Seed Dispersal Teacher Guide

Seed Dispersal At-A-Glance

70 minutes

Guiding Question:
Why does fruit have seeds?

Concepts:
Fruit, plant reproduction, plants, seed dispersal, seeds, angiosperm, flowers

Investigation Objective (Inspired by the NGSS Performance Expectations):
Students explore the structure and function of fruit, seeds, and flowers to provide evidence-based explanations of how animal-mediated seed dispersal supports plant populations.

Science and Engineering Practices:	Disciplinary Core Idea:	Crosscutting Concepts:
Developing and Using Models Develop and/or use a model to predict and/or describe phenomena. **Constructing Explanations and Designing Solutions** Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.	**LS1.B: Growth and Development of Organisms** Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.	**Patterns** Graphs, charts, and images can be used to identify patterns in data. **Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

Student Objective:
Explain why fruit has seeds. Support your explanation with evidence.

Prerequisites:

To successfully complete this investigation, students should have the following prerequisite knowledge:

- Flowering plants have seeds of different shapes and sizes.
- Seeds play a role in plant reproduction.
- Fruit comes from plants.
- All flowers have seeds.
- In the wild, fruit has at least one seed.
- Mass is measured in grams and kilograms.

Investigation Overview:

In this investigation, students explore how seed plants grow and reproduce. They examine the relationship between flowers, fruit, and seeds and learn about several types of seed dispersal.

<table>
<tr><td>Activate
(5 minutes)</td><td>Students watch a short video of a dragon fruit being sliced open and answer questions to support engagement.</td></tr>
<tr><td>Observe and Check
(45 minutes)</td><td>

Fruits: Seeds and Mass Data Manipulative Students explore data comparing the mass and number of seeds of various fruits.
Seed Plants Movie Students learn how seed plants grow and reproduce.
Seed Dispersal “Flora and Fauna” Related Reading Students read about the transformation of flowers into fruit and examine the characteristics of fruit that promote seed dispersal.
Seed Dispersal Worksheet Students compare and contrast several methods of seed dispersal.

Throughout this step, students complete quick, formative assessments to check their understanding of the completed resources and ensure they are prepared to answer the Guiding Question with a claim, evidence, and reasoning. Options for the Checkpoints:
<table>
<tr><th>Graded Mode</th><th>Review Mode</th></tr>
<tr><td>On submission, students see their score and the correct answers for review.</td><td>Students proceed to the next question when they select the correct answer.</td></tr>
</table>
</td></tr>
<tr><td>Explain
(15 minutes)</td><td>Students develop a Claim, Evidence, and Reasoning to answer the Guiding Question: Why does fruit have seeds?</td></tr>
<tr><td>Reflect
(5 minutes)</td><td>Students reflect on connections between what they have learned in this investigation and other aspects of their lives and experiences by answering the question: What questions do you still have after completing this lesson?</td></tr>
</table>

Academic Vocabulary:

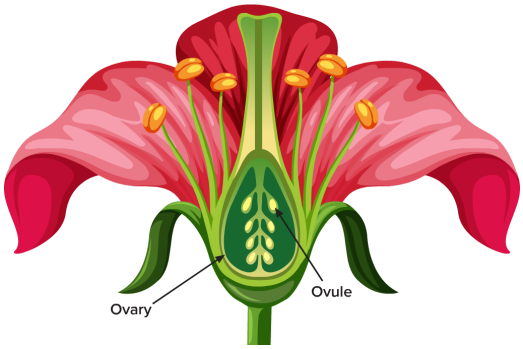
- **Angiosperm**
- Animal-mediated
- Disperse
- Excrete
- **Fruit**
- Native
- **Ovary**
- **Ovule**
- Pollen
- Pollination
- **Seed**
- **Seed dispersal**

Seed Dispersal In-Depth

The Science!

Plants can be classified as those with seeds (**seed plants**) and those without seeds (**seedless plants**). Seedless plants include ferns, mosses, and liverworts. These plants reproduce using spores. Seed plants are much more diverse, so they are further classified as either **angiosperms** (flowering plants) or **gymnosperms** (non-flowering plants). More than 80% of all living plant species are angiosperms, including almost all food crops. Angiosperms are defined by the presence of seed-bearing flowers and fruit. Gymnosperms have neither fruit nor flowers, and instead have "naked" seeds often stored in cones. Examples of gymnosperms include conifers and ginkgo trees.

