BIO208: Cell Biology Fall 2012 Dr. Karen Bernd
Classes: TR 8:15-9:30 Chambers 1006
Labs: Tuesday 12:15pm-2:55pm or Wednesday 12:30-3:20 Dana 220
kabernd@davidson.edu Watson 289: 894-2889

In order to understand how something works it is sometimes easiest to break it into its smallest parts, figure out how those work and build up from there. It is known that the 'smallest part' of an organism is the cell. Research has shown that from organisms having only one cell (bacteria and yeast) to those with many multicellular organs (plants, insects and animals) complex sets of interactions between cellular components control how cells live and die.

In order to understand a topic it is often easier if we can make comparisons between what we already know and the new, between the way something usually functions and what happens if we change an interaction or two. We will cover the basic parts of the cell by comparing 'normal' and 'diseased' systems as case studies. The textbook and computer animations will be used as reference material and scientific journal articles on related topics bring the concepts into a broader context. The goal is to understand the concepts committed to textbooks, to be able to critically analyze current dogma and to suggest what the next questions might be and what approaches can be used to investigate them.

Required materials
Molecular Cell Biology 6th Edition, Lodish et al. Hard copy is available through bookstore. Electronic version (one year access/ discounted cost) available through www.ebooks.bfwpub.com
Bio208 Laboratory Manual-- Provided as links from homepage. Download and print.

It is an 8:15 class. Do what you must to get here awake and alert. I expect class participation so you must come to class and be prepared. We will be using a case study approach where a particular disorder provides the framework for a discussion of topics in Cell Biology. Our study will follow the example of cellular organization. Cellular processes are exquisitely intertwined and balanced; therefore our case studies will draw on multiple chapters, animations and web readings. The reading schedule contains a Course Guide and discussion questions. Use these to help you focus your reading and class preparation. Read WORDS OF WIDSOM FROM PREVIOUS STUDENTS now and learn from their experience. (http://www.bio.davidson.edu/people/kabernd/cb/WofWisdom.html).

Lab In the first unit, techniques used to characterize the yeast mating reaction will be introduced and you will design experiments to investigate extracellular and intracellular signaling. In the second unit you will characterize yeast strains that are defective in the mating process. Because research requires planning and technical training as well as the ability to interpret data and communicate those results, each unit concludes with an individually written assignment. Throughout the semester there will be online assignments in Moodle. Surveys are not graded but pre-post lab assignments are. We will work with live organisms that require growth time between steps. This means that some lab set up or observations must be made outside of scheduled lab sessions. Each group must coordinate how this will occur. Regardless of who performs a certain task, every person is responsible for completing the procedures and for having the data. The Cell Bio Moodle site includes group 'file exchanges' that lab groups can use to store and distribute material.

NOTE 'ODD' LAB TIMES: Lab meets from 12:15-2:55 or 12:30-3:20 on the designated day. These times are earlier than the standard labs across campus. This should allow you to take advantage of different afternoon courses and reduce conflicts with athletic/music practices and travel. That said, do not miss lab and do not make appointments during any part of your entire laboratory period.

Attendance policy and Participation: It is in your best interest to be present since attendance is expected. An 'A' in participation requires consistent and very high quality preparation and participation in class. If you did not complete a written assignment you would expect to get a '0' on it. Not coming to class, coming to class unprepared, or never speaking is equivalent to forgetting to complete this assignment and will be evaluated as such.

Questions regarding the material covered in a written assignment, how to prepare for class, or how to study can be made at any time. Ask early and often! Talk to me during or after class and lab, by email or in my office. I am happy to review drafts of papers if they are given to ahead of time (at least 2 days before due date). I provide a lot of feedback on exams and papers. Read the comments to learn ways improve. Progress is the expectation. To reinforce learning from feedback, questions regarding the evaluation of a written assignment (paper or review) must be made within 10days of your receiving the graded material. Contact me to make an appointment at a time that is convenient for both of us.

