



enosine deaminase (that can be artificially removed). Would not an intelligent designer have inserted CGG to begin with?

### Directed Evolution

Finally, we note that in recent years, “directed evolution” (or in vitro evolution or molecular evolution) has been used to obtain proteins, often enzymes, with modified properties. In brief, this work involves random mutations in DNA followed by a selection process for the best-fitted. Such work has provided new enzymes with altered substrate specificity, specific activity, topology, enantioselectivity, thermal stability, and resistance to organic solvents. There is an extensive literature. To cite two recent papers (2003) in The Proceedings of the National Academy of Sciences, Williams and co-workers modified the stereochemistry of an aldolase (8) and Leong and co-workers optimized the expression and specific activity of an interleukin, IL-12 (9). We also cite the classic work of Hartley (10), a recent book (11), and a short review (12).

### Summary

The examples that we have noted argue for the absence of highly intelligent design. They are not intended as a comprehensive collection but as a limited sample of “inefficient” situations in metabolism. Students and instructors can readily unearth more to their own satisfaction. The current success in directed evolution shows that purposeful change, even by human intelligence, is not so difficult.

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