Keemiast bioloogias

Tartu
November 2008

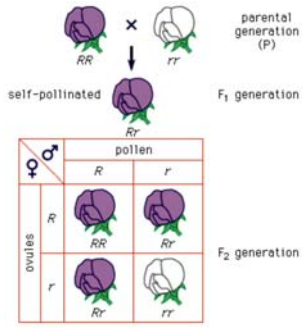
Pärilikkuse seadused

Gregor Mendel (1822 - 1884)

- Katsed aedhernega (*Pisum sativum*) aastail 1856 - 1863
- 28 000 taime ristamine
- Fenotüüpide analüüs
- Mendeli seadused

Pärilikud tunnused liiguvad põlvkonnast põlvkonda ühikute kaupa

Fenotüübi määrab nende ühikute vastastikune toime



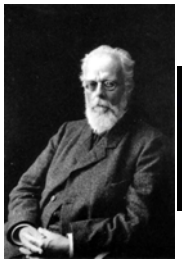
Happeline aine rakutuumadest

Friedrich Miescher (1844 -1895)

- Mädanevatest haavadest pärit valged vererakud
- Rakutuumade töötlus leelise & etanooliga :
  - tundmatu aine (*nukleiin*) sade
  - happeliste omadustega
  - sisaldab fosforit
- Hiljem leidis Miescher nukleiini paljudest teistest kudedest & organismidest

SEE AINE (NUKLEIIN) OLI DNA

Kromosoom - pärilikkuse füüsiline kandja

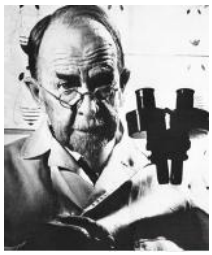


August Weizmann
1834 - 1914

Theodor Boveri
1862 - 1915

Kromosoomid sisaldavad geene

Thomas Hunt Morgan
(1866 -1945)



Katsed äädikakärbsega (*D. melanogaster*) :

- geenid paiknevad kromosoomidel
- geenid vahetavad kohti
- geenid muteeruvad (kemikaalid, kiirgus)
- mutatsioonid päranduvad Mendeli seaduste kohaselt
- geenide kaardistamine

GEENID ON FÜÜSILISELT EKSISTEERIVAD ASJAD

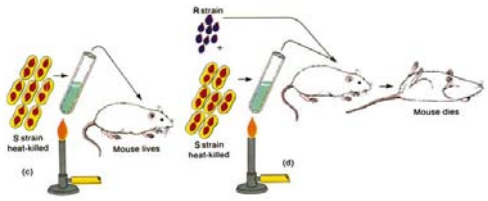
Frederick Griffith 1928 :

- Bakterid sisaldavad ainet, mille ülekandumisel ühest bakterist teise kandub üle ka esimese bakteri fenotüüp (virulentsus)
- Seda "miskit" hakati nimetama "*transforming principle*"

Oswald Avery, Colin MacLeod, Maclin MacCarty 1944 :

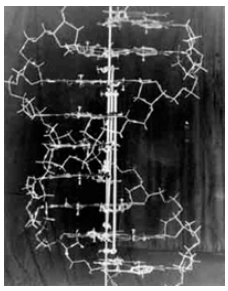
- "transforming principle" ei kao
  - töötlemisel proteaasiga (lagundab valku)
  - töötlemisel ribonukleaasiga (lagundab RNA-d)
- "transforming principle" kaob
  - töötlemise desoksüribonukleaasiga (lagundab DNA-d)

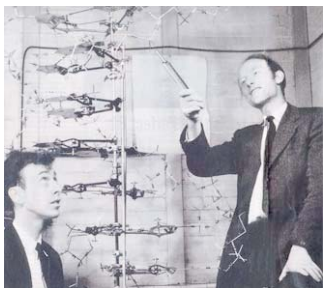
"TRANSFORMING PRINCIPLE ON - DNA"



