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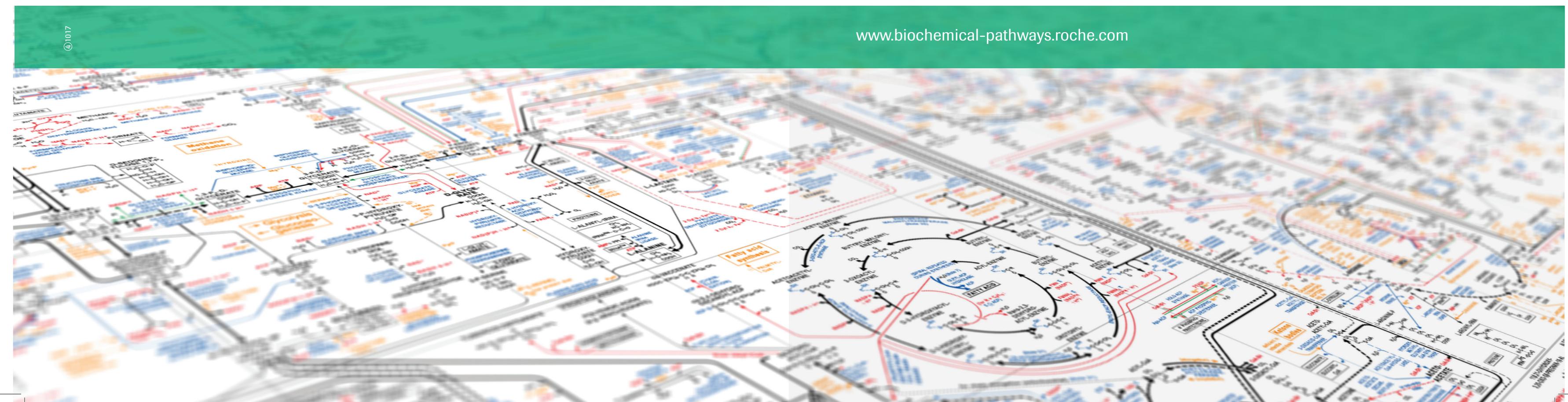
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Biochemical Pathways

4th Edition - Index

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Preface

The fourth edition marks the 40th anniversary of the "Biochemical Pathways" wall chart.

The first edition was published in 1965 and showed a compilation of the most central pathways of metabolism, such as glycolysis, citric acid cycle, synthesis and degradation of fatty acids, amino acids and nucleotides. This chart was well received. Many requests were made to expand it to other fields of biochemistry. This was taken into account by including into the second edition 1972 more details of these pathways as well as showing steroids, tetrapyrrole compounds and the basics of oxidative phosphorylation and protein synthesis. Most important, however, was the inclusion of regulation mechanisms, demonstrating the mutual interdependency of the members of the metabolic network.

The following years brought an enormous increase of biochemical knowledge. The third edition of the wall chart came out in 1992. Many new fields had to be incorporated into it. It became necessary to greatly enlarge the wall chart and divide it into 2 parts. In part 1, a revised selection of the "classical" biochemical reactions was shown. The substrates and products of these reactions are usually of low molecular weight and therefore the usual chemical formulas were adequate for demonstration. This did not hold for the newer aspects of biochemistry, which were the contents of part 2. The largest addition was the representation of DNA replication, the transcription and the translation mechanisms. Since large nucleic acid / protein complexes are involved in these reactions, different graphical methods had to be applied. This was also true for surface phenomena, such as the passage of molecules through membranes, as well as the signal transduction through them. Frequently, these signals are passed on via a cascade of reactions to their site of action, e.g. for expression of genes in the nucleus. In order to take this into account, in part 2 the cell and its organelles were shown in a schematic way and the reactions were arranged accordingly. Since many functions are different in prokaryotes and eukaryotes, the respective graphs had to be separated. Additionally, the mechanisms of the respiratory chain, photosynthesis and special microbial metabolism, especially with regard to the redox potentials were shown. Due to their importance in medicine, blood coagulation reactions, as well as the immunology and complement systems were included.

This work was performed with the help of many scientists. Without their assistance, a presentation of such a wide range of topics would not have been possible. I am grateful to them, either for their contribution to the contents or for checking the accuracy: Dr. Baron, Dr. Barz, Professor Dr. Böck, Dr. Bumann, Dr. Burtscher, Dr. Dony, Dr. Felber, Dr. Grossmann, Dr. Haselbeck, Dr. Heider, Dr. Hösel, Dr. Kehrel, Professor Dr. Klingenberg, Professor Dr. Kresse, Dr. Lill, Dr. Marwan, Professor Dr. Oesterhelt, Dr. Ofenloch, Professor Dr. Rieber, Professor Dr. Widdel.

In the years after the third edition, again much scientific progress took place. When considering the fourth edition, a decision had to be made regarding the material to be included. Although this problem always existed (see below), the question of selection became still more pressing. A wall chart should not surpass a certain size in order to be easily handled and to yield a general overview. I feel that this limit has been

reached by the present size of almost 2 ½ square meters (26 square foot). Thus it was decided that the new edition should show a limited updating of the topics and not a considerable expansion of its contents.

If a more detailed coverage of biochemistry in a similar style of representation is desired, the user is referred to the book "Biochemical Pathways". The graphs contain a greatly expanded range of information and are supplemented by explanatory texts. The book was compiled by essentially the same team as the wall chart and edited by myself. The English edition was published by John Wiley & Sons, New York etc. (ISBN 0-471-33130-9), the German edition by Spektrum Akademischer Verlag Heidelberg etc. (ISBN 3-86025-239-9, presently out of print).

General Aspects

In the wall chart "Biochemical Pathways" the following principles were applied:

a) There are many more pathways known than can be shown on a reasonably sized chart. Instead of concentrating on a single organism or organ, we chose to give a cross-section of general metabolism in various species and organs. This required at least some indication of occurrence of these reactions, as has been done by the color of the reaction arrows or special naming at segments of the cell membrane.

The selection of reactions has to be made arbitrarily. Of course, no discussion is necessary about e. g. glycolysis, protein biosynthesis and other central reactions. Peripheral reaction pathways are preferably selected if they are of high interest in biochemical, medical or biological research (receptors, vitamins, antibiotics, compounds of importance in regulation etc.), if they are of interest in medicine (e. g. blood coagulation, complement system), if they lead to important end products (e. g. microbiological fermentations) or if they enable comparison of phylogenetic development (anaerobic/aerobic respiration or photosynthesis in various species).

Some indication on the degree of selection can be taken from the fact that in the present "Pathways" about 1000 enzymes are shown, while the 1984 "Enzyme Nomenclature" with its 2 supplements names 2859 enzymes. Estimations of the number of proteins (with and without enzymatic activity) in a single mammalian cell are in the order of magnitude of 30000.

b) Whenever possible, the names of enzymes and substrates given in the "Enzyme Nomenclature 1984" (Academic Press, Orlando etc. 1984) and both supplements 1986 and 1989 [Eur.J.Biochem. 157, 1-26 (1988) and 179, 489-533 (1989)] have been used. Recently, abbreviations derived from gene symbols for proteins with enzymatic activity are used more frequently. They do not indicate the catalyzed reaction.

c) When chemical formulas are used, the conversion of the compounds with time is given by the direction of the reaction arrow. However, when structural arrangements are shown, movement of molecules and reaction progress with time have to be shown by the same two-dimensional representation. Whenever actual movements play the predominant role (e. g. H⁺ in the membranes in the respiratory chain or during photosynthesis), the "fixed" components (e. g. chlorophylls, FeS centers) are shown only once. When different states of components are

the most important facts (e. g. G-protein dependent receptors, receptors with tyrosine kinase activity), the different states are shown next to each other. Although this is not fully consistent, it still appears to be the simplest form of representation.

d) Although most biochemical reactions are reversible, most of them proceed *in vivo* preferably in one direction, depending on the supply of reaction partners, removal of reaction products and the equilibrium constant. Thus, the classical subdivision of "anabolic" and "catabolic" pathways is shown in the chart by solid and by dashed arrows. If the actual equilibrium in the biological system is far on one side, it is indicated with an additional orange arrow. "Amphibolic" pathways, which are passed through in either direction under biological conditions, are shown here like anabolic pathways, since further symbols would not improve legibility.

e) In general, we desisted from showing detailed reaction mechanisms. Only in cases where discrete steps (e. g. in multi-enzyme systems) are involved or well-characterized intermediates exist, single steps are given. The same holds true for receptor-activation steps etc.

f) The interrelationships of metabolic pathways cause the biggest technical problem of graphical representation. Since many compounds take part in various pathways, one would obtain a "spider web" of lines criss-crossing the whole chart. In order to avoid this, one has to "cut" connections. The respective compounds, which reoccur in other places of the chart, are written here in sharp-edged boxes.

g) On the other hand, in part 2, symbols for proteins have to be used. We chose round-edged boxes for them. Both kinds of boxes, therefore, have to be considered differently. If, e. g. by phosphorylation, structural and functional modifications occur, the shape of the boxes changes.

h) The lipid bilayers of membranes (cell surface and cell organelles) have approximately the same thickness. However, graphical reasons require drawing them in different widths, depending on the details of the membranes to be shown. Otherwise, much space would be wasted on little information.

i) For regulation of reaction velocity, two major systems are effective: the "quick" regulation by changing the activity of enzymes, e. g. by "allosteric" (Monod) or "cooperative" (Koshland) mechanisms and the "slow" regulation by synthesis or degradation of the respective enzymes. These are shown in the chart by full or by dashed arrows, respectively, pointing from the effector compound to the regulated reaction. \oplus and \ominus signs indicate activation or inhibition. The regulation usually has its point of attack on the first enzyme of a metabolic chain, but (at least in the "slow" regulation) the following enzymes are often affected in the same way. This, however, is not always mentioned specifically in the literature and therefore not shown here.

j) References are not included in this chart. The editor feels that there is no absolute need for this work, since the "Enzyme Nomenclature" (see above), the "Annual Reviews of Biochemistry" (Annual Reviews Inc., Palo Alto) and other review series, textbooks etc. give a wealth of information. It is beyond the scope of this chart to present complete references. Increased usefulness, however, might be drawn from the index. It should help to find a compound or reaction quickly.

I do hope that the new edition of the wall chart will again prove useful to its users.

Tutzing, October 31, 2005

Gerhard Michal

The decimal classification refers to the "Enzyme Nomenclature, Recommendations (1984)" (Academic Press, Orlando etc. 1984) and its supplements (Eur.J.Biochem. 157,1 (1986) and 179,489 (1989)). Enzymes named below without classification numbers are not listed there. Instead of "transaminase", "amino-transferase" is frequently used.