The focus of this investigation is on angiosperms and their flowers, fruit, and seeds. The **ovary** (shown in the diagram to the right) is part of the female portion of the flower structure, collectively known as the **pistil**. The flower's ovary houses one or more **ovules**. The flower is pollinated when pollen grains travel down the pistil and reach the ovule(s). The pollen can come from the flower's own male structures, collectively known as the **stamen**, or from the stamen of another flower. This results in self-pollination or cross-pollination, respectively. When pollen grains join ovules, fertilization occurs and the flower begins to die.



Even though the flower's petals wither and fall off, the ovary continues to grow. It changes color and shape and eventually becomes **fruit**. The flower's ovules are now referred to as the fruit's **seeds**. This means, for example, that a flower that has four ovules in its ovary will produce a fruit containing four seeds. Seeds are protected by the fruit's flesh and usually have their own hard coats or shells. Each seed contains a plant **embryo** capable of growth once it has access to the required amounts of water and sunlight. This usually means that seeds need to be **dispersed** away from the parent plant.

One vehicle for dispersal is fruit. Fruit is an enticing meal for many animals because it is often sweet, soft, and colorful. Animals typically consume the whole fruit and its seeds. As they fly or roam, animals excrete the seeds in new places. If conditions are suitable, the seeds will begin to sprout. Other types of **animal-mediated seed dispersal** include carrying seeds to new places (e.g., burs tangled in fur) and burying seeds (e.g., squirrels and acorns). Seed dispersal can also occur without animals, via water, wind, and fire. A plant's habitat and the physical characteristics of its seeds often determine which type of dispersal is most likely to occur.

Student Misconceptions and Common Struggles

During this investigation, you may hear some common misconceptions about seeds and seed dispersal. Identifying misconceptions can help determine which resources students should explore more in depth or which additional resources to assign. For example:

Student Misconception or Common Struggle	Relevant Scientific Concept	Response To Misconception or Common Struggle
Plants can grow flowers or fruit but not both.	Fruit comes from flowers. This means that all plants that grow fruit also grow flowers. As a group, flowering plants are referred to as angiosperms. When an angiosperm's flower is pollinated, its	Reassign Seed Dispersal "Flora and Fauna" Related Reading *Ask: What is the relationship between flowers and fruit?*

	petals begin to wilt and die. However, the flower's ovary and ovules remain. These parts eventually develop into fruit and seeds, respectively.	
Plants are neither male nor female and cannot reproduce sexually.	Many plants possess male and female parts in each flower. The female portion of a flower is referred to as the pistil. The pistil includes the stigma, style, ovary, and ovule. Recall that ovaries can develop into fruit and ovules can develop into seeds. The male portion of the flower—made up of anthers and filaments—is referred to as the stamen. The stamen produces pollen (the plant's male sex cells) while the pistil houses the ovules (the plant's female sex cells). Plants can self-pollinate if pollen and ovules from the same flower meet in a process called fertilization. Plants can also cross-pollinate if the pollen from one plant's flower fertilizes another plant's ovules. Because there are male and female sex cells involved, both self-pollination and cross-pollination are examples of sexual reproduction.	Reassign Seed Dispersal "Flora and Fauna" Related Reading *Ask: Do you think self-pollination and cross-pollination are examples of sexual reproduction or asexual reproduction? Why?*
All plants have seeds.	Not all plants grow from seeds, nor do all plants produce seeds. Seedless plants can be vascular (with roots, stems, and leaves) or nonvascular (without roots, stems, or leaves). Club mosses, ferns, and horsetails are examples of vascular seedless plants. On the other hand, liverworts, hornworts, and mosses are examples of nonvascular seedless plants. Despite differences in vascularity, all seedless plants either reproduce asexually or using structures called spores. Spores are reproductive cells that can develop into adult plants on their own, without fertilization by another reproductive cell.	Assign Seedless Plants movie *Ask: Identify several examples of seedless plants. Aside from being seedless, what makes these plants different from seed plants? What makes them similar?*

INVESTIGATION ROADMAP

Read the Guiding Question aloud: Why does fruit have seeds? Explain that students will investigate resources and record observations to answer this question.

