Utah SEEd Formative Cluster Development Template

Names of Developers:

<table>
<tr><td colspan="3">STEP 1:Define what you will assess by analyzing the following sections of the Core Guides: Strand, Standard, Concepts and Skills to Master: 3D Instructional Planning Table.</td></tr>
<tr><td colspan="3">SEEd Standard: Standard BIO.3.3
Engage in argument from evidence that inheritable genetic variation is caused during the formation of gametes. Emphasize that genetic variation may be caused by epigenetics, during meiosis from new genetic combinations, or viable mutations. (LS3.B)</td></tr>
<tr><td>Assessment Claim:

Engage in argument from evidence that inheritable genetic variation is caused during the formation of gametes.</td><td colspan="2">Relevant Core Guides Text:

SEP:
Engaging in Argument From Evidence: Students engage in argument from evidence about the causes of genetic variation in organisms.

CCC:
Cause and Effect: Genetic variation may have more than one cause and empirical evidence is required to make claims about specific causes

DCI:
(LS3.B): Variation of Traits: The information passed from parents to offspring is coded in the DNA molecules that form the chromosomes. In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes. Viable mutations in gametes can be inherited. Environmental factors also affect expression of traits.</td></tr>
<tr><td colspan="3">STEP 2: Delineate the components of the claim to be assessed using the following section of the Core Guides: 3D Student Expectations.</td></tr>
<tr><td>SEP:
Students do and use the Science and Engineering Practice (SEP) of Engaging in Argument From Evidence</td><td>CCC:
Students think and connect through the Crosscutting Concept (CCC) of Cause and Effect to reason
● Empirical evidence is</td><td>DCI:
Students know and apply the Disciplinary Core Idea (DCI) of LS3.B Variation in Traits in their thinking and reasoning to communicate</td></tr>
</table>

● Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. ● Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge, and student generated evidence.	required to differentiate between cause and correlation and make claims about specific causes and effects. ● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.	● In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. ● Environmental factors also affect expression of traits. Complex relationships between genes and interactions of genes with the environment (e.g. epigenetics) determine how an organism will develop and function.

STEP 3: Delineate specific details to be assessed using the following section of the Core Guides: Assessment Exemplars: What does it look like to demonstrate proficiency on this standard?

Specific Details: (Bold Areas)

Developing the claim
Students make a claim that includes the idea that inheritable genetic variations may result from:

- New genetic combinations through meiosis;
- Viable errors occurring during replication;
- Mutations caused by environmental factors; and
- The influence of environmental factors on gene expression.

Identifying scientific evidence
Students identify and describe* evidence that supports the claim, including:

- Variations in genetic material naturally result during meiosis when corresponding sections of chromosome pairs exchange places.
- Genetic mutations can occur due to: a) errors during replication; and/or b) environmental factors.
- Genetic material is inheritable.

Students use scientific knowledge, literature, student-generated data, simulations and/or other sources for evidence

Evaluating and critiquing the evidence

Students identify the following strengths and weaknesses of the evidence used to support the claim:

- Types and numbers of sources;
- Sufficiency to make and defend the claim, and to distinguish between causal and correlational relationships; and
- Validity and reliability of the evidence.

Reasoning and synthesis

- Students use reasoning to describe* links between the evidence and claim, such as:
    - Genetic mutations produce genetic variations between cells or organisms.
    - Genetic variations produced by mutation and meiosis can be inherited. b
- Students use reasoning and valid evidence to describe* that new combinations of DNA can arise from several sources, including meiosis, errors during replication, and mutations caused by environmental factors.
- Students defend a claim against counter-claims and critique by evaluating counter-claims and by describing* the connections between the relevant and appropriate evidence and the strongest claim.

*When “describe” is referenced, any of the following descriptions could be used: written, oral, pictorial, and kinesthetic.

