TEKNOLOGI ENZIM
Pertemuan ke-2

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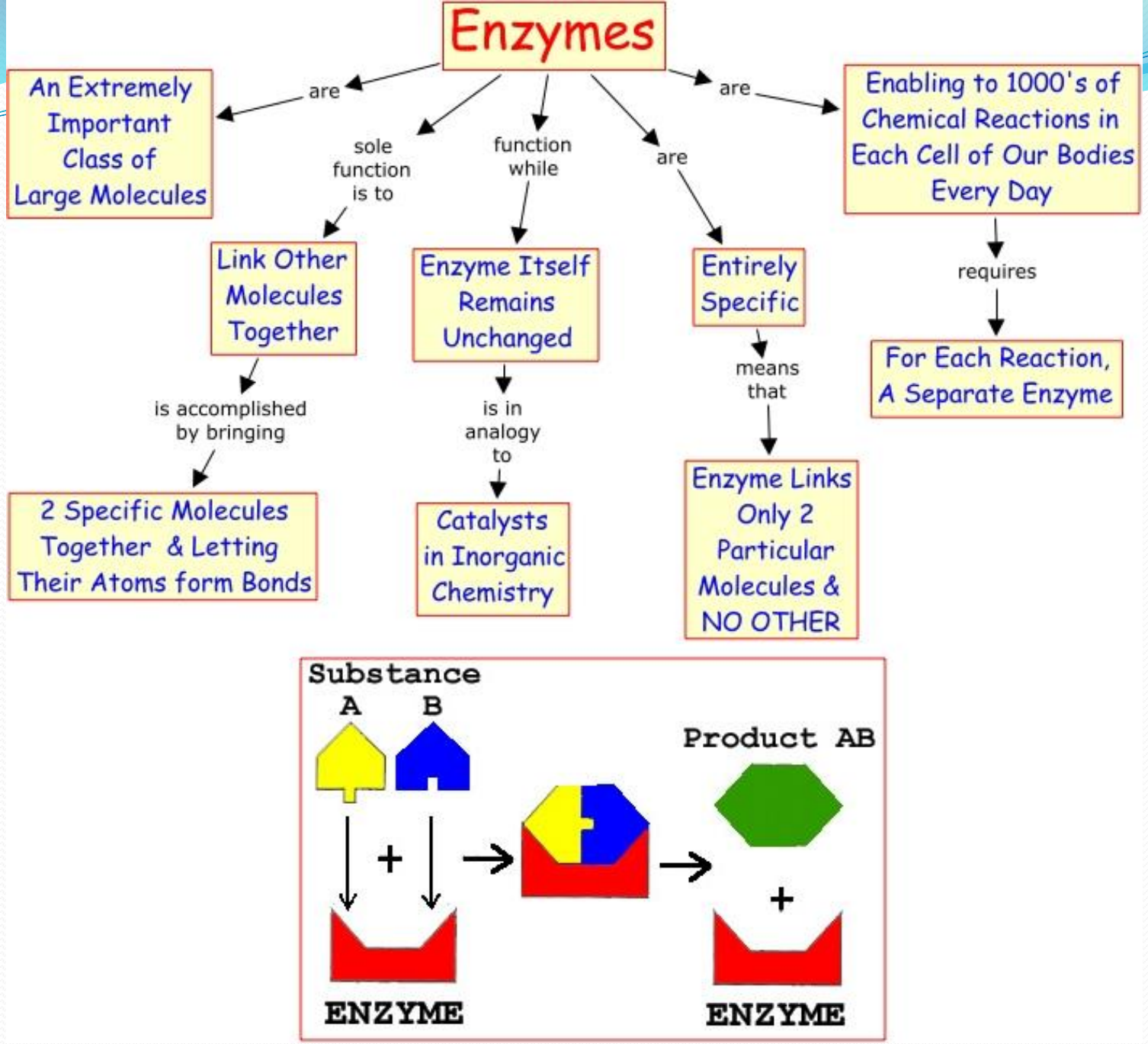
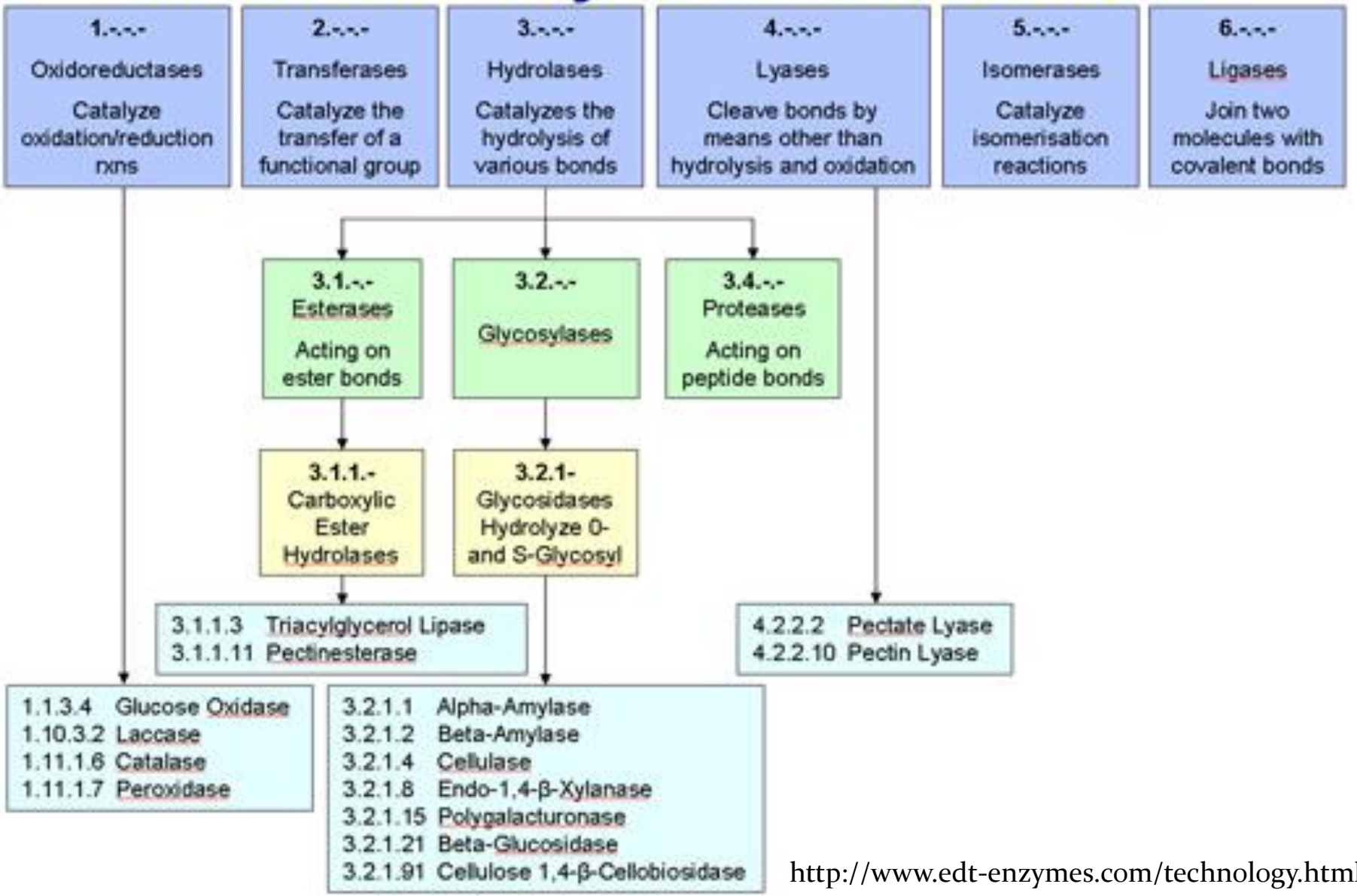


http://cmapspaceexp.ihmc.us/viewer/cmap/1173217183166_25605526_4552

Relevant Enzyme Classifications



http://www.edt-enzymes.com/technology.html

Industri berbasis enzim

International online shopping Worldwide delivery!

