

Discovering the Genome: Browsing Genomes Module – For Teachers

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Module <i>(Estimated time to cover module sections)</i>	Where can I cover this in my Biology curriculum? Highlights?	Next Generation Science Standards <i>HS-LS4 Biological Evolution: Unity and Diversity</i>	Other Resources <i>(Websites, related activities, etc.)</i>
Browsing Genomes	This could be done as part of a DNA Technology unit, when covering Classification and Diversity of Life or when covering the Immune System. It could also be done at the end of the unit on DNA & Protein Synthesis since it nicely incorporates most of that unit.	HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment	The Center for Disease Control has excellent life cycle diagrams of all parasitic infections! http://www.cdc.gov/parasites/
Toxoplasmosis <i>10 min reading and discussion</i>	This is a short general introduction to Toxoplasma.	HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations HS-ETS1-1 Engineering Design	

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<p>ToxoDB</p> <p><i>Video and discussion</i></p> <p><i>15-20 min</i></p>	<p>This section contains a short 5 minute video tutorial that uses a clear analogy to shopping at Amazon.</p>	<p>HS-LS4.C: Adaptation Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2) Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically , behaviorally , and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3),(HS-LS4-4) Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3) Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species. (HS-LS4-5) Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5)</p>	
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<p>GBrowse</p> <p><i>Video and discussion - 25 min.</i></p>	<p>This section contains a 12 minute tutorial demonstrating how to use a genome browser within the Toxo DB database. Speaker uses a nice analogy with Google Maps. In addition to be a clearly explained tutorial that is very applicable to other genome browsers, it is an excellent review of chromosomes, genes, introns/exons.</p>		<p>How to get more interesting data sets at any of the Databases? Under tracks, select - Transcript Expression Evidence - look for data sets of interesting topics</p> <p>More activities: http://workshop.eupathdb.org/athens/2011/index.php?page=schedule</p>
<p><i>The following sections should be done together and will take 30-45 min of browsing and discussion</i></p>			
<p>Open ToxoDB with GBrowse</p>	<p>This section gets you started on the activity involving two genes found in the ToxoDB database. It requires use of the terminology surrounding DNA structure, gene expression and also from the previous RNA Sequencing module.</p>		<p>The coding strand (sense strand or non-template strand) is the DNA strand which has the same base sequence as the RNA transcript produced (with thymine replaced by uracil). During transcription, RNA Pol II binds the non-coding strand (antisense strand, template strand, or transcribed strand) and transcribes their sequence to synthesize an RNA transcript with complementary bases. By convention, the coding strand is the strand used when displaying a DNA sequence. It is presented in the 5' to 3' direction. https://en.wikipedia.org/wiki/Coding_strand</p>

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Locate RNA Sequence Data	This section help you pull up data involving which RNA is being transcribed by which genes, on which days and in which host (cat, human) in the infection cycle of Toxoplasma.		
Interpreting a Coverage Plot	It is really exciting to actually work with this type of sophisticated data in a way that is made readily understandable for high school students!		
Questions	These will be challenging questions - you will need to gauge the format (individual, small group, whole class) that you use with your class. Every wrong answer will provide a window of opportunity for some excellent discussions and further questions.		