Assignment 'Weight'	
2 exams during the semester	50%
1 final exam	26%
Materials and Methods (2%), CV (2%), Lab Article (7%) Lab presentation (4%)	12%
Opinion Paper	4%
Lab Participation, Moodle assignments	5%
Class participation	3%

Grade Scale				
A 100-93	**B+** 89-87	**C+** 79-77	**D+** 69-67	**F** < 59
A- 92-90	**B** 86-83	**C** 76-73	**D** 66-60	
	B- 82-80	**C-** 72-70		

Papers/Reviews/Exams and the Honor Code

Note that the due dates/times are often outside of scheduled class meetings. All assignment dates are scheduled now and the dates will not change make sure you put them in your schedule now. In lab we will discuss grant and job applications and how they are submitted, often online, by a certain deadline. Miss the deadline, by even a minute, and you have no shot at that funding or job (meaning you and you lab do not get paid for a year). Late assignments are penalized (subtract 5% for 1min late and an additional 5% for every 60min after that. Since hall clocks vary in different buildings cell phone clocks represent the official time. I realize how busy all of our schedules are. Balancing the 'weight' of one assignment vs. another commitment (academic, family, athletic, social), prioritizing and planning are skills that will serve you well throughout life. Use them here.

I must be notified as soon as possible for the rare possibility of arrangements that vary from those in the syllabus (not the day or the hour it is due).

All of your exams are "take-home". They can be completed in 2 hours (3 hours for final), but you will have more than 2 days. Exams are distributed by email by the day indicated on the syllabus. The exams are to be completed by you alone, without text, notes, or other written/verbal/electronic/telepathic communication pertaining to the questions. Any use of such material is a violation of the honor code and must be reported to the Dean of Students or me. Any knowledge of a classmate using such materials must also be reported. Exceptions to this rule are not allowed.

For Lab papers, lab teams will, obviously, compile data together. You may discuss possible interpretations and share reference materials but all writing must be your own. Be sure to include proper in-text references and end of paper bibliographies for all sources used-- this includes lab manuals and online resources as well as texts and journal articles. Bibliographic references to texts and articles must follow the style and format used in the journal Cell. (see http://www.cell.com/authors - sectionsl). References to online resources (websites only) must follow the CSE format for online sources (see http://bcs.bedfordstmartins.com/resdoc5e/RES5e_ch11_s1-0003.html use #10 Homepage of a website and #11 Short work from a website only). There is no such thing as the 'three source rule' and not providing proper credit is plagiarizing. Read the DEPARTMENTAL STATEMENT ON PLAGIARISM. If you have questions--- ASK BEFORE YOU TURN SOMETHING IN.

Accommodations for Students With Disabilities: I am happy to provide accommodations for students with learning or physical disabilities. If you are a student with a learning disability documented by Davidson College please identify yourself to me within the first two weeks of class so that arrangements can be made. Students with other disabilities are encouraged to self-identify so that we may discuss if there is any way in which I can make accommodations that will enhance your learning experience. All such discussions will be fully confidential unless you otherwise stipulate.

BIO208 Cell Biology: Laboratory Syllabus
Tuesday 12:15pm-2:55pm or Wednesday 12:30-3:20 Dana 256

