4.4. How many ribosomes are actively synthesizing proteins at any instant in an *E. coli* cell growing with a 45-min doubling time? The birth size of *E. coli* is 1-μm diameter and 2-μm length. The water content is 75%. About 60% of the dry material is protein, and the rate of amino acid addition per ribosome is 20 amino acids per second. The average molecular weight of free amino acids in *E. coli* is 126.

4.5. Describe simple experiments to determine if the uptake of a nutrient is by passive diffusion, facilitated diffusion, active transport, or group translocation.

4.6. For the *m*-RNA nucleotide code below: (a) Deduce the corresponding sequence of amino acids. (b) What is the corresponding nucleotide sequence on the chromosome? This sequence codes for a part of insulin.

CCG UAU CGA CUU GUA ACA ACG CGC

4.7. Consider the pathway in Fig. 4A.1 for production of lysine, methionine, isoleucine, and theronine. You need to produce lysine. Describe a strategy for making large amounts of lysine. Your strategy can consist of adding various amino acids to the medium and choosing the mutant cells altered in regulation. Say you can identify up to two points of mutation (e.g., removal of feedback inhibition).

4.8. Suggest an experiment to determine if the uptake of a compound is by either facilitated or active transport.

4.9. What is catabolite repression, and how does it affect the level of protein expression from the lac operon?

4.10. Explain the difference between feedback inhibition and feedback repression.

4.11. You are asked by your boss to produce a human protein in *E. coli*. Because you have learned some of the differences in the way that procaryotes and eucaryotes make proteins, you worry about at least two factors that could complicate production of an authentic protein for human use.

a) What complication might you worry about if the human DNA encoding the protein were placed directly in *E. coli*?

b) Assume that the correct primary sequence of amino acids has been produced. What post-translational steps do you worry about and why?

4.12. Consider the process of N-linked glycosylation.

a) What organelles are required?

b) What is the residual sugar on a glycoprotein that has simple glycosylation?

c) If glycosylation is complete, what will be the final sugar on the glycoform?

d) Why may N-linked glycosylation be important?