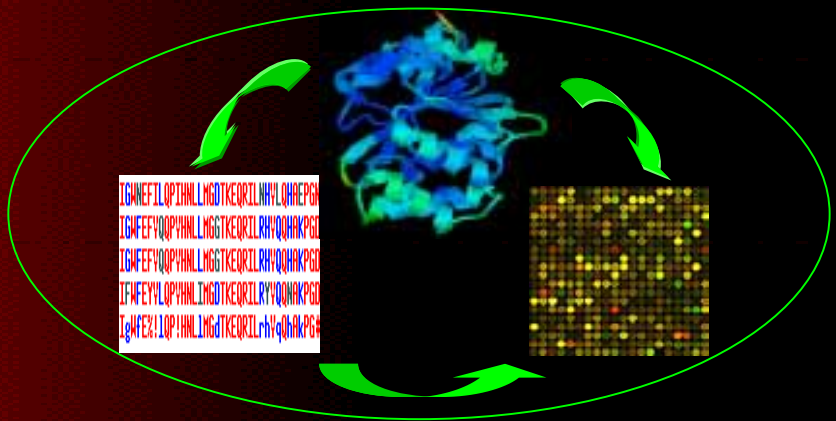
Biotecnología:

un nuevo desafío para la Ingeniería

Prof. Juan A. Asenjo

¿Qué es la Bioinformática?

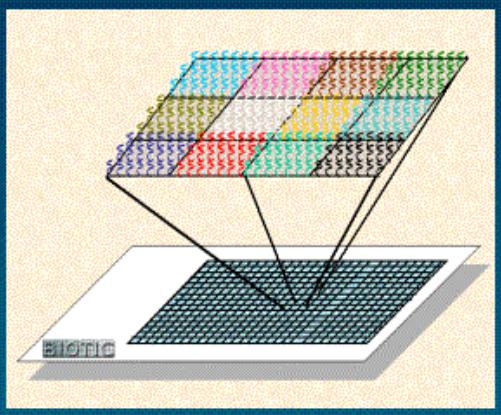


- **Organizar** datos y hacerlos accesibles

SOFTWARE

- **Comprende**r procesos celulares complejos
- **Predecir** fenómenos biológicos de múltiples variables