Week	
8/27	Lab overview **LAB MEETS FIRST WEEK** Lab Safety/ Microscopy/ Sterile Technique/Brainstorming
9/3	**Quiz 1 due Tuesday 10:59am** (covering safety/microscopy/sterile technique AND reading for week of this week) **Unit 1:** Learning techniques and Determining our baseline of response (Defining 'normal') **Unit 1:** 'The Signal 'and How Yeast Respond to It: Techniques for characterizing yeast mating reaction
9/10	**Quiz 2 due Tues by 10:59am** (covering results from last week and reading for this week) **Unit 1:** 'The Effect' Part I -changes over time What happens during long-term exposure?
9/17	**Quiz 3 due Tuesday by 10:59am** (covering results from last week and reading for this week) **Unit 1:** 'The Effect' II- How much mating is 'normal'?
9/24	**Quiz 4 due Tuesday by 10:59am** **Unit 1:** 'The Effect' Part III Differential gene expression Work on Materials and Methods- each person in team prepares separate one **DUE Friday before noon: Material and Methods**
10/1	**Mini unit: How do scientists communicate? Grants and Funding**
10/8	**DUE: Funding Opinion Paper due Beginning of your lab period.** We will discuss the opinion papers at beginning of lab **Unit 2:** Characterizing mating mutants See instructions for final project and final article in lab manual links. Prepare for next weeks' experiments
10/15	**Fall Break,** no formal lab, begin projects (you have access, start cultures)
10/22	**Overview of *curriculum vitae* assignment** Work on projects (WOP)
10/29	**DUE in lab: *Curriculum vitae*** WOP
11/5	WOP **Each person posts annotated bibliography by 9pm Sunday**
11/12	WOP **Wrap up data collection by Sunday 11/18**
11/19	(Thanksgiving Break) no lab
11/26	**Your initial sections of lab article posted to Moodle before your scheduled lab time** Lab cleanup, Revision time
12/3	**Revisions of lab article posted to Moodle** by your scheduled lab time (or before). Course evaluations, Article prep time **Lab Article Portfolios due Friday before 5pm**
12/10	Optional Class days-- no scheduled lab

BIO208 Cell Biology: Reading Schedule
TR 8:15-9:30 Chambers 1006

Required Text: Lodish et al. Molecular Cell Biology 6th edition (hardcover *or* electronic version, www.ebooks.bfwpub.com)
Videos and Animations from the chapters are available at www.whfreeman.com/lodish6e

<table>
<tr><td>Week</td><td>Topic/Text Reading</td></tr>
<tr><td>8/28
T</td><td>READING (yes, for today)
1) Class Syllabus **2)**Departmental Statement on Plagiarism== link from department website/ class website
3) The Practice of Science At the Edge of Knowledge; Grinnell **4)** The importance of stupidity in scientific research; Schwartz *To access these articles cut and paste the names into a Google search box.* (With drop/add not all of you may be on Moodle yet. This way makes sure you can all get to the reading)
What is the role of methodology in science? of intuition? of luck? of good PR?

In class: Introduction to course, Overview of case studies, discussion of articles
There is lab this week—Remember no open-toed shoes</td></tr>
<tr><td>R</td><td>Background: Why Cell biology is more than histology: Biological Membranes and Cellular components
<table>
<tr><td>Review Ch 10</td><td>**Cells Alive** animal *and* plant cell (anim)</td><td>Through the Virtual Cell (anim)</td></tr>
<tr><td>Ch15 video: Chemotaxis of a Single Dictyostelium Cell</td><td>Ch16 video: Protein Dynamics in Response to cAMP Stimulation of a Dictyostelium Cell</td><td>Ch 21 video :Time-Lapse Imaging of *C. elegans* Embryogenesis
C. elegans crawling</td></tr>
<tr><td>Ch 2.2 p41-49</td><td>Ch 14 animation: Protein secretion</td><td>Membrane Structure</td></tr>
</table>
'Review' means skim for main topics. Not necessary to ingest minutiae
Videos and Animations *from the chapters* are available at www.whfreeman.com/lodish6e

Two classes reviewing background-- Need know the players before anything else.
In **ch10** focus on the roles and components of biological membranes. **Ch2** reminds you what biomolecules are and what they look like. **Membrane Structure: The fluid mosaic model**
http://www.susanahalpine.com/anim/Life/memb.htm the parts in animated motion
Through the Virtual Cell: A guided flythrough http://vcell.ndsu.edu/animations/flythrough/index.htm
Cells Alive; animal *and* plant cell animations http://www.cellsalive.com/cells/3dcell.htm
Make sure you are familiar with all of the cellular components and their functions.
Chapter 15, 16, and 21 videos demonstrate the fluid nature of the membrane. Notice how it can re arrange the components to generate force and move.
In Chapter 14 animation focus on how organelles are 'connected'

Discussion question: What role do biological membranes play in the cell? What are the components that make them up? How are they important to its function? What are the fluid mosiac model and lipid rafts? How do biological membranes define organelles and what the organelles? (Is everything in the cell an organelle? what kinds of cells have organelles and what kinds do not?)</td></tr>
<tr><td>9/4

T</td><td>**Cellular components part II:** No Cell is an island
Introduction to Case Study I: Grave's Disease-- Symptoms. Causes?
(no new reading)
What are the functions of organelles and other cellular structures? Think about the interplay or connections there between a cell and its environment? Compare and contrast this interaction for a multicellular organism vs a single celled one.</td></tr>
</table>

R

Communication is the key.