STEP 4: Brainstorm and select effective phenomena using the Yes Test or brainstorm and select a design problem that can have a variety of appropriate solutions

Possible Phenomena/Design Problems (if engineering standard)	Phenomena that Meet the Yes Test:
• When mother rats show care for their babies by licking and grooming, their babies often experience less anxiety as adults. • When genetically identical twins who have been raised separately are studied, they often have very different characteristics. • Agouti mice mothers that are exposed to BPA, produce offspring that are fat and yellow. The same mice mothers who are not exposed to BPA produce offspring that are healthy and brown. • Astronaut Scott Kelly is an identical twin. After 340 consecutive days on the International Space Station, Scott’s genes experienced changes that his twin, Mark who stayed on Earth, did not.	

<table>
<tr><td colspan="2">STEP 5: Write a complete student explanation of the phenomenon or solution to the design challenge</td></tr>
<tr><td>Selected Phenomenon:

Twin girls with very different physical features.</td><td>Expected Student Explanation of Phenomenon

Skin inheritance is based on multiple different genes. This inheritance creates a wide-range of skin colors. Because the parents of the twins had very different skin colors, they have the potential to have children with a wide range of skin colors.

The lighter twin likely got an abc gamete from mom and an abc gamete from dad. This allele combination would result in light features because she didn’t receive a gamete with a dominant allele (capital letter). She might have received one dominant allele from her father, but the probability is low due to the fact that her father had either one or none.

The darker twin likely got an Abc gamete from dad (or a single dominant gene with two recessive genes) and an ABC gamete from mom. This allele combination would result in darker features because she received more dominant alleles.</td></tr>
<tr><td colspan="2">STEP 6: Develop a Cluster Task Statement, supporting information, and tasks that scaffold students to Gather, Reason, and Communicate using the 3D components delineated in Step 2</td></tr>
<tr><td colspan="2">Cluster Task Statement: (Represents the ultimate way the phenomenon will be explained or the design problem will be addressed)

Engaging in Argument From Evidence: Students engage in argument from evidence about the causes of genetic variation in organisms.</td></tr>
<tr><td colspan="2">Supporting Information:</td></tr>
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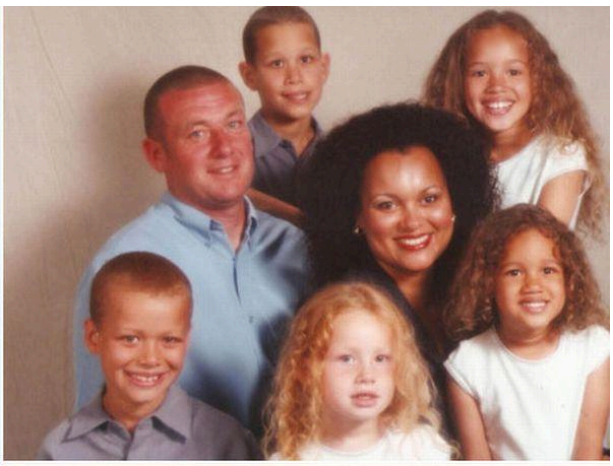


https://www.mirror.co.uk/news/real-life-stories/black-white-twins-meet-sisters-5256945

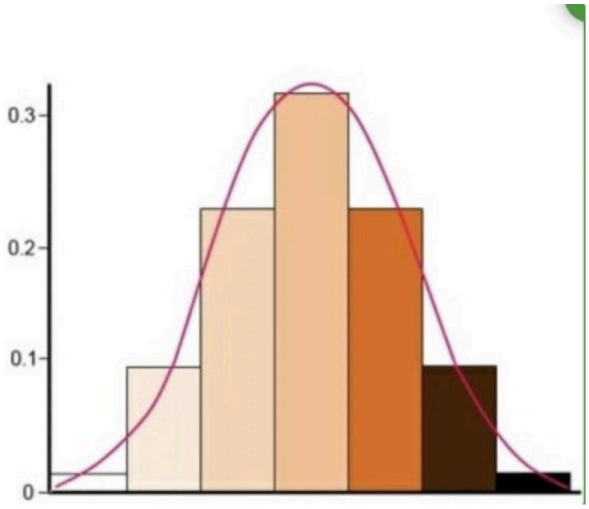
“These 18-year-old twins from U.K Lucy and Maria Aylmer are black and white twins that look totally different. That’s because of their half-Jamaican mother and Caucasian father. While the other siblings have a blend feature from their parents. These twins are totally opposite to each other. Maria has light brown skin and black hair while Lucy has red hair and fair skin and blue eyes.”

https://www.cnn.com/2015/03/03/living/feat-black-white-twins

Inheritance of Skin Color - There are many other factors that influence skin color, but this is a basic explanation.