Biochips

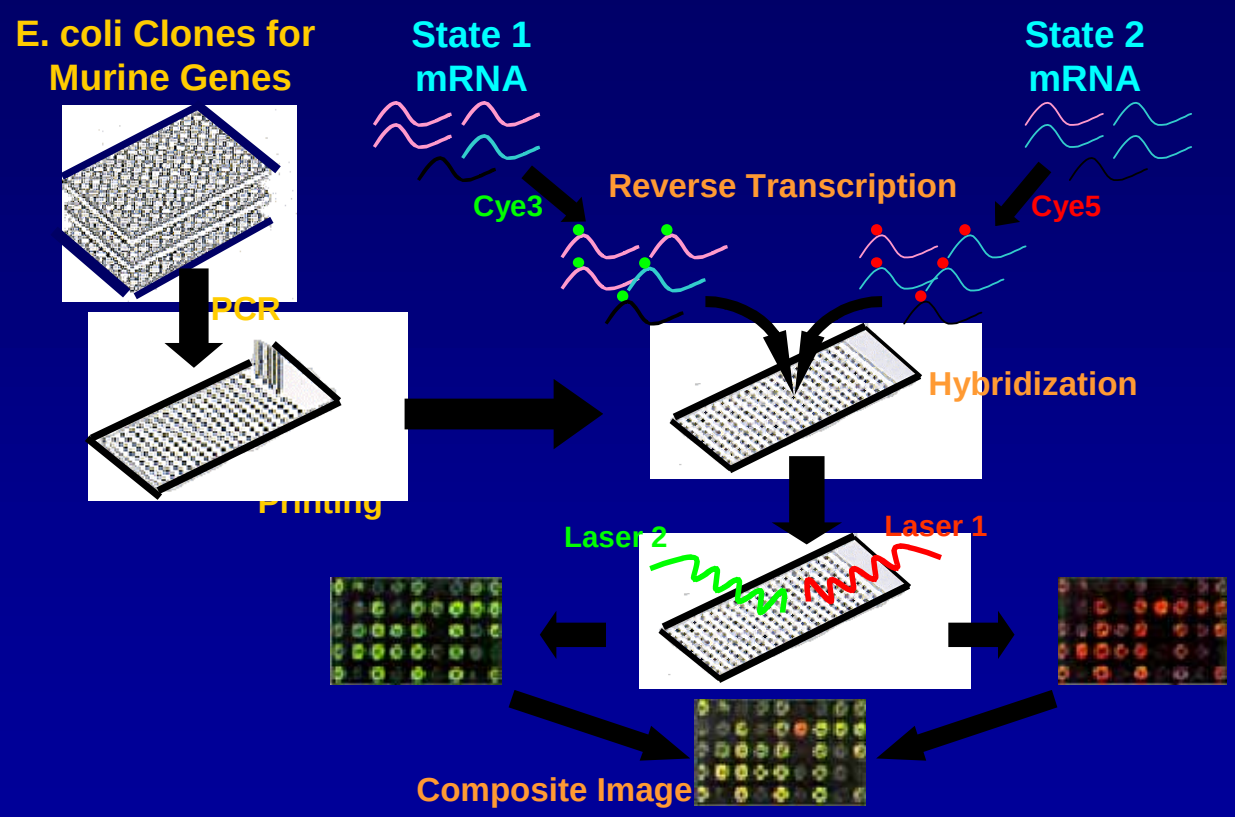


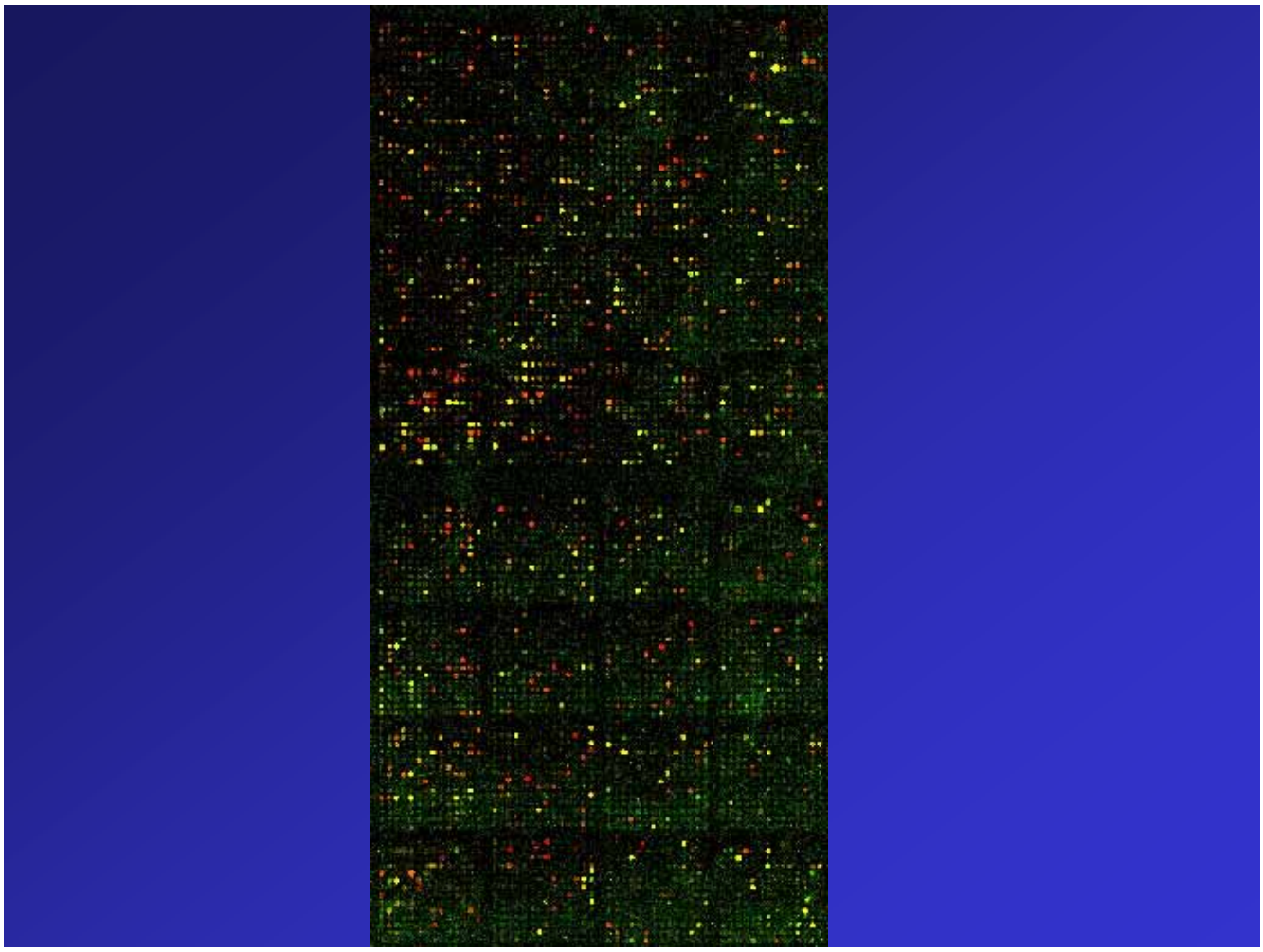
Dispositivos con una elevada densidad de material genético inmovilizado sobre un soporte sólido (cristal, plástico...)

