Introduction:

The Teacher Guide is designed to support teachers in teaching with the new Mystery Science Anchor Layer. This is a new feature, and we plan to revise and improve the Anchor Layer based on your feedback! Thank you!

What is the Anchor Layer?

In NGSS instruction, there is a distinction between *anchor* phenomena and *investigative* phenomena. Anchor phenomena are complex phenomena that students need an entire unit, and multiple scientific ideas, to explain. Investigative phenomena are specific, lesson-level phenomena that help students understand smaller conceptual pieces of a larger idea. As students investigate specific phenomena, they can use those learnings to make sense of the anchor phenomenon that guides the unit.

We think of our traditional lessons as investigative phenomena. This new Anchor Layer adds an anchor phenomenon to open and frame the unit. After each lesson, students return to the anchor phenomenon and apply what they've learned to develop increasingly sophisticated models, arguments, explanations or design solutions that help them make sense of the anchor phenomenon.

We've designed the Anchor Layer to be optional for teachers. Teachers can teach our lessons with or without the Anchor Layer.

Storylines:

Storylines provide a coherent overview of how the Anchor Layer unfolds, what students are figuring out at each step, and questions that lead to the next investigation. **View Anchor Layer Storylines**

Before Lessons

I. Anchor Phenomenon
Observe puzzling, complex real-world events explained through scientific evidence

II. Student Inquiry
Make observations and ask questions

III. Initial Student Ideas
Develop initial Conceptual Model, Argument, Explanation, or Design Solution

During Lessons

IV. Investigative Phenomena
Investigate specific real-world events that provide conceptual pieces to a larger idea

V. Student Revision
Revise Conceptual Model, Argument, Explanation, or Design Solution

After Lessons

VI. Performance Task
Demonstrate conceptual understanding in a new scenario

Power of Flowers Anchor Layer

Teacher Guide

TEACHER RESOURCE

Unit Overview

Key Concepts Overview:

- **Seeds** are baby plants.
- Flowers are plant **structures** with the primary **function** of producing seeds.
- When flowers produce seeds, the seeds are frequently contained in **fruit.** Fruits are the seed-containing structures produced by plants.
- Living things have variable **traits**. Many traits are passed from one generation to the next, but there is almost always variation in the traits of the next generation.
- Humans **select** for certain desirable traits in plants by only planting seeds that came from plants exhibiting those desirable traits.

3-Dimensional Alignment	
Crosscutting Concepts	**Systems and system models** **Cause and effect** **Structure and function**
Science and Engineering Practices	**Developing and Using Models** **Constructing Explanations** **Engaging in Argument from Evidence**
Disciplinary Core Ideas	**LS1.B: Growth and Development of Organisms** **LS3.A: Inheritance of Traits** **LS3.B: Variation of Traits**
Performance Expectations	**3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.** **3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.**

Unit Pacing Guide			
Anchor Phenomenon	1.5 hours	**Lesson 3**	1.5 hours
Lesson 1	1.5 hours	**Lesson 4**	1.5 hours
Lesson 2	1.5 hours	**Performance Task**	2.5 hours
Note: Using Extensions for lesson 1-4 can extend each lesson up to an additional 2 hours.			

TEACHER BACKGROUND INFORMATION

Anchor Phenomenon Explanation

Who is moving and burying the stinky seeds?



There are many examples of seeds being dispersed in nature through a variety of means. Wind blows dandelion seeds, coconuts float to new places via ocean currents, some types of seeds get tangled in the fur of animals and are carried to new places.

Scientists in South Africa were studying how seeds from the silver arrow reed plant were being dispersed. The plant produced seeds that were a good size for small animals such as mice to eat, but the outer seed coat is both very hard and has a very unpleasant odor. Small mice were found to be uninterested in the stinky seeds. However, motion-sensitive cameras caught the animals that were responsible for moving the seeds: small dung beetles!

Dung beetles are able to eat a variety of foods, but animal dung is one of their primary food sources. Many dung beetles gather dung, roll it away to new places, and bury it. Buried dung can be used as a food source or to lay eggs into. Dung beetle larva emerge from the eggs and have the dung immediately available as a food source.

Based on the fact that the dung beetles treat the stinky seeds in the exact same way that they treat dung, scientists have concluded that the beetles are actually confusing it with dung. Unfortunately for the beetles, it doesn't appear as though they realize the mistake until they have already gone through the work of burying the seeds.

