

Carbon source	Time (generations)		
	2,000	10,000	20,000
Bromosuccinic acid	7	11	12
D-alanine	1	3	6
D-malic acid	5	12	12
D-ribose	12	12	12
D-saccharic acid	9	11	11
D-serine	12	11	10
D-sorbitol	12	11	11
Fructose-6-phosphate	11	10	9
Fumaric acid	9	12	12
Glucose-1-phosphate	12	11	10
Glucose-6-phosphate	11	12	8
Glucuronamide	0	4	8
L-asparagine	8	12	12
L-aspartic acid	9	12	12
L-glutamine	12	12	12
L-lactic acid	11	12	10
L-malic acid	7	12	12
Malic acid	9	12	12
Mono-methylsuccinate	2	12	12
Mucic acid [']	12	8	9
p-Hydroxyphenylacetic acid	5	12	11
Succinic acid	9	12	12
Uridine	12	12	10

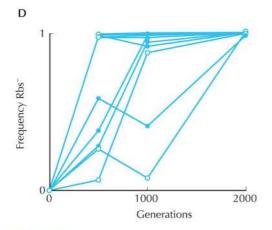


FIGURE 18.5. Adaptation of 12 *Escherichia coli* populations to live on minimal medium with glucose as the sole carbon source. (*A*) Decrease in total catabolic function calculated as the average of the growth rate measured on 64 different substrates relative to the ancestor. *Open circles* indicate populations that evolved high mutation rate. The *solid line* shows the mean across the low mutation rate lines and the *dashed line* the mean across the high mutation rate lines. (*B*) The detailed response to life in a new environment varied between replicate populations. The numbers show the number of populations that grew more slowly on each substrate than the ancestor did. *Red* highlights functions that consistently decayed; *turquoise* indicates two cases where there was a significantly improved function. (*C*) Variation in fitness among the replicate populations during the first 10,000 generations. *Curves* are fitted to measurements made every 500 generations. (*D*) Frequencies of deletions to the ribose operon, which eventually fixed in all 12 replicates.

18.5A,B, redrawn from Cooper V.S. et al., *Nature* 407: 736–739. © 2000 Macmillan, www.nature.com; 18.5C, redrawn from Lenski R.E. et al., *Proc. Natl. Acad. Sci.* 91: 6608–6618, © National Academy of Sciences, U.S.A.; 18.5D, redrawn from Cooper V.S. et al., *J. Bacteriol.* 183: 2834–2841, © 2001 American Society for Microbiology