ACTIVATE

Step 1	Phenomenon
This resource assesses prior knowledge and captures students' interest using a short video of a dragon fruit being sliced open to reveal the flesh and seeds inside.	
• Have students view the short dragon fruit video and then answer the Activate questions in the resource. Discuss answers to check for understanding. 1. The fruit shown in the video is called a dragon fruit or pitaya. Describe what the inside and the outside of the dragon fruit look like. [*Possible answer: The fruit has pink skin with green-tipped spikes. The inside of the fruit has white flesh with many small black seeds spread throughout.]* 2. Use the video to estimate how many seeds are found in a dragon fruit. (You don't need to count them! Just provide an estimate). [*Answers will vary. Each dragon fruit contains 1,000–1,500 seeds.]* 3. Like dragon fruits, many of the fruits we eat are sweet and colorful. However, it takes a lot of energy for a plant to produce sugary, delicious fruits. What benefits do you think a plant gets from having fruit? *[Possible answer: Fruits contain a plant's seeds. When fruit is eaten, its seeds can be transported over significant distances in an animal's digestive system. Fruit that is sweet and colorful is more likely to be noticed and eaten by an animal.]* 4. Plants are described as *native* to a place if they grow there naturally, without human involvement. Dragon fruits are native to Central America, South America, and the Caribbean islands. How do you think dragon fruits were able to grow in places separated by hundreds of miles of ocean? [*Possible answer: The seeds from dragon fruit must have traveled across those distances either by floating in water or in the digestive systems of birds.]*	
Expected Outcome: Students examine the video and apply prior knowledge of fruit and seeds.	

OBSERVE AND CHECK

Step 2	Fruit: Seeds and Mass Data Manipulative
This resource is a scatter plot comparing the mass and number of seeds in a variety of fruits. Students are prompted to manipulate the data and identify trends.	
• Instruct students to examine the data and then answer the questions in the resource. Discuss answers to check for understanding.	

1. Of the fruits represented in the graph, which one has the greatest mass?
   [*Answer: According to the graph, the pumpkin has the greatest mass: 6745 grams.]*
2. Of the fruits represented in the graph, which one has the most seeds?
   [*Answer: According to the graph, the muskmelon has 850 seeds, the most of any fruit shown.]*
3. Click on the Model Data icon in the toolbar (three dots separated by a diagonal line). Then, select "Least Squares Line." This line is used to represent overall data trends. Use the least squares line to summarize the relationship between a fruit's mass and its number of seeds.
   [*Possible answer: The least squares line shows that fruits with greater masses generally contain more seeds.]*
4. Identify a fruit with a data point located far from the least squares line. What about this fruit's mass or seeds makes it different from the others in the graph?
   [*Students should identify either the muskmelon or the pumpkin. If students identify the pumpkin, a possible answer is: The pumpkin is different from the other fruits in the graph because it has fewer seeds than would be expected for its mass. If students identify the muskmelon, a possible answer is: The muskmelon is different from the other fruits in the graph because it has a relatively low mass but a large number of seeds.]*
5. If you were to remove the data point representing the fruit you named in Question 4, what do you think would happen to the least squares line? (Hint: Would the line change direction, flatten out, get steeper, or do something else?)
   [*If students identified the pumpkin in Question 4, a possible answer is: If the pumpkin data point were removed, the least squares line would get flatter. If students identified the muskmelon in Question 4, a possible answer is: If the muskmelon data point were removed, the least squares line would get steeper.]*

Differentiation

Extend and Deepen Learning:	Provide Extra Support:
Ask students to pick four to five of the fruits represented in the graph. Then, direct students to find images showing the interior of each of their selected fruits (ideally cross-sections). Students should make predictions about how many seeds might come from a single fruit. Identify a few types of fruit that do not follow the trend shown in the graph. Examples of these fruits are berries, mangos, and coconuts. Provide students with information about each fruit's mass and number of seeds and then ask them to describe how adding these data points would affect the graph's least squares line.	Guide students to understand the graph by explaining the labels and units on the x-axis and y-axis. Then, show a picture of each fruit while identifying its data point. Ideally, the pictures should show students the whole fruits and the seeds. Project the graph onto a writing surface like a smartboard or a whiteboard, or recreate the graph. Label each data point with the fruit's name. Ask students to identify trends they notice and where additional fruit might be located on the graph.

Discussion Questions

- How would you summarize the information in this graph in one sentence?
  [Possible answer: Fruits with greater masses usually have more seeds than fruits with smaller masses.]
- Why do you think the number of seeds usually increases as the mass of the fruit increases?
  [Possible answer: The amount of energy used by the plant to produce the fruit would not be worth it if it did not greatly increase the chance of reproduction (as more seeds generally does).]