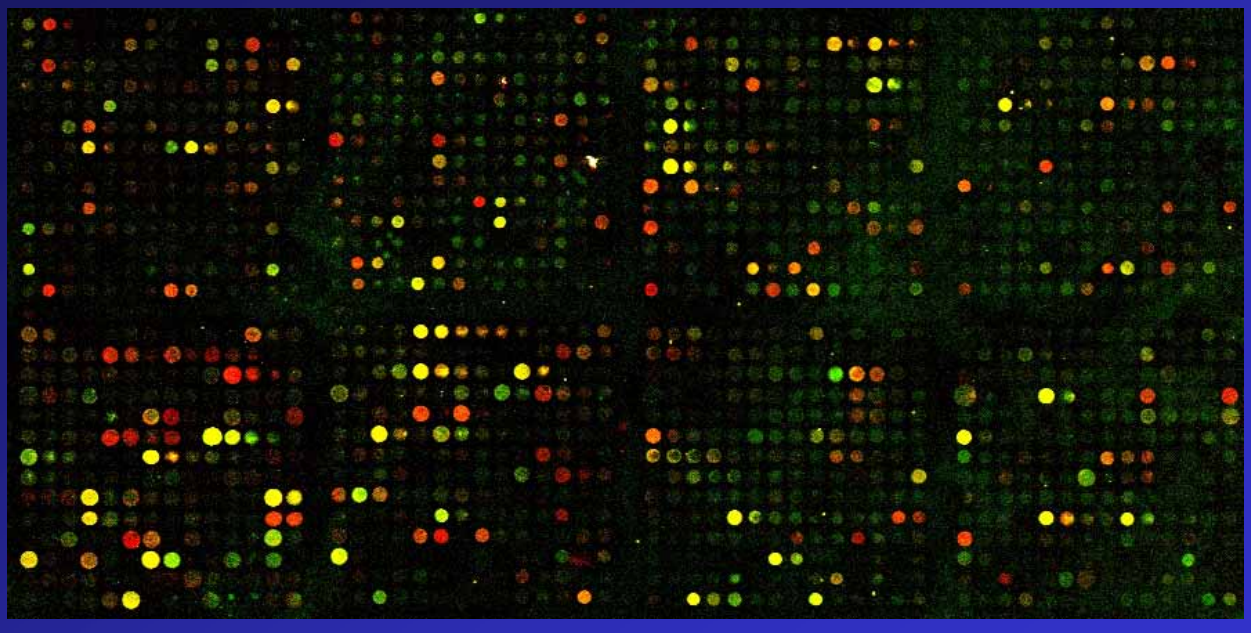
Conocidos como Biochips, Microarrays, DNA Arrays

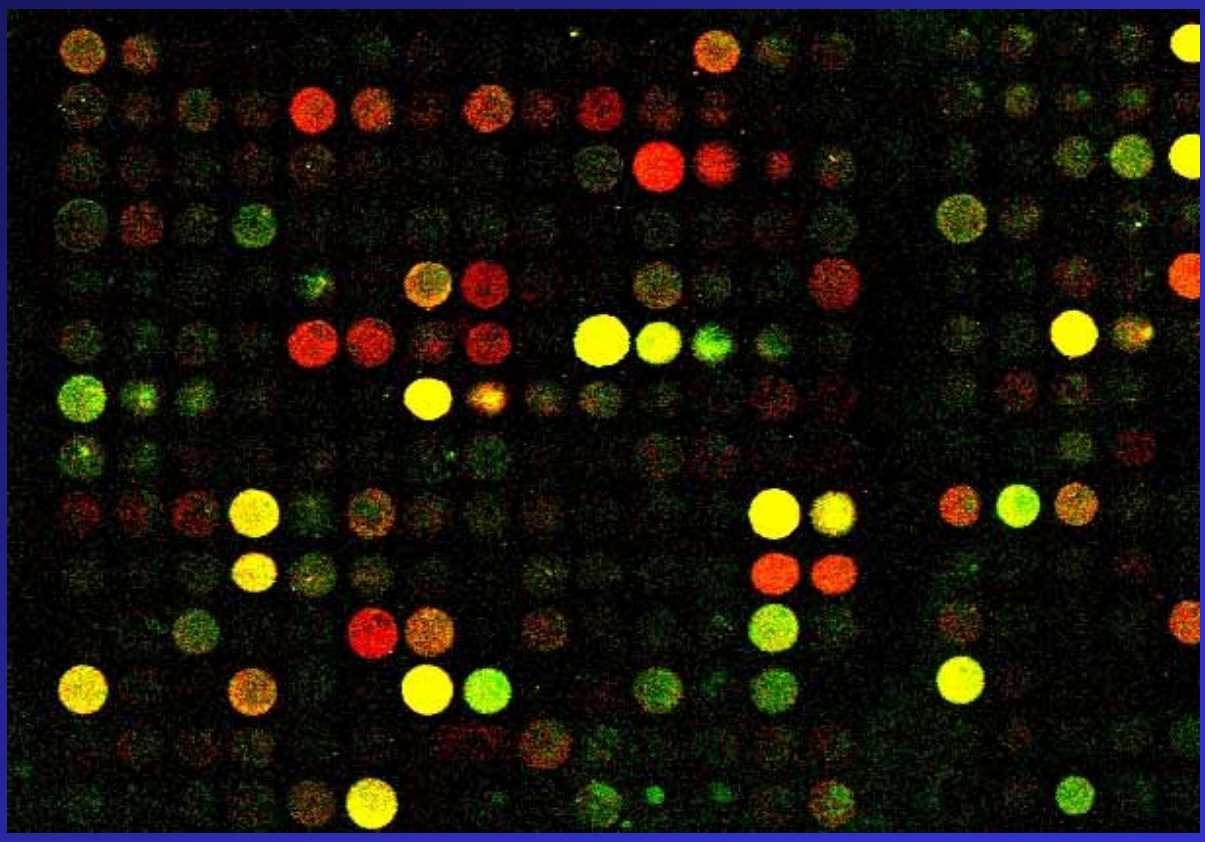
Gran diversidad tecnológica - varias clasificaciones