A

A gene product [blood groups] R2
 A specificity [blood groups] S2
 A-3,5-MP responsive element binding protein [CREB] P7, U4
 Acetaldehyde A8, B8, E6, H4
 Acetate C4, D4, F6, F7, G7, H6, I6
 Acetate kinase 2.7.2.1 C4
 Acetate-CoA ligase 6.2.1.1 J4
 2-Aceto-2-hydroxybutyrate A9
 Acetoacetate, F8,H3,L4
 Acetoacetate decarboxylase 4.1.1.4 F8, L3
 Acetoacetyl-CoA F8
 Acetoacetyl-CoA hydrolase 3.1.2.11 F8
 Acetoacetyl-CoA: acetate CoA transferase L4
 Acetoacetyl-enzyme E7
 (*R*)-Acetoin A10
 2-Acetolactate A10
 Acetolactate decarboxylase 4.1.1.5 A10, F8
 Acetolactate synthase 4.1.3.18 A9, A10
 Acetone E8
 Acetyl enzyme F7
 N-Acetyl- γ -glutamyl-phosphate reductase 1.2.1.38 G7
 Acetyl-CoA A9, C4, C9, F5, G3, G5, G7, H4, L4
 Acetyl-CoA acetyltransferase [thiolase] 2.3.1.9 F8, L4
 Acetyl-CoA acyltransferase 2.3.1.16 C9, E9, L4
 Acetyl-CoA carboxylase 6.4.1.2 F7
 [Acetyl-CoA carboxylase] phosphatase 3.1.3.4 F6
 Acetyl-CoA ligase 6.2.1.1 F6
 N-Acetyl-D-glucosamine D4
 N-Acetyl-D-glucosamine 1-phosphate D4
 N-Acetyl-D-glucosamine 6-phosphate D4
 N-Acetyl-D-mannosamine E4
 N-Acetyl-D-mannosamine 6-phosphate E3
 N⁶-Acetyl-L-lysine K3
 N⁶-Acetyl- β -L-lysine transaminase 2.6.1.65 K3
 Acetyladenylate F6
 (-) O-Acetylcarnitine F6
 O-Acetylcholine B8, V3, V4

Acetylcholinesterase 3.1.1.7 A8, B8, V4
 6-S-Acetyl dihydrolipoate F5
 N-Acetylgalactosaminyl-glycopeptide galactosyltransferase R4
 β -Acetylglucosamine D3
 N-Acetylglucosamine kinase 2.7.1.59 D4
 N-Acetylglucosamine-1-phosphodiester N-acetylglucosaminidase 3.1.4.45 S3
 N-Acetylglucosaminidase 3.2.1.50 D4
 N-Acetylglucosaminyl transferase R4
 N-Acetylglucosaminyl diphosphodolichol N-acetylglucosaminyltransferase 2.4.1.141 R5
 β -N-Acetylglucosaminylglycopeptide β -1, 4-galactosyltransferase 2.4.1.38 R3
 N-Acetylglutamate G7
 N-Acetylglutamate kinase 2.7.2.8 G7
 N-Acetylglutamate phosphate G7
 N-Acetylglutamate semialdehyde G7
 N-Acetyl lactosaminide α -2, 3-sialyltransferase R3
 Acetylmalonyl enzyme E7
 N-Acetylmannosamine kinase 2.7.1.60 E4
 N-Acetyl muramate O3
 N-Acetylneuraminate F3
 N-Acetylneuraminate 9-phosphatase E3
 Acetylneuraminate cytidyltransferase 2.7.7.43 F4
 N-Acetylneuraminate lyase 4.1.3.3 E4
 N-Acetylneuraminate synthase 4.3.1.19 E4
 (N-Acetylneuraminylinyl)-galactosylglucosylceramide N-acylgalactosylinylaminyltransferase 2.4.1.92 Q3
 N- α -Acetylornithine G8
 Acetylornithine deacetylase 3.5.1.16 G7
 Acetylornithine transaminase 2.6.1.11 G8
 Acetylphosphate C4
 Acetylsalicylate T6
 O-Acetylserine H4
 Aconitase [see aconitate hydratase] 4.2.1.3 F6
cis-Aconitate F6
 Aconitate decarboxylase 4.1.1.6 F6
 Aconitate hydratase 4.1.2.3 F6
 Acryloyl-CoA J4
 ACTH receptor V3
 Actin R3, U5
 Actinomycin D M8, Q6, R6, S6
 110 kD Activator, 110 kD proactivator U2
 Actomyosin [myosin ATPase] 3.6.1.32 U4, U5
 Acyl carrier protein [ACP] F8
 Acyl enzyme E7
 [Acyl-carrier-protein] acetyltransferase 2.3.1.38 F7
 [Acyl-carrier-protein] malonyltransferase 2.3.1.39 E7
 [Acyl-carrier-protein] phosphodiesterase 3.1.4.14 F8
 Acyl-CoA C7, C8, D7, E8
 Acyl-CoA acyltransferase 2.3.1.16 E8
 Acyl-CoA dehydrogenase 1.3.99.3 B9, B10, E8, J4
 Acyl-CoA ligases 6.2.1.x D8
 Acyl-lysine deacylase 3.5.12.17 K3
 Acyladenylate D8
 Acylcarnitine E8
 N-Acylglucosamine 2-epimerase 5.1.3.8 D4
 Acylglycerol 3-phosphate D7
 Acylglycerol kinase 2.7.1.94 D8
 Acylglycerol palmitoyl [acyl-] transferase 2.3.1.22 D8
 1-Acylglycerol-3-phosphate acyltransferase 2.3.1.51 D7
 N-Acylmannosamine kinase 2.7.1.60 E4
 N-Acylneuraminate-9-phosphate synthase 4.1.3.20 E3
 Acylsphingosine deacylase 3.5.1.23 C8
 Adenine H1, I1, O4
 Adenine deaminase 3.5.4.2 G1
 Adenine phosphoribosyltransferase 2.4.2.7 G2
 Adenosine G1, H3, K7
 Adenosyl cobinamide I6
 Adenosine 3',5'-diphosphate [PAP] I4, K4
 Adenosine 3',5'-monophosphate (cyclic) [A-3, 5-PMP; cAMP] A6, M6, U3
 Adenosine 5'-diphosphate [ADP] H2 + others
 Adenosine 5'-phosphate [AMP] G2 + others
 Adenosine 5'-triphosphate [ATP] H2 + others
 Adenosine deaminase 3.5.4.4 G1
 Adenosine kinase 2.7.1.20 G2
 Adenosine phosphosulfate [APS] M10, N10
 Adenosine triphosphatase [ATPase] 3.6.1.3 H1, H2
 Adenosine-phosphate deaminase 3.5.4.17 G2
 S-Adenosyl-L-homocysteine H3 + others
 S-Adenosyl-L-methionine H3 + others
 Adenosylhomocysteinase 3.3.1.1 H3
 Adenylate cyclase 4.6.1.1 A6, U3
 Adenylate kinase 2.7.4.3 G7
 Adenylosuccinate G2
 Adenylosuccinate lyase 4.3.2.2 F2, G2
 Adenylosuccinate synthase 6.3.4.4 G2
 Adenyl sulfatase 3.6.2.1 J4
 Adenyl sulfate [APS] J4
 Adenylylsulfate kinase 2.7.1.25 J4
 Adenylylsulfate reductase 1.8.99.2 J4, M9, M10, N9
 ADP-D-glucose B6, V9
 ADP/ATP carrier Q9
 ADPribose O3
 Adrenaline [see epinephrine] V3
 α_2 -Adrenergic receptor V3
 β -Adrenergic receptor V3
 β -Adrenergic receptor kinase 2.7.1.126 V3
 Adrenodoxin H9, H10, I9, I10, J9, K10
 Adrenosterone J9
 Adriamycin M8
 Agmatinase 3.5.3.11 F7
 Agmatine F7
 D-Alanine F4, N3
 L-Alanine B7, E6, F4, G6, I7, J2, N3
 β -Alanine B10, G4, K8
 Alanine dehydrogenase 1.4.1.1 E6
 Alanine racemase 5.1.1.1 F4, N3
 Alanine transaminase [ALT] 2.6.1.2 E6
 β -Alanine-(3-aminoisobutyrate)-pyruvate transaminase C10

Squares A...L refer to part 1, squares M...V to part 2.