- What is a possible reasoning for the outliers on the graph?
  [Possible answer: The type of environment the plant grows in might allow it to have more energy and not need as many seeds to reproduce. Also, the size of the seeds might affect these numbers. Larger seeds might have advantages in certain climates, and smaller seeds have advantages in others.]
- You've probably noticed seedless fruits in the grocery store. Some fruits that are now sold in "seedless" varieties are watermelons, grapes, and oranges. How do you think adding these fruits to the graph would affect the overall pattern it shows?
  [*Possible answer: Adding seedless fruits probably wouldn't change the trend line much, since the trait is developed in fruits of all different masses. We would see more points clustered near the y-axis, where x (Seeds per Fruit) equals zero.]*

Expected Outcome: Students will be able to

- Identify patterns in a scatterplot comparing the mass and number of seeds in various types of fruit.
- Describe how adding or removing seedless fruits would affect the graph's trendline.

Step 3	**Seed Plants Movie**

This resource explores the growth, development, and reproductive strategies of gymnosperms and angiosperms.

- As students watch the movie, consider asking these questions to support understanding:
  1. What is a seed?
     [Possible answer: A seed is a tiny undeveloped plant in a protective coating.]
  2. What are some examples of seed plants?
     [Answers will vary. Possible answers include trees, flowers, fruits, and vegetables, etc.]
  3. How are flowers and fruit related?
     [Possible answer: Once a flower is pollinated, it begins to die and eventually forms fruit. The seeds from the flower remain protected inside the fruit.]
  4. Most plants that people grow in their gardens or yards are seed plants. Why do you think that is the case?
     [Possible answer: Seed plants are often easier to sell. Humans buy the seeds and then plant them. Seedless plants would need to be sold and planted as a whole plant since they don't have seeds. Additionally, many seed plants have flowers. These are decorative and appealing for people to plant.]

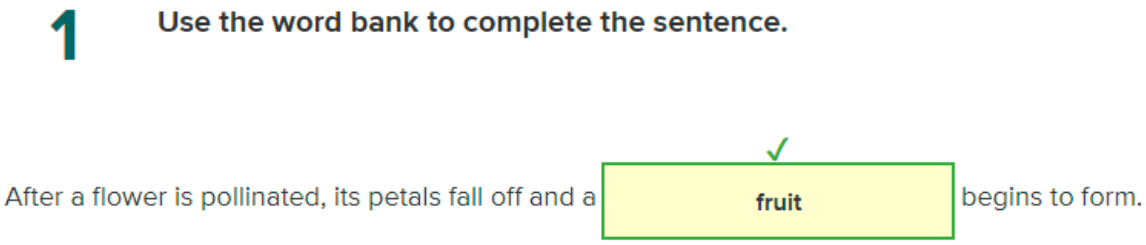
Differentiation

Extend and Deepen Learning:	**Provide Extra Support:**
Have students identify four to five examples of angiosperms and gymnosperms and create a Venn diagram to compare and contrast characteristics of both groups. Alternatively, provide students a list of terms from the movie (e.g., seed plant, seedless plant, angiosperm, gymnosperm, flower, seed, cone, monocot, dicot, conifer, and needles). Students should use these terms to create a concept	If possible, show students a living example of a seed plant and a seedless plant (e.g., moss or ferns). After students watch the movie, guide them to make a list of differences between seed plants and seedless plants. To support students as they learn new vocabulary, work together to make a branching diagram to sort terms from the movie. Begin with

map. Have students include a brief description of each word cluster to explain why they grouped those words together. If time permits, have students view their peers' concept maps and then discuss differences and similarities among them.	"seed plants" and "seedless plants." Then, divide seed plants into "gymnosperms" and "angiosperms." Next, divide angiosperms into "monocots" and "dicots," and so on. Have students define each term as you add it to the diagram. Then, watch the movie again with students, pausing to point out the terms on the branching diagram.

Checkpoint 1

After completing this resource, students are prompted to submit an automatically-scored question to check their understanding.



Expected Outcome: Students will:

- Differentiate between seed plants and seedless plants.
- Describe the general structure and function of seeds.
- Briefly describe the process of pollination.
- Articulate the relationship between flowers and fruit.