Podelite sa prijateljima

Miscellaneous: Bromelain

60 tabs, 500 mg

Old price: ~~EUR 14.38~~ (~~US$ 19.65~~)

New price: EUR 9.42 (US$ 12.87)

You save: EUR 4.96 (US$ 6.78)

We accept all currencies! Automatic conversion at the InterBank's daily medium currency rate.

Availability: Shipment within 48 hours.
World wide delivery: 7 - 15 working days for North America, 4 - 7 working days for Europe (Air Mail).

More about this product

http://www.yu4you.com/items/en/ostalo/item_662.html

Table 1

Enzymes used in various industrial segments and their applications.

Industry	Enzyme class	Application
Detergent (laundry and dish wash)	Protease	Protein stain removal
	Amylase	Starch stain removal
	Lipase	Lipid stain removal
	Cellulase	Cleaning, color clarification, anti-redeposition (cotton)
	Mannanase	Mannanan stain removal (reappearing stains)
Starch and fuel	Amylase	Starch liquefaction and saccharification
	Amyloglucosidase	Saccharification
	Pullulanase	Saccharification
	Glucose isomerase	Glucose to fructose conversion
	Cyclodextrin-glycosyltransferase	Cyclodextrin production
	Xylanase	Viscosity reduction (fuel and starch)
	Protease	Protease (yeast nutrition – fuel)
Food (including dairy)	Protease	Milk clotting, infant formulas (low allergenic), flavor
	Lipase	Cheese flavor
	Lactase	Lactose removal (milk)
	Pectin methyl esterase	Firming fruit-based products
	Pectinase	Fruit-based products
	Transglutaminase	Modify visco-elastic properties
Baking	Amylase	Bread softness and volume, flour adjustment
	Xylanase	Dough conditioning
	Lipase	Dough stability and conditioning (*in situ* emulsifier)
	Phospholipase	Dough stability and conditioning (*in situ* emulsifier)
	Glucose oxidase	Dough strengthening
	Lipoxygenase	Dough strengthening, bread whitening
	Protease	Biscuits, cookies
	Transglutaminase	Laminated dough strengths
Animal feed	Phytase	Phytate digestibility – phosphorus release
	Xylanase	Digestibility
	β-Glucanase	Digestibility
Beverage	Pectinase	De-pectinization, mashing
	Amylase	Juice treatment, low calorie beer
	β-Glucanase	Mashing
	Acetolactate decarboxylase	Maturation (beer)

Enzymes used in various industrial segments and their applications.

Industry	Enzyme class	Application
	Laccase	Clarification (juice), flavor (beer), cork stopper treatment
Textile	Cellulase	Denim finishing, cotton softening
	Amylase	De-sizing
	Pectate lyase	Scouring
	Catalase	Bleach termination
	Laccase	Bleaching
	Peroxidase	Excess dye removal
Pulp and paper	Lipase	Pitch control, contaminant control
	Protease	Biofilm removal
	Amylase	Starch-coating, de-inking, drainage improvement
	Xylanase	Bleach boosting
	Cellulase	De-inking, drainage improvement, fiber modification
Fats and oils	Lipase	Transesterification
	Phospholipase	De-gumming, lyso-lecithin production
Organic synthesis	Lipase	Resolution of chiral alcohols and amides
	Acylase	Synthesis of semisynthetic penicillin
	Nitrilase	Synthesis of enantiopure carboxylic acids
Leather	Protease	Unhearing, bating
	Lipase	De-pickling
Personal care	Amyloglucosidase	Antimicrobial (combined with glucose oxidase)
	Glucose oxidase	Bleaching, antimicrobial
	Peroxidase	Antimicrobial