D-Alanine-D-Alanine N3	2-Amino-4-hydroxy-6-hydroxymethyl-7, 8-dihydropteridine L1	2-Aminomuconate-semialdehyde dehydrogenase 1.2.1.32 K2	L-Arginine F8
D-Alanine-D-Alanine ligase 6.3.2.4 N3	2-Amino-4-hydroxy-6-hydroxymethyl-7, 8-dihydropteridine pyrophosphate L1	6-Aminopenicillinate L4	Arginine 2-monoxygenase 1.13.12.1 F8
Alanine-glyoxylate transaminase 2.6.1.44 B7, G5	2-Amino-4-hydroxy-6-hydroxymethyl-7, 8-dihydropteridine pyrophosphokinase 2.7.6.3 L1	4-(Aminophenyl)-1, 2, 3, 4-tetrahydroypentane K2	Arginine decarboxylase 4.1.1.19 F8
Alanine-oxo-acid transaminase 2.6.1.12 D6	5-Amino-4-imidazole-carboxylate H1	1-Aminopropan-2-ol H5	Arginine deiminase 3.5.3.6 G8
β -Alanine-pyruvate transaminase 2.6.1.18 F4, K10, L10	Amino-acid acetyltransferase 2.3.1.1 G7	(R)-Aminopropan-2-ol dehydrogenase 1.1.1.75 H5	Arginine kinase 2.7.3.3 F8
Alanine-tRNA ligase 6.1.1.7 E6	D-Amino-acid oxidase 1.4.3.3 B7, G6, H8, I8	5-Aminovalerate H8	L-Arginine phosphate F8
L-Alanyl-tRNA E6	L-Amino-acid oxidase 1.4.3.2 B9, H2	Ammonia G8, M10, N10	L-Arginine-tRNA ligase 6.1.1.19 F8
1-Alcohol D8	L-2-Aminoacetate H5	Ammonia monooxygenase N10	L-Argininosuccinate G8
Alcohol dehydrogenase 1.1.1.1 D8, E6, J10	Aminoacetone H5	AMP nucleosidase 3.2.2.4 G1	Argininosuccinate lyase 4.3.2.1 F8
Alcohol dehydrogenase (acceptor) 1.1.99.8 D5	Aminoacyl-phosphatidylglycerol D7	Amplification loop [complement system] QR1	Argininosuccinate synthase 6.3.4.5 G8
Alcohol sulfotransferase 2.8.2.2 I10, K4	Aminoacyl-tRNA ligases 6.1.1.x N4, Q5	α -Amylase 3.2.1.1 A6	L-Arginyl-tRNA F8
Aldehyde D8	Aminoacyl-tRNA ^{aa} [unspecified] N4, Q4	β -Amylase 3.2.1.2 A6	Aromatic amino acids D3...H3
Aldehyde dehydrogenase (NAD ⁺) 1.2.1.3 A2, D6, D8, E6, H2, I2, J10	L-2-Amino adipate, J3, L3	Amylopectin A5	Aromatic-L-amino acid decarboxylase 4.1.1.28 G2, I2
Aldehyde dehydrogenase (PQQ) 1.2.99.3 D8	2-Amino adipate reductase J3	Amylose A5	Arrestin V4
Aldehyde oxidase 1.2.3.1 F2	2-Amino adipate semialdehyde J3	Anaerobic respiration M9, M10	ARS sequence [of yeast] R8
Aldehyde reductase 1.1.1.21 C3, C6	2-Amino adipate transaminase 2.6.1.39 I3	Anaplerotic reactions F5	Aryl sulfotransferase 2.8.2.1 K4
Aldosterone G9	L-Amino adipate-semialdehyde dehydrogenase 1.2.1.31 J3	Androgen receptor U6	Arylamine sulfotransferase 2.8.2.3 K4
Aldosterone hemiacetal F9	L, L, D-Amino dipyl-cysteinyl-valine synthase K3	Androgens J10	Arylsulfatase 3.1.6.1 K4, K9
Alkaloids G2	ϵ -(D-2-Amino dipyl-L-cysteinyl)-L-valine K3	Androst-4-ene-3, 17-dione I9	Arylsulfotransferase 2.8.2.1 K4
Alkane D8	4-Aminobenzoate E3, L2	5 α -Androstan-3, 17-dione L9	L-erythro-Ascorbate C2
Alkane1-monooxygenase 1.14.15.3 D8	4-Aminobutyraldehyde F7	5 β -Androstan-3, 17-dione L10	Ascorbate 2, 3-dioxygenase 1.13.11.13 C2
Allantoate H2	Aminobutyraldehyde dehydrogenase 1.2.1.19 F7, H6	Androsterone L9	L-Ascorbate oxidase 1.10.3.3 B2
Allantoicase 3.5.3.4 H1	4-Aminobutyrate H6	Anion channel RS3	L-Ascorbate [vitamin C] B2, G2, I7
Allantoin H1	γ -Aminobutyrate receptor V4	Ankyrin R3	Asparaginase 3.5.1.1 F4
Allantoinase 3.5.2.5 H1	4-Aminobutyrate transaminase 2.6.1.19 F4, H6	Anthranilate E3, J2	L-Asparagine F4
Allolactose N6	Aminobutyraldehyde dehydrogenase 1.2.1.19 F7, H6	Anthranilate dioxygenase (deaminating, decarboxylating) 1.14.12.1 E3	Asparagine-oxo-acid transaminase 2.6.1.14 F4
Alternative complement pathway C3/C5 convertase 2.4.21.47 R1	4-Aminobutyrate H6	Anthranilate phosphoribosyltransferase 2.4.2.18 F3	Asparagine kinase 2.7.2.4 F4
α -Amanitin Q6, R6, R7, S6	γ -Aminobutyrate receptor V4	Anthranilate synthase 4.1.3.27 E3	Asparagine transaminase [AST] 2.6.1.1 F5
ω -Amidase 3.5.1.3 F5, G5	4-Aminobutyrate transaminase 2.6.1.19 F4, H6	Antigen-presenting cell PQ2	L-Aspartate F4, G8, J2
Amidophosphoribosyltransferase 2.4.2.14 D2	Aminocarboxymuconate-semialdehyde decarboxylase 4.1.1.45 K2	Antimycin A P9, S10	Aspartate 1-decarboxylase 4.1.1.11 F4
Amine oxidase (copper-containing) 1.4.3.6 F2, F7	Aminodeoxygluconate dehydratase 4.2.1.26 C4	α_2 -Antiplasmin [α_2 -AP] U2, V1	Aspartate 4-decarboxylase 4.1.1.12 F4
Amine oxidase (flavin-containing) 1.4.3.4 I2	Aminoimidazolase 3.5.4.8 H2	Antithrombin III [AT III] TUV1, V2	Aspartate carbamoyltransferase 2.1.3.2 G8
Amino sugars D4	Aminoimidazole H1	Aphidicolin S7	Aspartate group of amino acids FG4
2-Amino-3-carboxymuconate semialdehyde K2	(S)-3-Aminoisobutyrate C10, L8	Apocytochrome c K5	L-Aspartate semialdehyde G4
2-Amino-3-oxoadipate H5	5-Aminolevulinic H5	Apo ferritin K5	Aspartate-ammonia ligase 6.3.1.1 F4
2-Amino-4-hydroxy-6-(D-erythro-1, 2, 3-trihydroxypropyl)-dihydroneopteridine triphosphate L1	5-Aminolevulinic synthase 2.3.1.37 G5, H5	Apolipoprotein B-100 S2	Aspartate-semialdehyde dehydrogenase 1.2.1.11 G4
2-Amino-4-hydroxy-6-(D-erythro-trihydroxypropyl)-dihydroneopteridine [dihydro-neopterin] L1	5-Aminomethyl dihydrolipoyl protein B7	Apolipoprotein C S3	4-Aspartyl phosphate G4
	Aminomethyltransferase 2.1.2.10 A7, B7	Apyrase 3.6.1.5 G2, H2	ATP citrate (pro-3S)-lyase 4.1.3.8 F6
	2-Aminomuconate K1	L-Arabinitol dehydrogenase 1.1.1.12 C3	ATP phosphoribosyltransferase 2.4.2.17 D2
	2-Aminomuconate semialdehyde K2	L-Arabinose C3	ATPases 3.6.1.x H1, H2
		L-Arabinose isomerase 5.3.1.4 C3	Atractyloside Q9
		L-Arabinitol dehydrogenase (ribulose-forming) C3	Atrial natriuretic factor [ANF] V5
		L-Arabinitol [L-arabinitol] C3	Aurovertin Q9
		Arachidonate T6	Auxin [indole acetate] I2
		Arachidonate derived hormones [eicosanoids] TU6, TU7	
		Arbutin A3	
		Arginase 3.5.3.1 F8	

B	1-Butanol L3	N-Carbamyl-L-glutamate G2	Cellulase 3.2.1.4 A4
B gene product [blood groups] R2	Butanol dehydrogenase L3	Carbon-monoxide dehydrogenase 1.2.99.2 A7, A8, N9	Cellulose A4
B specificity [blood groups] S2	Butyraldehyde L3	3-Carboxy-3-hydroxyisocaproate A9	Cellulose synthase (GDP-forming) 2.4.1.29 A5
B, Ba, Bb [complement factors] 3.4.21.46 QR1, QR2	Butyraldehyde dehydrogenase L3	γ -Carboxyglutamate I7	Cellulose synthase (UDP-forming) 2.4.1.12 A5
B-lymphocyte P2, R3	Butyrate L3	1-(Carboxyphenylamino)-1-deoxyribose-5'-phosphate G3	Cephalosporin C K3, K4, O3
Bacitracin N3	Butyrate kinase 2.7.2.7 L3	O ⁵ -(1-Carboxyvinyl)-3-phosphoshikimate E3	Ceramide C8
Bacterio-chlorophylls [a, b, c] J6, R9, RS10	Butyryl-CoA L3	Cardiolipin D7	Ceramide cholinophotransferase 2.7.8.3 C8
Bacterio-pheophytins R9, RS10	Butyryl-CoA dehydrogenase 1.3.99.25 L3	Carnitine F6	Ceramide galactosyltransferase Q4
Band 3 glycoprotein R2, R3	Butyryl-enzyme E7	Carnitine acetyltransferase 2.3.1.7 F6	Ceramide glucosyltransferase 2.4.1.80 Q4
Band 4.1 glycolipid R3	Butyryl-malonyl-enzyme E7	Carnitine palmitoyltransferase 2.3.1.21 E8	Chemolithotrophy N9, N10
Barbiturase 3.5.2.1 J7	Butyrylphosphate L3	Carnosine G4	Chemotaxis receptor V3
Bathorhodopsin V4	C	Carnosine synthase 6.3.2.11 G4	Chendeoxycholate J10
Betaine B8	c-Fos Q7, U4	α -Carotene E9	Chitin D4
Betaine aldehyde B8	c-Jun Q7	β -Carotene E9	Chitobiose D3
Betaine-aldehyde dehydrogenase 1.2.1.8 B8	c-Myb P7	β -Carotene 15, 15'-dioxygenase 1.13.11.21 E9	Chitobiosyl-diphosphodolichol a-mannosyltransferase 2.4.1.142 R5
Betaine-homocysteine methyltransferase 2.1.1.5 H3	c-Myc Q7, U4	Carotenoids DE9	Chlatrin S3
Bile acids L10	c-Raf Q7	Casein kinase II P7	Chloramphenicol M3
Bile pigments L5	C1qr ₂ s ₂ [complement factor] 3.4.21.41...42 Q1, Q2	Castanospermine S5	Chlorophyll [a, b] E10, K6
Bilirubin L5	C2, C2a, C2b [complement factors] QR1	Catalase 1.11.1.6 K5	Chlorophyllase 3.1.1.14 K6
Bilirubin diglucuronide L5	C3, C3a, C3b, C3c, C3d, C3f, C3g, C3 (H ₂ O) [complement factors] QR1, QR2	Catechol E3	Chlorophyllide a E10, K6
Bilirubin oxidase 1.3.3.5 L5	C4, C4a, C4b, C4c [complement factors] QR1, QR2	Catechol 1, 2-dioxygenase 1.13.11.1 E3	Chloroplasts R...T9
Biliverdin L5	C4bp, C8bp [complement factor binding proteins] QRS1, QRS2	Catechol 2, 3-dioxygenase 1.13.11.2 E3	Cholate K10
Biliverdin reductase 1.3.1.24 L5	C5, C5a, C5b [complement factors] RS1, RS2	Catechol methyltransferase 2.1.1.6 H2	Cholate-CoA ligase 6.2.1.7 K10
Biotin carboxylase 6.3.4.14 J4	C6, C7, C8, C9 [complement factors] RS1, RS2	CD 2 P2, P3	Cholecalciferol [vitamin D3] F10
Bisphosphoglycerate phosphatase 3.1.3.13 D5, U10	CAAT-box Q7	CD 3 Q3	Cholera toxin U3, U4
1,3-Bisphosphoglycerate [1,3-diphosphoglycerate, 3-phospho-D-glyceralyl phosphate] D5, U10	Cadaverine K3	CD-3 accessory glycoproteins Q3	Cholest-5-ene-3 β , 7 α -diol 3 β -dehydrogenase 1.1.1.181 H10
2,3-Bisphosphoglycerate [2, 3-diphosphoglycerate, glycerate 2, 3-bisphosphate] D5	Calcium channel S4, S5, V3	CD 4 Q2, Q3	$\Delta^5, 24$ -Cholestadien-3 β -ol G10
Bisphosphoglyceromutase 5.4.2.4 D5	Calcium channel, L-type U3	CD 8 OP2, Q3	$\Delta^7, 24$ -Cholestadien-3 β -ol G10
Bleomycin M7	Calcium effects T5	CD 9 [platelet surface receptor] UV1	$\Delta^8, 24$ -Cholestadien-3 β -ol F10
Blood coagulation system S...V1, S...V2	Calcium transporting ATPase 3.6.1.38 S5	CD 11a/18 [LFA-1] P2, P3	Cholestanetriol 26-monoxygenase 1.14.13.15 J10
Blood group determining structures RS2	Calmodulin T5, U3, TU5, U6	CD 54 [ICAM-1] P2, P3	Δ^4 -Cholesten-3-on H10
Bonkrekate Q9	Calsequestrin S5	CD 58 [LFA-3] P2, P3, Q2	Δ^7 -Cholesten-3 β -ol G10
Borrelidin N4	Calvin cycle U9, U10	CDP-1, 2-diacylglycerol A3, C7, T3	Cholesterol G10, S2, S4
Bradykinin T1, T6	Cap protein M6	CDP-choline C8	Cholesterol acyltransferase 2.3.1.26 G10, T4
Branched-chain amino acids AB9, AB10	Capping [of mRNA] PQ6	CDP-diacylglycerol-glycerol-3-phosphate 3-phosphatidyltransferase 2.7.8.5 C7	Cholesterol ester G10, ST3, ST4
Branched-chain-amino-acid transaminase 2.6.1.42 B9, B10	Carbamate kinase 2.7.2.2 G8	CDP-diacylglycerol-inositol 3-phosphatidyltransferase 2.7.8.11 C7, U3, U4	Cholesterol esterase 3.1.1.13 G10, S4, U4
Brefeldin A S4	Carbamoyl-L-asparate G8	CDP-diacylglycerol-serine O-phosphatidyltransferase 2.7.8.8 C7	Cholesterol monoxygenase (side-chain cleaving) 1.14.15.6 H10
Bromoconduritol S5	Carbamoyl-phosphate G8	CDP-ethanolamine C7	Choline B8, V4
Bufotinin I2	Carbamoyl-phosphate synthase (ammonia) 6.3.4.16 G8	Cell envelope MN2, MN3	Choline acetyltransferase 2.3.1.6 B8
Bundle-sheath cell V9	Carbamoyl-phosphate synthase (glutamine-hydrolyzing) 6.3.5.5 G8	Cellbiose A4	Choline dehydrogenase 1.1.99.1 B8
α -Bungartotoxin V4	N-Carbamoylensarcosine F7	Cellbiose phosphorylase 2.4.1.20 A4	Choline kinase 2.7.1.32 B8
(R, R)-2, 3-Butanediol A10	N-Carbamoylensarcosine amidase 3.5.1.59 F7	Cellular immune interactions O...Q2	Choline oxidase 1.1.3.17 B8
(R, R)-Butanediol dehydrogenase 1.1.1.4 A10			Cholinephotransferase 2.7.8.2 C8

