



A Cases for Evolution Education Question Guide

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The Case of Lactase Persistence Evolution in Humans

This Evo-Ed case consists of three modules that support the teaching and learning of biology in the framework of evolution of lactase persistence in humans. Together, the modules present evidence that evolution occurs because of:

- 1) competition for resources and differential reproductive success in populations
- 2) heritable genetic variation and resulting differences in gene expression.

The following activities are designed to guide students' learning as they engage in the modules of this case. They can also be used as learning objectives. That is, "students will be able to" accomplish each of these as objectives.

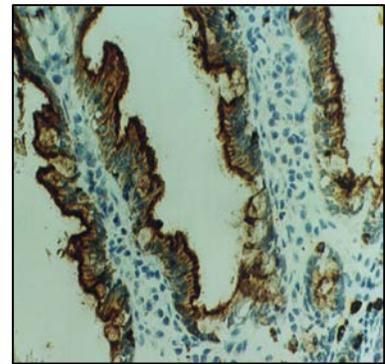
The modules and activities are presented in the order in which they appear in the case and can be used as in-class activities, homework and/or formative assessments.

The background information on this case, and accompanying slides can be found at:

→ www.evo-ed.org/Pages/Lactase

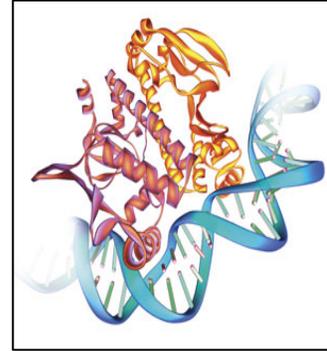
The Cell Biology of Lactase Persistence

- 1) Describe how the components of lactose become available for absorption into the blood stream.
- 2) Conduct research to determine if other sugars are digested in the same way as lactose.
- 3) Additionally, conduct research on how proteins and fats are digested in the small intestine.
- 4) Explain how the structure of enterocytes enables their function of absorbing digested molecules.
- 5) Describe the result, both at the cellular level and at the whole organism level, of lactose not being digested.
- 6) Research the cellular structure of a neuron (nerve cell - see clam toxin case). Determine the commonalities and specialties of neurons and enterocytes.



Molecular Genetics of Lactase Persistence

- 1) Develop a white board animation/model based on slides 24 - 30 that summarizes the function of regulators of transcription shown in red, green and blue (individual names not necessary). Include the stretches of DNA that are important for regulation of a coding gene.
- 2) Explain how and why coding genes are regulated.
- 3) Explain how the mutation associated with lactose persistence affects the regulation of the lactase gene.
- 4) Construct an argument for changes in the regulation of genes being a contributing factor to phenotypic changes leading to natural selection.
- 5) Compare and contrast the regulation of gene expression between eukaryotes and prokaryotes [see citrate metabolism *E. coli* case].



Anthropology and Biogeography of Lactase Persistence

- 1) Explain the cultural and biological underpinnings of lactose persistence in northern/central European countries and those in the deserts of Africa.
- 2) Research and explain the biochemical processes that allow lactose intolerant people to consume cheese and/or lactose free milk.
- 3) Provide and evaluate evidence that African and European lactose tolerance evolved independently.
- 4) Evaluate this statement: There no longer is either positive or negative selection for lactase persistence in modern advanced societies.
- 5) Explain how natural selection and patterns of inheritance have led to lactose persistence in human populations.

