DC SCIENCE ASSESSMENT ITEM WRITING GUIDE

DC Science Assessment Grade 5

June 21, 2021

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Introduction

This document will review two item sets created for fifth-grade Next Generation Science Standards (NGSS) assessment items in previous years. The documents will discuss the alignment and features of the sets.

Purpose

The purpose of this document is to provide educators with examples and in-depth modeling of the necessary alignment for NGSS-aligned item sets.

How to Use This Tool

In this document, there are two item sets of six items each. This document will go into detail about how each item is aligned with NGSS standards and Performance Level Descriptors (PLDs), and how the set as a whole meets specified criteria. Each item set in this document also has an associated classroom activity that relates to the standards for the item sets modeled.

The examples provided here may be a helpful guide during development of your own NGSS-aligned item sets and classroom activities.

Grade 5 - Item Set 1 *Durian Trees*

Performance Expectations (PEs) and Dimensions aligned to in this set.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
[Clarification Statement: Examples of evidence could include the needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

DCI: LS4.C: Adaptation
For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

SEP: Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

CCC: Cause and Effect
Cause and effect relationships are routinely identified and used to explain change.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
[Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.]
[Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

DCI: LS4.D: Biodiversity and Humans
Populations live in a variety of habitats and change in those habitats affects the organisms living there.

DCI: LS2.C: Ecosystem Dynamics, Functioning, and Resilience
When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die (secondary).

SEP: Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

CCC: Systems and System Models
A system can be described in terms of its components and their interactions.

CCC: Interdependence of Engineering, Technology, and Science on Society and the Natural World

Knowledge of relevant scientific concepts and research findings is important in engineering.

Performance Level Descriptors

For a list of all performance level indicators, please see Appendix A.

This table shows the PEs, PLD level, and NGSS dimensions that each of the 6 items in the cluster aligns to.

ITEM	PE	PLD LEVEL	SEP	DCI	CCC
Item 1	3-LS4-3	2		LS4.C	Cause and Effect
Item 2	3-LS4-4	2		LS4.D	Systems and System Models
Item 3	3-LS4-3	3	Engaging in Argument from Evidence	LS4.C	Cause and Effect
Item 4	3-LS4-4	3	Engaging in Argument from Evidence	LS4.D	Systems and System Models
Item 5	3-LS4-4	3		LS2.C	Systems and System Models
Item 6	3-LS4-3	3	Engaging in Argument from Evidence	LS4.C	Cause and Effect

Stimulus

Southeast Asia is experiencing a loss of biodiversity. Some organisms that could be affected by this are durian trees, flying fox bats, Asian elephants, and stem boring beetles.

Native durian trees are found in tropical rain forests in Southeast Asia. Flying fox bats land on durian flowers to drink nectar at night. They transfer pollen from one flower to the next, which helps the tree grow fruit. Asian elephants eat the fruit and spread the seeds of the fruit in their waste. Stem boring beetles lay their eggs in durian trees, and the larvae eat the wood (harming the tree).

Durian fruits have become a popular and valuable cash crop in recent years. Many people like to eat the fruit. Farmers clear land in the rain forest to plant more durian trees. This reduces biodiversity in tropical rain forests. Figure 1 shows the various organisms from a rain forest in Southeast Asia. Durian trees will grow with smaller plants underneath.

Scientists are very concerned about flying fox bats. The bats may quickly become extinct because of a loss of habitat. Bats typically feed at night and return to their homes to sleep during the day. When land is cleared, areas where they make their homes are destroyed. People also hunt flying fox bats for meat.

Figure 1. Organisms from Southeast Asia

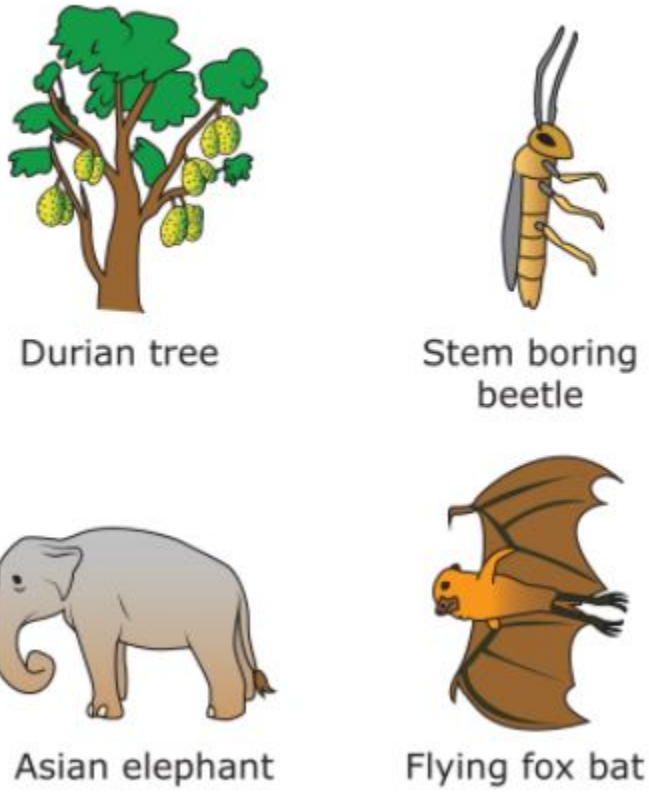


Table 1 describes characteristics of some organisms that live in Southeast Asia.

Table 1. Characteristics of Organisms in Southeast Asia

Organism	Habitat	Diet	Benefits to Humans
Durian tree	Tropical rain forests	--	Nutritional value, medicinal uses
Flying fox bat	Tropical rain forests	Nectar, fruit, leaves	Pollination, meat
Asian elephant	Tropical rain forests, grasslands, and scrublands	Bark, leaves, roots, fruit	Tourism
Stem boring beetle	Tropical rain forests	Fruit trees	No human use; considered a pest to trees

Items

Item 1

According to the information and Table 1, how will the Asian elephants likely be affected as the tropical rain forest is changed to durian tree farms?

