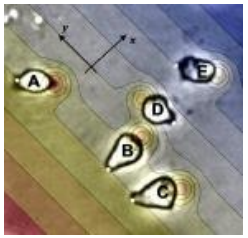
Physics 131- Fundamentals of Physics for Biologists I



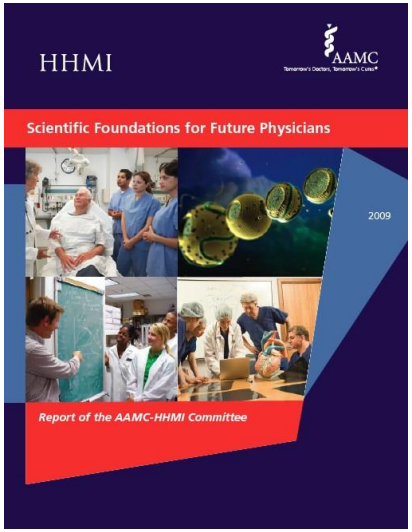
Professor: Wolfgang Losert
wlosert@umd.edu

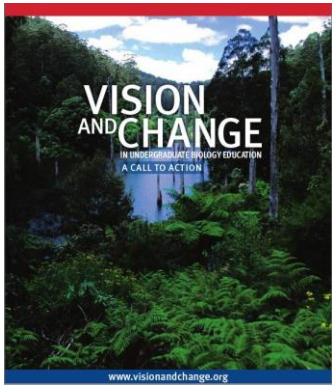
More Cowbell

More Physics

9/2/2013

- Over the past decade there have been increasing calls to modernize the education of biology and pre-med students.
- This class is part of a national project sponsored by the Howard Hughes Medical Institute and the National Science Foundation to respond to the *Scientific Foundations for Future Physicians Report* (2009)
- This report calls for multi-disciplinary competency-based science education to better prepare students for medical, pharmacy, and veterinary schools and also to better educate students who are studying the basic biological sciences.





The new Phys131/132 Sequence

The goal of this new physics course sequence is to provide you with competency in **physics relevant to living systems**

- Funding from HHMI (Project NEXUS)
- Tested in last two years with small classes
- We will do surveys to further improve the course
- You will see course observers in the back row
- There will be TAs and Learning Assistants in class
  - Learning Assistants (LA) are peer educators who have taken the class before

Surveys and Permissions (Vashti Sawtelle)

Do you have a clicker?

1. Yes: A physical clicker

Use channel **41**

2. Yes: An iPhone that is setup to click.

Use Code **Losert**

3. Not yet.

Who are you? (Major)

1. Pre-med
2. Pre-dent
3. Pre-health care not med or dent
4. Bio major but not one of the above
5. Other major

Who are you? (Year)

1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Post-bac student
6. Other

NEW in the Course (1)

Focus on Sense-making

NEW in the Course: (1) Focus on Sense-making

- This is a class very much about *making sense of physics*, not just about learning facts or equations.
- To make sense of physics you will need to actively think about, and discuss physics. *The class and lab activities are designed for this*.
- Whether you learn something in class critically depends on your active participation in class and lab activities.

- You will need to work with your classmates!
  - In labs you will work in groups of four to design and carry out experiments and discuss results.

Introduce yourself to a few of the folks around you!

How do you learn?

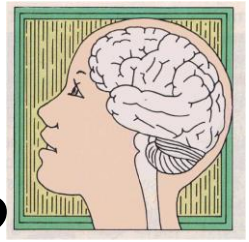
I am asking you to use a learning strategy that was developed based on how adults learn and develop knowledge

It may be very different from what you have used in other classes.

Lets do an exercise:

You have 1 minute to memorize 24 words

Exercise 1:
How good is your memory?



Thread	Thimble	Bed	Rest
Pin	Haystack	Awake	Tired
Eye	Knitting	Dream	Snooze
Sewing	Cloth	Blanket	Doze
Sharp	Injection	Slumber	Snore
Point	Syringe	Nap	Yawn

Roediger & McDermott J. Exp. Psych: Learning, Memory, & Cognition. 21 (1995) 803-814.

Coherence – Your safety net

- We will be establishing fundamental principles that we can (almost) always trust as "**stakes in the ground**."
- The links among the different views creates a "**safety net**" that protects us against errors of recalled or reconstructed memory.

NEW in the Course (1)
Focus on Sense-making

NEW in the Course (2)

Physics Topics relevant to living systems

What is Physics?

