Unit Title: Crazy Traits	**Content Area:** Life Science/Heredity	**Grade Level:** 8

Unit Summary: Crazy Traits contains a variety of hands-on investigations designed to help students learn important science concepts related to genetics and evolution. Students will practice skills such as problem-solving, critical thinking, and collaborative learning through inquiry-based instruction. It is designed with three ability levels. Level A investigations are introductory in nature and contain little or no math and can be covered in one or two basic classroom periods. Level B is for intermediate students or advanced middle school group. Students need a basic level of math knowledge for this level. Level C is for students with advanced math skills and prior science knowledge. It should be noted that level B and C investigations present a progression from basic observations to complex analysis. One classroom can be divided mostly into two levels. The lessons that follow present level A and B outlines for differentiated instructional purposes. Lessons can be done consecutively following level A based on student comprehension level.

Science practices: asking questions, developing and use a model, constructing explanations
Crosscutting concepts: Cause and Effect, Patterns, Structure and Function

Unit Essential Questions:

- How do organisms change as they go through their life cycle?
- \What factors contribute to an organism's heredity?
- How do adaptations help an organism survive in its environment?
- How does the environment influence adaptations?
- In what ways are organisms of the same kind different from each other?

Unit Enduring Understandings:

- Organisms reproduce, develop, have predictable life cycles, and pass on some traits to their offspring.
- Sometimes differences between organisms of the same kind give advantages in surviving and reproducing in different environments.

Possible Student Misconceptions:
Some students believe that traits are only inherited from one parent (mother) in particular.
The dominant allele is always more common in a population.
Students think that inherited traits are mainly the physical features of an organism.
Students believe that environmentally produced characteristics can be inherited, especially over several generations.

NJCCCS:

- 5.3.8.D.2 Explain the source of variation among siblings.
- 5.3.8.D.3 Describe the environmental conditions or factors that may lead to a change in a cell's genetic information or to an organism's development, and how these changes are passed on.
- 5.3.8.E.1 Organize and present evidence to show how the extinction of a species is related to an inability to adapt to changing environmental conditions using quantitative and qualitative data.
- 5.3.8.E.2 Compare the anatomical structures of a living species with fossil records to derive a line of descent.

NGSS Performance Expectations: *Students who demonstrate understanding can…*

- MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
- MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
- MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
- MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
  MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

Primary CCSS ELA/Literacy Connections: RI.6-8 RST.6-8.4 RST.6-8.7 WHST.6-8.2	**Primary CCSS Mathematics Connections:** 6.SP.A.2

Lesson 1

Lesson Title/Number: Dominant and Recessive Traits/1	**Learning Objective(s):** To determine what are dominant and recessive traits.	**Lesson Duration:** 50 minutes

Learning Cycle	*Learning Activities*	*Resources/Materials*	*Science and Engineering Practices*	*Disciplinary Core Ideas*	*Crosscutting Concepts*

What lesson elements will support students' progress towards mastery of the learning objectives(s)? ****Elements do not have to be in conducted in sequence.***	***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Students will inventory their own inherited traits. Students will compare their traits to what is the least and most common within a small group. Students will engage in discussion and development of questions on traits as a result.	• http://learn.genetics.utah.edu/content/inheritance/activities/	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2)	LS1.B: Growth and Development of Organisms • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MS-LS3-2)	Patterns • Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Students engage in observing pictures of common traits such as rolling tongue, hammer toe, attached and detached ear lobes in small groups. Students will discuss and probe possibilities of their personal trait.	• http://learn.genetics.utah.edu/content/inheritance/activities/	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Patterns • Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
Explore: What hands-on/minds-on common experience(s) will you provide for students?	In small groups students will engage in the investigation A1 or B1. Students will collect data on a population on traits of the creature following the procedure indicated on student worksheets.	• Student worksheets pages 1-13	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Patterns • Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
Explain: How will you help students connect their exploration to the concept/topic under	Students will construct an explanation on the offspring of the crazy creature and compare it to their group discussion on	• Science journal response from beginning of lesson • Trait cards	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes	Patterns • Patterns can be used to identify cause and effect relationships. (MS-LS4-2)

investigation?	human traits. Students will probe the possible dominant or recessive trait in their family.		real-world phenomena, examples, or events. (MS-LS4-2) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Students begin to expand inheritance to other living animals such as dogs and cats looking for variations. Student design an illustration of two animals (cat or dog) and determine the possible outcomes in their group or with a partner.	• Science journal notes • Drawing paper • Colored pencils	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Patterns • Patterns can be used to identify cause and effect relationships. (MS-LS4-2) Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2)
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	investigation assessment, explanations on traits and other animals	• Student worksheet page 14,			