cDNA Microarrays







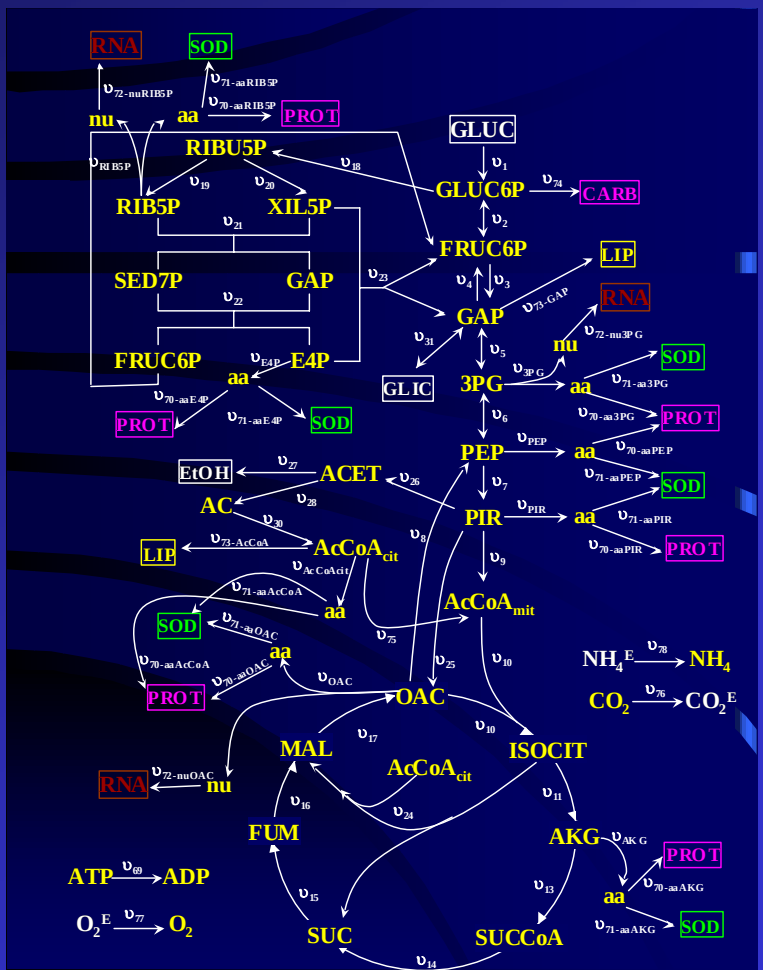


Metabolómica
Ingeniería Metabólica

- **Systems Biology: what comes after Genomics**

- **Uso de Análisis de Flujos Metabólicos y Tecnología de Microarrays de Genes**

Metabolomics

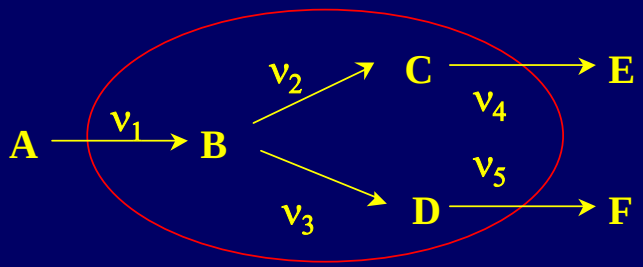


Metabolic Flux Analysis

Metabolic Flux Balance

$$dX/dt = S\,v - b$$

in SS: $S\,v = b$ or $S\,r = 0 \rightarrow S_c\,r_c + S_m\,r_m = 0$



S	Stoichiometric Matrix
r	Rate (Flux) vector
c	Calculated
m	Measured

$$S\,r=0 = \begin{array}{c|ccccc} & \nu_1 & \nu_2 & \nu_3 & \nu_4 & \nu_5 \\ B & 1 & -1 & -1 & 0 & 0 \\ C & 0 & 1 & 0 & -1 & 0 \\ D & 0 & 0 & 1 & 0 & -1 \end{array} \begin{pmatrix} \nu_1 \\ \nu_2 \\ \nu_3 \\ \nu_4 \\ \nu_5 \end{pmatrix} = \begin{array}{c|ccc} & \nu_1 & \nu_2 & \nu_3 \\ B & 1 & -1 & -1 \\ C & 0 & 1 & 0 \\ D & 0 & 0 & 1 \end{array} \begin{pmatrix} \nu_1 \\ \nu_2 \\ \nu_3 \end{pmatrix} + \begin{array}{c|cc} & \nu_4 & \nu_5 \\ B & 0 & 0 \\ C & -1 & 0 \\ D & 0 & -1 \end{array} \begin{pmatrix} \nu_4 \\ \nu_5 \end{pmatrix}$$

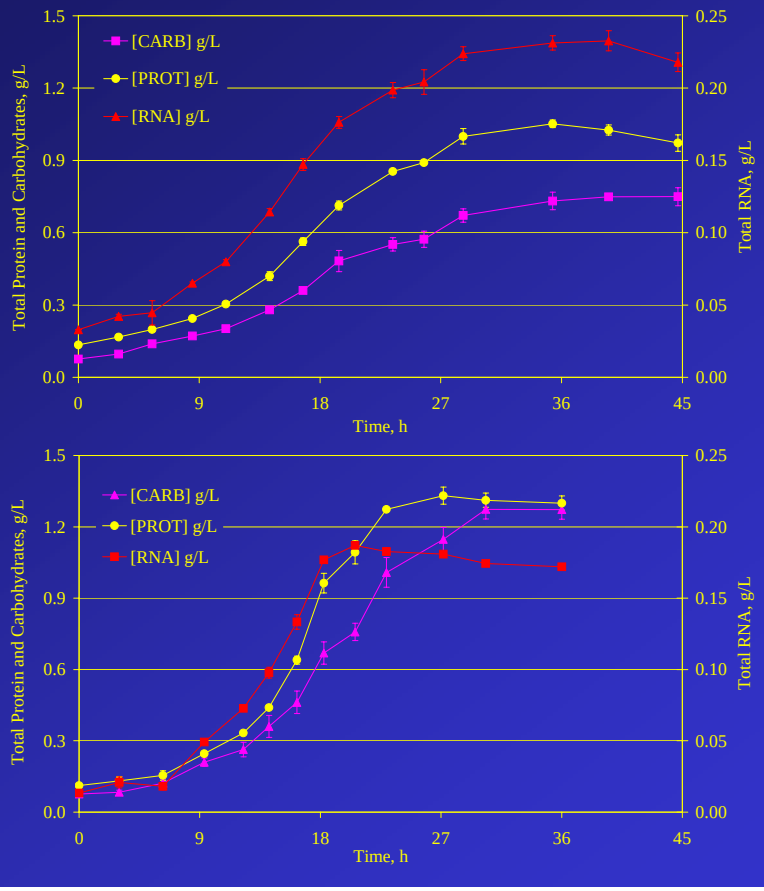
Glycolysis EMP pathway and gluconeogenesis