Squares A...L refer to part 1, squares M...V to part 2.

Chondroitin sulfotransferase 2.8.2.5	Cortexone H9	Cysteine transaminase 2.6.1.3 H4	7-Dehydrocholesterol G10
K4	Corticoids H10	Cytidine J7	7-Dehydrocholesterol reductase
Chondroitinsulfate Q3	Corticosteroid binding globulin I9	Cytidine 5'-diphosphate [CDP] J7	1.3.1.21 G10
Chorismate E3	Corticosteroids T6	Cytidine 5'-phosphate [CMP] A3, J7	11-Dehydrocorticosterone G9
Chorismate mutase 5.4.99.5 E3	Corticosterone G9	Cytidine 5'-triphosphate [CTP] J7	cis-3, 4-Dehydrodecanoyl-ACP E7
Chorismate synthase 4.6.1.4 E3	Corticosterone 18-monoxygenase	Cytidine deaminase 3.5.4.5 J7	Dehydrodolichol pyrophosphate E10
Christmas factor [factor IX / IXa]	1.14.15.5 G9	Cytidylate kinase 2.7.4.14 J7, K7	Dehydroepiandrosterone I9
3.4.21.22 UV1	Cortisol I9	Cytochrome c oxidase [complex IV of	Dehydroepiandrosterone sulfate I10
Chromatin R8	Cortisone J9	mitochondria] 1.9.3.1 P9	Dehydrogenases [NAD(P) ⁺ , general]
Chylomicra S3	Cortisone β -reductase 1.3.1.3 J9	Cytochrome d complex [<i>Escherichia coli</i>] P10	J1
Chylomicra remnants S3	Cortol K9	Cytochrome f R10, S9	2-Dehydropantoate A10
(S)-Citramalate I6	Cortolone K9	Cytochrome o complex [<i>Escherichia coli</i>] P10	2-Dehydropantoate reductase
Citrate F6	Coumarins UV1, V2	Cytochrome oxidase 1.9.3.1 N10	1.1.1.169 A10
Citrate (<i>pro-3(S)</i> -lyase 4.1.3.6 F6	Coumeomycin O8	Cytochrome-heme lyase K5	3-Dehydroquinate D3
Citrate (<i>si</i> -synthase 4.1.3.7 F5	CR1 [complement receptor type 1]	Cytochromes a, a ₃ K5, P9, QR10	3-Dehydroquinate dehydratase
Citrate cycle FG5, FG6	QR2	Cytochromes b M9, N10	4.2.1.10 D3
Citrulline G8	Creatinase 3.5.3.3 G7	Cytochromes b ₅₅₈ , b ₅₉₅ , d P10, Q10	3-Dehydroquinate synthase 4.6.1.3
Classical complement pathway C3/C5	Creatine G7, U5	Cytochromes b ₅₆₂ , b ₅₅₅ =O P10, Q10	D3
convertase 4.2.21.43 R1, R2	Creatine kinase 2.7.3.2 G7, U5	Cytochromes b _L , b _H [b ₅₆₆ , b ₅₆₂ , in	3-Dehydroshikimate D3
CMP-N-acetylneuraminate F3	Creatine phosphate G7	mitochondria] P9, QR10	3-Dehydroshinganine B8
CMP-sialate F3	Creatininase 3.5.2.10 G7	Cytochromes b _L , b _H [in chloroplasts]	3-Dehydroshinganine reductase
CO ₂ pumping (C ₄ plants) V9, V10	Creatinine G7	R10, S9, S10	1.1.1.102 B8
Coagulation control V1, V2	Creatinine deiminase 3.5.4.21 G7	Cytochromes c, c ₁ , c ₂ KL5, M9,	5 α -Dehydrotestosterone J9
Coagulation factors II, IIa, V, Va, VII, VIIa, VIII, VIIIa, IX, IXa, X, Xa, XI, XIa, XII, XIIa, XIII, XIIIa 3.4.21.x	CREB [A-3, 5-MP responsive element binding protein] P7	N10, P9, QR10, S10	2'-Deoxy-5-hydroxymethylcytidine 5'-diphosphate L7
T...V1, ...V2	Crotonyl enzyme E7	Cytoplasm [of bacteria] M3...08	2'-Deoxy-5-hydroxymethylcytidine 5'-phosphate L7
Coagulation [of blood] S...V1, S...V2	Crotonyl-CoA J3, L3	Cytoplasmic protein [eucaryotic] O4	2'-Deoxy-5-hydroxymethylcytidine 5'-triphosphate L7
Coated pit S3	CTF [CAAT binding protein] P7	Cytosine H3, J7	2'-Deoxyadenosine I1, L7
Coating proteins [of membranes] S4	CTP synthase 6.3.4.2 J7	Cytosine deaminase 3.5.4.1 J7	2'-Deoxyadenosine 5'-diphosphate [dADP] I2
Cobalamin [vitamin B ₁₂] I6	Cyanobacteria R...T9	D	2'-Deoxyadenosine 5'-phosphate [dAMP] I2
Cobyricinate diamide H6	Cyclic AMP [cAMP], see adenosine-3', 5'-monophosphate (cyclic)	D [complement factor] 3.4.21.46 Q1	2'-Deoxyadenosine 5'-triphosphate [dATP] I2
Coenzyme A [CoA] D10+others	A6, M6, U3	Daunomycin M8	5'-Deoxyadenosine cobalamin [coenzyme B ₁₂] J6
Coenzyme B ₁₂ B8, J6	Cyclic electron flow S9, S10	dCTP pyrophosphatase 3.6.1.12 L7	Deoxyadenylate kinase 2.7.4.11 I2
Coenzyme F ₄₂₀ B8	3', 5'-Cyclic-GMP phosphodiesterase 3.1.4.35 U4, UV5	Deacetylcephalosporin C K3	Deoxycholate L10
Coenzyme F ₄₃₀ I6	3', 5'-Cyclic-nucleotide phosphodiesterase 3.1.4.17 A6, U3	Deamido-NAD J1	11-Deoxycorticosterone H9
Collagen UV1	Cycloarterenol synthase 5.4.99.8 F10	Degradation of foreign DNA M2	11-Deoxycortisol I9
Collagen receptor [platelet surface, GP Ia/IIa] U1, U2	Cycloheximide P4	2-Dehydro-3-deoxy-D-glucarate A2	21-Deoxycortisol I9
Complement factor 1 inhibitor [C1-INH] T1	Cyclomaltooligosaccharide glucanotransferase 2.4.1.19 A5	2-Dehydro-3-deoxy-D-glucarate aldolase 4.1.2.20 A2	2'-Deoxycytidine K7
Complement factor 4b binding protein [C4BP] QR2, V1	Cycloserine N3	2-Dehydro-3-deoxygluconate B3	2'-Deoxycytidine 5'-diphosphate [dCDP] L7
Complement receptor I [CD 35] P3, Q2	5 β -Cyprinol sulfate J10	2-Dehydro-3-deoxygluconokinase 2.7.1.45 B4	2'-Deoxycytidine 5'-phosphate [dCMP] K7
Complement system Q...S1, Q...S2, U2	L-Cystathionine H4	5-Dehydro-4-deoxy-D-glucarate A2	2'-Deoxycytidine 5'-triphosphate [dCTP] L7
Coproporphyrin I J5	Cystathionine β -lyase 4.4.1.8 G4	2-Dehydro-D-3-deoxy-6-phosphoglucuronate C4	Deoxycytidine kinase 2.7.1.74 K7
Coproporphyrin III J5	Cystathionine γ -lyase 4.4.1.1 G4	3-Dehydro-L-gulonate B2	Deoxycytidylate deaminase K7
Coproporphyrinogen I I5, J5	Cystathionine β -synthase 4.2.1.22 H4	Dehydro-L-gulonate decarboxylase 4.1.1.34 B2	Deoxycytidylate hydroxymethyltransferase 2.1.2.8 K7
Coproporphyrinogen III J5	L-Cysteate I4	3-Dehydro-L-gulonate dehydrogenase 1.1.1.130 B2	2'-Deoxyguanosine I1, L7
Coproporphyrinogen oxidase (decarboxylating) 1.3.3.3 J5	L-Cysteine C10, H4, H7, K2	2-Dehydro-L-gulonolactone B2	2'-Deoxyguanosine 5'-diphosphate [dGDP] I1
Coprostanol G10	Cysteine dioxygenase 1.13.11.20 H4	Dehydroacyl-CoA D7, E7	
Corrinoids H...J6	Cysteine lyase 4.4.1.10 H4	trans-2, 3-Dehydroacyl-CoA E8	
	Cysteine reductase (NADH) 1.6.4.1 H4	trans-2, 3-Dehydroacyl-enzyme E7	
		L-Dehydroascorbate C7, G2, H7	

