

Discovering the Genome: Tour of the Genome 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-LS1 From Molecules to Organisms: Structures and Processes</i> <i>HS-LS3 Heredity: Inheritance and Variation of Traits</i>	Other Resources <i>(Websites, related activities, etc.)</i>
Tour of the Genome	This module describes genome structure and how it relates to function. It uses videos to introduce and visually represent the human genome. In small groups, students investigate how problems with genome structure can result in genetic diseases.	HS-LS1-6 Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.	
Genome Overview <i>Intro video plus discussion plus questions - 25 min.</i>	This introductory video fits well with DNA & Protein Synthesis or the first time you talk about chromosomes. It is a clear and entertaining look at these topics and sets the stage nicely for further detail and discussion. We would not recommend this as the main instructional video by which they learn the material--it's too fast and with too little detail--but it can be a great intro and conclusion video. Students could go back after the unit and see how much more they understand.		Excellent animations on DNA, Genes, Mutations, Chromosomes and much more: http://learn.genetics.utah.edu/content/basics/ Minds-on activities to introduce your students to basic biology background: Understanding the Functions of Proteins and DNA DNA or DNA Structure Function and Replication Transcription and Translation – From Gene to Protein – hands-on or analysis and discussion
Chromosome Close-up	This eye opening video fits well to help introduce DNA & Protein Synthesis, Genetics or the first time you talk about chromosomes. Students will never think		Available along with other animations and tutorials at DNA Interactive http://www.dnai.org/c/index.html (Select - Genome / Tour)

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<p><i>Video, discussion and questions 20 min</i></p>	<p>of a chromosome in the same way again! You could also use this when talking about evolution, in terms of gene duplication followed by mutation to one of the genes. It also discusses DNA repeats.</p> <p>It is important for teachers to reassure students that they do not need to learn the specific genes and their locations; the idea is to get an appreciation for the many different kinds of genes and non-coding regions that can be located on one short segment of a chromosome.</p>		<p>Video on how gene duplication can lead to evolutionary innovation: http://www.hhmi.org/biointeractive/making-fittest-birth-and-death-genes</p>
<p>Packaging DNA</p> <p><i>Video, discussion and questions- 10 min</i></p>	<p>This video can easily be used when first talking about DNA or chromosomes. It can also be used as a lead in to epigenetics and modification of histones.</p>		<p>Epigenetics unit: http://learn.genetics.utah.edu/content/epigenetics/</p> <p>Great videos and animations at NOVA Science Now: http://www.pbs.org/wgbh/nova/body/epigenetics.html</p>
<p>Chromosome Arrangement</p> <p><i>Video, discussion and questions 20 min</i></p>	<p>Video can easily be used when first talking about DNA or chromosomes or Mitosis. Be sure to walk students through the experiments and what would have been seen depending on which model was correct and why.</p>	<p>HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.</p>	
<p>Genome Structure and Disease</p> <p><i>Do these all together - 40-100 min depending</i></p>	<p>Karyotyping background and activity could be done during Meiosis or Genetics units, although having students also diagram how the mistake would have happened would help them understand the process of meiosis even better.</p>	<p>HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.</p>	<p>Chromosome and Karyotypes Unit: http://learn.genetics.utah.edu/content/chromosomes/</p> <p>Karyotyping Activities: http://www.biology.arizona.edu/human_bio/activities/karyotyping/karyotyping.html</p>

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<p><i>on how you have your students present their findings</i></p> <p>Karyotyping</p> <p>Activity</p> <p>Resources for Genetic Disorders</p>	<p>You might assign each group/student a picture of a normal and abnormal karyotype; have them determine the abnormality (match with the list) first and then do the research.</p> <p>Teachers should emphasize that there is a difference between chromosomal disorders and genetic disorders caused by a gene mutation. The disorders discussed in the Activity are all caused by chromosomal abnormalities. The link in the “Additional Resources” section includes both kinds.</p> <p>The primate chromosome comparison activity in the right column could be used as part of your Evolution unit when discussing evidence for evolution.</p>	<p>HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors</p> <p>HS-LS1.A: Structure and Function All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS -LS1-1.)</p> <p>HS-LS1.B: Growth and Development of Organisms In multicellular organisms’ individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.</p> <p>(HS-LS1-4) LS3.A: Inheritance of Traits. Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular</p>	<p>http://learn.genetics.utah.edu/content/chromosomes/karyotype/</p> <p>Primate Chromosome Comparison; Compare chromosomes of human, gorilla, chimp, and orangutan: http://www.utsouthwestern.edu/edumedia/edufiles/education_training/programs/stars/chromosome-analysis.pdf</p> <p>Genetic Disorders: 1. https://www.genome.gov/10001204/specific-genetic-disorders/ 2. https://ghr.nlm.nih.gov/condition 3. http://learn.genetics.utah.edu/content/disorders/</p> <p>Students learn how a mistake in meiosis results in Down syndrome: Meiosis and Fertilization – How Genes Are Inherited</p>
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		<p>segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)</p>	
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