Physics provides a framework for understanding **basic principles of nature**

e.g. **motion, forces, light**

Physics uses **models** and **Math** to describe basic principles of nature

Based on insights from models and math, physicists sometimes discover novel ways of controlling natural processes

- Light -> lasers -> Modern microscopes
- Electric charges -> transistors -> CPUs

What can Physics contribute to Biology and Medicine?

- Whiteboards: write down your ideas!
- Groups of 3 – discuss topics
  - Teaching Assistant and Learning Assistant will be in Lecture hall to participate in these discussions
- Pick one to talk about

- Discuss with another group of 3
- Share with Class

What can Physics contribute to Biology and Medicine?

Experimental Tools for Cell Biology

- Superresolution imaging (Betzig, Hell)
- NextGen Gene Sequencing (Quake)

Experimental Tools for Diagnosis and Therapy

- MRI for high resolution imaging
- Proton therapy to eliminate diseased cells

Physics approaches: Quantitative Approaches to Complexity & Information

Physical principles: Forces and Motion

Forces in Living Systems

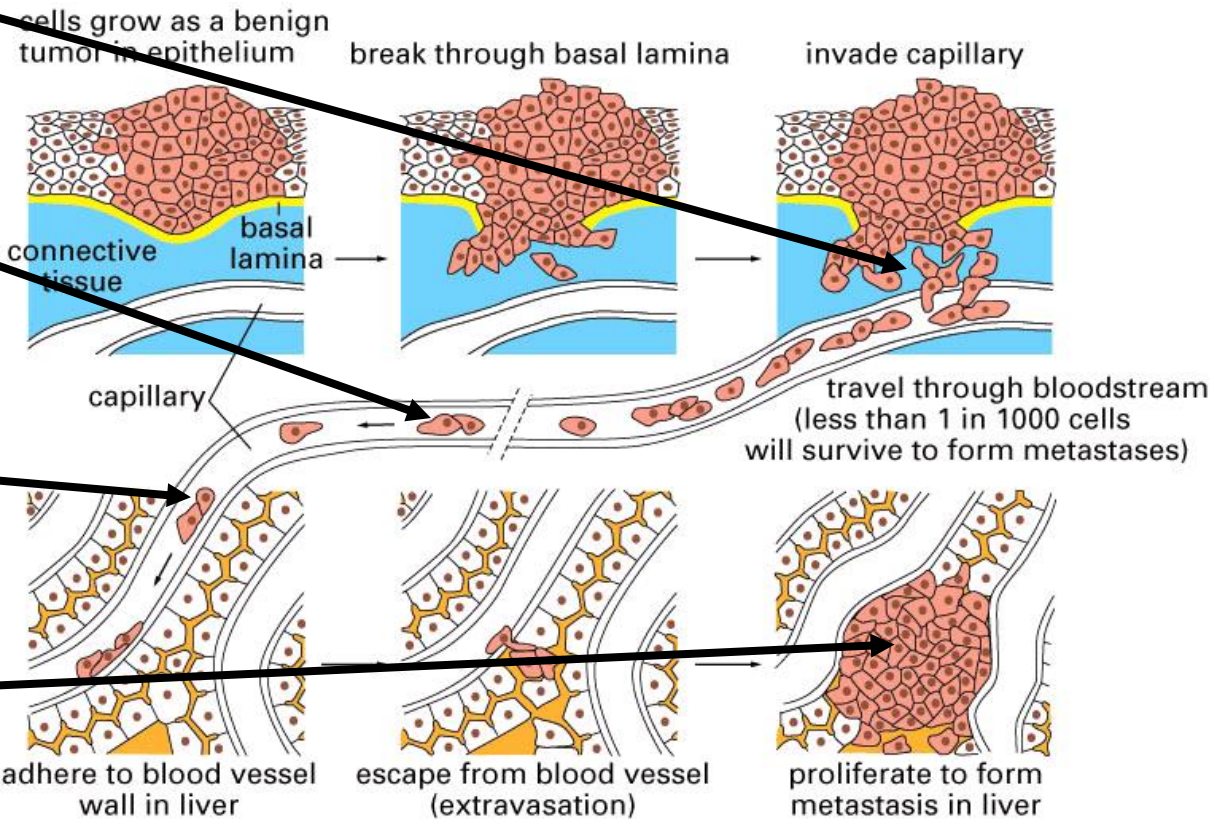
Example: The role of forces in Cancer