- 2'-Deoxyguanosine 5'-phosphate [dGMP] I1
 2'-Deoxyguanosine 5'-triphosphate [dGTP] I1
 Deoxyribodipyrimidine photo-lyase [photoreactivating enzyme] 4.1.99.3 MN7
 Deoxyribonuclease (apurinic or apyrimidinic) 3.1.25.2 N8
 Deoxyribonuclease (pyrimidine dimer) 3.1.25.1 N7
 Deoxyribonuclease I 3.1.21.1 L7
 Deoxyribonuclease II 3.2.22.1 L7
 Deoxyribonucleic acid MN7, QR7+others
 2'-Deoxyribose 1-phosphate K8
 Deoxythymidine-diphosphate-D-galactose B5
 Deoxythymidine-diphosphate-D-glucose B5
 Deoxythymidine-diphosphate-L-rhamnose B5
 2'-Deoxyuridine 5'-diphosphate [dUDP] L8
 2'-Deoxyuridine 5'-phosphate [dUMP] K8
 2'-Deoxyuridine 5'-triphosphate [dUTP] L8
 Depospho-CoA C10
 Depospho-CoA kinase 2.7.1.24 C10
 14-Desmethyl-lanosterol F10
 Desmosterol G10
 Desmosterol reductase G10
 Dextran A4
 Dextransucrase 2.4.1.5 A4
 α -Dextrin endo-1, 6 α -glucosidase 3.2.1.41 A6
 D-1, 2-Diacylglycerol A3, D8, S3, T3, V7
 Diacylglycerol 3-phosphate D7
 Diacylglycerol acyltransferase 2.3.1.20 D7
 Diacylglycerol kinase 2.7.1.107 D8
 LL-2, 6-Diaminopimelate J3
 meso-2, 6-Diaminopimelate J3
 Diaminopimelate decarboxylase 4.1.1.20 J3
 Diaminopimelate epimerase 5.1.1.7 J3
 Dietary lipids S2
 L-4, 5-Dihydro-orotate H8
 Dihydrobiopterin [quininoid] F3, G2, H2, K1
 2, 3-Dihydriodipicolinate G3
 Dihydriodipicolinate reductase 1.3.1.26 H3
 Dihydriodipicolinate synthase 4.2.1.52 G3
 7, 8-Dihydrofolate A7, L2, K7
 Dihydrofolate reductase 1.5.1.3 L2
 Dihydrofolate synthase 6.3.2.12 L2
 Dihydrolipoamide acetyltransferase 2.3.1.12 F5
 Dihydrolipoamide dehydrogenase 1.8.1.4 F6, G5
 Dihydrolipoamide succinyltransferase 2.3.1.61 G5
 7, 8-Dihydromethanopterin K2
 Dihydronoopterin aldolase 4.1.2.25 L1
 Dihydroorotate 3.5.2.3 H8
 Dihydroorotate dehydrogenase 1.3.99.1 H8
 Dihydropteridine reductase 1.6.99.7 K1
 7, 8-Dihydropteroate L2
 Dihydropteroate synthase 2.5.1.15 L2
 Dihydropyrimidinase 3.5.2.2 J8, L8
 Dihydrothymine L8
 Dihydrouracil J8
 Dihydrouracil dehydrogenase (NAD⁺) 1.3.1.1 J8
 Dihydrouracil dehydrogenase (NADP⁺) 1.3.1.2 J8, L8
 1, 4-Dihydroxy-2-naphtoate D3
 11 β , 21-Dihydroxy-3, 20-oxo-5 β -pregnan-18-al F9
 2, 3-Dihydroxy-3-methylvalerate A9
 3 α , 12 α -Dihydroxy-5 β -chol-6-enoate L10
 7 α , 12 α -Dihydroxy-5 β -cholestane-3-one I10
 3 α , 7 α -Dihydroxy-5 β -cholestane I10
 3 α , 21-Dihydroxy-5 β -pregnane-11, 20-dione G9
 17 α , 21-Dihydroxy-5 β -pregnane-3, 11, 20-trione JK9
 11 β , 21-Dihydroxy-5 β -pregnane-3, 20-dione G9
 Dihydroxy-acid dehydratase 4.2.1.9 A9, A10
 Dihydroxyacetone-phosphate [see glycerone-phosphate] D6
 3 β , 17 β -Dihydroxyandrost-5-ene I10
 1, 25-Dihydroxycalciferol F9
 7 α , 12 α -Dihydroxycholest-4-en-3-one I10
 17 α , 20 α -Dihydroxycholesterol I10
 20 α , 22 β -Dihydroxycholesterol H10
 2, 3-Dihydroxyisovalerate A10
 L-Dihydroxyphenylalanine G2
 2, 5-Dihydroxypyridine K1
 Diiodo-L-tyrosine G2
 Dimethylallylpyrophosphate D10
 Dimethylallyltransferase 2.5.1.1 D10
 Dimethylcitraconate A9
 Dimethylglycine B8, I3
 Dimethylglycine dehydrogenase 1.5.99.2 B8
 2, 3-Dioxo-L-gulonate C2
 Diposphomevalonate decarboxylase 4.1.1.33 D10
 Diphtheria toxin O3
 Diterpenes E10
 DNA (adenosine-N⁶-)-methyltransferase N7
 DNA (cytosine-5-)-methyltransferase 2.1.1.37 H3
 DNA degradation J1, L7
 DNA double helix M8, QR8
 DNA excision-repair MN7, MN8, PQ8
 DNA helicase MNO8, N7
 DNA polymerase [virus integration] Q8
 DNA replication [in eubacteria] K1, L1, M...O7, M...O8
 DNA replication [in eukaryotes] K1, L1, Q...S7, Q...S8
 DNA superhelix M8
 DNA topoisomerase (ATP hyrolyzing) [DNA topoisomerase type II, DNA gyrase] 5.99.1.3 N7, N8, S7, S8
 DNA topoisomerase [type I] 5.99.1.2 RS6, S7
 DNA-directed DNA polymerase [I, III; bacterial; α , β , δ , ϵ : eukaryotic] 2.7.7.7 IJ1, IJ2, L7, O78, Q7, R8, S8, S9
 DNA-directed RNA polymerase [procaryotic; I, II, III: eukaryotic] 2.7.7.6 JK7, JK8, H1, MN6
 DNA-uracil glycosylase N8
 DNA-virus PQ8, PQ9
 DnaA, DnaC proteins M8, N8
 Dolichol-phosphate-mannose-glycolipid α -mannosyltransferase 2.4.1.130 R5
 Dolichol E9, Q5
 Dolichol kinase 2.7.1.108 E9, QR5
 Dolichol phosphatase 3.1.3.51 E9
 Dolichol phosphate E9, R5
 Dolichol pyrophosphate E9
 Dolichyl-diphosphooligosaccharide-protein glycosyltransferase 2.4.1.119 R5
 Dolichyl-phosphate β -glucosyltransferase 2.4.1.117 R5
 Dolichyl-phosphate-glucose-glycolipid α -glucosyltransferase R5
 Dolichyl-phosphate-mannose-glycolipid α -mannosyltransferase 2.4.1.130 R5
 Dolichyl-phosphate mannosyltransferase 2.4.1.183 R5
 Dopa decarboxylase [see aromatic L-amino-acid decarboxylase] 4.1.1.28 G2
 Dopamine G2
 Dopamine β -monooxygenase 1.14.17.1 G2
 Dopaquinone G2
 dTMP kinase 2.7.4.9 K7
 dUTP pyrophosphatase 3.6.1.23 K8

E

- EF1 α , eEF1 β , eEF1 γ [eukaryotic elongation factors] P3, PQ4
 EF-G [bacterial elongation factor] M4
 EF-Tu, EF-Ts [bacterial elongation factors] N3
 eIF1, eIF2, eIF3, eIF4a, eIF4b, eIF4c, eIF5, eIF6 [or I1, I2, I3, I4a, I4b, I4c, I5, I6] [eukaryot.init.factors] O...Q5
 Endoplasmic reticulum Q...S4, Q...S5
 Endosome S3
 Endothelial cells S1, ST2
 Enolase 4.2.1.11 D5
 Enoyl-CoA hydratase 4.2.1.17 C9, C10, E8, K4
 Enoyl-[acyl-carrier-protein] reductase (NADPH) 1.3.1.10 E7
 Eosinophilic chemotactic factor of anaphylaxis [ECF- α] P1
 Epidermal growth factor receptor [EGF-receptor] T3, U4, V6
 Epidermal growth factor [EGF] V6
 L-Epinephrine [adrenaline] H2, V3
 eRF [eukaryotic release factor] OP4
 ERK V7
 Ergocalciferol [vitamin D₂] F9
 Ergosta-5, 7, 22, 24(28)-tetraen-3 β -ol F10
 Ergosterol F9
 Erythrocyte membrane R3
 D-erythro-neopterin L1
 Erythromycin M4
 D-Erythro-4-phosphate C5, U9
Escherichia coli OP10
 Estradiol 17 β -dehydrogenase 1.1.1.62 K9, K10

Squares A...L refer to part 1, squares M...V to part 2.