- A. Elephant populations will decline due to the presence of flying fox bats.
- B. Elephant populations will move elsewhere to look for another food source.
- C. Elephant populations will increase because they will live in the tree farms to eat the durian fruits.
- D. Elephant populations will increase because stem boring beetles help produce more durian trees.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
[Clarification Statement: Examples of evidence could include the needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

Levels	DCI Statements
Level 2	The student identifies organisms that survive well or cannot survive at all in a particular environment in relation to a phenomenon.

Levels	CCC Statements
Level 2	The student uses cause and effect relationships to explain change.

Metadata

NGSS PE Alignment	3-LS4-3
Dimensions	DCI: LS4.C: Adaptation CCC: Cause and Effect
PLD Level	2
Points	1
Key	B
Calculator	No

Alignment Analysis

This item aligns with DCI LS4.C. For a PLD 2 item, "The student identifies organisms that survive well or cannot survive at all in a particular environment in relation to a phenomenon." In this case, the Asian elephants are being identified as a population that will increase or decrease (including emigration) in this environment where the rainforest is changed to farms producing durian fruit.

Additionally, the item has a CCC alignment with Cause and Effect. For a PLD 2 item, the student uses cause and effect relationships to explain change. In this case, the student must identify the cause, which is food availability, connected to the effect of decreasing populations in the area.

Relationship to Stimulus

This item requires information from Table 1 because it introduces the idea that the elephants obtain their food from sources other than tropical rainforests.

Relationship to Phenomenon

The phenomenon at the start of this tab explains that there is a decrease in biodiversity, and this item addresses elephant survival, which would affect biodiversity. The item also presents a context of decreasing biodiversity due to clearing of tropical rainforests for durian tree farms.

Item 2

Based on information in Table 1, which statement describes an effect of the change of tropical rain forest land to durian tree farms?

- A. Elephant droppings will no longer contain durian tree seeds.
- B. Stem boring beetles will have fewer places in which to lay their eggs.
- C. Flying fox bats will no longer have access to the nectar of durian tree flowers.
- D. The Asian elephant population will have a smaller area of land on which to live.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
[Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.]
[Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

Levels	DCI Statements
Level 2	The student describes that populations live in a variety of habitats and that change in those habitats affects the populations living there, in relation to a phenomenon.

Levels	CCC Statements
Level 2	The student identifies that systems are made up of parts.

Metadata

NGSS PE Alignment	3-LS4-4
Dimensions	DCI: LS4.D: Biodiversity and Humans CCC: Systems and System Models
PLD Level	2
Key	D
Points	1
Calculator	No

Alignment Analysis

The item aligns to the DCI at PLD 2, and in this case, requires that the student describe the effects (fewer places to live) on a population (elephants) following a change in habitat (replacement of rainforest with durian farms).
For the CCC alignment, the greater area is a system that includes several interacting habitats as subsystems, just one of which is the rainforest. The student uses this to determine that the elephants will still have places to live, but a smaller area.

Relationship to Stimulus

The stimulus lists several different places that elephants live, including, but not limited to rainforests. This is essential for answering this item.

Relationship to Phenomenon

The phenomenon is dealing with changes that affect biodiversity. In this case, loss of habitat might challenge elephants' ability to survive in this environment, affecting biodiversity.

Item 3

Based on the information and on Table 1, what is most likely to happen to the population of the stem boring beetles in the areas where tropical rain forest land is changed to durian tree farms?

Circle the correct answers from the lists to complete the sentence.

The population of the stem boring beetle will [increase / decrease] because there will be [an increase / a decrease] in the area for them to lay eggs.

Rubric	
Score	Description
1	The population of the stem boring beetle will **increase** because there will be **an increase** in the area for them to lay eggs.
0	The response is incorrect or irrelevant.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include the needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

Levels	DCI Statements
Level 3	In addition to the proficiencies described for Level 2, the student uses evidence to explain that for any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

Levels	SEP Statements
Level 3	In addition to the proficiencies described for Level 2, the student interprets two or more pieces of evidence or data to construct a scientifically sound argument.

Levels	CCC Statements
Level 3	In addition to the proficiencies described for Level 2, the student identifies, tests, and uses cause and effect relationships to explain change.

Metadata

NGSS PE Alignment	3-LS4-3
Dimensions	DCI: LS4.C: Adaptation SEP: Engaging in Argument from Evidence CCC: Cause and Effect
PLD Level	3
Key	See rubric above
Points	1
Calculator	No

Alignment Analysis

For the DCI alignment, the focus for this item is on a population that will see an increase in survivability.
The test-taker uses evidence (increase in fruit trees, reliance on fruit trees for egg-laying) to make a cause-and-effect-based prediction, meeting the needs of the CCC and the SEP in a very integrated way.

Relationship to Stimulus

The text of the stimulus describes the fruit trees specifically as the type of trees where the beetles lay their eggs, so it is needed to determine if egg-laying options are increased or decreased.

Relationship to Phenomenon

Sudden increases in populations can have as much of an effect on biodiversity as decreases, so this could affect not only stem boring beetles, but organisms closely tied to them in local food webs.

Item 4

The scientists consider different information as they develop a solution that will support farmers and increase biodiversity. Choose which information statements are helpful and which information statements are not helpful for the scientists' solution.

Write each statement in the correct box. All statements will be used.

A. Amount of durian fruit needed by farmers

B. Habitat requirements of flying fox bats

C. Speed at which land can be cleared

D. Cost of seeds used to grow durian trees

Helpful Information	**Not Helpful Information**

Rubric	
Score	Description
1	Helpful Information: • **Amount of durian fruit needed by farmers** • **Habitat requirements of flying fox bats** Not Helpful Information: • **Speed at which land can be cleared** • **Cost of seeds used to grow durian trees**
0	The response is incorrect or irrelevant.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

Levels	SEP Statements
Level 3	In addition to the proficiencies described for Level 2, the student makes a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Levels	DCI Statements
Level 3	In addition to the proficiencies described for Level 2, the student uses evidence to explain how change in a habitat affects populations living there.

