

Panel D: Top families per module (product-mode + directionality)

Cofactor/Fe-S biogenesis

GF_00605: Fe-S cluster assembly ATPase SufC (?=0.73)

O₂/ROS protection

GF_01462: manganese catalase family protein (?=0.72)

Redox/electron supply

GF_01386: type I glyceraldehyde-3-phosphate dehydrogenase (?=0.80)

GF_00856: ArsJ-associated glyceraldehyde-3-phosphate dehydrogenase (?=0.73)

GF_02222: phosphoglycerate dehydrogenase (?=0.76)

GF_01834: type I glyceraldehyde-3-phosphate dehydrogenase (?=0.68)

GF_01659: fumarate reductase/succinate dehydrogenase flavoprotein subunit (?=0.72)

GF_00305: ferredoxin thioredoxin reductase catalytic beta subunit (?=0.75)

Regulation

GF_01426: response regulator transcription factor (?=0.78)

GF_01287: response regulator (?=0.75)

GF_00235: response regulator transcription factor (?=0.75)

Transport

GF_00622: amino acid ABC transporter ATP-binding protein (?=0.66)

GF_01733: urea ABC transporter substrate-binding protein (?=-0.11)

GF_00472: LPS export ABC transporter ATP-binding protein (?=0.79)

Unclassified/other

GF_02071: methionine adenosyltransferase (?=0.75)

GF_02141: transketolase (?=0.67)

GF_01337: sulfate adenylyltransferase (?=0.75)

GF_01027: methionine gamma-lyase family protein (?=0.78)

GF_00437: STAS domain-containing protein (?=0.74)

GF_00406: nucleoside-diphosphate kinase (?=0.77)