

Mouse vs Man—A Lesson on DNA Structure & Function

Unit: Genetics 3.1	Utah SEEd Standard / NGSS Performance Expectation: Construct an explanation for how DNA codes for the structure of proteins which regulate and carry out the essential functions of life and result in specific traits. Emphasize a conceptual understanding that the sequence of nucleotides in DNA determines the amino acid sequence of proteins through the processes of transcription and translation.	Time: 70 min
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Access to all material for this lesson: <https://byu.box.com/s/mxuhkn73tcpps8fnovhva08cg1oijh56>






Anchor Phenomenon	<ul style="list-style-type: none"> The percentage of DNA you share with other living things. DNA Structure and Function PowerPoint
Driving Question	<ul style="list-style-type: none"> How does an organism's DNA sequence determine the protein that makes its traits?
Performance Task	<ul style="list-style-type: none"> Constructing a model of a DNA strand that codes for a protein.



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Lesson Summary:

	Time	Guiding Question / Learning Objective	How are students answering the guiding question or meeting the learning objective? (Highlight the SEPs, DCIs, and CCCs in the corresponding color.)
 Engage	10 min	<p>How does an organism's DNA sequence determine the protein that makes its traits?</p> <p>"What part of structure and function of DNA make it possible to have similar segments of DNA with other living things?"</p>	<p>Students will view the PowerPoint and discuss how DNA structure is similar in various organisms.</p> <p>DNA Structure and Function PowerPoint</p>
 Explore	25	<ul style="list-style-type: none"> - Watch the Stated Clearly video on DNA. https://www.statedclearly.com/videos/what-is-dna/ - Compare Mouse to Human Chromosome - Questions about DNA structure from CK12 	<p>Students will construct an explanation on the structure of DNA</p>
 Explain	20	<p>Explain the relationship between DNA and traits using the model of DNA</p>	<p>Students build a model of DNA and explain the relationship between structure and function of the DNA molecule.</p>
 Elaborate	10	<p>Students use the DNA model to elaborate on their knowledge of structure by answering questions.</p>	<p>Students will answer questions on how genes are a section of DNA and how a protein is coded for in the sequence of nucleotides.</p>
 Evaluate	10	<p>Students explain the structure of their DNA model.</p>	<p>Teacher will evaluate students understanding of how the structure of DNA is related to the function of DNA coding for genetic traits.</p>

Three Dimensions Focused on in This Lesson



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<p>Disciplinary Core Idea: NGSS Appendix E</p> <p>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 cells.</p>	<p>Science and Engineering Practices: NGSS Appendix F</p> <p>Construct an explanation for how the <u>structure</u> of DNA is replicated, and how DNA and RNA code for the structure of proteins which regulate and carry out the essential functions of life and result in specific traits. Emphasize a conceptual understanding that the sequence of nucleotides in DNA determines the amino acid sequence of proteins through the processes of transcription and translation.</p>	<p>Crosscutting Concept: NGSS Appendix G</p> <p>Structure and Function: Investigating DNA structure requires a detailed examination of its different components in order to connect the structure of DNA to its function in a cell.</p>
<p>Learning Objectives</p> <ol style="list-style-type: none"> 1. Students construct an explanation that includes the idea that regions of DNA called genes determine the structure of proteins, which carry out the essential functions of life through systems of specialized cells. 		
<p>Related Knowledge and Skills from Prior Grades</p>		
<p>Disciplinary Core Idea: NGSS Appendix E</p> <ul style="list-style-type: none"> • LS3.A: Inheritance of Traits • LS1.A Structure and Function 	<p>Science and Engineering Practices: NGSS Appendix F</p> <ul style="list-style-type: none"> • Construct a scientific explanation based on valid and reliable evidence obtained from sources. • Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. • Construct an explanation using models or representations. 	<p>Crosscutting Concept: NGSS Appendix G</p> <p>Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.</p>
<p>Connections to Mathematics and ELA/Literacy Standards</p>		
<p>ELA/Literacy Standards:</p> <ul style="list-style-type: none"> • RST.11-12.1: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. 		<p>Mathematics Standards:</p>



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- **WHST.9-12.2:** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **WHST.9-12.9:** Draw evidence from informational texts to support analysis, reflection, and research.

Materials

Handouts	Lab Supplies	Other Resources
Student Handout 1	DNA Beads	Teacher Slides: DNA Structure and Function Student Handout grading rubric Resources linked in student handout: <ul style="list-style-type: none"> • Stated Clearly Video (What is DNA and How Does It Work?) • CK12 Website (DNA Structure and Replication) • Comparative Genomics resource

ENGAGE

- How does an organism's DNA sequence determine the protein that makes its traits?
 - Students will view the PowerPoint and discuss how DNA structure is similar in various organisms.



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- [DNA Structure and Function PowerPoint](#)

~10 min.