LESSON 2

Lesson Title/Number: Probability/A2	**Learning Objective(s):** What role does chance play in an organism's heredity?	**Lesson Duration:** 100 minutes

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Students observe a video presentation on some traits that we inherit, such as willow's peak, hammer thumb, attached or detached ear lobes. Student will then engage in discussion within their groups and	• Worksheet and observations • CPO Media - Heredity clip: http://www.cposcience.com/home/ForStudents/MiddleSchoolLifeScience/tabid/247/default.aspx?MediaFileId=2979	· Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.	Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1) LS3.B: Variation of Traits	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some

	questions will develop in the conversation. Questions that students have can be recorded.			• In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Students learn how chance affects an organism's genetic makeup. Students build a creature that they flip coins for and compare their creation to their classmates. This will demonstrate how genetically diverse the organisms can be even with just fourteen traits.	• Student worksheets • Kit materials • Colored pencils • Science journals • A2 pages1-7 • B2 page 1-7	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1), (MS-LS3-2) Using Mathematics and Computational Thinking • Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Explain: How will you help students connect their exploration to the concept/topic under investigation?	Small groups will respond and discuss questions "thinking about what you observed". Groups will explain how probability is a part of inherited traits.	• A2 - page 5 • B2 pages 3-4	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Students will revisit the video presentation and then proceed to play game of traits and traditions in small groups.	• http://learn.genetics.utah.edu/content/inheritance/activities/	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent.	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described

				These versions may be identical or may differ from each other. (MS-LS3-2)	using probability. (MS-LS4-4), (MS-LS4-6)
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Group A - The completed accuracy of the process of determined the genotype and connected to the illustrated phenotype of the offspring. Assessment 2	• A - Assessment 2 page 7 • Chart paper • Colored pencils	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1), (MS-LS3-2) Using Mathematics and Computational Thinking • Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)

LESSON 3

Lesson Title/Number: Other Patterns of Inheritance		**Learning Objective(s):** What are some exceptions to the basic pattern of inheritance?			**Lesson Duration:** 100 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***

Elicit: How will you access students' prior knowledge?	Students engage in Video presentation on Heredity "Brain Pop" (Note this episode is free, teacher may want to invest in subscription). Students continue to make connections to their lives on how they have inherited traits. Presentation includes "Mendel's Peas".	• http://www.brainpop.com/science/cellularlifeandgenetics/heredity/	· Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.	Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1) LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Students engage in continuing discussion on video presentation. Students will observe print resources on various plants/flowers and determine the possible same families or variations.	• Print books on flowers/plants, images (calendars are good for this)			
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Students individually observe some data that does not follow the basic rules for dominance. Students utilize the data to gain understanding on incomplete dominance and codominance.	• Student sheet B2 page 1-2 • Teacher's resource guide pg. 55-57 • Colored pencils	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)

Explain: How will you help students connect their exploration to the concept/topic under investigation?	Small group will orally explain the exceptions to the basic patterns of inheritance by responding to "Thinking about what you observed"	• Student sheet B2,page 2-3 • Teacher Resource pg. 57-58	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Students will brainstorm examples of friends of family members they know. Students will explain the data using percentage of inherited traits for dominance and incomplete dominance in each generation	• Student group data from sheet B2	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.		Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	The accuracy of computation of traits inherited for each generation. Students' ability to explain the difference between dominance and incomplete dominance reflected in worksheet. investigation assessment questions	• Student Sheet Assessment B2 pg. 7 • Teacher's Resource guide pg. 60			
LESSON 4					
Lesson Title/Number: Predicting Traits		• **Learning Objective(s):** How can you predict probable traits?		**Lesson Duration:** 200 minutes	

