

Contemporary Approaches to Genetics

Context: In this unit, students ponder the question: **How can sequences of DNA help us understand problems related to species identification and public health?** Students learn important ideas and concepts related to genetics (e.g., DNA structure, transcription, translation, protein synthesis, mechanisms associated with heredity, and inheritance). They employ various scientific practices, such as research design (e.g., asking testable questions and designing investigations), data analysis, and formulating scientific arguments using evidence as they participate in a DNA project.

Project: Students complete background research on a species identification problem of their choice, design a DNA barcoding investigation, collect DNA sequence data, and then write a scientific abstract for their study.

Approach: Students explore genetics using their own questions about disease, inheritance, and other topics of interest. Students pose these questions throughout the unit so that teachers and genetics experts are able to use student-generated questions and related experiences as vehicles through which to teach the content associated with the unit. Students conduct a series of hands-on labs, online simulations, and scientific games. In addition, students are able to pose their own research questions in their DNA barcoding project.

Literacy Design Collaborative (LDC) Template Task: Students will engage in extended reading and scientific writing as they complete research design plans outlining their investigations.

LDC Task: After researching background information on DNA barcoding and its variety of uses, you will write a research plan that (1) poses a testable scientific question about DNA barcoding, (2) discusses why the question is important, (3) states a hypothesis related to the question, (4) proposes a sample collection protocol, and (5) describes how you will know if your data does or does not support your hypothesis. **(Informational or Explanatory/Procedural-Sequential)**

Expert Involvement: At the beginning of the unit, experts from genetic-related fields respond to student-generated questions about genetics. This begins a dialogue between experts and students that lasts throughout the unit. Experts review students' DNA barcoding research design plans and provide feedback. Students revise their research design plans based on this expert feedback. As a culminating experience, experts provide feedback on students' scientific abstracts and discuss them with students in person or through video chat.

Digital Tools: Survey Monkey; BLAST database; Geniquest simulation; Foldit.

Primary Standards: Next Generation Science Standards- Performance Expectations
<ul style="list-style-type: none"> 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.
<ul style="list-style-type: none"> HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
<ul style="list-style-type: none"> HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
<ul style="list-style-type: none"> 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.
<ul style="list-style-type: none"> 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.
CC Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects
<ul style="list-style-type: none"> WHST 9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
<ul style="list-style-type: none"> WHST 9-10.7 Conduct short, as well as more sustained, research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.