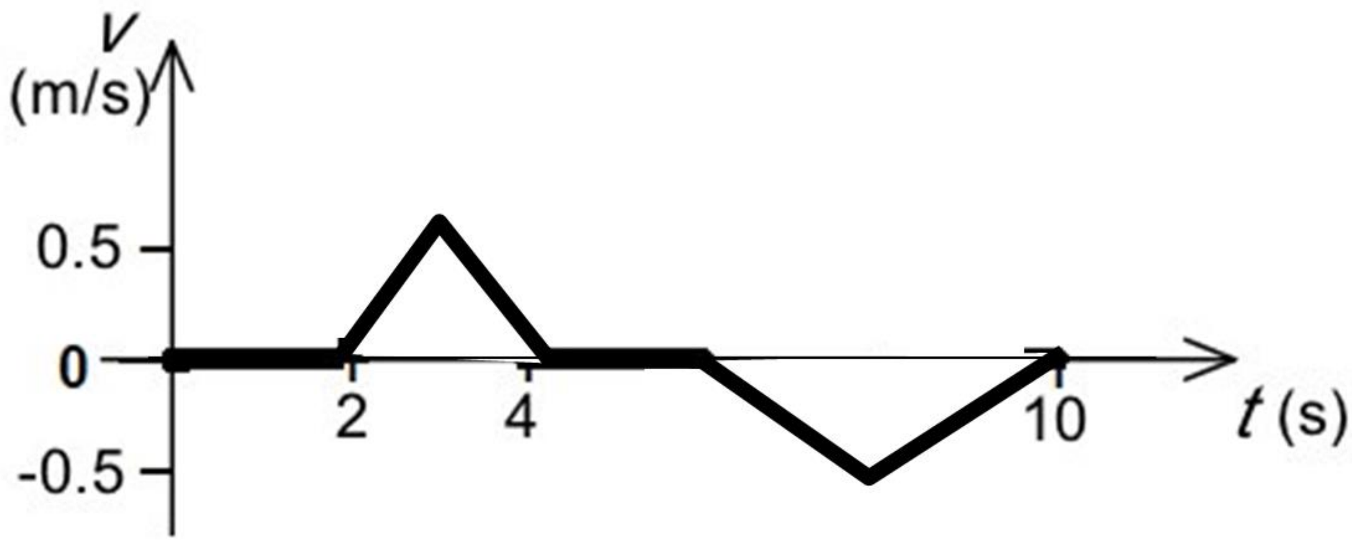
This means the average acceleration will be the same a_0 no matter what interval of time we choose.

$$\Delta \vec{v} = \vec{a}_0 \, \Delta t$$

$$\vec{v}(t_2) - \vec{v}(t_1) = \vec{a}_0 \, \Delta t$$

$$\vec{v}_{final} = \vec{v}_{initial} + \vec{a}_0 \, \Delta t$$

Sketch the acceleration vs time graph corresponding to this velocity vs time graph



The AVERAGE acceleration is

1. Zero
2. Positive
3. Negative
4. We cannot tell from velocity vs time graph