Power of Flowers Anchor Layer

Teacher Guide

BEFORE LESSON 1

Anchor Phenomenon

I. Anchor Phenomenon

Puzzling, complex real-world events explained through scientific evidence

1. Prepare your classroom for the Anchor Phenomenon lesson:
   a. Create a class See-Think-Wonder chart
   b. Print one copy per student of the Stinky Seeds worksheet
2. Begin the Anchor Phenomenon lesson. The lesson includes visuals and text describing the fact that the seeds are being moved and buried for unknown reasons.

Tip: *The unit anchor phenomenon is a real-world occurrence that motivates students to ask questions and learn more about scientific concepts. Encourage them to investigate throughout the unit.*





II. Student Inquiry

Students make observations and ask questions

1. Pass out See-Think-Wonder charts to students.
2. Students complete the first column *(I see…)* for the images displayed. We recommend using the Think-Pair-Share strategy for this activity.
3. Discuss class responses and write them in your class See-Think-Wonder chart.
4. Repeat Steps 2-3 for the second *(I think…)* and third *(I wonder…)* columns.

Tip: *The chart on the next page provides possible student responses. Use this resource to help you further the See-Think-Wonder discussion with your students.*

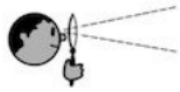
BEFORE LESSON 1

Anchor Phenomenon

II. Student Inquiry (continued)
Students make observations and ask questions

Sample student See-Think-Wonder responses

See-Think-Wonder Chart

See What did you observe? 	Think How can you explain what is happening? 	Wonder What questions do you have? 
• *Small brown seeds* • *Holes in the ground* • *Some seeds are buried, and some aren't*	• *Mice are burying the seeds* • *The seeds are being blown by the wind*	• *Is an animal burying the seeds?* • *Why do the seeds stink?* • *Are the seeds being buried because they smell bad?*

BEFORE LESSON 1 (continued)

III. Initial Student Ideas

Develop initial Conceptual Model, Argument, Explanation, or Design Solution

Students follow the step-by-step directions in the lesson to create an initial description of what is happening with the seeds and why. Their model should try to explain how the seeds form, how and why they are being moved, and how and why they are being buried.

Throughout the unit, students learn new concepts and conduct investigations to help them understand how plants reproduce and how animals can affect this process.

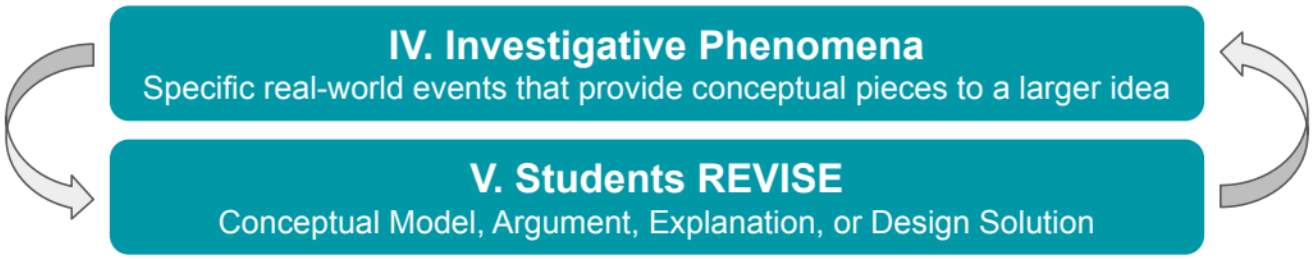
1. When instructed to do so in the Anchor Phenomenon lesson slides, pass out the Stinky Seeds worksheet.
2. Have students write and/or draw their initial explanation of how the seeds form, how and why they are being moved, and how and why they are being buried.
3. Small Group Discussion: Students discuss their initial thoughts.
4. Students can then update their initial explanations based on any new ideas that come up during the small group discussion.

Crosscutting Concepts: Cause and Effect, Systems

- This is a great opportunity to reinforce the crosscutting concepts of **cause and effect** and **systems**.
- A **system** is a group of related parts that interact with one another. Seeds can't move and bury themselves, so there must be at least one part of this system that we don't yet know about.
- When the parts of a system interact with one another, those interactions **cause** certain **effects** to occur.
- Students describe the various **causes** that are behind this bizarre situation.

