Introduction

Formative Assessment Exemplar - 7.4.1

Introduction:

The following formative assessment exemplar was created by a team of Utah educators to be used as a resource in the classroom. It was reviewed for appropriateness by a Bias and Sensitivity/Special Education team and by state science leaders. While no assessment is perfect, it is intended to be used as a formative tool that enables teachers to obtain evidence of student learning, identify gaps in that learning, and adjust instruction for all three dimensions (i.e., Science and Engineering Practices, Crosscutting Concepts, Disciplinary Core Ideas) included in a specific Science and Engineering Education (SEEd) Standard.

In order to fully assess students' understanding of all three dimensions of a SEEd standard, the assessment is written in a format called a cluster. Each cluster starts with a phenomenon, provides a task statement, necessary supporting information, and a sequenced list of questions using the gather, reason, and communicate model (Moulding et al., 2021) as a way to scaffold student sensemaking. The phenomenon used in an assessment exemplar is an analogous phenomenon (one that should not have been taught during instruction) to assess how well students can transfer and apply their learning in a novel situation. The cluster provides an example of the expected rigor of student learning for all three dimensions of a specific standard. In order to serve this purpose, this assessment is NOT INTENDED TO BE USED AS A LESSON FOR STUDENTS.

Because this assessment exemplar is a resource, teachers can choose to use it however they want for formative assessment purposes. It can be adjusted and formatted to fit a teacher's instructional needs. For example, teachers can choose to delete questions, add questions, edit questions, or break the tasks into smaller segments to be given to students over multiple days.

Of note: All formative assessment clusters were revised based on feedback from educators after being utilized in the classroom. During the revision process, each cluster was specifically checked to make sure the phenomena was authentic to the DCI, supporting information was provided for the phenomena, the SEPs, CCCs, and DCIs were appropriate for the learning progressions, the cluster supported student sensemaking through the Gather, Reason, and Communicate instructional model, and the final communication prompt aligned with the cluster phenomena. As inconsistencies were found, revisions were made to support student sensemaking. If other inconsistencies exist that need to be addressed, please email the current Utah State Science Education Specialists with feedback.

General Format:

Each formative assessment exemplar contains the following components:

1. Teacher Facing Information: This provides teachers with the full cluster as well as additional information including the question types, alignment to three dimensions, and answer key. Additionally, an example of a proficient student answer and a proficiency scale for all three dimensions are included to support the evaluation of the last item of the assessment.
2. Students Facing Assessment: This is what the student may see. It is in a form that can be printed or uploaded to a learning platform. (Exception: Questions including simulations will need technology to utilize during assessment.)

Accommodation Considerations:

Teachers should consider possible common ways to provide accommodations for students with disabilities, English language learners, students with diverse needs or students from different cultural backgrounds. For example, these accommodations may include: Providing academic language supports, presenting sentence stems, or reading aloud to students. All students should be allowed access to a dictionary.

References:

Moulding, B., Huff, K., & Van der Veen, W. (2021). *Engaging Students in Science Investigation Using GRC*. Ogden, UT: ELM Tree Publishing.

Teacher Facing Info

Teacher Facing Information

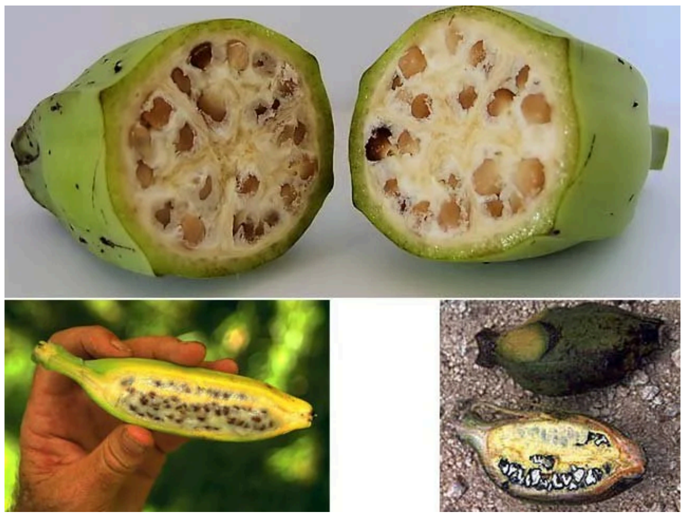
Standard: 7.4.1
Develop and use a model to explain the effect that different types of reproduction have on genetic variation, including asexual and sexual reproduction. (LS1.B, LS3.A, LS3.B)

Assessment Format: Printable or Online Format (Does not require students to have online access)