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	• ***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Think Pair Share - Students discuss how we can predict the traits of an offspring.		· Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.	Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1)	Patterns • Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Students read a scenario of a scientist in a lab that wants to create a new flower that can live in a harsh climate. The scientist are trying to determine if they cross A with C what will the results be. Students discuss, create questions, and connect how an accurate prediction can be done.	• Teacher generated scenario for each student.	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Patterns • Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Students explore using Punnett Squares to predict the most likely traits of the offspring of the creatures. Students observe the squares in Student sheet to determine the most probable phenotype for each trait. After their predictions they will use coins in kit to determine the actual trait.	• Crazy Trait Kit • Student Sheet A3	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)

Explain: How will you help students connect their exploration to the concept/topic under investigation?	Students will illustrate their offspring on large chart paper and each group will explain to the class the connection with this activity and how organisms inherit traits using key terms. Key terms: genotype, alleles, genes, dominant, recessive, phenotype, probability, chance	• Creatures • Large chart paper • Colored pencils • Markers	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Students will observe the offspring of the class and determine the traits that are dominant. Students will engage in an argument as to how differences occurred when the offspring are from the same parents (heterozygous).	• Creatures	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1) LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Patterns • Patterns can be used to identify cause and effect relationships. (MS-LS4-2) Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2)
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Formal observations of Punnett squares Exit Ticket Questions: If both parents have one dominant and one recessive allele for each trait (Tt), what possible combinations could the offspring inherit?	• Post-its • Index Cards for Exit Ticket			

Extend: How will students deepen their conceptual understanding through use in new context?	Students work with a partner on SpongeBob Genetics Activity. Activity presents a character scenario with Punnett squares used for predictions. Key terms such as genotype, dominant, recessive and phenotype are contained in the reading.	• SpongeBob Genetics Worksheet	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Patterns • Patterns can be used to identify cause and effect relationships. (MS-LS4-2) Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2)

LESSON 5

Lesson Title/Number: Probability		**Learning Objective(s):** I can create a tool used to predict the traits of an offspring.			**Lesson Duration:** 150 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Students will engage in discussion of the Punnett Squares completed on Sponge Bob Activity from previous extension activity.		· Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.		

Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	In small groups students will engage in reflecting on 3 important reasons that Punnett Squares are used for. Challenge students to think about any organism (plant, fish, animal, etc.) Each group will share one reason with the whole class and record on large chart paper.	• Large chart paper	· Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6) • Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Students continue exploring how to use Punnett squares to predict the most likely traits of the offspring of the creatures by creating their own model.	• Crazy creature kit • Student sheet B4 • Science journal	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1), (MS-LS3-2) Using Mathematics and Computational Thinking • Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6) • Patterns can be used to identify cause and effect relationships. (MS-LS4-2)

Explain: How will you help students connect their exploration to the concept/topic under investigation?	Student groups will explain the process of determining the setup of their Punnett Squares and if it can be applied to other predictions. Students will compare their predictions to the actual genotypes for each trait. Students will observe each group's squares through round robin strategy.		Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.		• Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Each small group will construct an explanation using the CER (claim, evidence, reason) for this question: How can scientist predict what traits offspring will most likely have?		Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	LS3.B: Variation of Traits • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)	• Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	CER, Punnett squares				

LESSON 6

Lesson Title/Number: Adaptations		**Learning Objective(s):** How do adaptations help an organism survive in its environment?			**Lesson Duration:** 100 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***

Elicit: How will you access students' prior knowledge?	Students will gather facts on what we (humans) do to survive in different seasons. Students observe images around the classroom to probe their knowledge. Activity can be done as a Think Pair Share.	• Large images of different seasons.	Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. (MS-LS4-4)	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Students continue to get deeper in how we adapt to the environment. Students determine two different locations on the Earth with different environment and brainstorm what humans have to do to adapt to this environment. Continue with a different Think Pair Share group to elicit facts in the concepts. Students will post there information to share with their peers.	• Computer internet • Globe • Images of different parts of the world with people of various cultures	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-4) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Students explore how an organism is suited for its environment in a game format. The class determines the habitat and then chooses traits that will be necessary for survival. Student groups build the creature and compare which organism is best suited for the environment.	• Environmental cards from kit, • Crazy creature kit	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)

