Course 2851 Principles of Metabolism
Metabolism and endocrinology programme, Karolinska Institutet

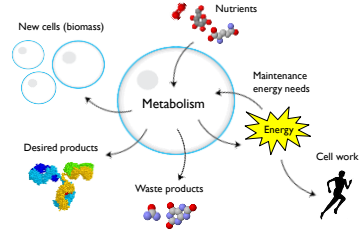
Lecture 2

A cell's material & energy budget

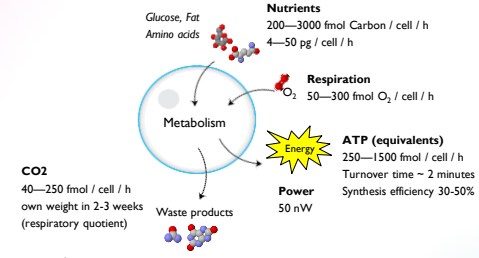
Roland Nilsson, Ph.D

Department of Medicine, Solna
Center for Molecular Medicine
Karolinska Institutet

Main nutrients, products, energy sources & expenses?



Energy metabolism



Nilsson & Jain, Science 336:1040—1044, 2012

What fraction of ATP comes from glycolysis / respiration ?

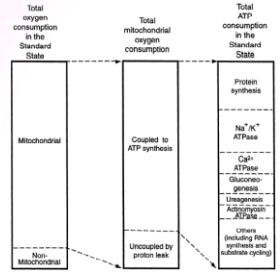
Table 2a
Glycolytic ATP contribution in normal cells

Cell type	Oxidative ATP production	Lactate production	Glycolytic ATP contribution[a] (%)	Reference
Adult mouse liver	4.69 μmol/h/mg	0.0446 μmol/h/mg	0.94	[1]
Adult mouse kidney	4.6 μmol/h/mg	0.0446 μmol/h/mg	0.94	[1]
Mouse macrophages	243 nmol/h/mg	51.9 nmol/h/mg	18	[28]
Pig platelets	1.32 nmol/min/10^{11} platelets	1.77 nmol/min/10^{11} platelets	57	[29]
Rat anococcygeus smooth muscle	2.08 nmol/min/g	0.212 nmol/min/g	9.3	[30]
Neonatal rat cardiomyocytes	16.39 nmol/min/10^6 cells	0.40 nmol/min/10^6 cells	2.4	[31]
Rabbit erythrocytes	2 nmol/h/cell	2.74 nmol/h/cell	58	[32]
Rabbit reticulocytes	201.7 nmol/h/cell	4.83 nmol/h/cell	2.3	[32]
Rat thymocytes (resting)	957 nmol/h/10^{10} cells	40 nmol/h/10^{10} cells	4.0	[33]
Rat thymocytes (proliferating)	880 nmol/h/10^{10} cells	1363 nmol/h/10^{10} cells	41	[33]
Rat heart H9c2	1282.5 nmol/h/10^6 cells	33 nmol/h/10^6 cells	2.5	[34]
Dog kidney cells	72.8 nmol/min/mg	24.3 nmol/min/mg	25	[35]
Porcine coastal artery smooth muscle	0.370 μmol/min/g	0.103 μmol/min/g	22	[36]
Rat coronary endothelial cells	22.4 nmol/min/mg	25.4 nmol/min/mg	53	[37]
Human platelets	19 nmol/h/10^{10} platelets	6 nmol/h/10^{10} platelets	24	[38]
In vivo rat small intestine	9750 nmol/min/g intestine	154.3 nmol/min/g intestine	1.6	[39]
Average contribution of glycolysis[b]			20 ± 21 ($n = 16$)	

Zu and Guppy, Biochem Biophys Res Comm 313:459—465, 2004.

Where does all the energy go?

A whole-body average



Mouse ascites tumor cell

	Percentage
ATP consumption by	
Protein synthesis	24.8 ± 2.0
Proteolysis	3.8 ± 0.1
Na^+/K^+-ATPase	17.1 ± 1.2
Ca^{2+}-transport	13.6 ± 1.0
RNA synthesis	12.7 ± 1.7

Schmidt et al,
Exp cell res 194: 122—127, 1991.
(modified)

Rolfe & Brown, Physiological reviews 77:731—758, 1997.

Biomass composition & biosynthesis