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Hands-On Two Interesting Problems

Problem 1

Which of the following mutational changes would be predicted to harm an organism? Explain your answers.

- Insertion of a single nucleotide near the end of the coding sequence (CDS).
- Removal of a single nucleotide near the beginning of the CDS.
- Deletion of three consecutive nucleotides in the middle of the CDS.
- Deletion of four consecutive nucleotides in the middle of the CDS.
- Substitution of one nucleotide for another in the middle of the CDS.

Problem 2

The Sonrisa protein is a hypothetical protein that causes people to smile more often. It is inactive in many chronically unhappy people.

The mRNA isolated from a number of different unhappy persons in the same family was found to lack an internal stretch of 173 nucleotides that is present in the Sonrisa mRNA isolated from a control group of generally happy people.

The DNA sequences of the Sonrisa genes from the happy and unhappy families were determined and compared. They differed by just one nucleotide change – and no nucleotides were deleted. Moreover, the change was found in an intron.

What can you say about the molecular basis of unhappiness in this family?

Problem 3

Consider the gene that specifies the structure of hemoglobin. Arrange the following events in the most likely sequence in which they would take place.

- Anemia is observed.
- The shape of the oxygen-binding site is altered.
- An incorrect codon is transcribed into hemoglobin mRNA.
- The ovum (female gamete) receives a high radiation dose.
- An incorrect codon is generated in the DNA of the hemoglobin gene.
- A mother (an X-ray technician) accidentally steps in front of an operating X-ray generator.
- A child dies.
- The oxygen-transport capacity of the body is severely impaired.
- The tRNA anticodon that lines up is one of a type that brings an unsuitable amino acid.
- Nucleotide-pair substitution occurs in the DNA of the gene for hemoglobin.

[*Introduction to Genetic Analysis* by Griffiths et al., 2005]