

CASE STUDY

AMINO ACIDS AND EVOLUTION

Objectives

- To use biochemical data to determine evolutionary relationships.
- To test the hypothesis that living things that are morphologically similar share similar protein structure.

Background Information

The sequencing of some 20 different amino acids is responsible for proteins, the building blocks of cells. Biologists knew that proteins are responsible for the morphological features of living things and hypothesized that organisms that share a similar heritage would demonstrate similarities in amino acid sequencing. Organisms most similar would have the most similarities in amino acids.

Materials

red and blue pens or highlighters of two different colors

Procedure

- A segment of the enzyme cytochrome c, a protein involved in cellular respiration in aerobic organisms, is provided in Table 1. The entire enzyme consists of 104 subunits; however, only 50 amino acids are provided to represent the protein. The names of the amino acids have been abbreviated. As you can see, the sequence of amino acids is slightly different in three organisms.
- Refer to Table 1 and calculate the percentage of each amino acid, as shown in the example below. Record your results in a table similar to Table 2.

The percentage of alanine in the silkworm moth is

$$\frac{5(\text{no. of alanines}) \times 100}{50} = 10\%$$

Table 1: Amino Acid Sequence

	1	2	3	4	5	6	7	8	9	10
Silkworm	Cys	Ala	His	Cys	Ala	AsA	Leu	Val	Try	Ser
Hornworm	Cys	Ala	His	Cys	Ala	AsA	Leu	His	Try	Ser
Fruitfly	Cys	GluA	His	Cys	Ala	AsA	Leu	GluA	Try	Ser
	11	12	13	14	15	16	17	18	19	20
Silkworm	Met	GluA	His	Leu	Arg	Phe	Ala	Ser	His	GluA
Hornworm	Met	GluA	His	Leu	Arg	Phe	Ala	Ser	His	GluA
Fruitfly	Met	GluA	His	Leu	Arg	Phe	Ala	Ser	His	GluA
	21	22	23	24	25	26	27	28	29	30
Silkworm	Thr	His	Tyr	Try	Ala	Pro	Phe	AsA	Val	Thr
Hornworm	Thr	Cys	Tyr	Try	Ala	Pro	Phe	AsA	Val	Thr
Fruitfly	Thr	Cys	Tyr	Try	Ala	Pro	His	AsA	Val	Thr
	31	32	33	34	35	36	37	38	39	40
Silkworm	GluA	Tyr	Pro	Met	Gly	Val	Arg	Met	Lys	Phe
Hornworm	GluA	Tyr	Pro	Met	Gly	Val	Arg	Met	Lys	Phe
Fruitfly	GluA	Tyr	Pro	Met	Gly	Ala	Arg	Met	Lys	Phe
	41	42	43	44	45	46	47	48	49	50
Silkworm	Thr	Met	Gly	His	AsA	His	Ala	His	Try	GluA
Hornworm	Thr	Met	Gly	His	AsA	His	Ala	His	Try	GluA
Fruitfly	Thr	Met	Gly	His	AsA	His	Ala	His	Try	GluA

a) Complete the table in your lab book.

Table 2: Amino Acid Percentage

Abbreviation	Amino acid name	Silkworm moth	Hornworm moth	Fruitfly
Ala	Alanine	10%		
Arg	Arginine			
AsA	Aspartic acid			
Cys	Cysteine			
GluA	Glutamic acid			
Gly	Glycine			
His	Histidine			
Leu	Leucine			
Lys	Lysine			
Met	Methionine			
Phe	Phenylalanine			
Pro	Proline			
Ser	Serine			
Thr	Threonine			
Try	Tryptophan			
Tyr	Tyrosine			
Val	Valine			

