**Photosynthesis**

R1 8 Light + 3 ADP + 3 Pi + H + 2 cNADP --> O2 + H2O + 2 cNADPH + 3 ATP

R2 CO2 + H2O + cRu15DP --> 2 cG3P

R3 ATP + cG3P --> ADP + H + c13DPG

R4 H + cNADPH + c13DPG <--> cNADP + Pi + cGAP

R5 cGAP <--> cDHAP

R6 cDHAP + cGAP <--> cF16P

R7 H2O + cF16P <--> Pi + cF6P

R8 cF6P + cGAP <--> cE4P + cX5P

R9 H2O + cE4P + cGAP <--> Pi + cS7P

R10 cGAP + cS7P <--> cR5P + cX5P

R11 cX5P <--> cRu5P

R12 cR5P <--> cRu5P

R13 ATP + cRu5P --> ADP + H + cRu15DP

R14 cGAP <--> GAP

**Glycerol** pathway

R15 GLYC\_ext + NADPH + H <--> GLYC + NADP

R16 DHAP\_ + H2O <--> DHA + Pi

R17 DHA + H + NADPH <--> GLYC + NADP

R18 ATP + GLYC --> ADP + GLYC3P + H

R19 DHAP <--> GAP

**Glyoxyzome**

R20 BUT + 4 ATP <--> BUT\_g + 4 ADP + 4 Pi

R21 BUT\_g + AcCoA\_g <--> BUTylCoA\_g + ACE\_g

R22 BUTylCoA\_g + O2 --> CrotonylCoA\_g + H2O2\_g

R23 CrotonylCoA\_g + H2O <--> 3-HydroxyBUTylCoA\_g

R24 3-HydroxyBUTylCoA\_g + NAD <--> AceAcCoA\_g + NADH

R25 AceAcCoA\_g + CoA\_g <--> 2 AcCoA\_g

R26 2 H2O2\_g --> O2 + 2 H2O

R27 ACE + 0.25 ATP <--> ACE\_g + 0.25 ADP + 0.25 Pi

R28 ACE\_g + ATP <--> ACEP\_g + ADP

R29 ACEP\_g + CoA\_g <--> AcCoA\_g + Pi

R30 AcCoA\_g + H2O + OXA\_g <--> CIT\_g + CoA\_g

R31 AcCoA\_g + H2O + glyoxylate\_g <--> MAL\_g + CoA\_g

R32 ISO\_g <--> SUC\_g + glyoxylate\_g

R33 CIT\_g <--> cisAconitate\_g + H2O

R34 cisAconitate\_g + H2O <--> ISO\_g

R35 MAL\_g + NAD <--> OXA\_g + NADH

R36 SUC <--> SUC\_g

R37 3.5 H + 2.5 ADP + 2.5 Pi + NADH + 0.5 O2 --> NAD + 2.5 ATP + 3.5 H2O

**Glycolysis**

R38 G6P <--> G1P

R39 F6P <--> G6P

R40 ATP + F6P --> ADP + F16P + H

R41 F16P + H2O --> F6P + Pi

R42 DHAP + GAP <--> F16P

R43 DHAP <--> GAP

R44 GAP + NAD + Pi <--> 13DPG + H + NADH

R45 13DPG + ADP <--> 3PG + ATP

R46 3PG <--> 2PG

R47 2PG <--> H2O + PEP"