Levels	CCC Statements
Level 3	In addition to the proficiencies described for Level 2, the student explains that a system can be described in terms of its parts and their interactions.

Metadata

NGSS PE Alignment	3-LS4-4
Dimensions	DCI: LS4.D: Biodiversity and Humans SEP: Engaging in Argument from Evidence CCC: Systems and System Models
PLD Level	3
Key	See rubric above
Points	1
Calculator	No

Alignment Analysis

For the DCI, the students are evaluating whether these factors will or will not impact biodiversity. The students need to distinguish which factors will affect the populations living in this environment. This will help them determine whether biodiversity is impacted.
By selecting the data to be collected, the students are providing the basis for an explanation of changes in populations for the SEP.
For the CCC alignment the key interactions being studied are between durian, flying foxes, and humans—different key parts of this system.

Relationship to Stimulus

The stimulus presents the benefits of durian trees to other organisms in the ecosystem and additionally describes durian trees as a product grown by farmers. Together with the information in the stimulus regarding the negative impacts to the flying fox bat when their land is cleared for farming, this information is key to understanding the conflicts between the needs of farmers and ecosystems.

Relationship to Phenomenon

This item ties back into the idea of biodiversity because it seeks to understand the impact of human actions on organisms living in an environment.

Item 5

The optimal temperature range for durian flowers to bloom is 68°F–86°F. At lower temperatures, the flowers begin to fall from the trees before the bats can drink their nectar. Predict what may happen if temperatures stay at 59°F for a long period of time.

Circle the correct answers from the lists to complete the sentence.

Because of cold temperatures, the availability of fruit may [decrease / increase], which may lead to a decrease in [flying fox bats / stem boring beetles].

Rubric	
Score	Description
2	Because of cold temperatures, the availability of fruit may **decrease**, which may lead to a decrease in **flying fox bats**.
0	The response is incorrect or irrelevant.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

Levels	DCI Statements
Level 3	In addition to the proficiencies described for Level 2, the student uses evidence to explain that when the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.

Levels	CCC Statements
Level 3	In addition to the proficiencies described for Level 2, the student explains that a system can be described in terms of its parts and their interactions.

Metadata

NGSS PE Alignment	3-LS4-4
Dimensions	DCI: LS2.C: Ecosystem Dynamics, Functioning, and Resilience CCC: Systems and System Models
PLD Level	3
Key	See rubric above
Points	1
Calculator	No

Alignment Analysis

The DCI alignment here comes from the effects of temperature on reproduction for the durian trees.
The parts of the system for the CCC alignment are the bats and durian trees, whose interactions are affected by temperatures.

Relationship to Stimulus

The stimulus is key here because the connection is made between bats and reproduction/production of fruit for the durian trees.

Relationship to Phenomenon

This is a cooperative relationship. If one species is hurt, both are hurt, which could lead to a loss of both species and reduced biodiversity.

Item 6 - Constructed Response

As land is cleared to grow durian trees, the amount of shade from the sun decreases. Some plants that require shade cannot survive, and biodiversity is reduced. Scientists consider planting another plant species to increase biodiversity. Plant Species X and Plant Species Y grow in the rain forest. Table 2 gives some requirements for these two plants.

Table 2. Requirements of Two Plant Species

Plant Species	Requirements			Height Relative to Durian Trees
	Shade	Temperature	Water	
X	Must have shade most of the day	Needs cool temperatures	Grows best with wet conditions	Taller
Y	Can grow in both shade and sunlight	Tolerates warm temperatures	Grows in both wet and dry conditions	Shorter

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.[Clarification Statement: Examples of evidence could include the needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

Levels	SEP Statements
Level 3	In addition to the proficiencies described for Level 2, the student interprets two or more pieces of evidence or data to construct a scientifically sound argument.

Levels	DCI Statements
Level 3	In addition to the proficiencies described for Level 2, the student uses evidence to explain that for any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

Levels	CCC Statements
Level 3	In addition to the proficiencies described for Level 2, the student identifies, tests, and uses cause and effect relationships to explain change.

Exemplary Response

Bullet 1	Plant Y
Bullet 2	As the rain forest is cleared, plants on the ground will have less shade. As more sunlight hits the ground, temperatures will go up, and the soil will dry out somewhat. Plant Y is tolerant of less shade and drier conditions. Because Plant Y is shorter than durian trees, it may receive partial shade on the durian tree farm. Plant X is taller than durian trees and would not receive any shade on a durian tree farm.
Bullet 3	Plant Y tolerates warm temperatures. The removal of the upper layers of leaves in the rain forest will result in warmer temperatures.

Metadata

NGSS PE Alignment	3-LS4-3
Dimensions	DCI: LS4.C: Adaptation SEP: Engaging in Argument from Evidence CCC: Cause and Effect
PLD Level	3
Key	See exemplary response above
Points	3
Calculator	No

Alignment Analysis

The three bullets combine to meet the requirements of the SEP, asking the students to construct an argument with more than two pieces of evidence (temperature, shade, and water reliance information from Table 2) for bullets two and three.

One of the elements, Bullet 1, from within the DCI is to explain, using evidence, that some species survive less well. This is done by comparing Plant X and Plant Y in constructing these explanations.

The students are required to use cause and effect relationships connected to shade, water, and temperature, satisfying the CCC alignment. This is especially important as the students answer bullets two and three.

Relationship to Stimulus

Because the students are providing predictions regarding changes to the system, it is essential for them to understand the ways in which different organisms are related to each other. This is laid out in Table 2, as well as the paragraphs in the stimulus. Bullet 1 in particular would direct the test-taker to all information on the species in question to determine which would best survive the clearing of land.

