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Homework 1

Due: 8/28/2019

PHYS 8170 Molecular Biophysics

Q.1. a) Who stated and when the Central Dogma of molecular Biology? Find the one citation.

**It was first stated by Francis Crick in 1957, then published in 1958.**

Q.2 An adult human is composed of about 1013 cells, all of which are derided by cell division from a fertilized egg.

a. Assuming that all cells continue to divide (like bacteria in rich media), how many generations of cell divisions would be required to provide 1013 cells?

b. Human cells in culture dive once per day. Assuming all cells continue to divide at this rate during development, how long would it take to generate an adult organism?

c. Why is it that adult humans take longer to develop than these calculations might suggest?

**A. 2x = 1013, x = (ln1013) / (ln2) ≈ 44**

**B．44 days**

**C. the divide rate above only works under perfect environment. However, in real human bodies those conditions are not satisfied, many environment variables will change (decrease) the divide rate of human cells, besides, apoptosis stats the fact that human cells will not divide forever. Thus, adult humans take longer to develop organism than calculation suggests.**

Q.3. In the beginning of the book “What is Life? The great physicist Erwin Schrödinger asked the following question: “How can the events in time and space which take place within the spatial boundary of a living organism be accounted for by physics and chemistry?” What would be your answer? Do you think that there are peculiar properties of living systems that disobey the laws of physics and chemistry?

**No, all of the properties of living system must obey the laws of physics and chemistry. Actually Erwin Schrödinger states that the obvious inability of present-day physics and chemistry to account for such events is no reason at all for doubting that they can be accounted for by those sciences. Because of ingenious work of biologists, what happens in space and time within a living organism is revealed however those systems are differ from the fundamental one for physicists and chemists at that time. But it doesn’t mean those properties of living system disobey any part of the laws above.**

Q.4. Cell growth depends on nutrient uptake and waste disposal. One might imagine that the rate of movement of nutrients and waste products across the cell membrane would be an important determinant on the rate of cell growth. Is there a correlation between a cell’s growth rate and its surface to volume ratio? Assuming that the cells are spheres, compare a bacterium (radius 1m), which divides every 20 minutes, with a human cell (radium 10 m) which divides every 24 hrs. Is there a match between surface to volume ratios and the doubling times for these cells?

**The surface to volume ratios of cell is in proportional to the reciprocal of radius of the cell. The doubling time of human cell is 72 times as of bacterium’s, where surface to volume ratios of human cell is 1/10 of bacterium’s.**

Q.5 Noji H. *et al* (1997) “Direct observation of the rotation of F1-ATPase” Nature 386, 299-302. doi:10.1038/386299a0

a. Read and type a 250 summary (in your own words). Minimum 200 words.

b. Describe the methods in your own words (250 words). Minimum 200 words.

c. State 3 critics to the paper.

A.