

Mutations: The Good, The Bad, & The Neutral

Unit	Utah SEEd Standard / NGSS Performance Expectation	Estimated Lesson Time:
7.4.3	Develop and use a model to describe why genetic mutations may result in harmful, beneficial, or neutral effects to the structure and function of the organism. Emphasize the conceptual idea that changes to traits can happen because of genetic mutations. Specific changes of genes at the molecular level, mechanisms for protein synthesis, and specific types of mutations will be introduced at the high school level. (LS3.A, LS3.B)	50 Minutes

LESSON OVERVIEW

Learning Objective(s)

Students will construct an argument based on evidence about specific mutations and their impact on an organism's likelihood of survival and reproduction.

Anchor Phenomenon

Spotted Zebra (Tira)

Driving Question(s)

Where do mutations originate, and what impact do they have on the organism?

Lesson Level Performance Expectations

Students will use supporting evidence to determine whether a mutation is helpful, harmful, or does not affect an organism's likelihood of survival and reproduction in at least 4 out of 6 given scenarios.



3D-RST is supported by the NSF under grant number #DRL-2101383



LESSON SNAPSHOT

LESSON SUMMARY:

	Estimated Time	Section Overview	How are students answering the driving question or meeting the learning objectives? (Highlight SEPs , DCl s, and CCCs)
Experience the Phenomenon	5 min	Watch a short video on a spotted zebra	Students are observing and questioning a zebra's different traits and how those traits might affect its survival.
Investigate the Phenomenon	20 min	Students play a game of telestrations to illustrate how genes could change over time. Students are learning about the characteristics of mutations. Misconceptions about mutations are clarified.	Students are experiencing how mutations occur and the effect it has on an organism's traits . They are given information that helps them formulate and defend their arguments about specific mutations.
Model the Phenomenon	25 min	Students work through the worksheet and argue whether specific mutations are beneficial, harmful, or neutral for the organism.	Students are given several scenarios of an organism and a specific mutation that it has . They then determine and make an argument about how that mutation affects the organism's ability to survive and reproduce.

DISCIPLINARY CORE IDEAS	SCIENCE & ENGINEERING PRACTICES	CROSSCUTTING CONCEPTS
NGSS Appendix E Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism.	NGSS Appendix F Engaging in Argument from Evidence Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.	NGSS Appendix G Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Related knowledge and skills from prior grades		
Disciplinary Core Idea: NGSS Appendix E - Young organisms are very much, but not exactly, like their parents and also resemble other organisms of the same kind. - Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.	Science and Engineering Practices NGSS Appendix F - Compare and refine arguments based on an evaluation of the evidence presented. - Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.	Crosscutting Concept: NGSS Appendix G - Events have causes that generate observable patterns. - Cause and effect relationships are routinely identified, tested, and used to explain change. - Events that occur together with regularity might or might not be a cause and effect relationship.



Materials

Link to all materials on the 3DRST website (3drst.byu.edu): <https://3drst.byu.edu/seventh-7-4-3-mutations>

Link to all materials on Canvas Commons: <https://tinyurl.com/3DRSTseventh>

Student Materials	Teacher Materials	Lab Materials/Other Resources
Student Worksheet: Mutations Student Worksheet Rubric Mutation Dice Game Slides Mutation Dice Game Slides (with accommodation)	Teacher Slides: Mutations Telestration Game Cards Spotted Zebra Video Return of Tira Video	Dice Small Notebooks (one for each student) Pencils

LESSON PREPARATION

Material Preparation:

Multiple notebooks to play Telestrations.

Print and cut out the Telestration game cards or write out word prompts for the game on small pieces of paper.

Required Previous Knowledge:

This lesson builds on students' prior understanding of the following DCIs developed in previous units:

- Genetic variation through asexual and sexual reproduction
- Adaptations and structures that affect the probability of successful reproduction.

Supports students will need/adaptations:

Adaptations could include students needing to answer 3-6 questions. You can also pair struggling students with stronger readers.

Vocabulary Definitions:

Gene - A small section of DNA that acts like a set of instructions, telling the body how to produce proteins that determine traits such as eye color or height.

Mutation - The process of passing traits from parents to their offspring through genes, like how a child might have the same hair color as a parent.

Inheritance - A change in a gene that can sometimes create new traits, like different fur colors in animals or resistance to diseases in plants.