Relationship to Phenomenon

This item is directly related to biodiversity, as it seeks solutions to repair the loss of biodiversity resulting from the planting of durian trees and the necessary clearing of land in Southeast Asia.

Notes about Constructed Response Items

Constructed response items are always aligned to all three dimensions. They require students to have an in-depth understanding of the phenomenon. The constructed response items require a mastery of all dimensions for a PLD level of at least 3, and preferably 4. Constructed response items should be answerable by the students within 5 minutes.

Analysis of Set as a Whole

This item cluster, as a whole, meets alignment requirements.

- *As a set, all dimensions of both PEs are covered within the set. LS4.C is covered four times, while LS2D, and LS4.D are covered once each. Engaging in Argument from Evidence is the only SEP for these Performance Expectations and is covered throughout. Two CCCs are connected to this set, and each is covered by three items: Cause and Effect is used throughout as students delve into different potential impacts (effects) of human actions (cause). Systems and System models are explored through several different interaction types between different organisms and even between different habitat types within the whole system.*

- *The items begin with a foundation of PLD 2 items (Items 1 and 2 - multiple choice items), then PLD 3 (Items 3-5 - all technology enhanced items), and then PLD 3 with the constructed response item at the end of the set. Note also that the set begins with two-dimensional items and finishes with items that are aligned to three dimensions.*

- *The set covers the PE in depth. All items prior to the final item provide opportunities for students to demonstrate skill with separate elements of the two Performance Expectations before applying these skills together. Individual interactions between components are explored early, while the latter items step back to a larger view where students put this knowledge to use in addressing the impacts of human actions on biodiversity.*

- *All the items in the set relate back to the phenomenon of loss of biodiversity in the area and the challenge of balancing competing interests of the ecosystem and the durian tree farmers. Items 1, 2, and 3 all address the effects of the clearing of tropical rainforest to make room for durian tree farms. In answering these items, the student has to explain the loss of biodiversity in the phenomenon by noting the effects on Asian elephants (items 1 and 2) and stem boring beetles (item 3). In item 4, the student has to decide which information is helpful to the scientists as they develop a solution that balances these competing interests. Removal of tropical rain forest canopy will result in temperature changes, and items 5 and 6 have the student predict the effects of this temperature change on flying fox bats and plant species.*

Aligned Classroom Task

Classroom Investigation to Support Mastery and Assessment of 3-LS4-3 and 3-LS4-4
Grade 5

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]
3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

Phenomenon

Wheat and rice plants have different responses to changing environmental conditions such as drought, light, or cold.

Objectives

- Uses evidence to explain that for any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (DCI LS4.C, 3-LS4-3, PLD 3)
- Uses evidence to explain how change in a habitat affects populations living there. (DCI LS4.D, 3-LS4-4, PLD 3)
- Interprets two or more pieces of evidence or data to construct a scientifically sound argument. (SEP Argument, 3-LS4-3, PLD 3)
- Makes a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (SEP Argument, 3-LS4-4, PLD 3)
- Identifies, tests, and uses cause and effect relationships to explain change. (CCC C/E, 3-LS4-3, PLD 3)
- Explains that a system can be described in terms of its parts and their interactions. (CCC Systems, 3-LS4-4, PLD 3)

Background

Different plants respond differently to changes in environmental conditions such as the availability of water, temperatures, salinity, and others. Plant responses have important implications in both agriculture and natural settings as environmental conditions change. The changes can be natural fluctuations or those arising from human interaction with the natural world. In agriculture, understanding of plant responses to environmental conditions is critical for crop selection and maintenance in an area. In the natural world, understanding of plant responses to environmental conditions is critical for predicting ecosystem effects of climate change, shrinking habitat, and human encroachment. This classroom activity allows students to observe the effects of several environmental conditions on wheat and rice plants.

Materials Needed

- Wheat and rice seeds, sprouted, about 25 of each (20 are needed, extras are recommended)
- 32 small planting pots, about 10 cm tall
- Potting soil
- Sodium chloride and scale
- Water and beakers or other volumetric measuring devices
- Cold, constant temperature environment (refrigerator or cold room)
- Window for sunlight
- Thermometer
- Ruler for measuring plant height
- Cell phone camera for taking pictures of the plants at different points in time

Tasks

1. Plant the seeds in the pots and sprout them. Keep them watered and let them grow for about 5 weeks before subjecting them to environmental changes. They can be kept in standard classroom light. It is important to treat all of the wheat plants the same. It is important to treat all of the rice plants the same. Add enough water to keep the soil moist but not overly wet.
2. Once 5 weeks have passed, label the pots. For each type of plant (wheat and rice), five will be controls (labeled 'control'), five will receive low levels of water (labeled 'drought'), five will receive reduced sunlight (labeled 'low light'), and five are grown at lower temperature (labeled 'cold'). This is shown in the table.

Experimental Setup

Number of Plants	Environmental Change	Pot label
5 wheat, 5 rice	None	Control
5 wheat, 5 rice	Reduced water	Drought
5 wheat, 5 rice	Reduced sunlight	Low light
5 wheat, 5 rice	Reduced temperature	Cold

3. The control plants will not be subjected to environmental changes. They should remain in the same space and receive the same amount of sunlight and water for 2 additional weeks.
4. The 'drought' plants will be subjected to a drought cycle. They are not to be watered for 8 days, then watered normally once a day for 2 days, and then not watered for 5 days.
5. The 'cold' plants should be transferred to a cold room or refrigerator kept at a constant temperature of about 10° C. They should receive the same amount of light and water as the control group.
6. The 'low light' plants should be kept in the dark for 2 days at the beginning of the period, after which the amount of sunlight they receive should be limited to 2 hours per day.
7. The investigation should be continued for all groups of plants for 2 weeks. At the end of the 2-week period, the students can measure the heights of the plants and record their observations in a table such as the ones shown.