With Graves' disease and many other disorders the symptoms can be summed up a quotation from the movie classic "Cool Hand Luke"-- 'What we have here is a failure to communicate'. The problem is that there are many ways to mess up communication-- what has happened in Graves' disease to cause excess secretion of T3 and T4? In the next four classes we will discuss 'normal' extracellular signalling, how the mechanisms cells use to perceive those signals and what happens once the signals get in. During this section keep two questions in mind-- 1) How could these molecular mechanisms be altered to result in the symptoms seen in Graves' disease and 2) How does this relate to the mating interactions we are examining in lab?

I. Extracellular signaling and the receptors that mediate it.

Ch15 623-37	Ch16.2 672-4	Ch16.5 p694-696 Ch16.6 p697-98 Ch16.7 p703-706	Fig 16.35 Ch7.7 p311-314
Fig 16.1: 8 classes of Receptors	Fig 16.12: 676		
Key concept boxes 16.1, 16.2, 16.3, 16.4	16.3 p 679-80 Fig 16.16: 681		Thyroid signaling loop (gif) RTK signaling pathway (web)

Thyroid signaling loop http://www.bio.davidson.edu/people/kabernd/cb/restricted/figures/Thyroidsignal.gif
RTK signaling pathway http://www.wiley.com/college/fob/quiz/quiz21/21-16.html

What are the types of extracellular signaling? Which types might be faster/slower (why)? Given the diagram of normal thyroid signaling what types of extracellular signaling are being used? What are the types of cell surface receptors? (Some signaling molecules don't use cell surface receptors-- how do they get in?) Given the symptoms of Graves' disease what might be going wrong in the thyroid signaling pathway? (Think of more than one possibility and how you might test it)

In class we will discuss the exact types of receptors involved in pathway connected to T3 and T4 release.

9/10
T

II. So many signals--how does a cell know when to react? Specificity and the receptor

Interactions require the proper fit between receptors and ligands. Since all of the receptors we know are proteins we need to discuss proteins and protein folding before we can get to binding specificity.

Ch2 40-44 Ch3 63-73 Ch3 (anim) Chaperone-Mediated Folding	Ch15: 626-632	

What are the amino acids and how do they come together and fold up into proteins? What are the levels of protein structure? What ways can you think of to change a protein's folding? What are binding sites and active sites? Knowing that TSH, T3 and T4 are the hormones involved and TSH receptor is found on the thyroid cells and is activated by TSH what structural changes could result in an over-stimulated thyroid?

R

III. Getting the signals in--Conformational changes to allow communication. 593-599 'Membrane proteins...' stop at 'The cytosolic side...' The ligands (signaling molecules) we have discussed are outside the cell. The PM is a barrier that these hormones cannot cross. In this class we will discuss how the receptor-ligand interaction allows a signal to cross the membrane even though the ligand stays 'outside'.

Web GTPase ras? Ch3.3 78-85	Ch15 626-632 (again)	Ch10.2 421-428

The Chapter 10 reading reviews membrane proteins like the TSH receptor. Other readings and animations show the effects of interactions between molecules.

What is the relationship between a protein's conformation (shape) and its function? TSH is polar (can't get across the thyroid cell membrane by itself) how could it have an effect on the thyroid cell? Why don't all cells react to TSH? What could be happening to cause the thyroid to be overstimulated in Graves' patients?