Cells generate forces to migrate

Cells are deformed by fluid forces

Cells adhere to new tissue

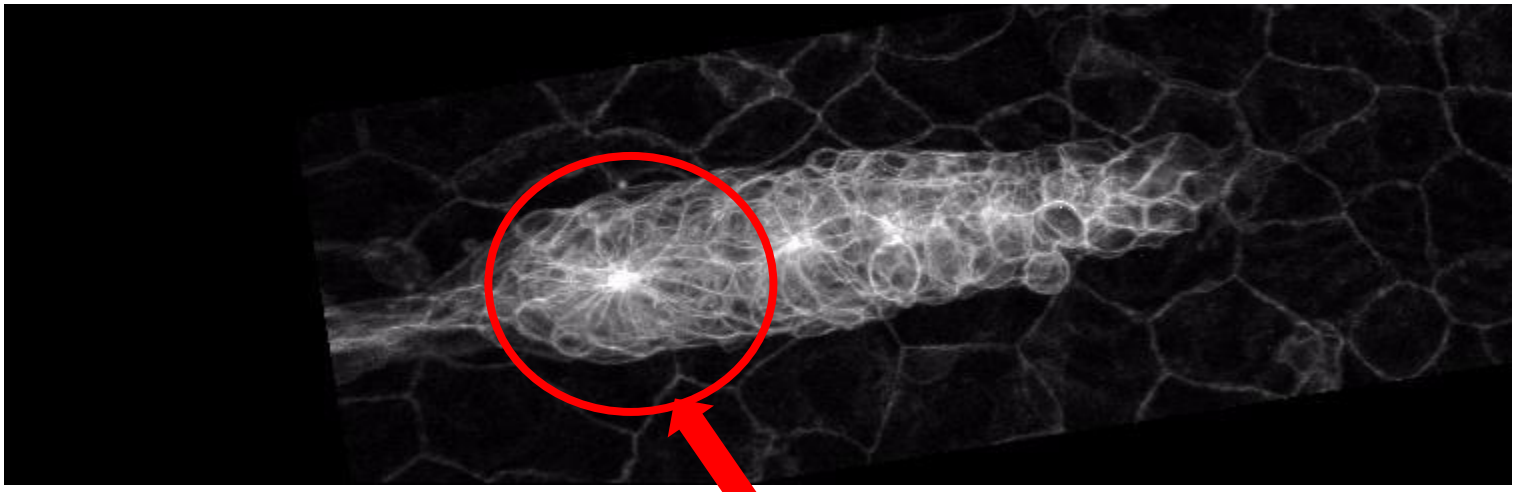
Cells grow in tissue with different stiffness



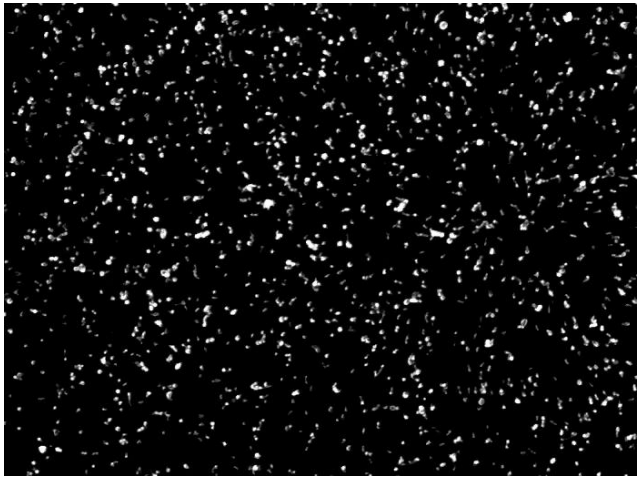
Dynamics (Motion) in Living Systems

Primordium

D. Hemingway, WL, AJ Chitnis



Will form Sensory Node



Collective Motion of
Slime Mold cells

Your Tasks (for points)

For details see our website: www.physics.umd.edu/courses/Phys131/fall2013/

Reading: Read a few wiki-pages (we replaced the textbook with a wiki) before each class. *Summarize 2-3 of these pages and write one question about them.*

Weekly Homework: Working together in course center (Physics Building Rm 0208) is encouraged. You must prepare solutions yourself

Labs

Weekly Quizzes (lowest score dropped)

Two Midterm Exams (with Makeup possibility)

Final Exam (without Makeup possibility)

Lab/Recitation

- Recitation starts week of Sept 9
- Lab starts week of Sept 9 with
  - a number of surveys
  - get your picture taken
  - You get help on installing ImageJ, an image analysis software we need for labs
  - Actual labs will start 9/16

Friday

Pre-reading for Friday

QUIZ on Monday