- Estradiol-17 β K9
Estriol K10
Estriol 2-hydroxylase K9
Estrogen receptor U6
Estrogens K10
Estrone K9
Estrone sulfotransferase 2.8.2.4 K4, K9
Ethanol E6
Ethanolamine B7, D7, O3
Ethanolamine kinase 2.7.1.82 B7
Ethanolamine phosphotransferase 2.7.8.1 C7
Ethanolamine-phosphate cytidylyltransferase 2.7.7.14 C7
Etiocholan-3 α -ol-17-one L10
Eubacteria M2...O8
Eukaryotes O1...V7
Excitons RS9, RS10, ST9
Exonuclease [viral] P8
Exoribonuclease II 3.1.13.1 O6
Extrinsic pathway inhibitor [EPI, LACI] V1
Extrinsic pathway of blood coagulation [cf.note 79] UV1
- F**
F(ab')₂-fragment [of immunoglobulins] Q2
Fab-fragmement [of immunoglobulins] Q2
Factor III [methanogenesis] A8
Factor P865 [purple bacteria] R10, S10
Factors A₀, A₁, A, B, P680, P700, X, Z [chloroplasts] R9, S9
 σ^{54} -, σ^{70} -Factors [bacterial transcription] MN6
Farnesyltrans-transferase 2.5.1.29 E10
Farnesyl-diphosphate farnesyltransferase 2.5.1.21 E10
Farnesylpyrophosphate E10
Fatty acid D8, S3
Fatty acid oxidation E8, J3
Fatty acid synthesis E7
Fc ε -receptor O3, P1
Fc γ -receptor II [CD 32] P3, Q2
Fc-fragment [of immunoglobulins] Q3
Ferrodoxin G5, G8, H10, MN10, N9, R9, ST9
Ferric reductase M10
Ferrochelatase 4.99.1.1 J5
Fibrin degradation products [FDP D, E, X, Y] V2
Fibrin, fibrin I (soluble), I_n, II_n, fibrin (insoluble) UV2
- Fibrinogen UV2
Fibrinogen receptor [platelet surface, GP IIb/IIIa] UV2
Fibrinolysis UV2
Fibronectin receptor [platelet surface, GP Ic/IIa] U1, U2
Ficoprenol pyrophosphate E9
Fletcher factor [plasma prekallikrein] S1, T1, T2
Fluorophosphates, organic V4
fMet peptides V3
Folate KL2
Follicle-stimulating-hormone [FSH] receptor V3
Folylpolyglutamates HI3
Formaldehyde dehydrogenase 1.2.1.46 D5
Formimidase 3.5.1.49 J2
Formate A7, D5, G5, J2, M4, M9, N10, Q9, Q10
Formate acetyltransferase 2.3.1.54 F5
Formate dehydrogenase 1.2.1.2 D5, G5
Formate dehydrogenase (cytochrome) 1.2.2.1 G5, M9, Q10
Formate-tetrahydrofolate ligase 6.3.4.3 A7
5-Formimino-tetrahydrofolate A7, G2
Formiminoglycine A7, H1
Formiminotetrahydrofolate cyclodeaminase 4.3.1.4 A7
N-Formimino-L-glutamate A8, F2
Formyl polypeptide M4
N-Formyl-1-glutamate A7
Formyl-CoA G5
Formyl-CoA hydrolase 3.1.2.10 G5
N-Formyl-L-methionyl-tRNA I3
5-Formyl-tetrahydrofolate A7, B8
10-Formyl-tetrahydrofolate A7, D2, F2, N4
5-Formyl-tetrahydrofolate cyclo-ligase 6.3.3.2 B7
N-Formylkynurenine J2
Formylmethanofuran A8
Formylmethanofuran-tetrahydro-methanopterin formyltransferase 2.3.1.101 A8
Formyltetrahydrofolate deformylase 3.5.1.10 A7
5-Formyltetrahydromethanopterin A8
 β -Fructofuranosidase [invertase] 3.2.1.26 A4
Fructokinase 2.7.1.4 C6
 β -D-Fructose A4, C6
- β -D-Fructose 1, 6-bisphosphate C5, U9, V9
 β -D-Fructose 1-phosphate C6
D-Fructose 2, 6-bisphosphate C6
 β -D-Fructose 6-phosphate A4, C5, U9
Fructose bisphosphatase 3.1.3.11 C5, D5, U9
Fructose-2, 6-bisphosphatase 3.1.3.46 C6
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 Lathosterol oxidase 1.3.3.2 G10
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- Le gene product [blood groups] R2
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 Leucine dehydrogenase 1.4.1.9 B9
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 Leucine-tRNA ligase 6.1.1.4 B9
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 Leukotriene A₄ T6
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 Lumirhodopsin V4
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 Lysine acetyltransferase 2.3.1.32 J3
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 Lysine-tRNA ligase 6.1.1.6 J3
 L-1-Lysolecithin D8
 L-2-Lysolecithin D8
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 L-Lysyl-tRNA J3
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- M**
 M-protein O2, O3
 α_2 -Macroglobulin [α_2 M] T1, T2
 Magnesium-2, 4-divinyl-phaeophorphyrin (a₅)-monomethyl ester K6

Squares A...L refer to part 1, squares M...V to part 2.