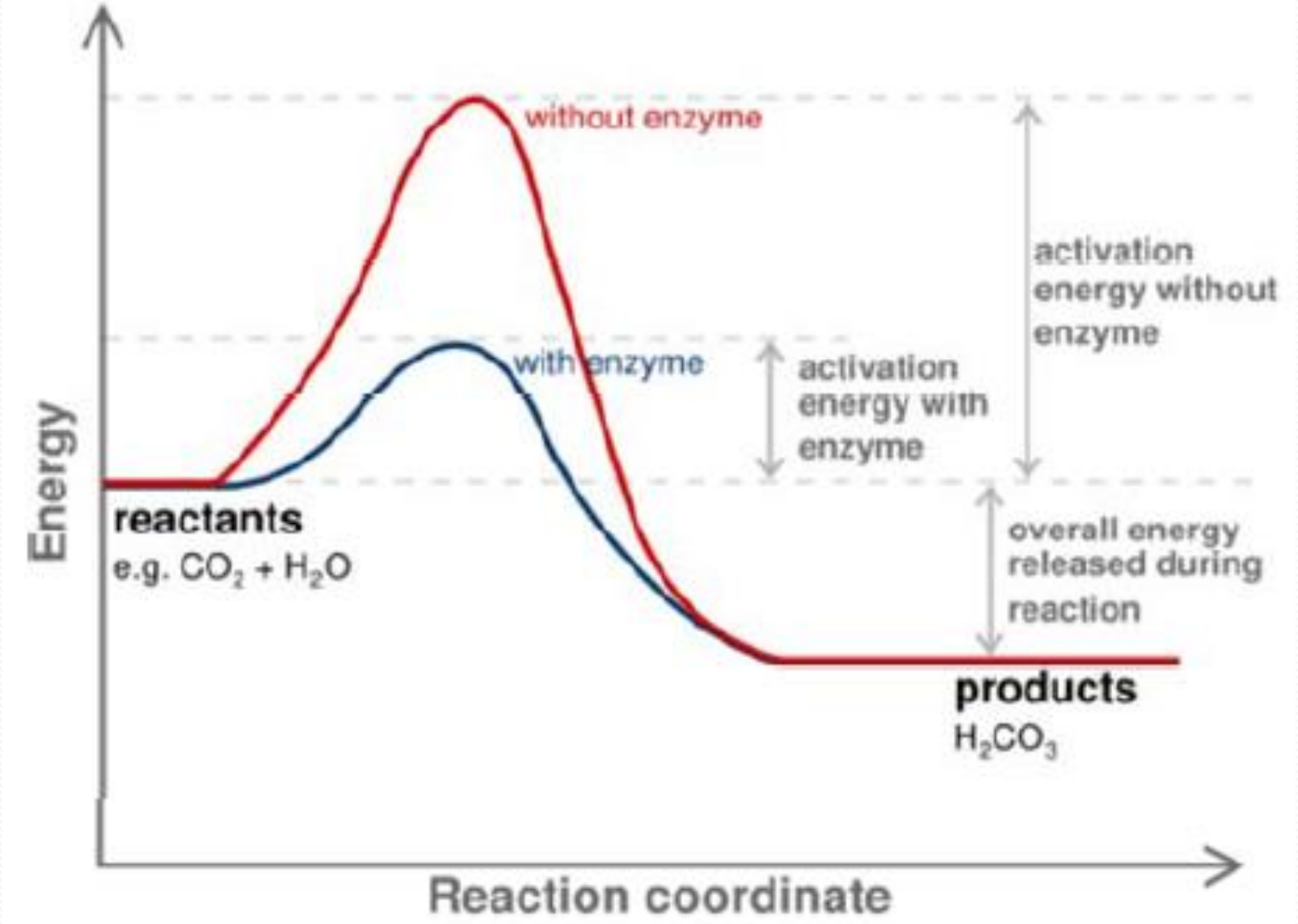
Kirk et al. (2002) Industrial enzyme applications. Current Opinion in Biotechnology 13:345-351

