Cell Biology by the Numbers – Exercise 4

Rates and Durations AKA "How time flies by…"

1) Choose one vignette to read from Chapter 4 of "Cell Biology by the Numbers" textbook (you are welcome to read others if you like…), preferably one vignette that is related to your research topic or that you have previous knowledge of. Write a few sentences on what you learned from it, how you suggest to make it better and anything insightful you have to add. Bonus given to new insights and most useful suggestions.

1. Estimate how long does it take a ribosome to make another copy of itself. Consider only the protein portion of the ribosome, and assume the molecular weight of the ribosome is about 10^6 Da. *Think how to break the question into components and then find the numbers and calculate the answer. Give specific references to where you got each number you use and notice the number of significant digits used (reminder: http://book.bionumbers.org/rigorous-rules-for-sloppy-calculations/).*

2. In wild conditions, cells experience conditions which are starkly different than conditions at which they are grown in the lab. Consequently, the characteristics of cells in the wild differ quite significantly than what we consider as "normal". In the ocean, for example, one of the most numerous bacteria, *Pelagibacter ubique*, has an average volume of ≈0.04 µm^3 (Zhao et al., AEM, 2017), which is about 25-fold lower than our rule of thumb 1µm^3 for *E. coli*. The average doubling time of *P. ubique* is about 30 hours (BNID 105462), more than an order of magnitude slower than lab-grown bacteria.

   a) What is the minimal number of ribosomes required to synthesize the entire protein mass of a *P. ubique* cell in a doubling time of 30 hours (the combined mass of the cell which is composed of protein)? Assume ribosomes work as fast as they do in *E. coli*.

   b) Using cryo-ET, researchers have measured ≈500 ribosomes in *P. ubique* (Zhao et al., AEM, 2017). How does this number compare to your calculation? Calculate the average polymerization rate of a ribosome in *P. ubique*.

   c) Optional: If there is an order of magnitude difference in the results, suggest explanations.

exercise