Control plant	Height (cm)	Is the plant wilting?	Color and appearance of leaves	Are there any signs of stress?
1				
2				
3				
4				
5				

'Cold' Group	Height (cm)	Is the plant wilting?	Color and appearance of leaves	Are there any signs of stress?
1				
2				
3				
4				
5				

'Drought' Group	Height (cm)	Is the plant wilting?	Color and appearance of leaves	Are there any signs of stress?
1				
2				
3				
4				
5				

'Low Light' Group	Height (cm)	Is the plant wilting?	Color and appearance of leaves	Are there any signs of stress?
1				
2				
3				
4				
5				

Questions for Discussion

1. Which change in environmental conditions had the greatest effect on the rice plants? On the wheat plants?
2. Among the five plants in a group, how uniform was the response to the change in environmental conditions? What could give rise to a lack of uniformity?
3. How could a farmer use this information?
4. Do you think plants other than wheat and rice may also be affected by environmental change?
5. Do you think other plants would respond in a similar way? In a different way?
6. Based on these results, how do you think long-term drought could affect the plants in a forest?
7. How could removal of large trees that provide canopy cover affect plants on the forest floor?

Note: The teacher can either prepare the plants ahead of time and show the class the results OR the students can be involved in growing the plants, changing the environmental conditions, and monitoring the plants over time.

References

Effects of Changing Environmental Conditions on Plants

Grade 5 - Item Set 2 *Pendulum*

Performance Expectations (PEs) and Dimensions aligned to in this set.

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
[Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.] [*Assessment Boundary: Assessment does not include technical terms such as period and frequency.*]

DCI: PS2.A: Forces and Motion
The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

SEP: Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

CCC: Patterns
Patterns of change can be used to make predictions.

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.
[Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

DCI: PS2.B: Types of Interactions
Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

SEP: Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple problem that can be solved through the development of a new or improved object or tool.

CCC: Interdependence of Engineering, Technology, and Science on Society and the Natural World
Knowledge of relevant scientific concepts and research findings is important in engineering.

Performance Level Descriptors

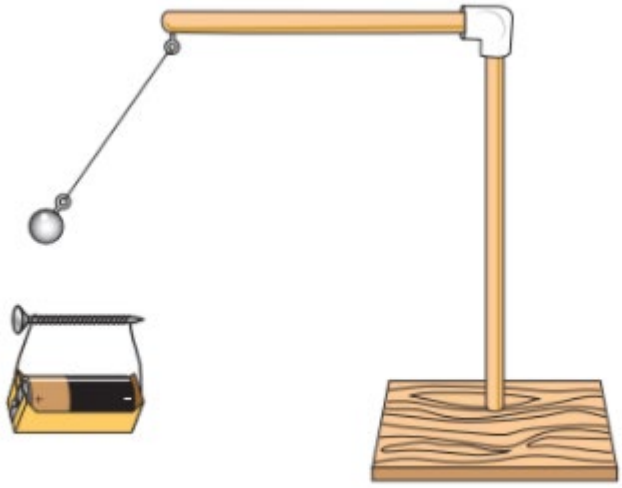
For a list of all performance level indicators, please see Appendix B.
This table describes item alignment to PEs, PLDs, and PLD level.

ITEM	PE	PLD LEVEL	SEP	DCI	CCC
Item 1	3-PS2-4	2	Asking Questions and Defining Problems	PS2.B	
Item 2	3-PS2-2	2	Planning and Carrying out Investigations	PS2.A	
Item 3	3-PS2-2	3	Planning and Carrying out Investigations		Patterns
Item 4	3-PS2-4	3	Asking Questions and Defining Problems	PS2.B	
Item 5	3-PS2-2	3		PS2.A	Patterns
Item 6	3-PS2-4	4	Asking Questions and Defining Problems	PS2.B	

Stimulus

A class visiting a science museum sees a pendulum with an electromagnet as shown in Figure 1. The metal ball of the pendulum swings back and forth, but it does not stop or slow down. The ball is made of iron. Back in class, they make a similar setup with their teacher. They discuss the purpose of including the electromagnet in the design. They know that the strength of the electromagnet depends on the number of times the wire is wrapped around the nail.

Figure 1. Pendulum with Electromagnet



The students discuss the fact that electromagnets are commonly used in pendulums. They make an electromagnet using wire, a nail, and a battery. The wire is wrapped around the nail, and the two ends of the wire are connected to the battery, causing an electric current to flow. When the electromagnet is brought close to a pile of metal paper clips on a table, its magnetic force picks up some of the paper clips, as shown in Figure 2. The students repeat the experiment with a battery that has a different voltage and using different distances between the electromagnet and the paper clips. Table 1 shows the number of paper clips picked up with each type of battery and distance.

Figure 2. Electromagnet

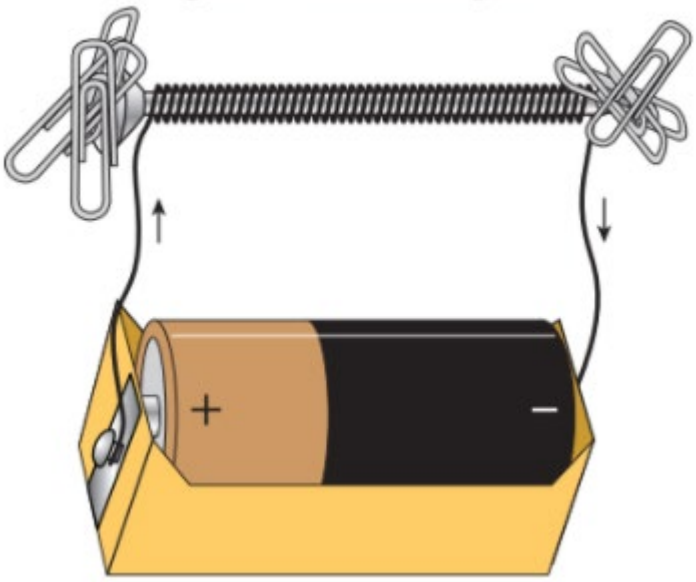


Table 1. Effect of Battery Voltage and Distance on Paper Clips

Battery Voltage (volts)	Distance (centimeters)	Number of Paper Clips Picked Up
1.5	5	13
1.5	10	7
3.0	5	26
3.0	10	14

Items

Item 1

Which design problem is being addressed by including the electromagnet as shown in Figure 1?