EXPERIENCE THE PHENOMENON/PROBLEM (ENGAGE)

What Students Are Doing	Teacher Tips
-------------------------	--------------



3D-RST is supported by the NSF under grant number #DRL-2101383



Students watch the video of the spotted zebra. During the video, students should make observations and ask questions as a whole class discussion. Telestrations Instructions: In this game, students are provided with a prompt. They are given 20 seconds to draw the prompt before passing it on to the next person. When the next student receives the drawing, they must write what they think it is. What they wrote down is the next student's prompt. These repeats as many times as time allows. Suggested Telestrations prompts: House Fire Truck Dinosaur Donut Boomerang When finished, students tear out the pages of their Telestrations and lay them out in order.	Divide the class into roughly equal groups. Each group should have a small notebook with one of the prompts written on the first page. Have Student 1 read the prompt, turn the page, draw the image, and then pass the notebook. Student 2 looks at the drawing, turns the page, and writes down what they think it is. Continue this process until everyone in the group has participated. Explain how the prompt evolved, even slightly, with each version. Connect this to how mutations can cause small changes in organisms across generations. Clearly show how each update in the game is similar to a mutation, and how changes in the DNA result in physical changes in the organism.
What Teachers Are Doing Introduce and play the video of the zebra born with spots instead of stripes, emphasizing that both of its parents had the expected zebra pattern of black and white stripes.	Teacher Tips

INVESTIGATE THE PHENOMENON (EXPLORE)	
What Students Are Doing	Teacher Tips
Students are filling in the blanks of what mutations are and what mutations are not. Use the word bank to decide if the word/phrase goes under "Mutations are _____" or Mutations are not _____". Students will use the "Mutation Slides for Students" slide set to complete this section of the worksheet. They roll the dice and click on the corresponding die on the second slide, which will take them to the slide for the animal they will investigate. Students read the information on the slide and fill in details about the animal and its habitat. Then, they roll the dice again to see which mutation may appear. After that, they click on the matching die on the slide to go to the	Each student needs a die and access to the slideshow. The worksheet allows for 6 rounds of the mutation slide activity. Depending on the time available, the teacher can require anywhere from 3 to 6 organisms to be evaluated. Two versions of the slide presentation are available. One lacks accommodation for struggling readers, while the other includes a voice recording of each slide that students can play if needed.



mutation slide. The students decide if the mutation is good, bad, or neutral to the animal and support their decision with evidence. Repeat this process for at least three organisms.	Link to a Google Slides version with audio recordings on each slide to help accommodate students.
What Teachers Are Doing	Teacher Tips
Leading a discussion about the questions on slide 6. During the discussion, clarify misconceptions and answer any questions the students might have. Questions from slide 6: - What is a mutation? - What is the difference between an inherited mutation and an environmental mutation? - Do all mutations have the same level of impact or visibility in an organism? Explain how to use the slide show. Monitor and support students as they complete this section.	Instruct students to run the slideshow in present mode. This will enable the links to work smoothly.

MODEL THE PHENOMENON (EXPLAIN)	
What Students Are Doing	Teacher Tips
- Students will tally which mutation they rolled for each organism (1 to 6) and determine which number they rolled most often. This determines which group the student will be assigned to meet with. - Groups compare their answers from the slide activity. All of the students with the same organism (they should have the same mutation because of grouping) discuss their claim about the mutations being good, bad, or neutral, and defend their argument with evidence. - Watch the next video of the zebra and participate in a class discussion about whether the zebra's color trait is beneficial, harmful, or neutral. - Divide into three groups – those who think it is beneficial, those who think it is harmful, and those who think it is neutral. - Discuss their choice with the group and, as a group, prepare an argument supported with evidence about their claim. - Present their claim and argument to the entire class.	Make sure students are reading the information. Help if there is any confusion with the slides. Link to a Google Slides version with audio recordings on each slide to help accommodate students.
What Teachers Are Doing	Teacher Tips



- Monitor and support students as they discuss their answers.
- Play the video “The Return of Tira, The Spotted Zebra” <https://youtu.be/QJy3n-zGM7M?si=Sk6seVemWdLe2lkw>.
- Ask if Tira’s coloration trait is a beneficial, harmful, or neutral trait.

This could be done with a modified 4-Corners. Have three corners and send those who think it is beneficial to one, harmful to a second, and neutral to a third.

POSSIBLE EXTENSIONS/ALTERNATIVE ADAPTATIONS

Students can conduct research on the following mutations, their effect, and their prominence in humans:

- Lactose tolerance (in adults)
- Sickle cell anemia
- Colorblindness

This lesson was created by Megan Sitterud, Denver Smith, Parker Peterson, and Brindy Grange



3D-RST is supported by the NSF under grant number #DRL-2101383