R48 ADP + H + PEP <--> ATP + PYR

**Tricarboxylic** acid cycle

R49 CoA + NAD + PYR --> AcCoA + CO2 + NADH

R50 AcCoA + H2O + OXA <--> CIT + CoA + H

R51 CIT + NAD <--> AKG + CO2 + NADH

R52 AKG + CoA + NAD --> CO2 + NADH + SUCCoA

R53 ADP + Pi + SUCCoA <--> ATP + CoA + SUC

R54 FAD + SUC <--> FADH2 + FUM

R55 FUM + H2O <--> MAL

R56 FAD + MAL <--> FADH2 + OXA

R57 ATP + CO2 + H2O + PYR --> ADP + OXA + Pi + 2 H

R58 ATP + OXA --> ADP + CO2 + PEP

R59 CO2 + H2O + PEP <--> H + OXA + Pi

**Pentose phosphate pathway**

R60 G6P + H2O + NADP <--> 6PG + NADPH + 2 H

R61 6PG + NADP <--> CO2 + NADPH + RU5P

R62 RU5P <--> R5P

R63 RU5P <--> X5P

R64 R5P + X5P <--> GAP + S7P

R65 GAP + S7P <--> E4P + F6P

R66 F6P + GAP <--> E4P + X5P

**Glycerol synthesis**

R67 GLYC3P + NAD <--> DHAP + H + NADH

N fixation

R68 H + NADH + NO3 <--> H2O + NAD + NO2

R69 5 H + 3 NADPH + NO2 <--> NH4 + 2 H2O + 3 NADP

**S fixation**

R70 ATP + SO4 --> APS + PPi

R71 APS + NADH --> AMP + NAD + SO3

R72 5 H + 3 NADPH + SO3 <--> H2S + 3 H2O + 3 NADP

**Oxidative phosphorylation**

R73 1.5 ADP + 1.5 H + 1.5 Pi + FADH2 + 0.5 O2 --> FAD + 1.5 ATP + 2.5 H2O

R74 3.5 H + 2.5 ADP + 2.5 Pi + NADH + 0.5 O2 --> NAD + 2.5 ATP + 3.5 H2O

R75 H2O + PPi --> H + 2 Pi

R76 AMP + ATP --> 2 ADP

R77 ATP + H2O --> ADP + H + Pi + MAINT

**Amino acids and protein synthesis**

R78 AKG + H + NADPH + NH4 --> GLU + H2O + NADP

R79 ATP + GLU + NH4 --> ADP + GLN + H + Pi

R80 AKG + GLN + H + NADPH <--> NADP + 2 GLU

R81 3PG + GLU + H2O + NAD <--> AKG + H + NADH + Pi + SER

R82 SER --> NH4 + PYR

R83 AcCoA + H2S + SER <--> Ace + CYS + CoA + H

R84 ATP + Ace + CoA --> ADP + AcCoA + Pi

R85 GLU + PYR --> AKG + ALA

R86 H + THR <--> 2-oxobutan + NH4

R87 2-oxobutan + GLU + H + NADPH + PYR <--> AKG + CO2 + H2O + ILE + NADP

R88 2 H + ALA + NADPH + PYR <--> CO2 + H2O + NADP + VAL

R89 2 PYR + AcCoA + GLU + H + NAD + NADPH <--> AKG + CoA + LEU + NADH + NADP + 2 CO2

R90 2 PEP + ATP + E4P + NADPH --> ADP + CHO + NADP + 4 Pi

R91 CHO <--> PRE

R92 GLU + H + PRE <--> AKG + CO2 + H2O + PHE

R93 GLU + NAD + PRE <--> AKG + CO2 + NADH + TYR

R94 CHO + GLN <--> ANTH + GLU + H + PYR

R95 ANTH + H + PRPP + SER <--> CO2 + GAP + PPi + TRYP + 2 H2O

R96 3 H2O + 2 NAD + ATP + GLN + PRPP --> AICAR + AKG + HIS + Pi + 2 NADH + 2 PPi + 5 H

R97 GLU + OXA <--> AKG + ASP

R98 ASP + ATP + GLN + H2O --> ADP + ASN + GLU + H + Pi

R99 2 ATP + 2 H2O + CO2 + GLN --> CaP + GLU + Pi + 2 ADP + 3 H

R100 2 GLU + ASP + ATP + CaP + NADH --> AKG + AMP + ARG + FUM + H2O + NAD + PPi + Pi