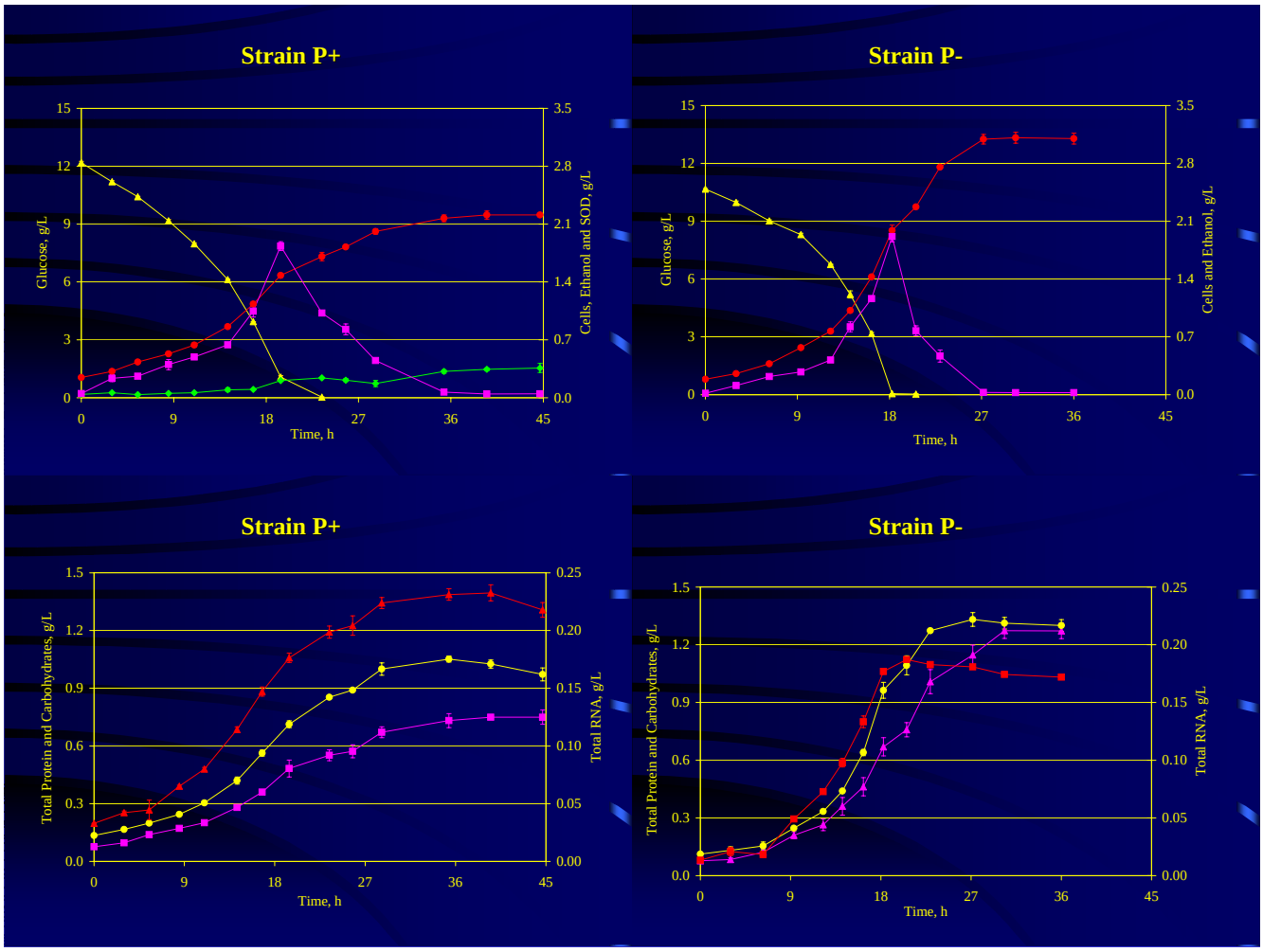
1. GLUC + ATP ⇒ GLUC6P + ADP + H
2. GLUC6P ⇔ FRUC6P
3. FRUC6P + ATP ⇒ 2 GAP + ADP + H
4. 2 GAP + H_2O ⇒ FRUC6P + P_i
5. GAP + NAD + P_i + ADP ⇔ G3P + ATP + NADH + H
6. G3P ⇔ PEP + H_2O
7. PEP + ADP + H ⇒ PYR + ATP
8. OAC + ATP ⇒ PEP + ADP + CO_2