Phenomenon	
Though there are many types of bananas, the bananas *that we eat* are at risk of extinction! Sources: Bananas Have Changed Radically Over Time History of the Banana World-first Panama disease-resistant Cavendish bananas	Proficient Student Explanation of Phenomenon: The Cavendish bananas we eat are at risk of dying out because they reproduce asexually and thus have lower genetic diversity than the wild bananas which reproduce sexually. This causes the Cavendish banana to be more likely to die from the fungus.
Cluster Task Statement	
(Represents the ultimate way the phenomenon will be explained or the design problem will be addressed) In the questions that follow, you will create and use a model to explain how sexual and asexual reproduction affect the survival of bananas.	
Supporting Information	
Reading 1 - Changes in Bananas Adapted from: Bananas Looked totally different in the 1940s — before disaster struck Wild bananas make hard seeds that aren't good to eat. In nature, bananas reproduce by using sperm cells created inside pollen. This pollen lands on the female part of a flower. The pollen then fertilizes the plant's egg cell. This creates a seed that contains the offspring, and the flower develops into a fruit. Unfortunately for humans, most of the bananas that reproduce in this way are not good to eat. Some bananas, like the ones you see at the grocery store, are edible. Humans grew the edible bananas they found and created a variety called the Cavendish banana, which is the most eaten banana around the world. However, this banana does not have seeds and can't reproduce on its own. This means the	

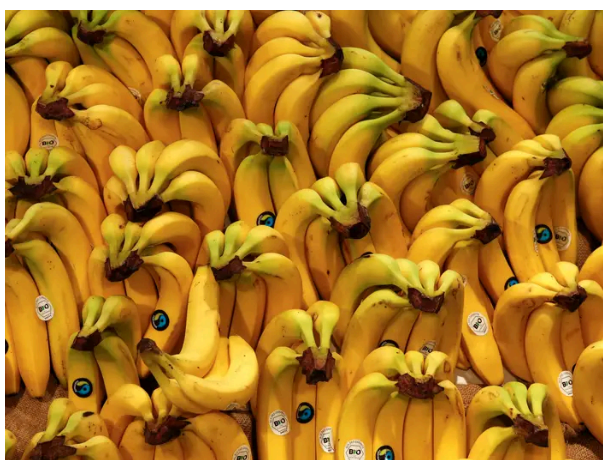
only way to keep growing these bananas is to use cuttings or clones from a single parent plant. Unfortunately, these bananas are at risk of dying out. The problem is a type of fungus that infects the roots of a banana tree and keeps the plant from taking in nutrients and water. This fungus has already wiped out one banana variety, the Gros Michel, which used to be the most popular banana. Bananas have a gene called RGA2 that makes them resistant to the fungus. This gene can be either **active** (represented by the allele A) and <u>resistant</u> to the fungus or **inactive** (represented by the allele a) and <u>not resistant</u>. Cavendish bananas typically have the inactive form of the gene and can't resist the fungus.

Figure 1 - Wild bananas have large, inedible seeds



This image shows wild bananas with large, inedible seeds.

Figure 2 - Cavendish bananas on their way to the grocery store



This image shows cavendish bananas on their way to the grocery store.

Cluster Questions	
Gather: Cluster Question #___1___ Question Type: Fill in the Blank Addresses:	Question 1: Complete the sentence below based on the information in **Reading 1.**

<table>
<tr>
<td>__X__ DCI: Inheritance of Traits
_____ SEP:
__X__ CCC: Cause and Effect
Answer: sexually/more/egg and sperm cells</td>
<td>Wild bananas reproduce <u>(asexually/sexually)</u>, which means they have <u>(more/less)</u> genetic diversity. I know this because they have (a clone/egg and sperm cells).</td>
</tr>
<tr>
<td>Gather:
Cluster Question #___2___
Question Type: Fill in the Blank
Addresses:
__X__ DCI: Inheritance of Traits
_____ SEP:
__X__ CCC: Cause and Effect
Answer: asexually/less/clone</td>
<td>Question 2:

Complete the sentence below based on the information in Reading 1.

Cavendish bananas reproduce <u>(asexually/sexually)</u>, which means they have <u>(more/less)</u> genetic diversity. I know this because they have (a clone/egg and sperm cells).</td>
</tr>
<tr>
<td>Gather:
Cluster Question #___3___
Question Type: Fill in the Blank
Addresses:
__X__ DCI: Variation of Traits
_____ SEP:
__X__ CCC: Cause and Effect
Answer: would/would not</td>
<td>Question 3:

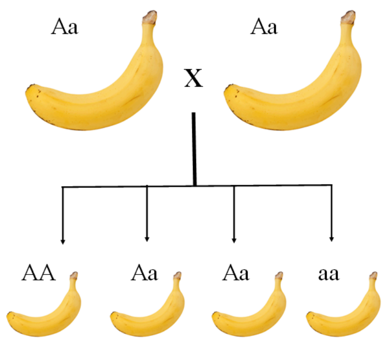
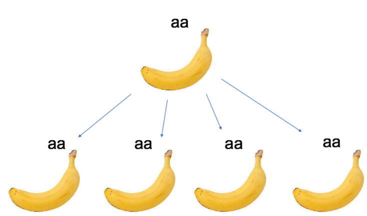
Complete the sentence below based on the information in Reading 1.