1. Students should infer similarities between organisms as they view [DNA Structure and Function PowerPoint](#)
2. Focus Question “Why do we share DNA with other organisms?”
3. When sharing the similarities between bananas and humans etc., the teacher may choose to share a quick story about one of the organisms or ask engaging questions (see teacher tips on the right).
4. Discuss questions or wonderments that students had when viewing these things.

Teacher Tips

- Previous knowledge about Biomolecules and Cell Division from earlier in the school year's curriculum will be helpful.
- This lesson (DNA Structure) will build upon knowledge of DNA replication.
- Have students look at the first 4 slides to answer the questions on the last slide.
- To help with student engagement, ask questions about students' experience with the organisms in the PowerPoint.

EXPLORE

How does an organism's DNA sequence determine the protein that makes its traits?

~5 min

1. Have students compare Mouse and Human DNA using slide #6 of the PowerPoint. Teachers show the human & mouse chromosome comparison slide on the PowerPoint.
 - a. The numbers on the **mouse chromosomes** correspond to the **human chromosome** number.
2. Ask students: “Why are there sections of the mouse genome that do not correspond to the human genome?”
3. Ask students one or two of the following questions to allow students to **construct an explanation** to understand better the phenomenon and the connections between **structures and functions**.
 - a. If humans & mice—or humans & bananas—are genetically so similar, why are we visually so different?
 - b. HOW IS IT that we are similar? (Teacher may emphasize that many of the same proteins are necessary for life or necessary for mammals, etc.).

~20 minutes

4. Watch the [Stated Clearly Video](#) (What is DNA and How Does It Work?)
5. Teacher moves to the last slide of the PowerPoint which has the question: “If DNA is so important for all of the various proteins of life, how is it that DNA can code for so many types of proteins?”
(Answer should show knowledge of how computers code using 0 and 1 format and DNA code uses 4 letter format)
6. Students will then use the [Ck12 FlexBook](#) to answer questions about the structure of DNA.

Teacher Tips

Introduce students to the idea of what DNA is and how it is used in cells using the video.

Students could also use glue and colored paper to build new chromosomes.

The PowerPoint could be made available to the students online to give them a closer view of the human chromosome colors needed for this activity.



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EXPLAIN

How does an organism's DNA sequence determine the protein that makes its traits?

~20 minutes

1. Students model DNA with [DNA Beads](#) from Flinn Scientific.
2. Teachers should write on the board a sequence of DNA nucleotides for students to build.
3. Students should recognize the pairing of A with T and G with C.
4. Teacher should reinforce the concept that the sequence of DNA nucleotides results in the final sequence of amino acids and, therefore, proteins and function. Relate how genes turn into the gene expression of an organism.
5. Have students answer the post-model questions.

Teacher Tips

You might ask students if anyone has seen a model of DNA before. What types of models have they seen? (Connect to prior learning.)

Accommodations in building model

- Students can build either smaller or longer strands of DNA.
- The teacher should help lower-level students understand and interpret "after model" questions from the student handout.

ELABORATE

How does an organism's DNA sequence determine the protein that makes its traits?

~10 minutes

1. Have students refer to the student handout instructions that ask them to create their own sequence of DNA nucleotides.
2. Students should be able to write the nucleotide sequence for the corresponding paired DNA strand.
3. Teacher asks (individuals/groups): Do you ever think DNA strands pair incorrectly? What will happen if chromosomes pair incorrectly?
4. Have students create a model of their section of DNA.

Teacher Tips

Teachers can assign specific DNA sequences for students to make.

For extension, students can model replication, transcription, or translation with their model.

EVALUATE

How does an organism's DNA sequence determine the protein that makes its traits?



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1. Teachers evaluate student models.
 - a. Students should show an understanding of gene structure through the informal building of DNA strands.
 - b. Modeling with beads is an excellent opportunity for teachers to see which students are struggling with understanding.
 - c. Use answers to post-model questions to evaluate student understanding. See [Rubric](#).
 - d. Have students ask themselves (See After Model Question #5): "How could you revise your physical DNA model to more accurately represent DNA?" Rubric in student worksheet to be used by students and/or teacher.

Teacher Tips

A [rubric](#) is available in the student worksheet to help teachers/students evaluate student models

POSSIBLE EXTENSION / ALTERNATIVE ADAPTATIONS

Students could do one of the following digital extensions:

- Protein synthesis game: <https://biomanbio.com/HTML5GamesandLabs/LifeChemgames/protsynthracehtml5page.html>
- DNA replication game: <https://biomanbio.com/HTML5GamesandLabs/LifeChemgames/replicationinteractivepage.html>
- DNA sentences: <https://www.uen.org/lessonplan/view/37611>
- Students can use the beads to create an mRNA chain based on the DNA sequence that they have created.

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