9/17
T

IV. Response Cascades and 2nd messengers. **(discussion ?'s on next page)**

Ch15.3 632-34 Fig 15-9, 15-13, 15-21, Table 15-1 Ch15 1st 2 animations	Ch 15.6: 646-53 Fig 15-30, 15-31 Ch16 1st anim	RTK signaling pathway (web) IP3 signaling (web) MAPK pathway (web)

RTK signaling pathway http://www.wiley.com/college/fob/quiz/quiz21/21-16.html
IP3 signaling http://www.bio.davidson.edu/courses/immunology/FLASH/IP3.html
MAPK pathway http://www.bio.davidson.edu/courses/Immunology/Flash/MAPK.html

What are second messengers? Why do we need them? Why do you think the cell uses these molecules as second messengers? What do they have going for them? What is a second messenger cascade? What are examples of some? The TSH receptor is a G-protein coupled receptor, what signaling cascade would you

	predict it is connected to? Stopping a cascade is as important as starting one, how do each of the cascades you listed stop and what makes the cell return back to resting levels of the signaling molecules? Graves' disease causes overstimulation, what could be wrong in the signaling cascade that would cause it to be overactive?
R	**Activation by another means & Introduction to paper discussion (how we'll do it)** The immune system and autoimmune diseases (downloads a pdf) http://www.bio.davidson.edu/people/kabernd/cb/the_immune_system.pdf The pdf is a good brief introduction to the immune system and immune responses. Read sections through 'Genetic factors'. This reading may seem to be a jump- what could antibodies have to do with Graves' disease right? Think about the connection between antibody form and function. How does the body realize that it 'should' mount an immune attack? What happens during an immune response? What happens (to the body) when the immune system loses the ability to differentiate between self and non-self? How could autoimmune diseases be related to an overactive thyroid?
9/24 **T**	**Paper 1:** A. Hammes et al. 2005. Role of endocytosis in cellular uptake of sex steroids. Cell 122; 751-762. Discussion of Terms, Techniques and Background (see handout: Moodle)
R	Continue paper discussion, wrap up section **Review 1 available by 8:30am Friday (due MONDAY before 10:00am)** Reread Syllabus sections regarding Papers/Reviews/Exams and the Honor Code Policies
10/1 **T**	**Introduction to Case Study 2: Bipolar Disorder** The Neuron and The Nerve message (stop at Nerve systems) — Ch23 1005-1012 Ch 23: Fig23-4 — Ch23 1025 (GAP) - 1026 The Neuron: http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookNERV.html Review parts of synapse/overview of normal nerve transmission Background on Bipolar disorder will be presented. It is a mental illness that effects neuronal transmission resulting in wide variations in mood that are very disruptive to the individual's life. What is a neuron? A synapse? What are the types of synapses and how are signals passed across them? Think about the types of problems-- at the molecular level-- that could cause not just depressed or elevated moods but wide swinging of the pendulum between these two states.
R	**The players: Neurotransmitters and their receptors** Fig 23-19 | Ch23.3 1018-1020 | Exp fig: 23-23 | Signals and receptors (web) Signals and receptors http://www.bio.davidson.edu/people/kabernd/cb/restricted/figures/signals_n_receptors.html The **'Catecholamine theory of affective disorder'** proposes that mania and depression are caused by changes in the amount of activity at noradrenergic receptors. To discuss this proposal we need to make sure the basics are covered first-- the types of synapses are already covered. What are the compounds that mediate signaling at the synapse? What types of receptors are involved with and what kinds of responses do they elicit? Why might the fact that amino acids, nucleotides/nucleosides and peptides are used as neurotransmitters cause potential problems in the body? What else do these molecules do? How does the body get around these problems? What are excitatory and inhibitory synaptic responses? What are the two basic classes of neurotransmitter receptors? How are they similar and different? What differences would you predict between the relative amount of hydrophobicity/hydrophilicity of a neurotransmitter and a neurotransmitter receptor? (why)
10/8 **T**	**Tale of 2 proteins: neuropeptide and neurotransmitter receptor** Protein #1: Cytosolic neuropeptide or enzyme that modifies tyrosine--How is it made? (DNA/Transcription/Translation--in a day--should be a review) If a person with bipolar disorder suffers from varied activity at a synapse then perhaps there is a problem with the way the signaling molecule is made or packaged. Neuropeptides and many neurotransmitters are made from amino acids. Neuropeptides are proteins and epinephrine and norepinephrine are tyrosine derivatives (so an enzyme--a protein-- must have modified the tyrosine). All neuronal signaling molecules must be able to diffuse across the synaptic cleft. So how do you make a diffusible protein? How do you get it into a synaptic vesicle so that it can be released during synaptic transmission? Ch4 111-139 (overview) — Ch6.1 217-222 — Ch7.3 key concepts (p285) Ch4 (anim) Protein Synthesis — Ch7 269-70 — Fig 8-1 Yes today's reading is long. Yes it covers a lot of material, but it *should* be review. DNA structure,