The wild bananas with the active genes (AA) <u>(would/would not)</u> be protected against the fungus. The Cavendish bananas with the inactive genes (aa) <u>(would/would not)</u> be protected against the fungus.</td>
</tr>
<tr>
<td>Reason:
Cluster Question #__4____
Question Type: Draw a Model
Addresses:
__x__ DCI: Inheritance of Traits
__x__ SEP: Developing and using a model
__x__ CCC: Cause and effect
Answer:

<table>
<tr><td></td><td>A</td><td>a</td></tr>
<tr><td>A</td><td>AA</td><td>Aa</td></tr>
<tr><td>a</td><td>Aa</td><td>aa</td></tr>
</table>
</td>
<td>Question 4:

Fill in the Punnett square for <u>wild</u> banana reproduction.
a. Female: Aa
b. Male: Aa

<table>
<tr><td></td><td colspan="2">Female</td></tr>
<tr><td rowspan="2">Male</td><td></td><td></td></tr>
<tr><td></td><td></td></tr>
</table>
</td>
</tr>
<tr>
<td>Reason:
Cluster Question #__5____</td>
<td>Question 5:</td>
</tr>
</table>

<table>
<tr>
<td>Question Type: Draw a Model
Addresses:
__x__ DCI: Inheritance of Traits
__x__ SEP: Developing and using a model
__x__ CCC: Cause and effect
Answer:

</td>
<td>Using your Punnett square to help you, draw a model of reproduction in <u>wild</u> bananas. Your model should show:
a. Number of banana parents
b. Chromosomes (alleles) of the parent(s)
c. Chromosomes (alleles) of four offspring
<table>
<tr><td colspan="2">Use this key to help with your model:</td></tr>
<tr><td>Banana parent</td><td></td></tr>
<tr><td>Dominant allele</td><td>A</td></tr>
<tr><td>Recessive allele</td><td>a</td></tr>
</table></td>
</tr>
<tr>
<td>Reason:
Cluster Question #__6____
Question Type: Draw a Model
Addresses:
__x__ DCI: Inheritance of Traits
__x__ SEP: Developing and using a model
__x__ CCC: Cause and effect
Answer:

</td>
<td>Question 6:

Draw a model of reproduction in <u>Cavendish</u> bananas. Your model should show:
a. Number of banana parents
b. Chromosomes (alleles) of the parent(s)
c. Chromosomes (alleles) of four offspring
<table>
<tr><td colspan="2">Use this key to help with your model:</td></tr>
<tr><td>Banana parent</td><td></td></tr>
<tr><td>Dominant allele</td><td>A</td></tr>
<tr><td>Recessive allele</td><td>a</td></tr>
</table></td>
</tr>
<tr>
<td>Communicate:
Cluster Question #___7___
Question Type: Long Answer
Addresses:
__x__ DCI: Variation of Traits</td>
<td>Question 7:

Using your Punnett square and your models, explain why Cavendish bananas are at risk of dying out, but wild bananas are less likely.</td>
</tr>
</table>

_____ SEP __x__ CCC: Cause and effect Answer: The Cavendish bananas we eat are at risk of dying out because they reproduce asexually and thus have lower genetic diversity than the wild bananas which reproduce sexually. This causes the Cavendish banana to be more likely to die from the fungus.	Idea bank: **sexual, asexual, variation, cause/effect**

Proficiency Scale

Proficient Student Explanation:

The Cavendish bananas we eat are at risk of dying out because they reproduce asexually and thus have lower genetic diversity than the wild bananas which reproduce sexually. This causes the Cavendish banana to be more likely to die from the fungus.

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:** Develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.	**SEP:** Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.	**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 routinely identify and explain a change.	**CCC:** Uses cause and effect relationships to predict phenomena in natural systems. Recognizes phenomena may have more than one cause, and some cause and	**CCC:** Extends beyond proficient in any way.

		effect relationships in systems can only be described using probability.	
DCI: Does not meet the minimum standard to receive a 2.	**DCI:** Organisms reproduce to create new organisms. Many characteristics of organisms are inherited from their parents. Different organisms vary in how they look and function because they have different inherited information.	**DCI:** Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. 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	**DCI:** Extends beyond proficient in any way.

		other.	