R101 3 H + 2 NADH + GLU <--> PRO + 2 H2O + 2 NAD

R102 AKG + O2 + PRO <--> CO2 + HydPro + SUC

R103 ASP + ATP + H + NADPH --> ADP + ASA + NADP + Pi

R104 2 H + ASA + GLU + NADH + PYR <--> AKG + DAP + H2O + NAD

R105 DAP <--> CO2 + H + LYS

R106 ASA + H + NADPH <--> HSER + NADP

R107 ATP + H2O + HSER --> ADP + H + Pi + THR

R108 AcCoA + CYS + H2O + HSER <--> Ace + CoA + HCYS + H + NH4 + PYR

R109 HCYS + MTHF <--> H + MET + THF

R110 4.306 ATP + 3.306 H2O + 0.111 ALA + 0.092 GLY + 0.09 LEU + 0.061 VAL + 0.06 LYS + 0.056 PRO + 0.056 THR + 0.054 SER + 0.052 ARG + 0.052 GLN + 0.052 GLU + 0.047 ASN + 0.047 ASP + 0.041 PHE + 0.037 ILE + 0.03 TYR + 0.024 MET + 0.017 HIS + 0.012 CYS + 0.009 HydPro + 0.001 TRYP --> PROTEIN + 4.306 ADP + 4.306 Pi + 4.319 H

R111 GLY + H + PYR <--> ALA + glyoxylate

R112 SER + glyoxylate <--> GLY + HydPyr

R113 GLY + H2O + METHF <--> SER + THF

R114 GLY + NAD + THF <--> CO2 + METHF + NADH + NH4

R115 H + HydPyr + NADH <--> Glycerate + NAD

R116 ATP + Glycerate --> ADP + 2 H + 3PG

**THF metabolism**

R117 ATP + R5P --> AMP + H + PRPP

R118 5FTHF + H <--> H2O + MYLTHF

R119 H2O + MYLTHF <--> H + N10FTHF

R120 ATP + FORM + THF --> ADP + N10FTHF + Pi

R121 MYLTHF + NADPH <--> METHF + NADP

R122 H + METHF + NADPH <--> MTHF + NADP

R123 5FTHF + ATP + H2O --> ADP + H + N10FTHF + Pi

R124 FORM + H + THF <--> H2O + N10FTHF

R125 DHF + H + NADPH <--> NADP + THF

**Lipids synthesis**

R126 ACP + AcCoA + H <--> AcACP + CoA

R127 ATP + AcCoA + CO2 + H2O <--> ADP + H + MalCoA + Pi

R128 ACP + MalCoA <--> CoA + MalACP

R129 10 H + 10 NADPH + 5 MalACP + AcACP <--> C12:0ACP + 5 ACP + 5 CO2 + 5 H2O + 10 NADP

R130 12 H + 12 NADPH + 6 MalACP + AcACP <--> C14:0ACP + 6 ACP + 6 CO2 + 6 H2O + 12 NADP

R131 14 H + 14 NADPH + 7 MalACP + AcACP <--> C16:0ACP + 7 ACP + 7 CO2 + 7 H2O + 14 NADP

R132 C16:0ACP + H + NADH + O2 <--> C16:1ACP + NAD + 2 H2O

R133 C16:1ACP + H + NADH + O2 <--> C16:2ACP + NAD + 2 H2O

R134 C16:2ACP + H + NADH + O2 <--> C16:3ACP + NAD + 2 H2O

R135 16 H + 16 NADPH + 8 MalACP + AcACP <--> C18:0ACP + 8 ACP + 8 CO2 + 8 H2O + 16 NADP

R136 C18:0ACP + H + NADH + O2 <--> C18:1ACP + NAD + 2 H2O

R137 C18:1ACP + H + NADH + O2 <--> C18:2ACP + NAD + 2 H2O

R138 C18:2ACP + H + NADH + O2 <--> C18:3ACP + NAD + 2 H2O

R139 GLYC3P + 0.474 C16:0ACP + 0.446 C18:3ACP + 0.276 C18:2ACP + 0.253 C16:3ACP + 0.16 C18:1ACP + 0.140 C16:2ACP + 0.104 C12:0ACP + 0.051 C14:0ACP + 0.048 C18:0ACP + 0.04 C16:1ACP <--> PA + 2 ACP + 2 H