Refleksi

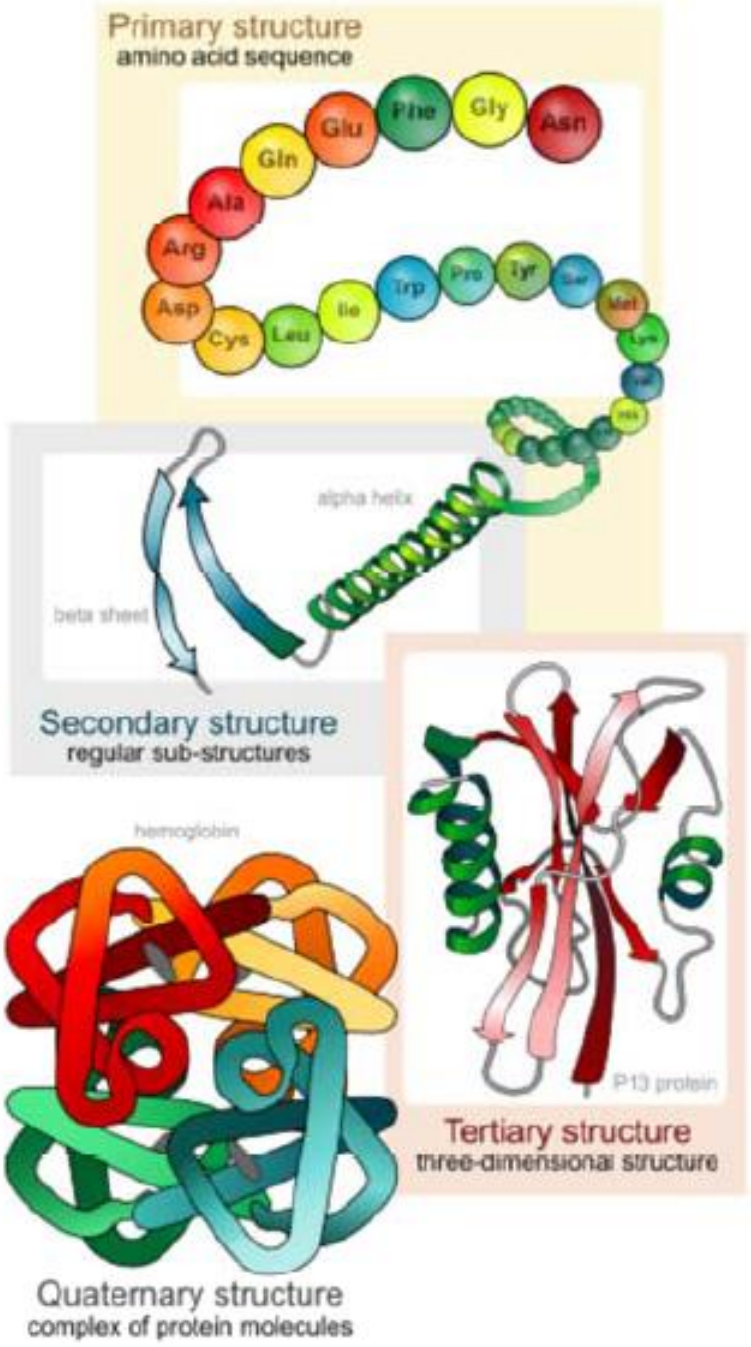
What are enzymes?

- All enzymes are globular **proteins** → spherical in shape (Fig 1)
- Control biochemical reactions in cells
- They have the suffix "-ase"
- Intracellular enzymes are found inside the cell
- Extracellular enzymes act outside the cell (e.g. digestive enzymes)
- Enzymes are catalysts → speed up chemical reactions (Fig 2, Fig 3)
  - Reduce activation energy required to start a reaction between molecules
  - Substrates (reactants) are converted into products
  - Reaction may not take place in absence of enzymes (each enzyme has a **specific** catalytic action)
  - Enzymes catalyse a reaction at max. rate at an optimum state