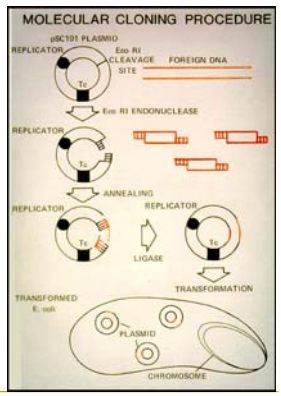
- 1909 – Levene & Jacobs määravad DNA keemilise koostise : pentoos + lämmastikalus + fosforhape
- 20. saj. I pool – DNA tetranukleotiidsuse hüpotees
- 1938 – Hammarsten & Caspersson näitavad, et DNA on kõrgmolekulaarne ühend : Mw = 200 000 – 1 000 000 Da
- 1930 – 1940 – esimesed röntgenülesvõtted DNA-st
- 1944 – Chargraffi reeglid : mistahes DNA sisaldab 1:1 suhtes A- ja T-d ning 1:1 G- ja C-d
- 1951 – Alexander Todd & nukleotiidide keemiline süntees

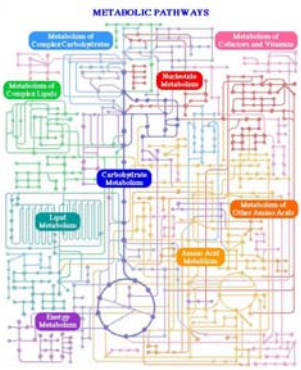
Pärilikkusaine struktuur 1953

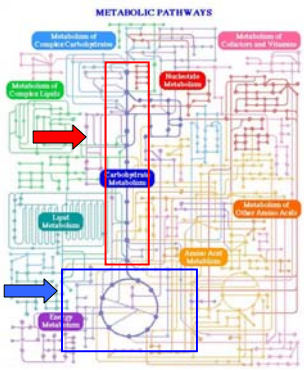




- 1957 – Roger Kornberg avastab DNA polümeraasi
- 1958 – Meselson & Stahl : DNA replikatsiooni mudel
- 1958 – Francis Crick postuleerib tRNA olemasolu
- 1961 – mRNA ja geenieksprессiooni reguleerimine
- 1963 – Nirenberg, Ochoa, Stahlin : geneetiline kood
- 1970-ndad – insenergeneetika (*genetic engineering*) teke
- 1978 – Fred Sanger & DNA sekveneerimine
- 1990 – algab Inimgenoomi projekt
- 2003 – Inimgenoomi järjestuse teada

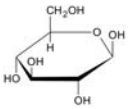






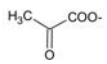
Glükolüüs

Glükoos



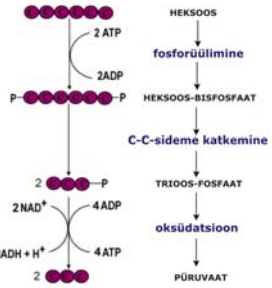
$\Delta G^{\circ} = -85$ kJ/mol

Püruvaat



Glükoos + ADP + P_i → 2 püruvaat + 2 ATP + 4H

Glükolüüs

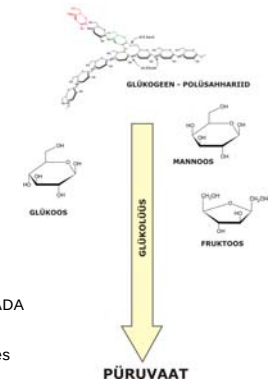


Glükolüüs kui keskne ainevahetusrada :

- väga erinevad süsivesikud
  - GLÜKOOS
  - FRUKTOOS
  - MANNOS
  - LAKTOOS
  - GLÜKOGEEN
- vaheproduktid lähteaineteks teistele radadele
  - PENTOOSFOSFAATRADA

  ↓

  nukleotiidide biosüntees



Glükolüüs

- C-aatomite järkjärguline OKSÜDEERIMINE
- NAD^+ redutseerimine
- MAKROERGILISTE ühendite (**ATP**) teke
- C-C sidemete katkemine
- 10 ENSÜÜMKATALÜÜSITUD reaktsiooni
- Eraldub 5 % glükoosis peituvast VABAST ENERGIAST

Redoksreaktsioonid

- Elektroni(de) ülekanne ühelt aatomilt teisele :