	transcription and translation are some of the topics you should have had at least twice in your biological career so we will move on to how these basic principles would relate to 'our' neurotransmitter at noradrenergic receptor. The animations are the short version-- focus on them and use the text to fill in rough spots. What is the central dogma? How would a neuropeptide get made (in general terms)? What are the basic parts of DNA, RNA, and proteins? What is the difference between hnRNA, mRNA and tRNA? How does RNA polymerase work and what does it make? How does it know where to start and stop? How does a ribosome work and what does it make? How does it know where to start and stop? If the DNA in every cell in your body is the same why don't your adipose (fat) cells secrete epinephrine? If the DNA contains all of the information why doesn't the ribosome just 'read' it? Why have intermediate steps?
R	More protein manufacturing (finish translation) Sorting the neurotransmitter-- some a mechanism of direct access—pump them in http://www.bio.davidson.edu/people/kabernd/cb/restricted/figures/fillingv.html Now the neuropeptide is made or the tyrosine has been enzymatically modified into epinephrine and they end up in the cytosol. How does the polar molecule get into the synaptic vesicle? Direct access provides one method. (we will see others) What is active transport? Which types of signaling molecules may be more likely to use this approach? Which cellular membrane would the molecule be actively transported through? Bipolar disorder sufferers experience periods of varied neuronal transmission. How could problems in neurotransmitter synthesis or delivery be responsible for this phenotype? In order to get the mania and the depression what would have to happen? (This is where you get to add to science-- the molecular basis of bipolar is not known. What avenues of research look promising to you? Which ones would you put on the back burner?)
10/15 T	**Fall Break:** no Tuesday Class (you will have access in lab this week to begin cultures for your projects.
R	**Protein #2: Neurotransmitter receptor** How is it made? Packaged? Intro to vesicles Ch13 533-549 | Ch13(anim) Protein Sorting | Ch13 (anim) Synthesis of Secretory and Membrane-Bound Proteins Neurotransmitter **receptors** need to be part of a membrane-- they are integral membrane proteins (also called transmembrane proteins). Like other proteins ribosomes that make the *receptors* are in the cytosol. How do they get into the membrane? How can they be made in an aqueous environment and end up with parts in the hydrophobic membrane and parts on either side of that membrane? A simple 'door' through the membrane can't be enough. (A door to a room does not let you become part of the wall). The process of inserting membrane proteins is known as protein translocation and is part of protein sorting. How are the 'right' proteins chosen for translocation? (Said another way-- why is a neurotransmitter receptor synthesized in the cytosol and translocated but the parts of a trimer G protein are synthesized in the cytosol and remain there?) When does translocation take place? Does it occur during translation or after the protein has been made? Is there translocation machinery on every membrane or can newly made membrane proteins only get into a membrane at certain organelles? Moving a protein across a membrane is thermodynamically unfavorable (to say the least) where does the energy come from that powers translocation? Be able to describe the translocation mechanisms and think about how you would be able to tell which one was being used (what are their similarities and differences).
10/22 T	Continue discussing last reading
R	**How are the packages delivered? Secretion and the SNARE hypothesis** Ch14(Anim) Protein Secretion | Ch14: 579-80 | Ch14.2 586-605 Table 13-1 Uptake-Targeting (557) | Ch14 (anim) Clathrin Now that the receptor is in the membrane and the neurotransmitter is in the synaptic vesicle how do we get them to the right place? Why do synaptic vesicles fuse with the plasma membrane of the nerve terminal and not with the plasma membrane at the nerve cell body? Why don't they fuse with the membrane of the lysosome? The 'easy' answer is that synaptic vesicles only fuse at the synaptic terminal because that's where the neurotransmitter is supposed to go. Releasing it anywhere else would be wasteful and possibly detrimental. The translocator gets the receptor 'into' the ER membrane but vesicles are needed to get the membrane protein to the dendrite membrane where it can function correctly. How do these vesicles form? How do they end up containing the right content? (things that are supposed to be delivered, not ones that