Mekanisme kerja enzim



Struktur enzim



http://www.biologyguide.net/unit1/2_enzymes.htm

Mekanisme Kerja Enzim

Persamaan reaksi enzim

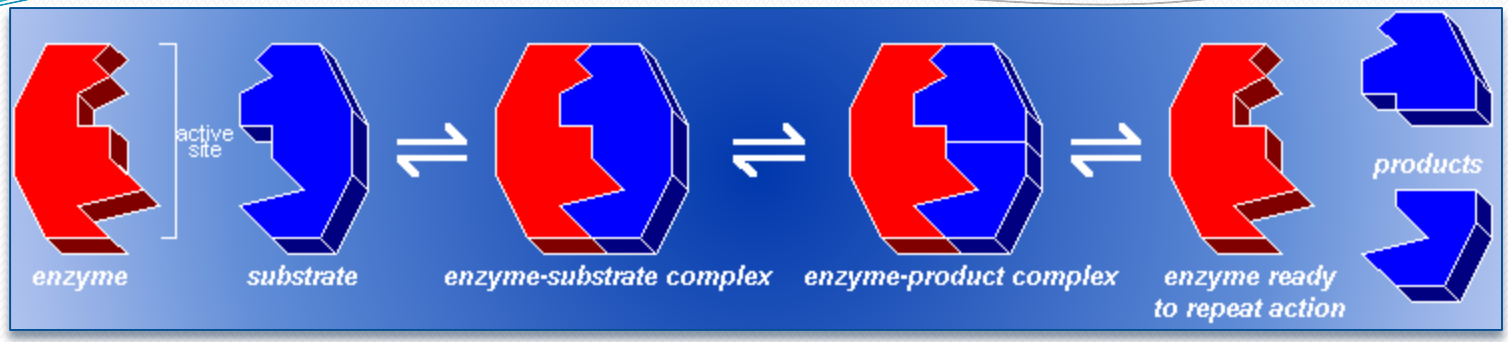
Enzim + Substrat ⇌ Enzim-Substrat Kompleks → Enzim + Produk

$$E + S \rightleftharpoons ES \longrightarrow E + P$$

Pembentukan [ES] diyakini terjadi menurut mekanisme:

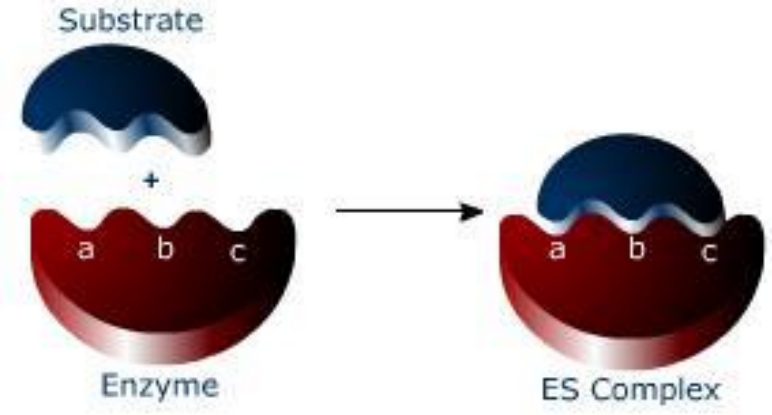
1. Key and lock theory
2. Induced fit theory