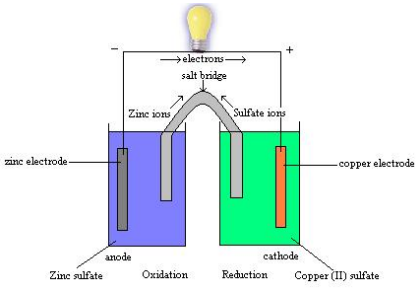
  1) $Fe^{2+} \rightarrow Fe^{3+} + e^-$

  2) $Cu^{2+} + e^- \rightarrow Cu^+$

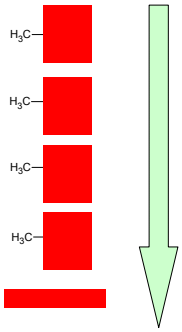
  1 + 2) $Fe^{2+} + Cu^{2+} \rightarrow Fe^{3+} + Cu^+$

- Fe^{2+} - *redutseerija* : loovutab
  Cu^{2+} - *oksüdeeria* : seob
  } e^-

Redoksreaktsioonid



Red-oks & biokeemia



max. redutseeritud

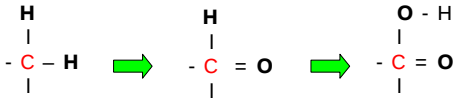
max. oksüdeeritud

Red-oks & biokeemia

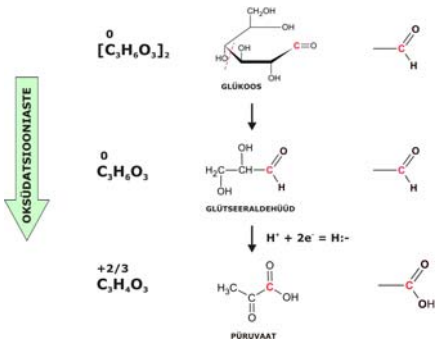
"Kuldreegel" :

