

MCDB 4650 MidTerm #1 review questions

Class 1: Introduction to the course

What is an animal?
What are the core components of the cell theory?
When is a cell an organism?
What is a social cheater?
Are cells inherently asymmetric? what does that mean?

Class 2: Developmental and decision processes in bacteria.

What are the common characteristics of a molecular machine?
added: Where does the energy to run such machines come from?
How can cellular asymmetries be generated?
added: What is meant by the “half-life” of a molecule? What factors can influence it?
What exactly is a polypeptide, a protein, an RNA, a macromolecular complex (what is a ribosome?)
What is meant by evolutionary “costs and benefits”?
How do social factors influence such costs and benefits?
What types of bacterial responses might be under the control of quorum sensing control and why?
Why is the type of autoinducer produced critical?
What, if anything, is the value of stochastic decision making?
How is the threshold for the quorum response set?
Why isn't the lac operon always expressed?
What (generically) determines the threshold concentration of a cellular response?

Class 3/4: Origins of aggregative (temporary) multicellularity

How might changing the # of lac repressor binding sites (O) or repressor molecules [R] in the cell influence the expression of the lac operon?
How might changing the # of lac repressor molecules/cell (say from 10 to 1000) influence expression of the lac operon?
How would the lac operon behave in the absence of lactose?
What is quorum sensing and why is it useful?
How would quorum sensing response change in response a mutation that decreased receptor binding affinity for the signaling molecule?
What factors will determine whether DNA should be imported from the environment?
What might the cell do with the DNA it imports?
What factors will determine whether a bacterial cell should commit suicide?
What forms of “altruistic self-sacrifice” make sense evolutionarily?
What is a (social) cheater, how does selection influence their prevalence in a population?
What is “swarm intelligence”? How do (how might) ants solve a maze?

Class 4/5: Evolutionary origins of (clonal) multicellularity

What kind of behavior(s) emerged in *Chlorella vulgaris* in the response to the predator *Ochromonas vallescia*? (Borass et al paper)
What is meant by the terms homolog, ortholog, paralog, and convergence?
How do new genes arise? What is the role of gene duplication?
What are the possible fates of a newly generated gene?
What is a null mutation? how can a mutation produce such an effect?
How could a null mutation produce a dominant allele?

Class 6: Establishing Asymmetries / Left-Right

What could asymmetric determinants be? In what situation(s) could there be problems with these determinants and how would that affect the early embryo?

What is chromatin diminution and how does it emerge from cellular asymmetry?

How does it influence cell behavior?

How might asymmetries arise from DNA replication? Cell division plane? Centrosome inheritance? Sperm entry cite?

What types of cellular systems display chirality? How might we visualize cellular asymmetry?

Class 7: Morphogens and gradients: signaling systems.

What types of myosin are you familiar with? How might these different myosins have arisen molecularly (evolutionarily)?

Why does muscle contract rather than expand (or both)?

Why is it that MTs can support movement in both directions?

How do microfilament and microtubule systems interact?

Myo1D paper

Does the microtubule system have a handedness? (Myo1D paper)

What is ectopic expression and how is it done?

What does it mean that “phenotype is 100% penetrant and is specific to Myo1D”?

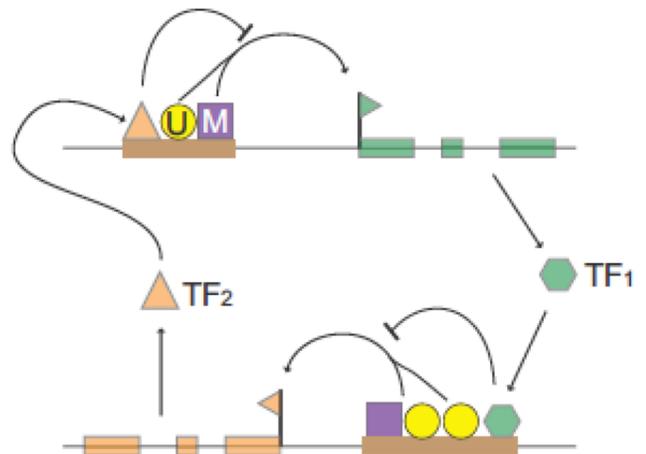
What does GFP expression control for?

What is a “chimera” what is a chimeric protein (polypeptide)?

What does a morpholino do?

What is the implication that myoD1 has a similar role in L/R behavior in *Drosophila* and *Xenopus*?

What is going on (what is described) in this picture (→). which interactions might be cooperative? how would positive versus negative cooperative interactions influence the behavior of the system?



Class 8: Establishing embryonic axes

Mike Levine video completed

What is meant by an enhancer?

How many enhancers does a gene have? How would you determine that?

How does “in situ hybridization work, what does it reveal?

Besides distribution of RNA, what other ways might you get a protein gradient?

How would changes in a transcription factor binding motif lead to changes in response to morphogen gradient?

We give you a TF sequence logo, how would you rank binding affinities of various sequences?

How is the response of a cell to a morphogen gradient similar to or different from a bacterium’s quorum sensing response?

Beside the distribution of the morphogen, what other factors might influence the behavior (read out) of a morphogen gradient?

What roles might antagonists / “carriers” play in defining gradient shape?

What types of responses can be generated by a morphogen gradient?