Step 4	**Seed Dispersal "Flora and Fauna" Related Reading**

This resource describes how fruit develops from flowers. It also defines seed dispersal and its role in the spread of plant populations over great distances.

- Direct students to read the informational text and record observations about different types of seed dispersal.
- After students finish reading, consider asking these questions to support understanding:
  1. Think of the last plant you saw, whether it was outside or on your plate. Would you classify that plant as an angiosperm? Why or why not?
     [Answers will vary. Most plants students cite will likely be angiosperms, including grass, weeds, trees, fruit, grains, nuts, and the majority of vegetables. Examples of common gymnosperms (non-angiosperms) are conifers.]
  2. The reading tells us that animals usually eat an entire fruit, including its flesh, stem, and seeds. What characteristics do you think a seed would need to have in order to survive a trip through an animal's digestive system?
     [Possible answer: Most seeds have a protective outer shell or coating that helps the plant embryo inside survive passage through an animal's digestive system.]

3. Why do seeds need to be dispersed?
   [Possible answer: Seeds need the proper amount of soli, light, and water and need to leave the area very close to the parent in order to get them.]
4. What would happen if an animal chewed up a seed? Would that stop seed dispersal?
   [Possible answer: If the animal chewed up the seed it would no longer be able to grow. This could stop seed dispersal for that plant, but this is why many fruits have lots of seeds.]
5. Which plant do you think would be better able to reproduce and increase in an area: one that has sweet fruit or one whose fruit makes animals throw up? Why?

   [*Possible answer: The plant with sweet fruit will be more successful. Sweet fruit is much more likely to be eaten by animals so seed dispersal can occur. While throwing up a fruit's seeds could also contribute to dispersal, animals are less likely to return to a plant that made them sick, limiting how often the fruit is actually consumed.]*

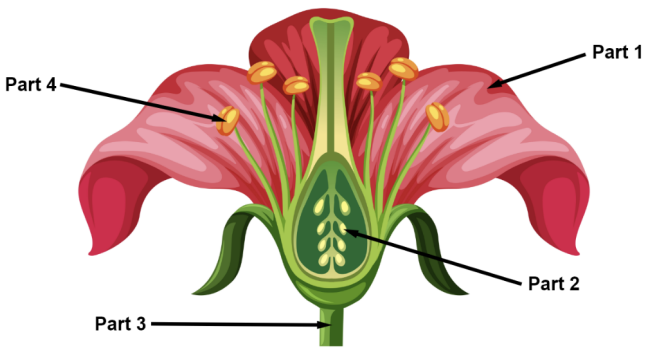
Differentiation

Extend and Deepen Learning:	Provide Extra Support:
Ask students to design the ideal fruit. Clarify that this fruit will only grow in the wild and thus rely on seed dispersal, but its traits are up to students to decide. Students should draw a diagram of their imaginary fruit, labeling its parts. The diagram should show the outside of the fruit as well as a cross-section of the inside. Students should include a brief description of why they chose each of their fruit's traits, focusing on the number of seeds, size, color, the presence or absence of a hard shell, and the target animal consumers.	Read the passage aloud with students, stopping after each paragraph to ask students to summarize. Record each summary sentence so that when the entire passage has been read, there is a summary paragraph. To help engage students, show a video of wild animals consuming different fruits. Ask students to identify how animals eat fruits differently than people do and how that affects seed dispersal.

Checkpoint 2

After completing this resource, students are prompted to submit an automatically-scored question to check their understanding.

1



In the image, four parts of a flower are labeled 1 through 4. Which part of the flower is most likely to develop into seeds?

- ○ Part 1
- ◉ Part 2 ✓
- ○ Part 3
- ○ Part 4

2 **What is the purpose of seed dispersal?**

- ○ To keep the seeds of a parent plant close together
- ○ To help all plants in one area sprout at the same time
- ◉ To spread seeds to places where they can successfully sprout ✓
- ○ To increase competition for soil and nutrients among related plants

Expected Outcome: Students will . . .

- Use a diagram to identify a flower's ovules and ovary.
- Describe the structure and function of flowers, fruit, and seeds.
- Define seed dispersal as the movement of seeds away from their parent plant.
- Identify multiple methods of seed dispersal.

Step 5	**Seed Dispersal Worksheet**

This resource describes multiple types of seed dispersal and prompts students to make inferences about what type of dispersal is most likely to occur based on a seed's characteristics.