* side **H**-ga – redutseerimine

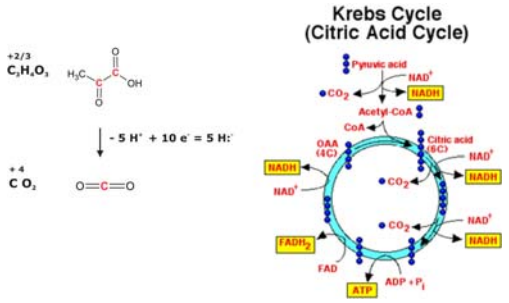
* side **O**-ga - oksüdeerimine

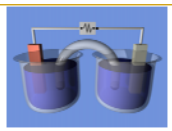


Glükolüüs



Glükoosi täielik oksüdeerimine tsitraaditsüklis





GLÜKOLÜÜS — HINGAMISAHEL

GLÜKOOS → 2 x PÜRUVAAT

4 e⁻

2 H₂O

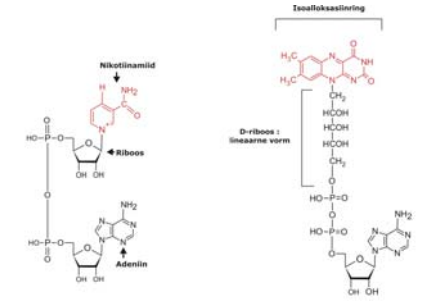
O₂ + 4H⁺

TSÜTOSOOL : ANOOD

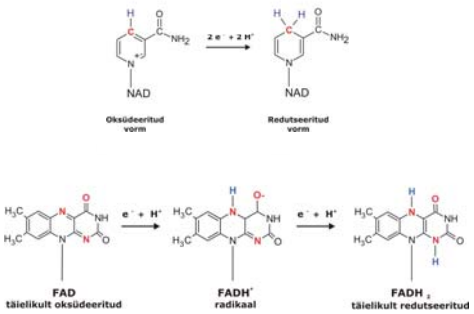
ATP

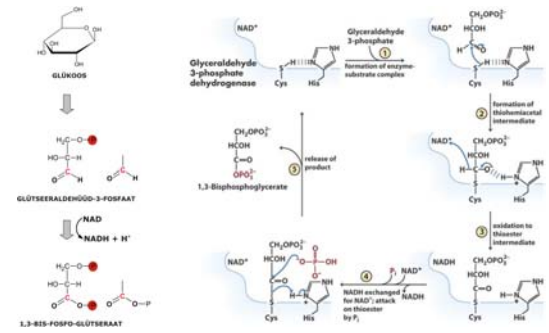
MITOKONDER : KATOOD

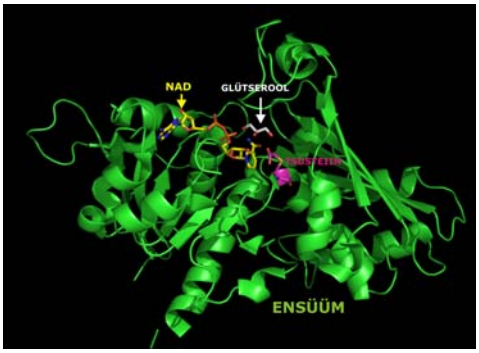
Elektrijuhe e. elektronkandjad NAD / FAD

