NGSS Connections

www.nextgenscience.org

DNA Extraction (Berries…with a side of DNA?)
Grade Level: High School

Performance Expectations: Students' ability to complete the following performance expectation(s) will be supported by participation in this activity.

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-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.

Dimension	NGSS Code or citation	Corresponding student task in activity
Disciplinary Core Idea	LS1.A & S1.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, which carry out most of the work of the cells.	Students review cells and cell structure, labeling organelles in plant and animal cells, and identifying the roles of the organelles. Students explore in the pre-laboratory that all living things are made of cells, and that all living things have DNA in their cells. During the pre-laboratory exercises, students explore the role of DNA in living things and how DNA codes for mRNA, which codes for proteins. Students also explain that the DNA of each species varies, and provides the instructions to make that specific species. Students reinforce the role, structure, and function of DNA by watching the video, "What is DNA?" and summarizing the information.

	LS3.A Inheritance of Traits • Each chromosome consists of a single very long DNA molecule, and each gene on a chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in the DNA. All cells in an organism have the same genetic content, but the genes are used (expressed) by the cell may be regulated in different ways.	During the pre-laboratory exercises, students explore the role of DNA in living things and how DNA codes for mRNA, which codes for proteins. Students also explain that the DNA of each species varies, and provides the instructions to make that specific species. Students reinforce the role, structure, and function of DNA by watching the video, "What is DNA?" and summarizing the information.
Practice	Asking Questions and Defining Problems • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • Evaluate a question to determine if it is testable and relevant. • Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.	Students ask questions leading to the driving question, "Does food have DNA in it?" Students ask questions to determine if they can answer the driving question, "Does food have DNA in it?" based on the proposed laboratory investigation . Students ask questions to determine the limits learned in the fruit-based investigation and information gained from reading. Students write a hypothesis to test in the laboratory exercise, predicting if their fruit sample will contain DNA.
	Planning and Carrying out Investigations • Plan an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data, and refine the design accordingly.	Students use reasoning skills to sequence the steps of the protocol to carry out the investigation to answer the driving question, "Does food have DNA in it?" Some student groups design their own protocols to extract DNA, determine quantities of reagents, sequence of steps, and reagents used.

		Students identify positive and negative controls, and write their hypotheses for the investigation.
	Analyzing and Interpreting Data • Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).	Students analyze and interpret data from individual and class investigations to determine if food contains DNA. Students are asked if, based on the data collected, they can determine that all living things contain DNA and to identify further investigations if necessary.
	Construction Explanations and Designing Solutions • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Students construct explanations using data from their investigations to answer the driving question, "Does food have DNA in it?" Students use a Claim-Evidence-Reasoning chart to frame their scientific explanations using data from the lab and answering the driving question.
Crosscutting Concept	Structure and Function • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components and connections of components to reveal its function and/or solve a problem.	Students explore the purpose for each step in the DNA extraction protocol, and relate the step to its correlating function in removing cellular structures and successfully isolating DNA so it is extracted from the cell.
Nature of Science Scientific Investigations Use a Variety of Methods • Science investigations use diverse methods and do not always use the same set of procedures to obtain data. Scientific Knowledge is Open to Revision in Light of New Evidence • Most scientific knowledge is quite durable but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.		

Science is a Way of Knowing

- Science is both a body of knowledge that represents a current understanding of natural systems and the processes used to refine, elaborate, revise, and extend this knowledge.

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.

Connections to Common Core State Standards

English Language Arts/Literacy RST.9-10.3 RST.10-11.3 RST.9-10.6 RST.11-12.6 RST.9-10.9 RST.11-12.8	