<table>
<tr><td></td><td>should stay in the ER)? What is the difference in regulations level between constitutive and regulated secretion</td></tr>
<tr><td>10/29
T</td><td>Continue discussing last readings</td></tr>
<tr><td>R</td><td>Other types of intracellular traffic.
Of course cells don't only exocytose they also endocytose, recycle and transcytose proteins. All of these forms of traffic use vesicles. How are the vesicles similar and different? Given any experimental method you wanted could you tell them apart? If no--why not? If yes--how?
<table><tr><td>Fig14-29
Fig 14-25 (& video)</td><td>Fig24-10 (p1065)
Fig14-31</td><td>Fig 14-32
Fig14-35</td></tr></table>How do the packages get there? Molecular roads and infrastructure.
Vesicles could just float around until they bump into the right membrane, but they don't. The speed of vesicular traffic testifies to the fact that brownian motion and diffusion aren't controlling the ways that vesicles move. Perhaps that's where mutations causing bipolar come into play--metaphorically speaking, maybe the parts are fine but the delivery trucks go on strike periodically or the roads are bad. What are the molecular road and delivery trucks? The cytoskeleton and molecular motors that move vesicles along the cytoskeleton.
<table><tr><td>Ch15 (video) Chemotaxis in Dicty.</td><td>Ch18 (video) Transport of Syn Ves down MT</td><td></td></tr></table>Look at the video clip as an example of how the cell can change shape. Think about the kinds of structures that would be necessary to maintain those shapes. What are the components of the cytoskeleton? What do they have in common and how are they different. Are they rigid or flexible? Are they built once, remodelled sometimes or constantly changing? Why is this property important to cellular function? How could it effect cellular function if this property was altered? (Increased flexibility or increased rigidity)
(Paper #2 and questions are now available on Moodle. Questions are due on Wednesday 11/7 BEFORE our discussion of the paper)</td></tr>
<tr><td>11/5
T</td><td>Molecular roads and infrastructure.
Regulation of cytoskeleton-- building and maintaining the roads and the engines that move vesicles
Reading
<table><tr><td>Ch17.2 718-723
actin dynamics</td><td>Ch17.3 723-30 actin
modification</td><td>Ch18.2 762-766
MT dynamics</td><td>Ch18.3 767-768
MT modification</td></tr><tr><td>Ch17.5 731-738 actin
motor proteins</td><td>Ch18.4 769-777
MT motors</td><td>Inner Life of a Cell
animation
http://www.youtube.com/watch?v=fZZ3DD_tV9k</td><td>Kinesin animation
http://www.youtube.com/watch?v=686qX5yzksU&feature=related</td></tr></table>The cytoskeleton acts as both structural support and roads for the cell. The video clips illustrate the dynamic nature of the cytoskeleton. How can that be? How can you have a constant structure if the skeleton keeps falling apart? How can vesicles end up in the right place if the roads break down? What are the processed of dynamic instability and treadmilling? How are they similar and different? Why is this instability important to the cell? Do cytoskeletal elements and the regulation of their stability seem like a good direction for study?
Inner life of a cell animation—recommend the whole thing but focus in on min 2:30 to 4:30
http://www.youtube.com/watch?v=fZZ3DD_tV9k
Kinesin animation http://www.youtube.com/watch?v=686qX5yzksU&feature=related
Now we have a little better understanding of the cellular 'roads'. Now we turn our attention to the engines that drive along those roads-- molecular motors. As with most cellular machines, molecular motors are made of proteins. These proteins have certain specificities and enzymatic activity that are important for their function. What are the motors? How do they 'know' what cargo to bind with and what roads to move along? Do molecular motors seem like a plausible candidate for the cause of bipolar disorder? Why or why not?</td></tr>