- A. the need to make the metal ball swing in a circle when it is near the electromagnet
- B. the need to make the metal ball swing farther in the direction of the electromagnet
- C. the need to increase the weight of the metal ball as it passes near the electromagnet
- D. the need to decrease the speed of the metal ball as it passes over the electromagnet

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.
[Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

Levels	SEP Statements
Level 2	The student defines a simple design problem that can be solved.

Levels	DCI Statements
Level 2	The student identifies electric and magnetic forces between pairs of objects that are not in direct contact.

Metadata

NGSS PE Alignment	3PS2-4
Dimensions	DCI: PS2.B: Types of Interactions SEP: Asking Questions and Defining Problems
PLD Level	2
Key	B
Points	1
Calculator	No

Alignment Analysis

The stem text coincides well with the SEP, asking the student to decide what the design problem is in this situation. The DCI is clearly targeted because the attractive force between magnets and metal objects is useful in defining the problem here.

Relationship to Stimulus

The stimulus is needed for this item because the specific arrangement of the pendulum and electromagnet shown in Figure 1 would determine the effect of the magnet.

Relationship to Phenomenon

This relates back to the phenomenon because some force is needed to keep the pendulum from simply stopping over time.

Item 2

The class wants to measure the speed of the ball by the number of swings per 10 seconds. Which statement correctly explains how they can do this?

- A. They can see how long it takes for the metal ball to swing 10 times.
- B. They can count from 1 to 10 because this should take about 10 seconds.
- C. They can measure 1 second with a stopwatch and multiply the number of swings by 10.
- D. They can measure 10 seconds with a stopwatch and count swings of the metal ball during this time.

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.] [*Assessment Boundary: Assessment does not include technical terms such as period and frequency.*]

Levels	SEP Statements
Level 2	The student makes an observation or measurement as directed.

Levels	DCI Statements
Level 2	The student makes an observation or measurement related to an object's motion (e.g., distance traveled, time).

Metadata

NGSS PE Alignment	3-PS2-2
Dimensions	SEP: Planning and Carrying out Investigations DCI: PS2.A: Forces and Motion
PLD Level	2
Key	D
Points	1
Calculator	No

Alignment Analysis

The item requires identification of the observations needed for this particular goal, thus aligning to the SEP.
The particular measurements are related to the speed of the pendulum, thus aligning to the DCI.

Relationship to Stimulus

The experimental set-up in the stimulus provides necessary context for the student to understand different answer options.

Relationship to Phenomenon

This is related to the phenomenon because measurements of the speed would allow the design of this exhibit.

Item 3

The motion of the pendulum is affected by where the electromagnet is placed. How should the students perform the experiment, and what information would the students need to gather to determine the best position for the electromagnet?

Circle the correct answers from the lists to complete the sentences.

The students will need to drop the metal ball from the same height and test the effect of the electromagnet at [different locations / the same location] with multiple trials. To compare the patterns of the motion of the pendulum, the students should measure the resulting [string length / swing time].

Rubric	
Score	Description
1	The students will need to drop the metal ball from the same height and test the effect of the electromagnet at **different locations** with multiple trials. To compare the patterns of the motion of the pendulum, the students should measure the resulting **swing time.**
0	The response is incorrect or irrelevant.

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.] [*Assessment Boundary: Assessment does not include technical terms such as period and frequency.*]

Levels	SEP Statements
Level 3	In addition to the proficiencies described for Level 2, the student decides which data need to be collected as evidence to explain the phenomenon and/or which methods are used to collect that data.

Levels	CCC Statements
Level 3	In addition to the proficiencies described for Level 2, the student compares patterns of phenomena.

Metadata

NGSS PE Alignment	3-PS2-2
Dimensions	SEP: Planning and Carrying out Investigations CCC: Patterns
PLD Level	3
Key	See rubric above
Points	1
Calculator	No

Alignment Analysis

The SEP is met here because the student is deciding what data to collect (swing time) to answer the question.
The CCC is met because the student determines what patterns (from the multiple trials of data) need to be compared.

Relationship to Stimulus

The stimulus is needed to determine what variables might be changed if the electromagnet position is changed. In this case, the pendulum is free to swing, but the string is not free to change in length—information only accessible through the stimulus.

Relationship to Phenomenon

The data obtained would be used in the design of this pendulum exhibit.

Item 4

The students would like to improve a pendulum with a 50-centimeter string and a total swing time of 4.67 seconds. The students want to replace the metal ball with a magnet to see if the swing time would reach 5 seconds or longer. The electromagnet is placed underneath the pendulum, as shown in Figure 1.

Write the correct answer in each box.

First Blank	Second Blank
A. string length of 50 centimeters	C. number of swings
B. swing time of 5.1 seconds	D. length of the pendulum string

A result that would indicate that the criteria for success was met would be obtaining a [ ]. The strength of the magnetic force between the magnets is limited by the [ ].

Rubric	
Score	Description
2	A result that would indicate that the criteria for success was met would be obtaining a **swing time of 5.1 seconds**. The strength of the magnetic force between the magnets is limited by the **length of the pendulum string**.
0	The response is incorrect or irrelevant.

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.
[Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

Levels	SEP Statements
Level 3	In addition to the proficiencies described for Level 2, the student identifies criteria for success and constraints on materials, time, or cost and/or asks questions about what would happen if a variable in the design is changed.

Levels	DCI Statements
Level 3	In addition to the proficiencies described for Level 2, the student analyzes and compares the sizes of electric and magnetic forces, which depend on the properties of the objects and the distance between them and, for forces between two magnets, their orientation relative to each other.