Skin color is largely determined by the amount of melanin the skin produces. Dark-skinned individuals produce more melanin than light-skinned individuals. At least three genes regulate the amount of melanin produced. Each gene has two forms: dark-skin allele (A, B, and C) and light-skin allele (a, b, and c). Neither allele is completely dominant to the other, and heterozygotes exhibit an intermediate phenotype (incomplete dominance). Each dark-skin allele in the genotype adds pigment by increasing melanin production. There are seven different shades of skin color ranging from very light (aabbcc) to very dark (AABBC); most individuals have the intermediate skin color (AaBbCc).

In the graph below we see a cross between two individuals with intermediate skin color produces offspring with a range of phenotypes (bell-shaped curve).



The table below shows a simplified model of possible gametes and genotypes of offspring produced from those gamete crosses.

# of dominant alleles	0	1	2	3	4	5	6
skin color							

(each square shows the number of dark skin alleles in the genotype)

Gametes	ABC	ABc	AbC	Abc	aBC	aBc	abC	abc
ABC	6 AABBCC	5 AABBCc	5 AABbCC	4 AABbCc	5 AaBBCC	4 AaBBCc	4 AaBbCC	3 AaBbCc
ABc	5 AABBCc	4 AABBcc	4 AABbCc	3 AABbcc	4 AaBBCc	3 AaBBcc	3 AaBbCc	2 AaBbcc
AbC	5 AABbCC	4 AABbCc	4 AAbbCC	3 AAbbCc	4 AaBbCC	3 AaBbCc	3 AabbCC	2 AabbCc
Abc	4 AABbCc	3 AABbcc	3 AAbbCc	2 AAbbcc	3 AaBbCc	2 AaBbcc	2 AabbCc	1 Aabbcc
aBC	5 AaBBCC	4 AaBBCc	4 AaBbCC	3 AaBbCc	4 aaBBCC	3 aaBBCc	3 aaBbCC	2 aaBbCc
aBc	4 AaBBCc	3 AaBBcc	3 AaBbCc	2 AaBbcc	3 aaBBCc	2 aaBBcc	2 aaBbCc	1 aaBbcc
abC	4 AaBbCC	3 AaBbCc	3 AabbCC	2 AabbCc	3 aaBbCC	2 aaBbCc	2 aabbCC	1 aabbCc
abc	3 AaBbCc	2 AaBbcc	2 AabbCc	1 Aabbcc	2 aaBbCc	1 aaBbcc	1 aabbCc	0 aabbcc

Question Types:

- **Short Answer:** Fill in the blank, short sentences.
- **Long Answer:** Explanation, Model, Argument
- **Multiple Choice:** 4 options, 1 correct
- **Multi Select:** 5-8 options, multiple correct
- **Modeling:** Student develops a model
- **Table Match:** Sort objects into two or more categories
- **Highlighting Text:** Select part of the text
- **Table Grid:** Fill in a table with accurate information
- **Graphing** Create a graph in a grid
- **Simulation:** Provides inputs to manipulate, runs an animation, and/or create an output table

Gather: Cluster Question #__1____ Question Type: Multiple Choice Addresses: __X__ DCI ____ SEP ____ CCC Answer: A	Item: In this scenario, the Mother is bi-racial, half black and half white, and the father is caucasian. Refer to images 3 and 4. The most likely genotype of the father would be? A. 1–Aabbcc B. 3–AaBbCc C. 5–AABBCc D. 6-AABBCC
Gather: Cluster Question #___2___ Question Type: Multiple choice Addresses: __X__ DCI ____ SEP ____ CCC Answer: B	Item: In this scenario, the Mother is bi-racial, half black and half white, and the father is caucasian. The most likely genotype of the Mother would be? A. 0–aabbcc B. 3–AaBbCc C. 5–AABBCc D. 6-AABBCC
Reason: Cluster Question #___3___ Question Type: Short Answer Addresses: __x__ DCI ____ SEP __x__ CCC Answer: abc, Abc	Item: Using what you know about meiosis, what are the possible gamete combinations that the father can pass on to his offspring?