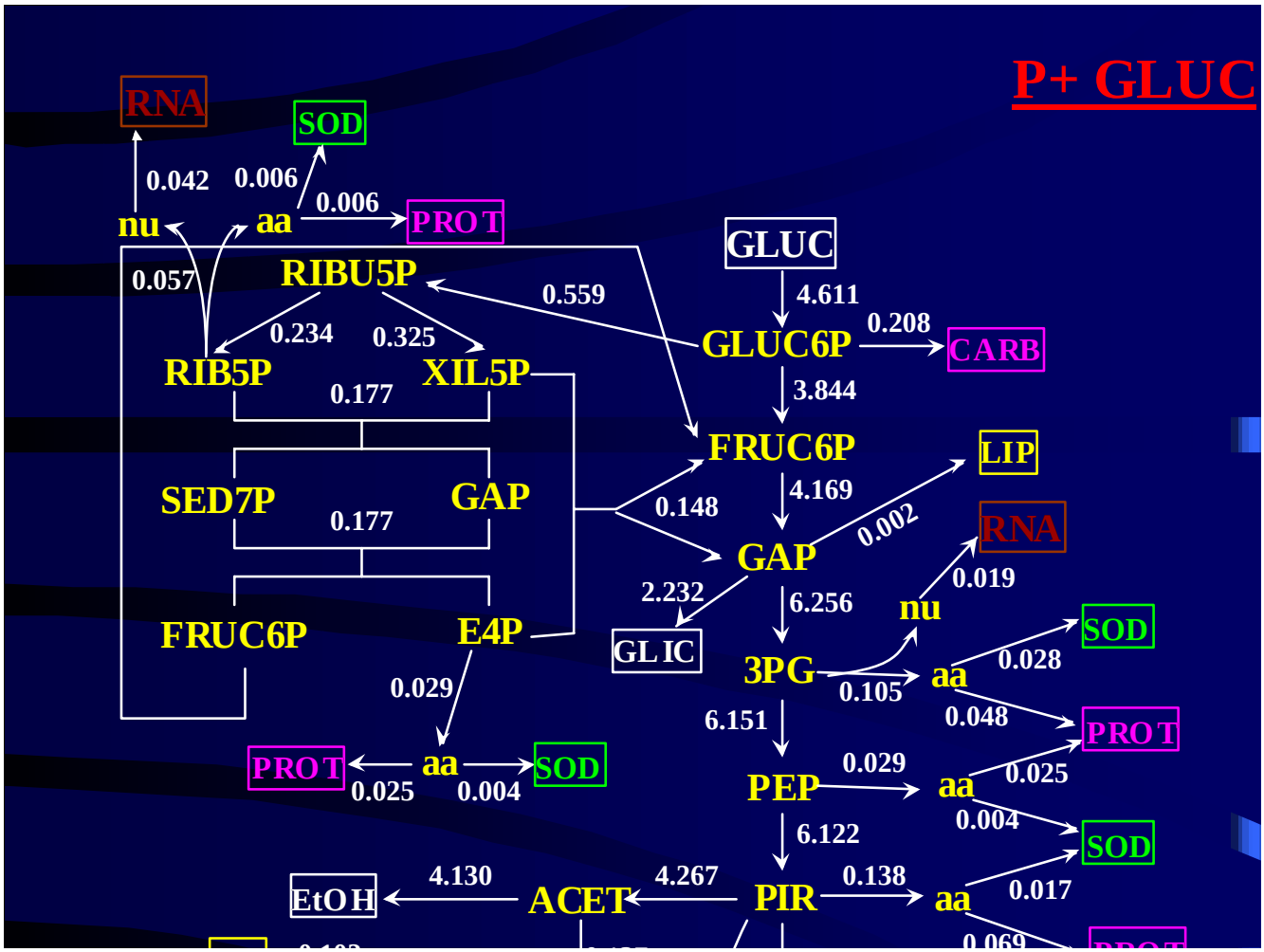
Tricarboxylic acid cycle

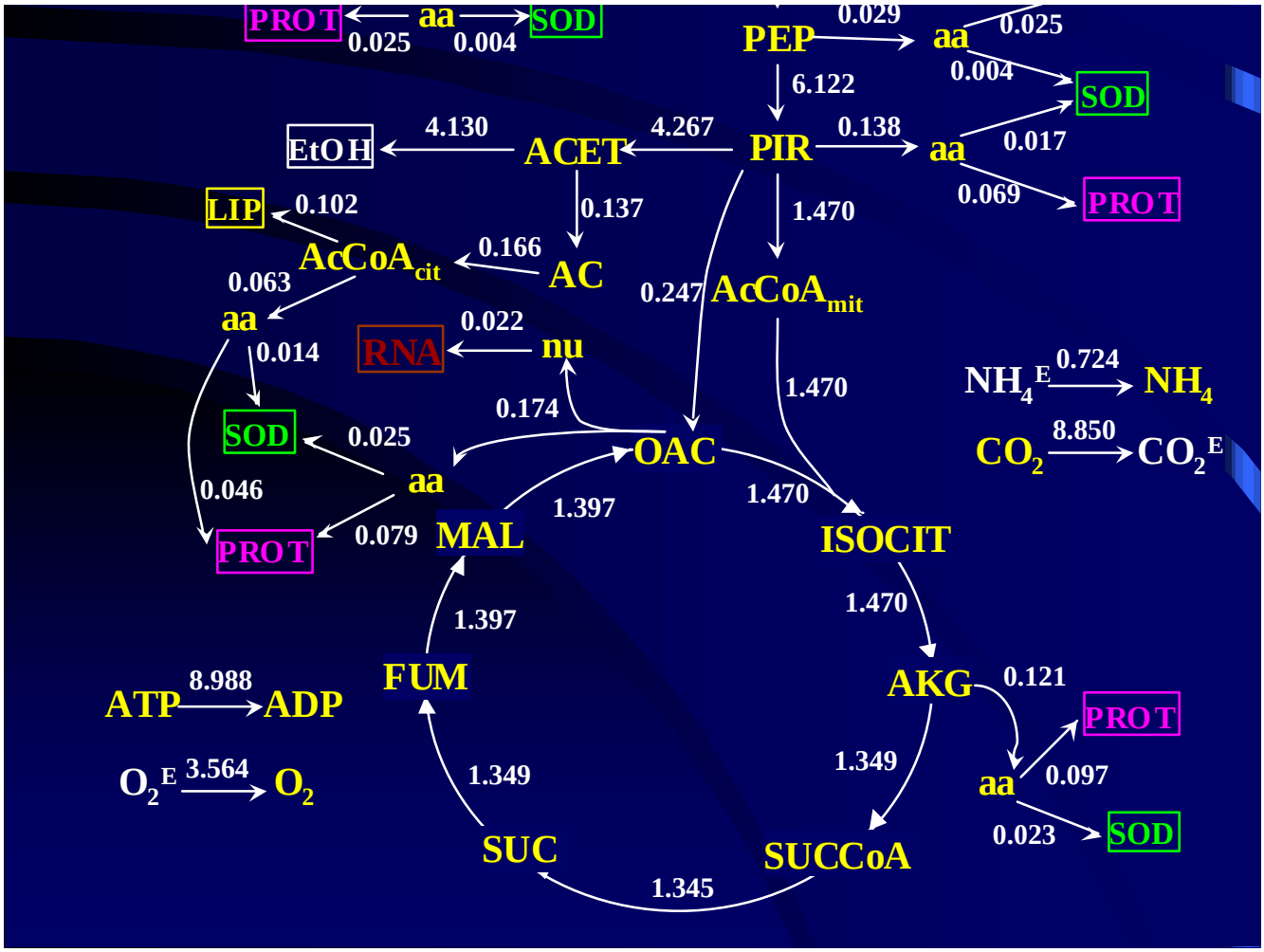
9. PYR + NAD + CoA ⇒ AcCoA*mit* + NADH + CO_2
10. OAC + AcCoA*mit* + H_2O ⇒ ISOCIT+ CoA + H
11. ISOCIT+ NAD ⇒ AKG + NADH + CO_2
12. # ISOCIT+ NADP ⇒ AKG + NADPH + CO
13. AKG + CoA + NAD ⇒ SUCCoA + NADH + CO_2
14. SUCCoA+ ADP + P_i ⇒ SUC + ATP + CoA
15. SUC + FAD ⇔ FUM + $FADH_2$
16. FUM + H_2O ⇔ MAL
17. MAL + NAD ⇒ OAC + NADH + H

P+ vs P-




Strain P+
Glucose, g/L
Cells, Ethanol and SOD, g/L
Time, h
Strain P-
Glucose, g/L
Cells and Ethanol, g/L
Time, h
Strain P+
Total Protein and Carbohydrates, g/L
Total RNA, g/L
Time, h
Strain P-
Total Protein and Carbohydrates, g/L
Total RNA, g/L
Time, h


P+ GLUC
RNA
SOD
0.042
0.006
