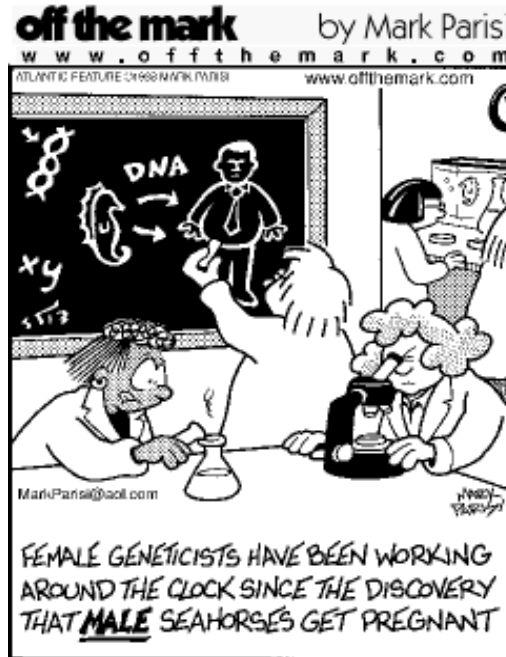


Recitation 06 Problems



WARM UP 1 (Exam 2, 2002)

You decide to construct "magnoglobin," a new type of hemoglobin in which you have substituted the smaller Mg atoms (atomic number 12) for the larger Fe atoms (atomic number 26) in the porphyrin ring of all the subunits. Although you are able to find experimental conditions where magnoglobin will bind oxygen, magnoglobin does not show any cooperativity. Devise an explanation for why this might be.

QUESTION 1 (Gumport, 10-1)

What would be the kinetic consequences if a substrate were to have equal affinities for the R form and the T form of an allosteric enzyme?

QUESTION 2 (Problem Set 6, 2002)

An anemic individual, whose blood has only half the normal Hb content, may appear to be in good health. However, a normal individual is incapacitated by exposure to sufficient carbon monoxide to occupy half his heme sites (CO binds to Hb with 2000X greater affinity than oxygen does). Explain.

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QUESTION 3

The crocodile can remain under water without breathing for up to one hour. An adaptation that aids the crocodile in doing so is that it can utilize virtually 100% of the oxygen in its blood, whereas humans, for example, can extract only approximately 65% of the oxygen in their blood. Crocodile Hb does not bind BPG. However, crocodile deoxy Hb preferentially binds bicarbonate ions. How does this help the crocodile remain under water for so long?

QUESTION 4 (1995 Exam 4)

What would be the significance of finding a drug that bound to a hydrophobic patch that includes Phe- β 85 and Leu- β 88 on the surface of hemoglobin?

QUESTION 5

A mutant hemoglobin is isolated. In this mutant protein, the pKa's for all ionizable groups are the same in the T and R states, except for one histidine that has a higher pKa in the R state.

- (A) Sketch a representation of the oxygen binding curve at pH 7.6 and pH 7.2 for the mutant hemoglobin.
- (B) Why would a person with this mutant hemoglobin have medical problems?

QUESTION 6

G-proteins are involved in signal transduction in many types of cells in the body. In intestinal epithelial cells, a signal mediated by a G-protein regulates water transport in these cells through certain membrane proteins. The effects of certain drugs and toxins on the G-protein can cause an abnormality in which excess water exits from the blood into the intestinal tract through these cells. The water is then lost through diarrhea.

The cholera toxin irreversibly modifies the G α subunit of the G-protein so that it continuously stimulates adenylate cyclase. Cholera can lead to severe, potentially fatal dehydration if not treated properly.

- (A) What function of the G α subunit is altered by the toxin so that adenylate cyclase is continuously active?
- (B) What is the effect of the toxin on cAMP levels in the intestinal cells?

QUESTION 7 Is Spring Break here yet?