Reason: Cluster Question #___4___ Question Type: Short Answer Addresses: __x__ DCI ____ SEP __x_ CCC Answer: Any combination, for example: ABC, abc, Abc, aBc, AbC, abC, ABc, aBC	Item: Using what you know about meiosis, what are 4 possible gametes combinations that the mother can pass on to her offspring?
Communicate: Cluster Question #__5____ Question Type: Short Answer Addresses: _X___ DCI __X__ SEP __X__ CCC Answer: The lighter twin likely got an abc gamete from mom and an abc gamete from dad. This allele combination would result in light features because she didn't receive a gamete with a dominant allele (capital letter). She might have received one dominant allele from her father, but the probability is low due to the fact that her father had either one or none.	Item: Using what you know about meiosis, what was the likely gamete combination for the twin with lighter features? Support your answer (claim) with evidence and reasoning.
Communicate: Cluster Question #__6____ Question Type: Short Answer Addresses: _X___ DCI __X__ SEP __X__ CCC Answer:	Item: Using what you know about meiosis, what was the likely gamete combination for the twin with darker features? Support your answer (claim) with evidence and reasoning.

The darker twin likely got an Abc gamete from dad (or a single dominant gene with two recessive genes) and an ABC gamete from mom. This allele combination would result in darker features because she received more dominant alleles.	

STEP 7: Develop a proficiency scale for the final communicate section that explains the phenomenon using the student explanation as the example of a proficient answer (Refer to Step 5).

A. Copy and paste the Level 2 and 3 descriptors from the following rubric for the SEP and CCC.
   K-2
   3-5
   6-8
   9-12
B. Remove any descriptors that do not align with the questions in the communicate section.
C. Copy grade level DCI descriptors from the Core Guides: Grade Band Progressions for grade level. That is the Level 3 in the rubric.
D. Remove any descriptors that do not align with the questions in the communicate section.
E. Review the progression of the grade band below (except K-2) to see if these are reasonable descriptions for the item. If not, or are K-2, write an appropriate descriptor that depicts a lack of conceptual understanding.

Proficient Student Explanation:

1. A
2. B
3. abc, Abc, aBc, abC
4. Any combination, for example: ABC, abc, Abc, aBc, AbC, abC, ABc, aBC
5. The lighter twin likely got an abc gamete from mom and an abc gamete from dad. This allele combination would result in light features because she didn't receive a gamete with a dominant allele (capital letter). She might have received one dominant allele from her father, but the probability is low due to the fact that her father had either one or none.
6. The darker twin likely got an Abc gamete from dad (or a single dominant gene with two recessive genes) and an ABC gamete from mom. This allele combination would result in darker features because she received more dominant alleles.

Level 1 - Emerging	Level 2 - Partially Proficient	Level 3 - Proficient	Level 4 - Extending
SEP: Does not meet the minimum standard to receive a 2.	**SEP:** Construct, use, and present a written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon.	**SEP:** Construct, use, and present a written argument based on data and evidence. Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student generated evidence.	**SEP:** Extends beyond proficient in any way.
CCC: Does not meet the minimum standard to receive a 2.	**CCC:** Uses cause and effect relationships to predict phenomena in natural or designed systems. Recognizes phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	**CCC:** Explains why empirical evidence is required to differentiate between cause and correlation and makes claims about specific causes and effects. Suggests and predicts cause and effect relationships for complex natural systems by examining what is known about smaller scale mechanisms within the system. Understands that changes in systems may have various causes that may not have equal effects.	**CCC:** Extends beyond proficient in any way.
DCI: Does not meet the minimum standard to receive a 2.	**DCI:** In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals	**DCI:** In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new	**DCI:** Extends beyond proficient in any way.

	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.	genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.	