Explain: How will you help students connect their exploration to the concept/topic under investigation?	Students will connect their exploration through a series of questions "thinking about what you observed" on student sheet. Students expound on the "what" and are given a scenario.	• Student sheet A5 pages 4-5	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-4) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Students will choose a familiar species and map out their environmental habitat and traits. Student will then connect the map to a new environment for the same species and determine how, what possibilities for it to adapt to this environment. Student can create a collage from magazine images of a species and its environment. Students will work within their small groups apply their learning to adaptation.	• Cut-outs of various species • Cut-outs of various environments • 11x17 white paper • Glue • Internet access • Books on various species	Developing and Using Models • Develop and use a model to describe phenomena. (MS-LS3-1), (MS-LS3-2) Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-4) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Investigation Assessment presentations Completed Student Sheet Quick Write - Distinguish between physical and behavioral adaptations. How are organisms	• Paper • Student sheet A5 pages 1-6 • Assessment A5 - page 7			

	suited to their habitat?				

LESSON 7

Lesson Title/Number: Changing Environments		**Learning Objective(s):** How does the environment influence adaptations?			**Lesson Duration:** 150 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Students observe images of different organisms in their environment. Some will be organisms that do not fit the environment. Students will determine at least 3 different questions on the impact of the environment on the organism.	• Various images of environmental/habitats of organisms using photos or Smartboard tiles.	Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. (MS-LS4-4)	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)	

Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Students will engage discussion in how the environment has influence human ability to adapt using questions and images from previous activity.	• Various images of environmental/habitats of organisms using photos or Smartboard tiles.	Constructing Explanations and Designing Solutions • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-4) Engaging in Argument from Evidence Compare and refine arguments based on an evaluation of the evidence presented.	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Students continue to explore the affects of an environment on organisms. Students use creatures from previous investigation to change the environment and determine its effect. Students will use the adaptation game for choosing the environment.	• Student Sheet A6 • Data from A5 • Environmental Cards	Developing and Using Models	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)

Explain: How will you help students connect their exploration to the concept/topic under investigation?	Students will draw a picture of what the crazy creature might look like after many generations of living in the new environment. Student groups will develop an analysis of what adaptations the creature has developed to survive in its new habitat. Groups will present their analysis to the class.	• Newsprint or large chart paper • Computer for writing the analysis	Developing and Using Models · Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. Construct an explanation using models or representation.	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Students will use the environment cards to determine what known organism can possibly adapt to the environment. Students take on roles as an expert for each component. Structure Expert, Habitat, Breeding and Change over Time. (Note this can be done with technology, paper. or duplication of the environment in 3D. Students can work on this in small groups (3) for 3 days if needed). Students will present to each other.	• Crazy Creature Kit • Adaptation Environmental Cards • Paper • Markers, colored pencils • Computer/internet • Shoe boxes • Various materials (construction paper, Styrofoam. foam board) • Any materials available to students for final product.	Developing and Using Models · Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. Construct an explanation using models or representation.	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS3-2) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4), (MS-LS4-6)

Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Presentation of organism, completed student sheet, oral explanation of environment/organism	• Crazy Creature Kit • Adaptation Environmental Cards • Paper • Markers, colored pencils • Computer/internet • Shoe boxes • Various materials (construction paper, Styrofoam. foam board) • Any materials available to students for final product.			
Extend: How will students deepen their conceptual understanding through use in new context?	Students will use the environment cards to determine what known organism can possibly adapt to the environment. Students take on roles as an expert for each component. Structure Expert, Habitat, Breeding and Change over Time. (Note this can be done with technology, paper. or duplication of the environment in 3D. Students can work on this in small groups (3) for 3 days if needed). Students will present to each other.	• Crazy Creature Kit • Adaptation Environmental Cards • Paper • Markers, colored pencils • Computer/internet • Shoe boxes • Various materials (construction paper, Styrofoam. foam board) • Any materials available to students for final product.	Developing and Using Models · Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. Construct an explanation using models or representation.	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	

LESSON 8		
Lesson Title/Number: Pedigrees and Genetic Disorders	**Learning Objective(s):** How can a pedigree be used to trace a genetic disorder over generations?	**Lesson Duration:** 100 minutes

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Individually students will write 1-2 illness or diseases that more than one member of their family have. Refer to familiar diseases such as asthma, diabetes, sick cell anemia.				
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Participants are challenged to track and record the passage of colored pom poms (representing genes) through generations of a family using a pedigree. Participants learn that common chronic diseases (such as heart disease) run in families and are caused by the combined action of multiple genes.				