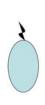
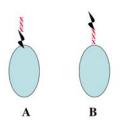
Systems Microbiology 1.084J/20.106J PROBLEM SET #1 – Due Monday Sept 18

- 1.
- a. Describe the different sorts of evidence for life's appearance on the early Earth ~ 3.5 bya.
- b. Which evidence seems most compelling to you, and why?
- b. What dramatic change ~ 2.5 billion years ago has influenced biology on Earth ever since, and how did it happen?
- 2.
- a. Describe how you might determine the stable isotope compositions of different compounds in inorganic, as well as organic or living materials.
- b. What elements might be useful for investigating biological processes using stable isotope ratios?
- c. Describe in detail the metric that's used to differentiate stable isotope content of a specific element in different compounds.
- 3.
- a. Draw the general structure of gram negative and gram positive bacterial cell walls.
- b. What gives these cell walls their structural integrity, how, and why is that important.
- c. What are the major differences, and their biological implications?
- 4.
- a. Describe the various functions of the cell membrane in bacteria.
- b. Name three different classes of transport systems.
- c. Describe the three different functional types of transport systems, and their general similarities and differences.
- 5. There exists a motile marine cyanobacterium that can swims at speeds of 80 um/sec, but no one has ever identified its flagella, despite repeated attempts. Its mode of motility still remains a mystery, but its Reynolds (R) number is not. Assuming a swimming speed of 80 um/sec, and a cell radius of 2000 nm, calculate R for this bacterium. How does this compare to *E. coli*?
- 6.
- a. Draw and describe the structural and functional components and properties of bacterial flagella, and their general mode of synthesis.
- b. If you were to follow the synthesis of flagella with a "pulse chase" experiment, by adding first unlabelled amino acids followed by radio-labeled amino acids, what pattern of labeling during flagellar biosynthesis would you expect to see? (A, B, or C)



Start of experiment Black= unlabelled new flagella



Result after radiolabelled amino acid addition $\boldsymbol{A}\boldsymbol{n}\boldsymbol{d}$ incorporation.

X = site of radiolabel incorporation into newly synthesized flagella filament.