(Student Facing Format on following page)

Student Assessment

Name: ____ Date: ________

Stimulus

Though there are many types of bananas, the bananas that we eat are at risk of extinction!

Reading 1 - Changes in Bananas

Adapted from: Bananas Looked totally different in the 1940s — before disaster struck

Wild bananas make hard seeds that aren't good to eat. In nature, bananas reproduce by using sperm cells created inside pollen. This pollen lands on the female part of a flower. The pollen then fertilizes the plant's egg cell. This creates a seed that contains the offspring, and the flower develops into a fruit. Unfortunately for humans, most of the bananas that reproduce in this way are not good to eat.

Some bananas, like the ones you see at the grocery store, are edible. Humans grew the edible bananas they found and created a variety called the Cavendish banana, which is the most eaten banana around the world. However, this banana does not have seeds and can't reproduce on its own. This means the only way to keep growing these bananas is to use cuttings or clones from a single parent plant. Unfortunately, these bananas are at risk of dying out. The problem is a type of fungus that infects the roots of a banana tree and keeps the plant from taking in nutrients and water. This fungus has already wiped out one banana variety, the Gros Michel, which used to be the most popular banana. Bananas have a gene called RGA2 that makes them resistant to the fungus. This gene can be either **active** (represented by the allele A) and <u>resistant</u> to the fungus or **inactive** (represented by the allele a) and <u>not resistant</u>. Cavendish bananas typically have the inactive form of the gene and can't resist the fungus.

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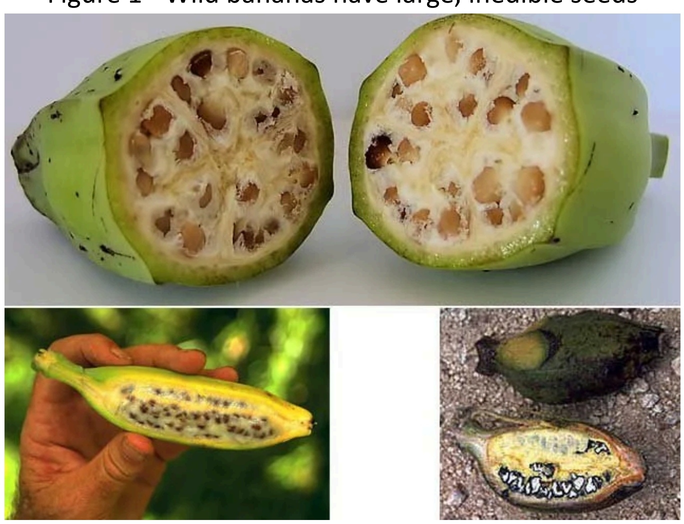

This image shows wild bananas with large, inedible seeds.

Figure 2 - Cavendish bananas on their way to the grocery store

This image shows cavendish bananas on their way to the grocery store.

Your Task

In the questions that follow, you will create and use a model to explain how sexual and asexual reproduction affect the survival of bananas.

Question 1

Complete the sentence below based on the information in **Reading 1**.

Wild bananas reproduce _(asexually/sexually)_, which means they have _(more/less)_ genetic diversity.

I know this because they have _(a clone / egg and sperm cells)_.

Question 2

Complete the sentence below based on the information in **Reading 1**.

Cavendish bananas reproduce _(asexually/sexually)_, which means they have _(more/less)_ genetic diversity.

I know this because they have _(a clone/egg and sperm cells)_.

Question 3

Complete the sentence below based on the information in **Reading 1**.

The wild bananas with the active genes (AA) _(would/would not)_ be protected against the fungus. The Cavendish bananas with the inactive genes (aa) _(would/would not)_ be protected against the fungus.

Question 4

Fill in the Punnett square for **<u>wild</u>** banana reproduction.

a. Female: Aa

b. Male: Aa

	Female	
Male		

Question 5

Using your Punnett square to help you, draw a model of reproduction in **<u>wild</u>** bananas. Your model should show:

a. Number of banana parents

b. Chromosomes (alleles) of the parent(s)

c. Chromosomes (alleles) of four offspring

Use this key to help with your model:	
Banana parent	
Dominant allele	A
Recessive allele	a

Question 6

Draw a model of reproduction in **<u>Cavendish</u>** bananas. Your model should show:

a. Number of banana parents

b. Chromosomes (alleles) of the parent(s)

c. Chromosomes (alleles) of four offspring

Use this key to help with your model:	
Banana parent	
Dominant allele	A
Recessive allele	a

Question 7

Using your Punnett square and your models, explain why Cavendish bananas are at risk of dying out, but wild bananas are less likely. Idea bank: **sexual, asexual, variation, cause/effect**