- Magnesium-protoporphyrin IX J6
 Magnesium-protoporphyrin methyltransferase 2.1.1.11 J6
 Magnesium-protoporphyrin monomethyl ester K6
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 Malate dehydrogenase (decarboxylating) 1.1.1.39 F5
 Malate dehydrogenase (NADP $^+$) 1.1.1.82 V10
 Malate dehydrogenase (oxaloacetate-decarboxylating)(NADP $^+$) 1.1.1.40 V9
 Malate synthase 4.1.3.2 F5
 Maleamate K1
 4-Maleylacetooacetate G3
 Maleylacetooacetate isomerase 5.2.1.2 G3
 Malic enzyme 1.1.1.39 F5
 Malonate E4, F4, G4, K7
 Malonate semialdehyde F4, K4
 Malonate-CoA transferase 2.8.3.3 F7, K4
 Malonate-semialdehyde dehydrogenase 1.2.1.15 F4, K4
 Malonate-semialdehyde dehydrogenase (acylating) 1.2.1.18 F4, K4
 Malonyl-CoA F7, L4
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 Maltase [α -glucosidase] 3.2.1.20 A6
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 Maltose binding protein [MalE] N3
 Maltose permease [MalF, MalG, MalK] N3
 Maltose phosphorylase 2.4.1.8 A6
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 Mannose isomerase 5.3.1.7 C6
 α -D-Mannose 6-phosphate C6
 Mannose-6-phosphate isomerase 5.3.1.8 C6
 Mannose-6-phosphate receptor S3
 α -1, 3-Mannosyl-glycoprotein β -1, 2-N-acetylglucosaminyltransferase 2.4.1.101 S4
 Mannosyl-oligosaccharide 1, 2- α -mannosidase 3.2.1.113 S5
 Mannosyl-oligosaccharide 1,3-1,6- α -mannosidase 3.2.1.114 RS4
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 Mast cell O3, P1
 Mature tRNA Q5, Q6
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 MCP [membrane cofactor protein] QR1, QR2
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 Melanin G2
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 Membrane attachment [of ribosomes] R4
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 Membrane cofactor protein [MCP] QR1, QR2
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 Menaquinol D3, Q10
 Menaquinone [vitamin K2] D3, E10, Q10
 3-Mercaptopyruvate H4
 3-Mercaptopyruvate sulfurtransferase 2.8.1.2 I4
 Mesaconate H6
 Mesaconate pathway HI6
 Mesobilirubinogen L6
 Mesophyll cell V10
 Messenger RNA [mRNA] M5
 Metarhodopsin V4
 Methacrylyl-CoA B10
 Methane A8, D5, M9, N9
 Methane monooxygenase 1.14.13.25 D5
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 Methanofuran [MFR] A8
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 Methene-THF cyclohydrolase 3.5.4.9 A7
 5, 10-Methenyl-THF A7
 5, 10-Methenyltetrahydromethanopterin A8
 5, $\text{t}10$ -Methenyltetrahydromethanopterin cyclohydrolase A8
 L-Methionine I3, N4, Q5
 Methionine adenosyltransferase 2.5.1.6 I3
 L-Methionine sulfoxide I3
 Methionine-S-oxide reductase 1.8.4.5 I3
 Methionine-tRNA ligase 6.1.1.10 I3
 Methionyl-tRNA formyltransferase 2.1.2.9 I3, N4, N5
 Methionyl-tRNA^{Met} I3, N4
 Methionyl-tRNA^{Met} I3, Q4
 2-Methoxyestradiol-17 β L9
 2-Methoxyestrone L9
 3-Methyl-2-oxobutanoate dehydrogenase (lipoamide) 1.2.4.2 B9, B10
 [3-Methyl-2-oxobutanoate dehydrogenase] kinase 2.7.1.115 AB9
 [3-Methyl-2-oxobutanoate dehydrogenase] phosphatase 3.1.3.52 AB9
 3-Methyl-2-oxobutanoate hydroxymethyltransferase 2.1.2.11 AB10
 2-Methyl-3-hydroxybutyryl-CoA C9
 5-Methyl-tetrahydrofolate A87, H3
 2-Methylacetoacetyl-CoA C9
 L-threo-3-Methylaspartate A9, H6
 Methylaspartate ammonia-lyase 4.3.1.2 H6
 Methylaspartate mutase 5.4.99.1 H6
 2-Methylbutyryl-CoA B9
 Methylcoenzyme M A8
 Methylcoenzyme-M reductase A8
 3-Methylcrotonyl-CoA B9
 Methylcrotonyl-CoA carboxylase C9
 5-Methylcytosine H3
 5, 10-Methylene-THF B7, K7, K8
 5, 10-Methylene-THF dehydrogenase (NADP $^+$) 1.5.1.5 B7
 5, 10-Methylene-THF reductase (NADPH) 1.5.1.20 B7
 5, 10-Methylenetetrahydromethanopterin A8
 5, 10-Methylenetetrahydromethanopterin reductase A8
 5, 10-Methylenetetrahydromethanopterin dehydrogenase 1.5.99.9 A8
 trans-3-Methylglutaconyl-CoA C9
 Methylglyoxal H5
 N-Methylhistamine F2
 N-Methylhydantoin F7
 N-Methylhydantoinase 3.5.2.14 F7
 (S) -2-Methylmalate dehydratase 4.2.1.34 H6
 (S) -Methylmalonate semialdehyde C10
 Methylmalonate semialdehyde dehydrogenase (acylating) 1.2.1.27 C9
 (S) ($=D$)-Methylmalonyl-CoA I4
 (R) (=L)-Methylmalonyl-CoA I4
 Methylmalonyl-CoA carboxyltransferase 2.1.3.1 J4
 Methylmalonyl-CoA decarboxylase 4.1.1.41 J4
 Methylmalonyl-CoA epimerase 5.1.99.1 I4
 Methylmalonyl-CoA mutase 5.4.99.2 F5, I4
 Methylnicotinate H3
 Methyloxaloacetate A9
 5-Methyltetrahydrofolate B8
 Methyltetrahydrofolate methyltransferase B8
 5-Methyltetrahydromenopterin A8
 5-Methyltetrahydropteroylglutamate: homocysteine methyltransferase H3
 Mevalonate D9
 Mevalonate 5-phosphate D10
 Mevalonate 5-pyrophosphate D10
 Mevalonate kinase 2.7.1.36 D10
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 Mitochondrial myopathy O9, P9
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 Molybdopterin L1
 1 (or 2)-Monoacylglycerol D8, T5
 Monoamine oxidase [amine oxidase (flavin-containing)] 1.4.3.4 H2, H5, I2
 Monoiodo-L-tyrosine G2
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 mRNA (guanine-N⁷)-methyltransferase 2.1.1.56 PQ6
 mRNA (nucleoside-O²)-methyltransferase 2.1.1.57 PQ6
 mRNA biosynthesis [eukaryotic] Q6, Q7
 mRNA guanylyltransferase 2.7.7.50 PQ6
 mRNA splicing OP5, OP6
 Mucolipidose II S4
 cis-cis-Muconate E3
 Muconate cycloisomerase 5.5.1.1 E3
 Muconolactone Δ -isomerase 5.3.3.4 F3
 Murein N2, NO3
 Muscarinic receptor V3
 Muscular contraction U4
 MutH, MutL, MutS [DNA repair enzymes] N7
 Myosterols F9
 Myelin basic protein U4
 Myoglobin K5
 Myosin phosphate U5
 Myosin [light chain, heavy chain] U5
 Myosin-actin interactions U4, U5
 Myosin-light-chain kinase 2.7.1.117 U4, TU5
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N			
N1, N2, N3, N4 [iron-sulfur clusters in complex I of mitochondria]	O9, QR9, QR10	Nitrite:acceptor oxidoreductase N10	Oxydative phosphorylation O...Q9, O...Q10
Na ⁺ /K ⁺ transporting ATPase	3.6.1.37 S3	Nitrogen M10	Oxyhemoglobin K5, T4
NAD(P) ⁺ nucleosidase	3.2.2.6 J1	Nitrogenase 1.18.6.1 G8	
NAD(P) ⁺ transhydrogenase	1.6.1.1 J1, S10	Nitrous oxide M10	
NAD(P) ⁺ transhydrogenase [complex I of mitochondria]	1.6.1.1 O9	Nitrous-oxide reductase 1.7.99.6 M10	
NAD ⁺ J1+others		Noncyclic electron flow ST9, ST10	P
NAD ⁺ kinase	2.7.1.23 J1	L-Norepinephrine H2	p21 ^{c-ras} UV7
NAD ⁺ synthase	6.3.1.5 J1	Novobiocin O8	p33 ^{c-mos} U7
NADH J1+others		NtrB, NtrC [gene activator proteins] M5, M6	p36 V6
NADH dehydrogenase	1.6.5.3 M9, N9, O9, O10	Nucelar location signal binding protein [NBP] S5, S6	p42 V6
NADH dehydrogenase (ubiquinone)	1.6.5.3 S10	Nuclear pore S5, S6	p62/64 UV7, V6
NADH peroxidase	1.11.1.1 J1	Nuclear protein import S5	p74 ^{c-raf} U7
NADP ⁺ J1+others		Nuclear-protein kinase P7	p190 UV7, V6
NADP ⁺ reductase (ferredoxin)	T9	Nucleocapsid [of retrovirus] PQ8	Palmitate D8
NADPH J4+others		Nucleolus RS6, RS7	Palmitoyl-CoA B8, D8
NADPH-ferrithemoprotein reductase	1.6.2.4 TU6	3'-Nucleosidase 3.1.3.6 K7, L7	Palmitoyl-CoA-enzyme palmitoyltransferase E7
Nalidixic acid	O8	Nucleoside deoxyribosyltransferase 2.4.6.2 I1, K8	Pantetheine C10
Neomycin	M4, N4	Nucleoside-diphosphatase 3.6.1.6 G1, J8	Pantetheine kinase 2.7.1.34 C10
Neurosporene	E9	Nucleoside-diphosphate kinase 2.7.4.6 K8	Pantetheine-phosphate adenylyltransferase 2.7.7.3 C10
Neutrophilic chemotactic factor	P2	Nucleosome QR8	(R)-Pantothenoate A10, G4
Nicotinamide	J1, O3, U3, U4, V3	5'-Nucleotidase 3.1.3.5 G1, G2, I1, I2, J7, J8, L7	Pantothenase 3.5.1.22 B10
Nicotinamide adenine dinucleotide [NAD ⁺]	J1+others	Nucleotide sugars B3	(R)-Pantothenate B10, G4
Nicotinamide adenine dinucleotide phosphate [NADP ⁺]	J1+others	Nucleus O5...S8	Pantothenate kinase 2.7.1.33 B10
Nicotinamide nucleotide adenylyl-transferase	2.7.7.1 J1	O	Pantothenate-β-alanine ligase 6.3.2.1 B10
Nicotinamide nucleotide [NMN]	J1	O-specific side chain N2	Pantothenol A10
Nicotinamide riboside	J1	Okazaki fragment O7	N-Pantothenoylcysteine BC10
Nicotinamide-nucleotide adenylyl-transferase	2.7.7.1 J1	Oligomycin Q9	Pantothenoylcysteine decarboxylase 4.1.1.30 C10
Nicotinate	H3, J1	One carbon-pool B7, B8	Paracoccus O...Q9
Nicotinate methyltransferase	2.1.1.7 H4	Operator site MN7	Parkinsons disease O9
Nicotinate nucleotide	J2	Opsin V4	PCNA [proliferating cell nuclear antigen] S7, S8
Nicotinate phosphoribosyltransferase	2.4.2.12 J2	Opsonized antigen Q2	Penicillin O3
Nicotinate-nucleotide adenylyltransferase	2.7.7.18 J1	OrIC [replication origin] M7	Penicillin amidase 3.5.1.11 L3
Nicotinic acetylcholine receptor superfamily	V3, V4	L-Ornithine G7	Penicillin G L3
Nicotinic-acetylcholine receptor	V4	Ornithine carbamoyltransferase 2.1.3.3 G8	Pentosans B3
Nitrate	M10, N10	Ornithine decarboxylase 4.1.1.17 F7	Pentose cycle C5
Nitrate reductase	1.7.99.4 M10	Ornithine-oxoacid transaminase 2.6.1.13 H8	Pentose interconversions C3
Nitric oxide	M10	Orotate H8	Peptide deformylase M4
Nitric-oxide reductase	1.7.99.2 M10	Orotate phosphoribosyltransferase 2.4.2.10 I8	Peptidyl transferase 2.3.2.12 M3, P3
Nitrite	M10, N10	Orotidine 5'-phosphate I8	Perforin P2
Nitrite reductase	1.7.99.3 M10	Orotidine-5'-phosphate decarboxylase 4.1.1.23 I8	Perinuclear cisternal space S6
		Ouabain S3	Periplasmic space MN2, MN3
		Outer membrane [of gram-negative microorganisms] MN2	Peroxidase 1.11.1.7 K5, T6
			Pertussis toxin V3
			Phenylacetate L3
			L-Phenylalanine F3
			Phenylalanine 4-monooxygenase 1.14.16.1 F3
			L-Phenylalanyl-tRNA F3
			Phenylethanolamine N-methyltransferase 2.1.1.28 H2
			Phenylpyruvate F3
			Pheophytine K6, R9, S9
			Phorbolester U3

Squares A...L refer to part 1, squares M...V to part 2.