- Direct students to read the Worksheet and then answer the questions in the resource. Then, discuss answers to check for understanding.
  1. Based on this information, how would you define the word *disperse*?
     [*Possible answer: Disperse means to spread something out, especially over a large area.]*
  2. The flowering plant shown above is known as Colorado blue columbine. This species grows on cold, rocky mountains. Do you think it's more likely for the columbine's seeds to be dispersed by water, fire, or wind? Why?
     [*Possible answer: The seeds are most likely to be dispersed by wind. The plant's habitat is described as cold and rocky, suggesting that not much water is present. Also, because the habitat is cold, fire is not likely to occur. Mountains are often very windy, so many mountain plants are likely to rely on wind to disperse their seeds.]*

Student instructions: Now, examine the three images below. Then, considering the structure and characteristics of the seeds shown, decide what type of animal-mediated dispersal (burying, eating, or carrying) is most likely to occur. Justify your answer.

	Possible answer: This seed is most likely to be dispersed by carrying. The seed is covered in spikes that could easily get tangled in an animal's fur.
	Possible answer: This seed is most likely to be dispersed by burying. The seed is too smooth to catch in an animal's fur, and the hard outer shell will make the seed difficult to eat. However, this structure will make it easy for an animal to bury.
	Possible answer: These seeds are probably dispersed by eating. The seeds are surrounded by fruit. As a result, animals are likely to eat the fruit and disperse the seeds through excretion.

Differentiation

Extend and Deepen Learning:	Provide Extra Support:
Direct students to create a three-column chart with Carrying, Burying, and Eating as column heads. Then, have students list two to three examples of each animal mediated seed-dispersal method, such as birds eating berries. Students should compare and contrast the habitats, animal consumers, and seed characteristics for each method. Ask students to describe trends they find.	Read through the first paragraph aloud and work with students to come up with a class definition for the word "disperse." Ask students to think-pair-share answers for Questions 1 and 2. Repeat the same procedure for the second half of the Worksheet. If possible, bring in examples of different types of seeds for students to hold. This can include acorns, apple seeds, an avocado pit, maple "helicopters," dried peas, burs, and sunflower seeds. After students complete the Worksheet, work with them to sort the sample seeds into those that are most likely to be carried, buried, and eaten.

Checkpoint 3

After completing this resource, students are prompted to submit an automatically-scored question to check their understanding.

1

The seeds shown here come from a burdock plant. Burdocks grow in moist soil across most of the United States.

Considering the structure of burdock seeds, how is seed dispersal most likely to occur?

- ○ Animals eat the seeds
- ○ The wind carries the seeds
- ○ Squirrels bury the seeds
- ◉ The seeds stick in animal fur ✓

Expected Outcome: Students will:

- Identify examples of plants whose seeds are dispersed by water, wind, and fire.
- Distinguish among three types of animal-mediated seed dispersal (carrying, burying, eating).
- Make inferences about the likeliest method of dispersal given a seed's physical characteristics.

EXPLAIN

Step 6	Claim, Evidence, Reasoning
Students will now use their evidence to construct a Claim, Evidence and Reasoning answer to the Guiding Question: Why does fruit have seeds?	
Expected Outcome: Students write a scientific claim using collected evidence and scientific reasoning. See rubric below.	

REFLECT

Step 7	Student Reflection
Students answer a reflection question to consider their experience with the investigation.	
What questions do you still have after completing this lesson?	
Expected Outcome: Students will reflect on any questions they may still have after completion of the investigation.	

Claim, Evidence, and Reasoning (CER) Framework Rubric

Please use the rubric as a guide and adjust accordingly for your specific needs and use.

	0	1	2	3
Claim Statement that answers the Guiding Question	Not attempted	Claim is attempted but it: ☐ Does not answer the Guiding Question ☐ Is not accurate or relevant	Claim attempts to answer the Guiding Question but it: ☐ Is incomplete ☐ Is not completely accurate	Claim is present and it: ☐ Completely answers the Guiding Question ☐ Is scientifically accurate
Evidence Scientific data and observations that support the claim	Not attempted	☐ Evidence is attempted ☐ Evidence is inaccurate, inappropriate, or irrelevant	☐ Has at least one piece of evidence that supports the claim ☐ Some evidence is missing, inaccurate, or irrelevant	☐ Has two or more pieces of evidence that sufficiently support the claim ☐ Does not include any inaccurate or irrelevant evidence
Reasoning Scientific principle(s), concepts, and definitions that connect evidence to the claim	Not attempted	Reasoning is attempted but it: ☐ Does not link the claim to the evidence ☐ Includes unrelated scientific principles ☐ Is not scientifically accurate	Reasoning is present but it: ☐ Only connects some evidence to the claim ☐ Only cites some of the relevant scientific principles ☐ Includes some inaccuracies	Reasoning is present and it: ☐ Sufficiently and clearly links all evidence to the claim ☐ Includes only relevant scientific principle(s) ☐ Is scientifically accurate