Metadata

NGSS PE Alignment	3-PS2-4
Dimensions	DCI: PS2.B: Types of Interactions SEP: Asking questions and Defining Problems
PLD Level	3
Key	See rubric above
Points	1
Calculator	No

Alignment Analysis

The SEP alignment is present because the criteria (swing time) and constraints (string length) are both identified by the student.

The constraint is identified in connection with the magnetic force, so the student does need to perform the analysis noted in the DCI to answer the question.

Relationship to Stimulus

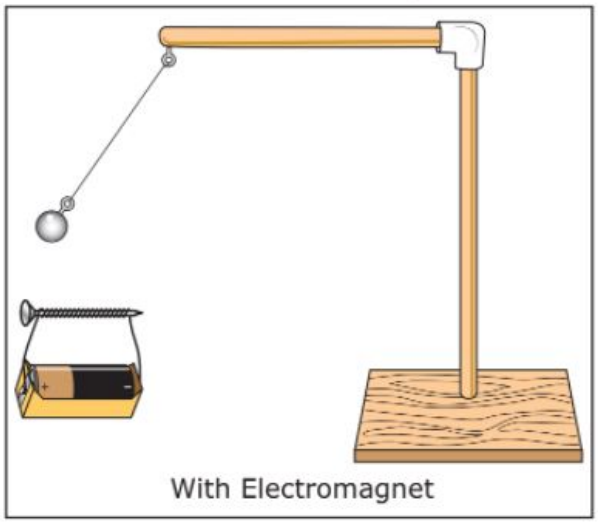
This item is only answerable through use of the stimulus because it shows that a shorter distance (possible with a longer string) leads to a stronger magnetic force.

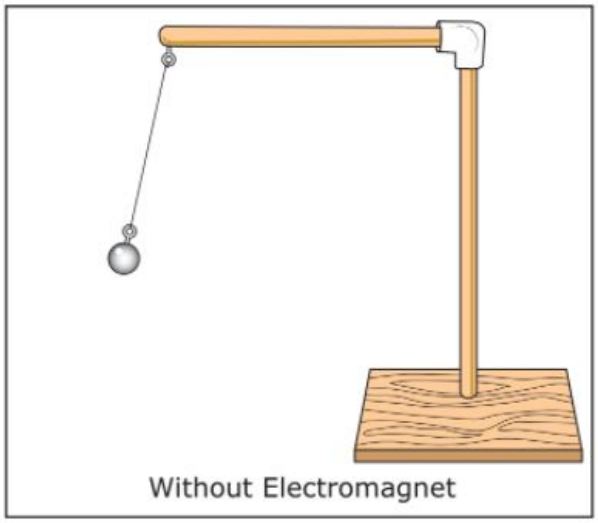
Relationship to Phenomenon

These relationships and testing would all have to take place in the testing and design of the pendulum exhibit.

Item 5

Figure 3. Pendulum with and without Electromagnet





The students compare the two setups shown in Figure 3. They want to design an investigation to explain the effect of the electromagnet on the metal ball. They look at the data in Table 1.

Circle the correct answers from the lists to complete the sentences.

The students should change the [number of paper clips / voltage of the battery] to see how the strength of the electromagnet affects the motion of the metal ball. They correctly predict that as it increases, the [weight / height] of the metal ball's swing will increase.

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
[Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.] [*Assessment Boundary: Assessment does not include technical terms such as period and frequency.*]

Levels	DCI Statements
Level 3	In addition to the proficiencies described for Level 2, the student analyzes the pattern of an object's motion in order to make predictions.

Levels	CCC Statements
Level 3	In addition to the proficiencies described for Level 2, the student compares patterns of phenomena.

Metadata

NGSS PE Alignment	3-PS2-2
Dimensions	DCI: PS2.A: Forces and Motion CCC: Patterns
PLD Level	3
Key	See rubric above
Points	1
Calculator	No

Alignment Analysis

The DCI and CCC alignments are present here because the student must analyze the patterns in Table 1 in order to predict the effects of these changes on the pendulum.

Relationship to Stimulus

The questions here rely on accurate analysis of the patterns shown in Table 1.

Relationship to Phenomenon

The battery voltage is an important consideration in the design of the pendulum exhibit.

Item 6 - Constructed Response

Students in the class consider the design shown in Figure 1 to decide whether changes could be made that would change the force of attraction between the metal ball and the electromagnet. Evaluate the design to propose ways that the design could be adjusted. Explain your answer.

- Propose **one** change to the design in Figure 1 that would increase the force of attraction between the metal ball and the electromagnet.
- Propose **one** change to the design in Figure 1 that would decrease the force of attraction between the metal ball and the electromagnet.
- Describe what students could measure to evaluate whether there is a change in the force of attraction between the metal ball and the electromagnet.

Analyze the information carefully. Then write your response in the space provided. Support your answer with details.

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.
[Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

Levels	SEP Statements
Level 4	In addition to the proficiencies described for Level 3, the student describes what would happen if a variable in the design is changed and predicts reasonable design solutions based on evidence.

Levels	DCI Statements
Level 4	In addition to the proficiencies described for Level 3, the student evaluates arrangements of objects designed to maximize or minimize electric and magnetic forces between objects and proposes changes in the arrangement of the objects with the aim of altering the forces in a desired way.

Exemplary Response

Bullet 1	In order to increase the force of attraction between the metal ball and the electromagnet, the students could increase the voltage of the battery. As the battery voltage increases, the strength of the electromagnetic force increases.
Bullet 2	In order to decrease the force of attraction between the metal ball and the electromagnet, the students could increase the distance between the metal ball and the electromagnet . As the distance between them increases, the strength of the electromagnetic force on the metal ball decreases.
Bullet 3	To evaluate whether there is a change in the force of attraction between the metal ball and the electromagnet, the students could measure the length of time the metal ball of the pendulum continues to swing with either different battery voltages or different distances between the electromagnet and the metal ball.