Phosphatases (alkaline or acid) 3.1.3.1...2 C7, J7, L7	Phosphoenolpyruvate D3, E3, E4, E5, N3, V10	5'-Phosphoribosyl-5-aminoimidazole [AIR] E2	3-Phosphoshikimate 1-carboxyvinyl- transferase E3
Phosphate acetyltransferase 2.3.1.8 C4	Phosphoenolpyruvate carboxykinase (ATP) 4.1.1.49 F5	5'-Phosphoribosyl-5-formamido-4- imidazole carboxamide A7, F2	Phototransferase system [enzymes I, II, III] N3
Phosphate butyryltransferase 2.3.1.19 L3	Phosphoenolpyruvate carboxykinase (GTP) 4.1.1.32 F5	Phosphoribosyl-AMP D2	Photoreactivation [of DNA] Q8
L-Phosphatidate D7, T3, U3	Phosphoenolpyruvate carboxykinase (pyrophosphate) 4.1.1.38 F5	Phosphoribosyl-AMP cyclohydrolase 3.5.4.19 D2	Photorespiration T10
Phosphatidate cytidylyltransferase 2.7.7.41 D7	Phosphoenolpyruvate carboxylase 4.1.1.31 F5, V10	Phosphoribosyl-ATP D2	Photosynthesis R...T9, R...T10
Phosphatidate phosphatase 3.1.3.4 D8	Phosphoethanolamine C7	Phosphoribosyl-ATP pyrophosphatase 3.6.1.31 D2	Photosynthetic reaction center [purple bacteria] S10
Phosphatides CD7, CD8	6-Phosphofructo-2-kinase 2.7.1.106 C6	Phosphoribosyl-formylglycinamide cycloligase 6.3.3.1 E2	Photosystems I, II [chloroplasts] S9
(O ³ -Phosphatidyl)-L-serine C7	Phosphofructokinase 2.7.1.11 C6	5'-Phosphoribosyl-N-formylglycinami- de [FGAR] A7, D2	Phycocyanobilin K5
3-(3-Phosphatidyl)glycerol D7	Phosphogluokinase 2.7.1.10 B5	5'-Phosphoribosyl-N-formylglycinami- de [FGAM] E2	Phylloquinol D3, H7
3-(3-Phosphatidyl)glycerol 1-phospha- te C7	Phosphoglucomutase 5.4.2.2 B5, U9	Phosphoribosylamine-glycine ligase 6.3.4.13 D2	Phylloquinone epoxide I7
1-Phosphatidyl-1D-myo-inositol C7, U3	D-6-Phosphogluconate C5	Phosphoribosylaminoimidazolecarbox- amide carboxylase 4.1.1.21 E2	Phylloquinone monooxygenase 1.14.99.20 HI7
1-Phosphatidyl-1D-myo-inositol 4, 5- bisphosphate T3	Phosphogluconate dehydratase 4.2.1.12 C4	Phosphoribosylaminoimidazolecarbox- amide formyltransferase 2.1.2.3 A7, F2	Phylloquinone [vitamin K ₁] D3, E10
1-Phosphatidyl-1D-myo-inositol 4- phosphate T3	Phosphogluconate dehydrogenase (decarboxylating) 1.1.1.44 C5	Phosphoribosylaminoimidazolesuc- cinocarboxamide synthase 6.3.2.6 E2	Physostigmin V4
Phosphatidyl-N-methylethanolamine methyltransferase 2.1.1.71 C8	6-Phosphoglucono-1, 5-lactone C5	Phosphoribosylanthranilate isomerase G3	3-Phytase T4, T5
L-1-Phosphatidylethanolamine C7	6-Phosphogluconolactonase 3.1.1.31 C5	Phosphoribosylformimino-AICAR phosphate D2	6-Phytase 3.1.3.26 T4, T5
Phosphatidylethanolamine methyl- transferase 2.1.1.17 C8	D-3-Phosphoglycerate dehydroge- nase 1.1.1.95 D6	Phosphoribosylformimino-AICAR- phosphate isomerase 5.3.1.16 D2	Phytoene E10
1-Phosphatidylinositol kinase 2.7.1.67 U3, V5	Phosphoglycerate kinase 2.7.2.3 D5, U10	Phosphoribosylformylglycinamide synthase 6.3.5.3 D2	Phytol K6
1-Phosphatidylinositol-4,5-diphosphate V5, V6	Phosphoglycerate mutase 5.4.2.1 D5	Phosphoribosylglycinamide formyl- transferase 2.1.2.2 A7, D2	Phytosterols F9
1-Phosphatidylinositol-4-phosphate kinase 2.7.1.68 T3, V7	Phosphoglycolate T10	5'-Phosphoribosylglycinamide [GAR] A7, D2	Phytyl pyrophosphate E10, K6
Phosphatidylserine decarboxylase 4.1.1.65 C7	Phosphoglycolate phosphatase 3.1.3.18 T10	α-D-5-Phosphoribosylpyrophosphate [PRPP] C2, F3, I8	Picolinate J2
7-Phospho-2-dehydro-3-deoxy-D- arabino-heptanoate D3	Phosphoketolase 4.1.2.9 C4	Phosphoribulokinase 2.7.1.19 U10	Piercidin A O9
Phospho-2-dehydro-3-deoxy-heptano- ate aldolase 4.2.1.15 D3	Phospholamban S5, U4	Phosphoribulosyl-formimino-AICAR phosphate E2	L-Pipecolate K3
Phospho-2-dehydro-3-deoxygluconate aldolase 4.2.1.14 C4	Phospholipase A ₁ 3.1.1.32 D7, D8	Phosphorylase kinase 2.7.1.38 A5, A6, U4, U6	Pipecolate dehydrogenase K3
2-Phospho-D-glycerate D5	Phospholipase A ₂ 3.1.1.4 D7, D8, T5	Phosphorylase phosphatase 3.1.3.17 A5, U6	Δ ¹ -Piperideine-2, 6-dicarboxylate H3
3-Phospho-D-glycerate D5, U10	Phospholipase C 3.1.4.3 D8, T3	Phosphorylase [a, b] 2.4.1.1 A5, U6	Δ ¹ -Piperideine-2-carboxylate reduc- tase 1.5.1.21 K3
O-Phospho-L-homoserine H4	Phospholipase C _γ 3.1.4.3. T3, V6	Phosphorylcholine cytidylyltransferase 2.7.7.15 C8	Δ ⁶ -Piperideine-2-L-carboxylate K3, J3
Phospho-N-acetyl muramoyl-penta- peptide transferase 2.7.8.13 N3	Phospholipase D 3.1.4.4. D7, D8, V7	Phosphorylethanolamine cytidylyl- transferase 2.7.7.14 C7	Plasma kallikrein [KK] 3.4.21.34 T1, T2
4'-Phospho-N-pantothenoyl cysteine C10	Phosphomevalonate kinase 2.7.4.2 D10	O-Phosphoserine D6	Plasma prekallikrein [PK] S1, T1, T2
5-Phospho-β-D-ribosylamine C2	5-Phosphonoxy-L-lysine K3	Phosphoserine phosphatase 3.1.3.3 C6	Plasmin 3.4.21.7 UV2
Phosphoacetylglucosamine mutase 5.4.2.3 D4	4'-Phosphopantetheine C10	Phosphoserine transaminase 2.6.1.52 D6	Plasminogen activator inhibitor 1, 2, 3 [PAI-1, 2, 3] UV2
Phosphoadenyl sulfatase 3.6.2.2 K4	4'-Phosphopantetheate B10		Plasminogen [PLG] U2
3'-Phosphoadenylsulfate reductase J4	Phosphopantetheate-cysteine ligase 6.3.2.5 C10		Plastocyanine R10, S9
3'-Phosphoadenylsulfate [PAPS] JK3	Phosphopantothenoylcysteine decarboxylase 4.1.1.36 C10		Plastoquinol-plastocyanin complex [cytochrome b-f complex] S9
O-Phosphocholine C8	N-(5'-Phosphoribosyl)-anthranilate G3		Plastoquinone G3, RS9, R10
Phosphocreatine U5	5'-Phosphoribosyl-4-(N-succinocar- boxamide)-5-aminoimidazole E2		Platelet activating factor [PAF] P2, V2
	5'-Phosphoribosyl-4-carboxy-5-imida- zole E2		Platelet activation UV2
	5'-Phosphoribosyl-5-amino-4-imida- zole carboxamide [AICAR] F2		Platelet derived growth factor [PDGF] V7
			Platelet-derived-growth-factor [PDGF] receptor T3, U4, U7, V6, V7
			Platelet factor 3 [PF 3, microvesicles] V2
			Polyadenylated mRNA Q5
			Polyadenylated pre-mRNA Q5
			Polydeoxyribonucleotide synthase (NAD ⁺) [DNA ligase] 6.5.1.2 O7, QR6, S7

Polyenoic acids D7	Proline racemase 5.1.1.4 H7	Proteoglycans Q3	Pyruvate E5+frequently
Polynucleotide adenyltransferase 2.7.7.19 Q5, Q6	D-Proline reductase (dithiol) 1.4.4.1 H8	Protochlorophyllide reductase 1.3.1.33 K6	Pyruvate carboxylase 6.4.1.1 F5
Polypeptide N-acetylgalactosaminyl-transferase 2.4.1.41 QR4	Promotion [of transcription] M5, PQ7	Protoheme J5	Pyruvate decarboxylase 4.1.1.1 E6
Polyperforin P2	Promotor region Q7	Protoporphyrin IX J5	Pyruvate dehydrogenase (cytochrome) 1.2.2.2 E6
Polypropenyl <i>cis</i> -transferases 2.5.1.x E10	1, 2-Propanediol D6	Protoporphyrinogen IX J5	Pyruvate dehydrogenase (lipoamide) 1.2.4.1 E5
Polypropenyl <i>trans</i> -transferases 2.5.1.x E10	2-Propanol L3	Protoporphyrinogen oxidase 1.3.3.4 J5	[Pyruvate dehydrogenase (lipoamide)] kinase 2.7.1.99 E6
2-Polypropenylphenol E3	2-Propanol dehydrogenase (NAD ⁺) L3	Pseudomonic acid N4	[Pyruvate dehydrogenase (lipoamide)] phosphatase 3.1.3.43 E6
Polyribonucleotide nucleotidyl transferase 2.7.7.8 H1, H2, JK7, JK8	Properdin QR1	Pseudouridine O4	Pyruvate kinase 2.7.1.40 E5
Polysaccharides A5	Propionate J4	Pseudouridylate synthase O4	[Pyruvate kinase] phosphatase 3.1.3.49 E5
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Squares A...L refer to part 1, squares M...V to part 2.

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 3 α , 7 α , 12 α -Trihydroxy-5 β -cholestanate J10
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Squares A...L refer to part 1, squares M...V to part 2.

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UDP-N-acetylglucosamine 2-epimerase	5.1.3.14 E4	Undecaprenyl phosphates	N3	Uronolactonase	3.1.1.19 A2	Vitamin K ₁ [phylloquinone]	D3, E10
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UDP-N-acetylglucosamine-dolichyl-phosphate N-acetylglucosamine phosphotransferase	2.7.8.15 R5	Uracil	J8, N4, O4	Uroporphyrinogen decarboxylase	4.1.1.37 I5	Vitronectin [S-protein]	RS1, RS2, T2
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UDP-N-acetylmuramoyl-L-alanyl-D-glutamate-lysine ligase	6.3.2.7 O4	Urate 3-ribonucleoside	H1	UTPglucose-1-phosphate uridylyl-transferase	2.7.7.9 B5	W	
UDP-N-acetylmuramoylalanine-D-glutamate ligase	6.3.2.9 O4	Urate oxidase	1.7.3.3 H1	UTPhexose-1-phosphate uridylyl-transferase	2.7.7.10 B4	<i>Wolinella succinogenes</i>	Q10
UDP-N-acetylglucosamine pyrophosphorylase	2.7.7.23 D4	Urate-ribonucleotide phosphorylase		UvrA, UvrB, UvrC, UvrD [DNA repair enzymes]	N7		
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UDPGlucose dehydrogenase	1.1.1.22 B3	Urease	3.5.1.5 G8			Xanthophylls	E9
UDPGlucose-hexose-1-phosphate uridylyltransferase	2.7.7.12 B4	5-Ureido-4-imidazole-carboxylate	H1			Xanthosine	G1
UDPGlucuronate 4-epimerase	5.1.3.6 B3	Ureidoglycolate	I1			Xanthosine 5'-phosphate	G1
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		Uridine 5'-diphosphate [UDP]	J8			Xylose isomerase	5.3.1.5 C3, C6
		Uridine 5'-phosphate [UMP]	J8			Xylulokinase	2.7.1.17 C3
		Uridine 5'-triphosphate [UTP]	J8			L-Xylulokinase	2.7.1.53 C4
		Uridine kinase	2.7.1.48 J7, J8			D-Xyulose	C3
		Uridine nucleosidase	3.2.2.3 J8			L-Xyulose	C3
		Uridine phosphorylase	2.4.2.3 J8			D-Xyulose 5-phosphate	C5, U10
		d-Urobilin	L6			L-Xyulose 5-phosphate	C3
		i-Urobilin (IXa)	L6			D-Xyulose reductase	1.1.1.9 C3
		d-Urobilinogen	L6			L-Xyulose reductase	1.1.1.10 C3
		i-Urobilinogen	L6				
		Urocanate	F2				
		Urocanate hydratase	4.2.1.49 F2				
		Urocortisol	K9				
		Urocortisone	K9				