Key and lock theory

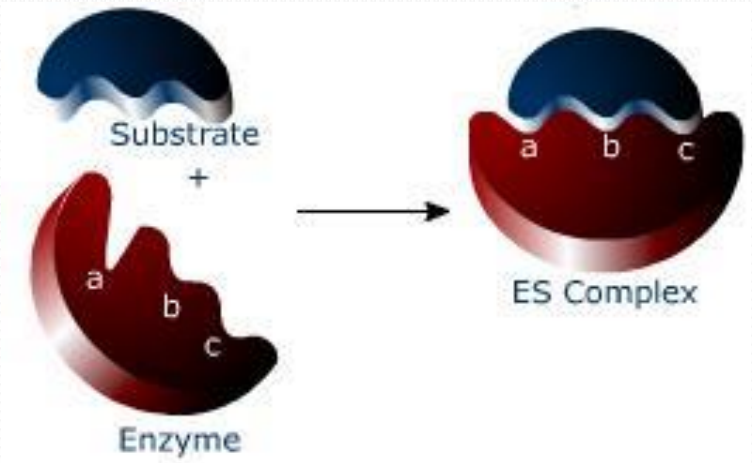


http://library.thinkquest.org/3659/orgchem/proteins.html

Key and lock theory



Induced fit theory



http://chemistry.tutorvista.com/physical-chemistry/catalysis-and-enzymes.html

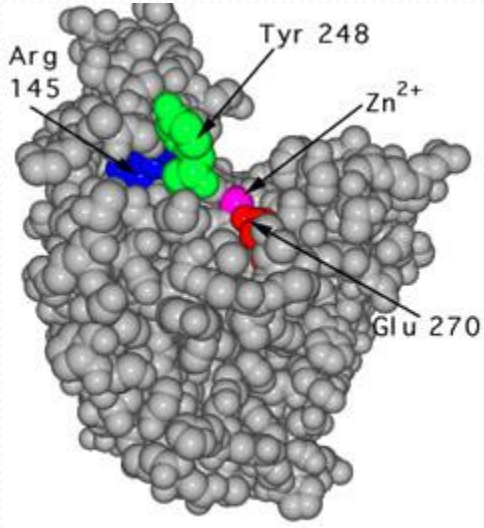
Untuk flash tutorial enzim heksokinase dpt dilihat pada :
http://www.chem.ucsb.edu/~molvisual/ABLE/induced_fit/index.html

- http://www.absorblearning.com/chemistry/contents.html

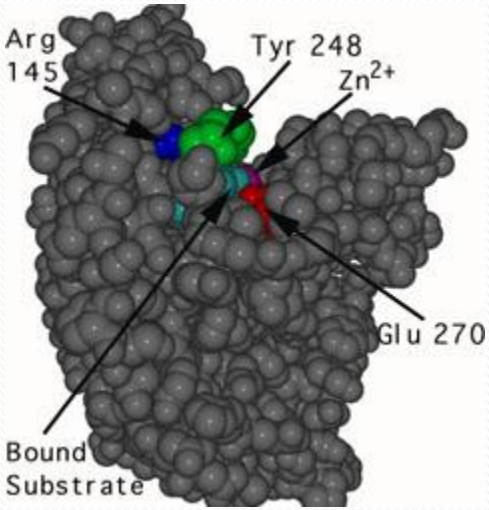
Daniel Koshland (1920-2007), US biochemist. Koshland studied enzymes and the movement of bacteria in response to chemical stimuli (chemotaxis). He developed the 'induced fit' theory of enzyme and substrate interaction, which was a modification of the accepted 'lock and key model'. Koshland was editor of the journal 'Science' from 1985-1995

http://www.sciencephoto.com/media/395647/enlarge

Carboxypeptidase A dan pembentukan Enzim-Substrat kompleks (Demonstrasi induced-fit theory)



This is a molecular model of the unbound carboxypeptidase A enzyme. The cpk, or space-filled, representation of atoms is used here to show the approximate volume and shape of the active site. Note the zinc ion (magenta) in the pocket of the active site. Three amino acids located near the active site (Arg 145, Tyr 248, and Glu 270) are labeled



This is a cpk representation of carboxypeptidase A with a substrate (turquoise) bound in the active site. The active site is in the induced conformation. The same three amino acids (Arg 145, Tyr 248, and Glu 270) are labeled to demonstrate the shape change.

Note: Coordinates for Figures 2 and 3 are from x-ray crystallographic data

http://www.chemistry.wustl.edu/~edudev/LabTutorials/Carboxypeptidase/carboxypeptidase.html

Sel dan organelnya, sebuah mesin enzim