0.006
nu
aa
PROT
0.057
RIBU5P
0.559
0.234
0.325
RIB5P
XIL5P
0.177
SED7P
GAP
0.177
FRUC6P
E4P
0.029
PROT
aa
SOD
0.025
0.004
GLUC
4.611
GLUC6P
0.208
CARB
3.844
FRUC6P
LIP
4.169
0.148
0.002
RNA
GAP
2.232
6.256
0.019
nu
GLIC
3PG
SOD
0.028
0.105
aa
0.048
PROT
6.151
0.029
PEP
aa
0.025
0.004
SOD
6.122
4.130
4.267
0.138
EtOH
ACET
PIR
aa
0.017


PROT
aa
SOD
0.025
0.004
PEP
0.029
aa
0.025
0.004
SOD
6.122
EtOH
4.130
ACET
4.267
PIR
0.138
aa
0.017
0.069
PROT
LIP
0.102
0.137
1.470
AcCoA cit
0.166
AC
0.247
AcCoA mit
0.063
aa
0.022
RNA
nu
0.014
NH4 E
0.724
NH4
1.470
0.174
SOD
0.025
OAC
CO2
8.850
CO2 E
aa
0.046
1.397
1.470
PROT
0.079
MAL
ISOCIT
1.470
1.397
FUM
AKG
0.121
ATP
8.988
ADP
PROT
1.349
O2 E
3.564
O2
1.349
aa
0.097
0.023
SOD
SUC
SUCCoA
1.345