Matrix of Crosscutting Concepts in NGSS

DURING LESSONS



1. Teach the lesson (Investigative Phenomenon).
2. **Anchor Connection (after Activity):**
   a. After the Activity of each lesson, continue advancing through the slides to the Anchor Connection.
   b. Discuss the **Anchor Phenomenon Connection** questions.
   c. Revise the Stinky Seeds sheet to include new information learned in each lesson.

Lesson *(Investigative Phenomenon)*	**During the Anchor Phenomenon Connection slides, guide students toward these ideas:**	**If they haven't already, students can update their explanations and/or drawings by:**
Lesson 1: Why do plants grow flowers? *(3-LS1-1)*	Flowers are structures that produce seeds. The stinky seeds are formed in flowers at the tips of the plant. The flowers don't look quite like flowers from other plants, but they function in very similar ways.	• Drawing seeds into the flowers • Explaining that the seeds are made in the flowers
Lesson 2: Why do plants give us fruit? *(3-LS1-1)*	Fruit are structures that plants produce that contain seeds. Many animals eat the fruit that plants produce. The dung beetles have confused the seeds as their source of food -- which is not fruit, but poop! They collect the seeds exactly the way they normally would collect their food: by rolling it away.	• Explaining that dung beetles are responsible for moving the seeds

DURING LESSONS

Continued from page 8

Lesson *(Investigative Phenomenon)*	**During the Anchor Phenomenon Connection slides, guide students toward these ideas:**	**If they haven't already, students can update their explanations and/or drawings by:**
Lesson 3: Why are some apples red and some green? *(3-LS3-1)*	The stinky seeds have a variety of traits that cause the dung beetles to treat them as if they are poop. When compared with poop from animals that live in this area, the seeds are a similar size, shape, and color, and have a similar smell. These traits cause the dung beetles to treat the seeds exactly as they treat dung. This includes burying the seeds. Dung beetles lay eggs into the balls of dung they bury, but they can't do this with the seeds.	• Explaining which traits the seeds have that cause the dung beetles to roll the seeds away and bury them • Explaining that the beetles bury the seeds because they normally bury dung so that they can lay eggs into it
Lesson 4: How could you make the biggest fruit in the world? *(3-LS3-1)*	In Lessons 3 and 4 of this unit, students learned about how people can produce plants with specific traits by being selective in which seeds they choose for the next generation of plants. The dung beetles are effectively doing the same thing by selectively burying stinky seeds.	• Adding a new plant that has grown from the buried seeds, and predicting that the new plant will grow even stinkier seeds because of what the dung beetles chose to bury

AFTER LESSONS

Performance Task Lesson

VI. Performance Task

Students demonstrate conceptual understanding

The performance task is an opportunity for students to apply their conceptual understanding to a new scenario. In this performance task, students will use models of the life cycles of the dung beetle and silver arrow reed plant to predict how each organism is influenced by the other.

Crosscutting Concepts:
Cause and Effect

- This is a great opportunity to reinforce the crosscutting concept of **cause and effect**.
- The stinky seeds have a variety of traits that **cause** the dung beetles to confuse the seeds for dung. This has the **effect** of the dung beetles treating the seeds like dung.

Matrix of Crosscutting Concepts in NGSS

Crosscutting Concepts:
Systems

- This is a great opportunity to reinforce the crosscutting concept of **systems and system models**.
- A system is a group of related parts that interact with one another.
- When it was initially observed that the seeds were being buried in new places, scientists knew they were missing some part of the **system** because seeds cannot do those things on their own.

Matrix of Crosscutting Concepts in NGSS

1. Prepare in advance
   a. We recommend having students work in pairs, but this is flexible.
   b. Print one copy of the Stinky Life Cycles Diagrams for each group.
   c. Print one Stinky Life Cycles worksheet packet for each group.

2. Begin the Unit Review, which includes a review of the:
   a. Unit key concepts (*page 3 of Teacher Guide*)
   b. Anchor phenomenon worksheet

3. Begin Activity Step-by-Step
   a. Have students get into groups.
   b. Pass out the life cycle diagrams.
   c. Follow the step-by-step instructions.
   d. When instructed, pass out the worksheet packets.