Biochemistry Cumulative Examination

November 3, 2016

100 points total.

1. (20 points) Name the three stages of mRNA transcription and briefly describe the key events during each stage.

2. (15 points) What is the primary reason why population measurements (i.e., measuring average behavior of millions of cells) often do not reflect the behavior in individual cells regarding transcription, in particular?

3. (30 points = 10 x 3) (1) Describe how the single-molecule fluorescence in situ hybridization technique that has been used to measure RNA polymerase dynamics in LIVING cells (i.e., not fixed cells) works.

(2) Using this technique to monitor endogenous transcription in mammalian cells has been difficult. Why?

(3) Suggest ways you can overcome the limitation described in (2).

4. (20 points) Using single-cell measurements, it has been shown that transcriptional bursting is a conserved property of transcription, observed from bacteria to human. What is transcription bursting? Briefly describe at least two current hypotheses underlying the bursting.

5. (15 points) Briefly describe the fluorescent recovery after photobleaching (FRAP) technique and how this has been used to characterize the transcriptional kinetics in single cells.