<tr><td>R</td><td>questions due Noon Wednesday 11/7
Discussion of Paper #2: C. McCann, et al. (2005) Peptide tags for labeling membrane proteins in live cells with multiple fluorophores. Biotechniques 38</td></tr>
<tr><td>11/12
T</td><td>Finish Article Discussion
<table><tr><td>Depression's evolutionary</td><td>Personality Traits</td></tr></table></td></tr>
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<table>
<tr><td></td><td>
<table><tr><td>roots (Moodle)</td><td>& Bipolar (Moodle)</td></tr></table>
Wrap up: Review 2 available by 8:30am
</td></tr>
<tr><td>R</td><td>Review Due Friday 11/17 before 5pm</td></tr>
<tr><td>11/19T</td><td>
Introduction to Case Study 3: Introduction to Werner's Syndrome
<table><tr><td>Cell Cycle Tutorial (web)</td><td></td></tr></table>
Cell Cycle Tutorial http://www.biology.arizona.edu/cell_bio/tutorials/cell_cycle/cells2.html
Werner's syndrome is a progeriac disease. Individuals that suffer from it undergo the 'symptoms' of rapid aging and have a significantly shortened life-span. To discuss aging we must first understand the normal cycle and control of cell life--the cell cycle.
</td></tr>
<tr><td>R</td><td>Thanksgiving Break</td></tr>
<tr><td>11/26
T</td><td>
Life of a Cell: Cell cycle and its regulation
<table><tr><td>Ch20.6 879-892</td><td></td><td></td></tr></table>
Today's reading covers many of the details of the cell cycle. With so much riding on its correct completion you can understand why the cycle would have many checks and balances. What are some of the ways that a cell determines it is 'ok' to go through the cell cycle? How do positive and negative feedback play a role in the process? What kinds of enzymes are involved? If a CDK need a cyclin in order to be functional why aren't these proteins found in 1:1 ratios? (Are there more CDK's or cyclins? How do they work together to regulate the cell cycle). The Breast Cancer video clip illustrates what happens when lack of control leads to too much cell division. In Werner's there seems to be too little. Cells die and are not replaced leading to death of the individual. It's a delicate balance, too much or too little and problems occur. In class we will discuss the theories that connect cell cycle regulation to the aging process.
(Final exam 'prequestions' were emailed to you on Monday)
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<tr><td>R</td><td>
Lab articles sections due
Telomere theory of Aging
<table>
<tr><td>Fig 6-48 and animation
Telomere replication</td><td>Fig6-49 and animation
Mechanism of action of telomerase</td><td>Ch6 263-4</td></tr>
<tr><td>Ch25 1143-45</td><td>Researchers Identify Protein–telomere Interactions That Could Be Key in Treating Cancer (Moodle)</td><td>Nobel09 (Moodle)</td></tr>
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Paper and Discussion questions for post-Thanksgiving article available on Moodle
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<tr><td>12/3
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(Prefinal questions were emailed to you on Monday)
Paper 3: Austriaco, Jr and Guarente 1997 PNAS vol 94, 9768-72
Paper and Discussion questions available on Moodle
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<tr><td>R</td><td>
Why and how do cells die? Apoptosis and Death due to damage
<table><tr><td>Fig 21-33 and animation</td><td>Senescence—the more the merrier (Moodle)</td><td>Ch21.5 936-944</td></tr></table>
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<tr><td>12/10</td><td>Both sections of the final exam will be emailed to you by Dec 7th
The final is due in My OFFICE Monday December 17th BEFORE NOON</td></tr>
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