Student question of the day....

Q1: The number of possible 10mer peptides is enormous \((20^{10} \approx 10^{13})!\) Do all of these exist, and if so, how many different functions do they have?

A: No, they do not all exist. How many do exist? Maybe \(10^5\) different peptides of this size. Thus there is a lot of “protein space” that has not been explored.

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7.013 Lecture 5
2.16.07

Biochemistry III

The cell as a factory
Materials
Manufacturing process

Purves 6.3: does a reaction occur spontaneously?

- Exergonic reaction: \(\Delta G^{-}\), spontaneous, releases energy
- Endergonic reaction: \(\Delta G^{+}\), requires energy

\(G^{-}\), spontaneous, releases energy
\(G^{+}\), requires energy

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Purves 6.3: does a reaction occur spontaneously?
Purves 6.8: How fast does a reaction initiate?
Transition state

Purves 6.11: Catalysts lower activation energy required for a reaction

Enzyme/substrate specificity

Purves 6.10: Active site specificity
“lock and key” model
An enzyme-catalyzed reaction: Hydrolysis of sucrose

The catalytic cycle of sucrase

See Purves 6.10

A tale of one enzyme....

Purves 6.12: how enzymes promote transition state

A tale of one enzyme.....
Regulation of enzyme activity

Purves Table 6.1: enzyme partners
Purves 6.22: pH optima
Purves 6.23: temperature optimum

1/451 amino acids changed
Arg 408 >> Trp
in active site
Dihydrofolate and tetrahydrofolate are required for nucleotide synthesis and DNA modification.

Dihydrofolate reductase: target of anticancer drug methotrexate (human) and of antibiotic trimethoprim (bacteria).

DHFR catalytic cycle: NADP(H), DHF, THF

Purves 6.18a: competitive inhibition
Gleevec is a competitive inhibitor of a “leukemia protein”

Allosteric regulation of enzyme activity

(a) Conformational changes in an allosteric enzyme
(b) Allosteric regulation of the enzyme’s activity

See also Purves 6.18b, 6.19

Feedback regulation

Purves 7.19: feedback in a metabolic pathway
Isoleucine synthetic pathway and feedback inhibition

See Purves 6.21

Enzymes and energy

The ATP cycle (see Purves 6.6)

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