Example Claim, Evidence, and Reasoning (CER) Responses

The following are three sample student responses (*Meets Expectations, Approaches Expectations,* and *Needs Improvement*). Please note that student claims, evidence, and reasoning will vary and should be assessed individually using the rubric above.

Guiding Question: Why does fruit have seeds?

Meets Expectations:

Claim	Fruit creates a tasty carrier for a plant's seeds, increasing the likelihood that they are eaten and dispersed by animals.

Source	Evidence
Fruits: Seeds and Mass Data Manipulative	Fruits with greater mass tend to have more seeds.
Seed Plants movie	Seeds are small plants with a protective coating.
Seed Dispersal "Flora and Fauna" Related Reading	Seed dispersal is the movement of seeds away from their parent plant.
Seed Dispersal "Flora and Fauna" Related Reading	A seed needs the right amount of soil, water, and sunlight, and this usually means it needs to be transported away from the parent plant.
Seed Dispersal Worksheet	Animals sometimes eat seeds and then excrete them.
Seed Dispersal Worksheet	The type of dispersal that happens depends on a seed's physical characteristics.

Reasoning	**Fruits** form on **angiosperms**, or flowering plants, from pollinated flowers. The seeds that were originally in the flower as **ovules** remain inside the fruit as **seeds**. Fruits are usually sweet and juicy, making it more likely for animals to eat them, seeds and all. When this happens, seeds don't get digested by the animal, so when they poop, the seeds are still fine and have a new place to grow. This is an example of **animal-mediated seed dispersal**. Seeds can also get dispersed by wind and water. The plant needs to disperse the seeds so it has a better chance of reproducing. Some plants produce more seeds so there is a greater chance of success.

Scoring Rationale:

- Claim (3 points) - The student's claim is scientifically accurate and fully answers the Guiding Question.
- Evidence (3 points) - The response includes at least two pieces of evidence that are scientifically accurate and clearly relate to the claim. The claim is sufficiently supported by the evidence provided.
- Reasoning (3 points) - The student's reasoning thoroughly explains how the evidence supports the claim. The reasoning is scientifically accurate and explicitly mentions relevant scientific principles (shown above in bold).

Approaches Expectations:

Claim	Fruits have seeds so they can grow more plants.

Source	Evidence
Fruits: Seeds and Mass Data Manipulative	Bigger fruits have more seeds.
Seed Dispersal “Flora and Fauna” Related Reading	Flower ovules turn into seeds.

Reasoning	Fruits have lots of seeds, especially if they are bigger fruits with greater mass. Animals eat fruit and then poop, spreading the seeds out to new places. This helps the plants grow and reproduce successfully. The fruit tastes good so animals are more likely to eat it, but some seeds can also spread in the air or water.

Scoring Rationale:

- Claim (2 points) - The claim attempts to answer the Guiding Question but it is not entirely accurate.
- Evidence (2 points) - There is at least one piece of evidence that is scientifically accurate and clearly relates to the claim. However, there is some evidence missing.
- Reasoning (2 points) - The student’s reasoning connects some of the evidence to the claim and is generally accurate. However, it does not mention all relevant scientific principles.

Needs Improvement:

Claim	In order to be a fruit and not a vegetable, seeds have to be inside the plant.

Source	Evidence
Seed Plants movie	Monocots and dicots are the two classes of angiosperms.

Reasoning	Fruits have seeds in them because if they didn't they wouldn’t live. Seeds help the fruit to survive and live longer on the ground. The fruit makes the seeds.

Scoring Rationale:

- Claim (1 point) - A claim is present but it is neither entirely accurate nor completely relevant.
- Evidence (1 point) - One piece of evidence is included but it is not relevant to the claim.
- Reasoning (1 point) - Reasoning is attempted but it is scientifically inaccurate. It does not explain how the evidence supports the claim, nor does it mention the relevant scientific principles.