Discovering the Genome: DNA Sequencing Module – For Teachers

Module *(Estimated time to cover module sections)*	**Where can I cover this in my Biology curriculum?** **Highlights?**	**Next Generation Science Standards**	**Other Resources** *(Websites, related activities, etc.)*
DNA Sequencing *Background readings & discussion - 45-60 min.* *Activity - 45 min*	This module explains why DNA sequencing information is important for the biological sciences. It provides a brief description of the technical challenges of DNA sequencing. Students learn the basic principles of sequencing-by-synthesis, which is a widely used next-generation sequencing (NGS) technology. Students will do an online activity that simulates sequencing strings of DNA. This unit can be covered during a DNA Technology unit or added as a very relevant example to your DNA replication unit, since sequencing relies on the principles of DNA replication.	**ETS1.B: Developing Possible Solutions** *When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. **HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.** **HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.** **LS1.A: Structure and Function** *Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) *All cells contain genetic information in the form of DNA molecules.	How PCR works http://www.DNAlc.org/resources/animations/pcr.html http://learn.genetics.utah.edu/content/labs/pcr/ DNA Sequencing: http://www.hhmi.org/biointeractive/disease/Sequence_Assembly/01.html (Read slides 1-17 and watch the videos on slides 2, 6 and 17) How Sanger Sequencing works http://www.wiley.com/college/pratt/0471393878/student/animations/dna_sequencing/index.html http://www.dnalc.org/resources/animations/cycseq.html http://www.dnalc.org/view/15479-Sanger-method-of-DNA-sequencing-3D-animation-with-narration.html Visit HHMI for DNA Sequencing

		*Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) **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.** **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** **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. **LS3.A: Inheritance of Traits** * Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular 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) **LS3.B: Variation of Traits** *Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. *Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2)	

		HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. **LS4.A: Evidence of Common Ancestry and Diversity** *Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)	