**Nucleic acids synthesis**

R140 4 ATP + 2 GLN + 2 H2O + ASP + CO2 + GLY + N10FTHF + PRPP --> AICAR + FUM + PPi + THF + 2 GLU + 4 ADP + 4 Pi + 7 H

R141 ASP + CaP + H + O2 + PRPP <--> CO2 + H2O + H2O2 + PPi + Pi + UMP

R142 2 H2O2 <--> O2 + 2 H2O

R143 ATP + UMP --> ADP + UDP

R144 ATP + UDP <--> ADP + UTP

R145 ATP + GLN + H2O + UTP --> ADP + CTP + GLU + Pi + 2 H

R146 ATP + CDP <--> ADP + CTP

R147 AICAR + N10FTHF <--> H2O + IMP + THF

R148 ATP + H2O + IMP + NAD + NH4 --> AMP + GMP + NADH + PPi + 3 H

R149 ATP + GMP --> ADP + GDP

R150 ATP + GDP <--> ADP + GTP

R151 ASP + GTP + IMP <--> AMP + FUM + GDP + Pi + 2 H

R152 ATP + H + METHF + NADPH + UDP --> ADP + DHF + H2O + NADP + dTTP

R153 ATP + CDP + H + NADPH --> ADP + H2O + NADP + dCTP

R154 ATP + GDP + H + NADPH --> ADP + H2O + NADP + dGTP

R155 ATP + H + NADPH <--> H2O + NADP + dATP

R156 2.372 H2O + 1.372 ATP + 0.18 dATP + 0.18 dTTP + 0.32 dCTP + 0.32 dGTP --> DNA + PPi + 1.372 ADP + 1.372 Pi + 2.372 H

R157 1.4 H2O + 0.56 ATP + 0.34 GTP + 0.16 UTP + 0.34 CTP --> 0.4 ADP + 0.4 H + 0.4 Pi + PPi + RNA

**Chlorophyll synthesis**

R158 12 H + 8 ATP + 8 GLU + 8 NADPH + 2.5 O2 --> PPorphyrin + 4 NH4 + 6 CO2 + 8 AMP + 8 NADP + 8 PPi + 13 H2O

R159 18 H + 15 NADPH + 8 ATP + 4 GAP + 4 PYR --> Phytyl-PP + 4 ADP + 4 AMP + 4 CO2 + 7 PPi + 8 H2O + 15 NADP

R160 ATP + H2O + MET --> AdMET + H + PPi + Pi

R161 AdHCYS + H2O <--> Ad + HCYS

R162 ATP + Ad --> ADP + AMP + H

R163 4 NADPH + 2.5 O2 + 2 ATP + AdMET + Mg2 + PPorphyrin + Phytyl-PP --> AdHCYS + Chlorophyll + PPi + 2 ADP + 2 H2O + 2 Pi + 3 H + 4 NADP

**Carbohydrate synthesis**

R164 G1P <--> CARB + Pi

R165 G6P + 2 ATP <--> CARB

**Biomass synthesis**

R166 5.5595 ATP + 5.5595 H2O + 0.6025 PROTEIN + 0.2641 CARB + 0.0876 PA + 0.0011 DNA + 0.0101 Chlorophyll + 0.0329 RNA --> Biomass + 5.5595 H + 5.5595 ADP + 5.5595 Pi

**Glucose utilisation**

R 167 GLC + ATP --> G6P + ADP + H

**Transport reactions**

R168 # <--> CO2

R169 # <--> O2

R170 # <--> H2O

R171 # <--> Pi

R172 # <--> SO4

R173 # <--> NH4

R174 # <--> Mg2

R175 # --> Light

R176 # <--> H

R177 Biomass --> #

R178 # --> BUT

R179 # --> ACE

R180 MAINT --> #

R181 # --> GLC

R182 # --> GLYC\_ext

R183 # <--> ATP

R184 # <--> ADP

R185 # --> GAP

R186 # --> SUC

R187 # <--> NADPH

R188 # <--> NADP