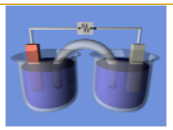


Elektronkandjad

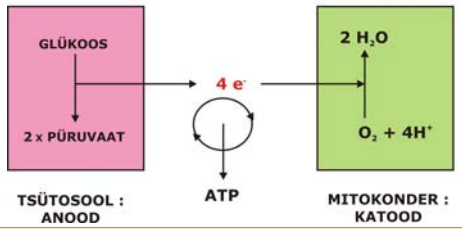


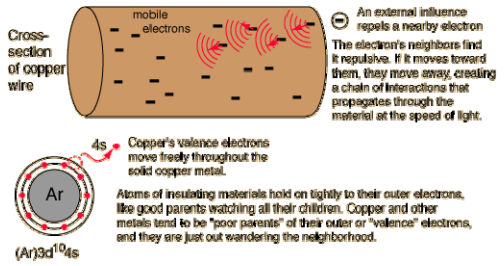




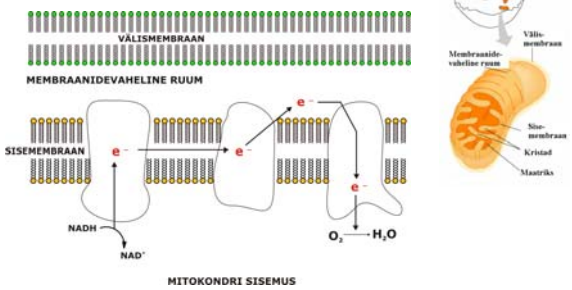


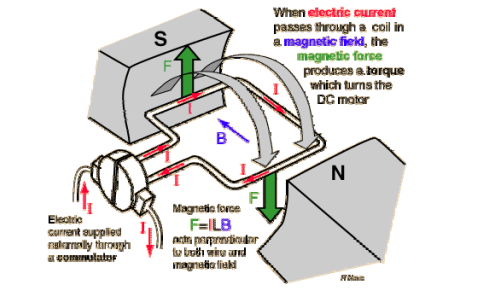
GLÜKOLÜÜS HINGAMISAHEL



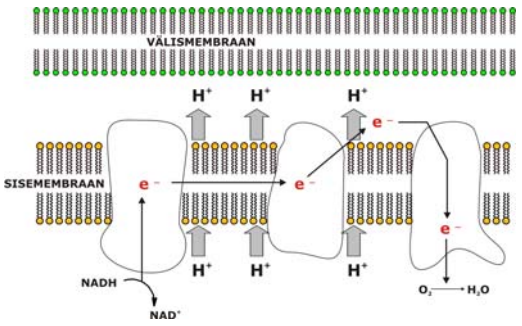


Elektrontransport rakus

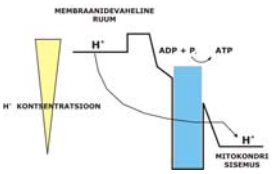




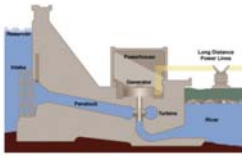
Prootongradient



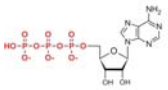
RAKUS



ENERGEETIKAS

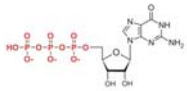


Makroergilised ühendid

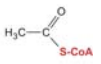


ATP

Fosfokreatiin

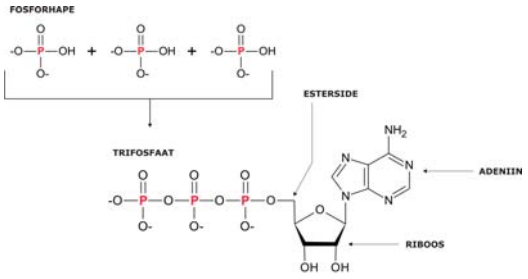


GTP



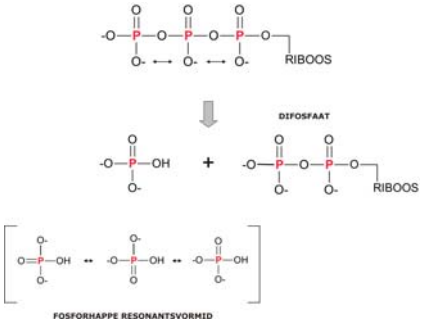
Atsetüül-CoA

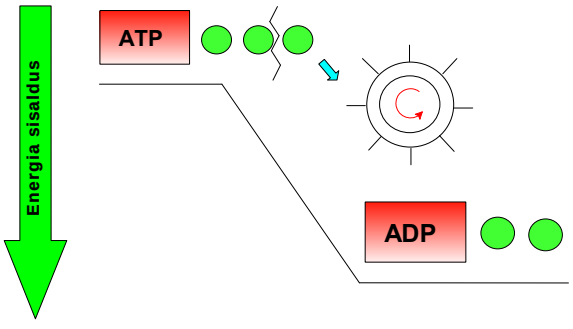
ATP



ATP : ADENOSIIN TRI FOSFAAT

Trifosfaat kui energiareservuaar

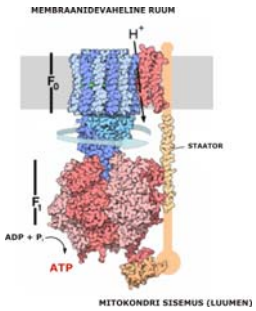




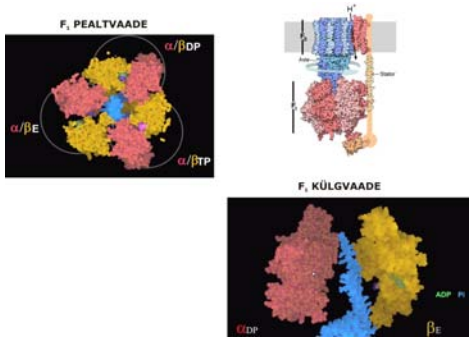
ATP süntaas

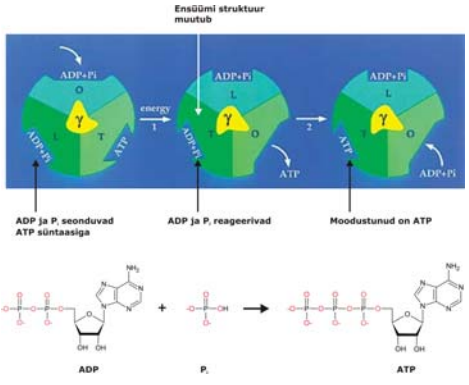
- Koosneb 8 eri tüüpi valgust
- Katalüüsib ATP sünteesi

  $ADP + P_i \rightarrow ATP$
- H^+ liikumine läbi süntaasi
- H^+ liikumine = ATP teke
- 3 - 4 H^+ = 1 ATP

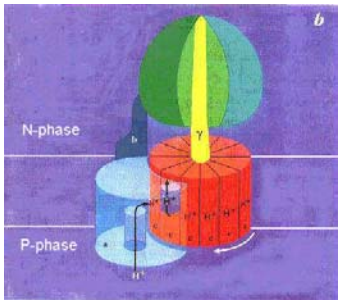


ATP süntaas





ATP süntaas



ATP süntaas