Metadata

NGSS PE Alignment	3-PS2-4
Dimensions	DCI: PS2.B: Types of Interactions SEP: Asking Questions and Defining Problems
PLD Level	3
Key	See exemplary response above
Points	3
Calculator	No

Alignment Analysis

The SEP alignment is met through the design of a solution that is evidence-based.

The solutions designed by students intend to increase and decrease the magnetic force, satisfying the DCI alignment here.

The CCC is met in light of the fact that the changes to the swing of the pendulum would improve the performance of the exhibit.

Relationship to Stimulus

All the work on this item is pulling from the data table in Figure 2, so the test-taker is relying heavily on the patterns in data discovered within. They also use the structure of the exhibit as they consider the effects of these changes on the functioning of the exhibit.

Relationship to Phenomenon

The design solutions here would have an impact on the functioning of the pendulum exhibit because the amount of attraction could affect the swing speed and size of the swing.

Notes about Constructed Response Items

Constructed Response items are always aligned to all three dimensions. They require students to have an in-depth understanding of the phenomenon. The constructed response items require a mastery of all dimensions at a PLD level of at least 3 and preferably 4. Constructed response items should be answerable by the students within 5 minutes.

Analysis of Set as a Whole

This item cluster, as a whole, meets alignment requirements.

- *This set was aligned to two different PEs, with three items in the set aligned to each. The DCIs are each covered (PS2.A in items 2 and 5, and PS2.B in items 1, 4, and 6) with students making predictions about the motion of the pendulum for PS2.A and relating these motions to forces coming from the magnet for PS2.B. The SEP, Asking Questions and Defining Problems, is met on different levels, from simply identifying criteria and constraints to predicting the results of possible solutions to problems. The SEP, Planning and Carrying Out Investigations, is met through simple identification of measurements that need to be made, as well as more specifics on the methods for successfully making those measurements. The CCC, Patterns, is met through simple pattern identification from Table 1, up to using those patterns to make predictions. (ETS alignment notes will follow receipt of the PLD language).*
- *These items progress from level 2 (items 1 and 2) to level 3 (items 3 through 5) to level 4 (item 6). In addition to increasing in complexity (multiple choice to constructed response), the items also require higher-level tasks to be completed, from* identifying *criteria and constraints to* designing *solutions.*
- *The pendulum exhibit that is described as a phenomenon provides the interesting observation that things do not dampen out and stop moving over time. The item set begins with simple observations and descriptions of relationships in data, which builds to the student designing changes to the electromagnet and predicting the effects of those changes on the system.*
- *The phenomenon in this set poses a series of design challenges related to the coupling of a pendulum with an electromagnet, construction of the electromagnet, and the making of measurements that guide the design of both the electromagnet itself and the pendulum with the electromagnet. The first item has the student define the design problem, while the second item has the student explain how they would make measurements needed to describe motion of the metal ball (the number of swings per 10 seconds). The third item has the students design an investigation to determine the effect of the location of the electromagnet on the motion of the pendulum (the time needed for the metal ball to swing a given distance is measured, and the location of the electromagnet is varied). The fourth item has the students define the criteria and constraints that are important to improving the design, and in the fifth item the students design an investigation to further explain the effect of the electromagnet on the motion of the metal ball. In the sixth item, the students propose design changes that increase or decrease the force of attraction between the metal ball and the electromagnet. They describe how these design changes could be evaluated as to their effectiveness in impacting the force of attraction.*

Aligned Classroom Task

Classroom Investigation to Support Mastery and Assessment of 3-PS2-2 and 3-PS2-4

Grade 5

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets. [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

Phenomenon

The students will design a magnetic see-saw. The size and strength of the magnets under the board, as well as that of masses on each end, affect the maximum height that the see-saw travels as well as the speed at which it travels up and down.

Objectives

1. Analyzes the pattern of an object's motion in order to make predictions. (DCI PS2.A, 3-PS2-2, PLD 3).
2. Analyzes and compares the sizes of electric and magnetic forces, which depend on the properties of the objects and the distance between them and, for forces between two magnets, their orientation relative to each other. (DCI PS2.B, 3-PS2-4, PLD 3)
3. Decides which data need to be collected as evidence to explain the phenomenon and/or which methods are used to collect that data. (SEP PCI, 3-PS2-2, PLD 3)
4. Identifies criteria for success and constraints on materials, time, or cost and/or asks questions about what would happen if a variable in the design is changed. (SEP Questions, 3-PS2-4, PLD 3)
5. Compares patterns of phenomena. (CCC Patterns, 3-PS2-2, PLD 3)

Background

Magnetic seesaws mimic the motion of standard see-saws, except that the maximum height of the seesaw is somewhat lower. This is due to the attraction between the magnet under the board that is the "seesaw" and the magnet on the ground. Varying the size, strength, and location of the magnets affects the maximum height of the seesaw, as well as the speed at which it travels up and down. The masses placed on each end of the seesaw also affect the maximum height and speed of the seesaw. In summary, there are 3 factors including the length of the seesaw, the magnets (size, strength, and placement all can contribute), as well as gravitational forces, the strength of which is determined by the masses of objects placed on the seesaw.

Gather materials

- Kit for the magnetic seesaw (reference below) OR wood pieces, magnets, glue. Ideally, wood pieces of different lengths are available to allow for building seesaws of different lengths.
- Masses (kit purchased below) OR wood pieces cut to masses at regular intervals
- Stopwatch or timer (could be a cell phone timer)
- Ruler (cm)
- Flat surface for placing the seesaw

Tasks (Ideally, students have their own materials and can each build their own OR work in small groups.)

1. Build the magnetic see-saw. This can be done with a kit such as that listed in the references, if preferred, or using some other method. The YouTube video below shows a simple homemade version.
2. Build or purchase masses to be placed on either end of the magnetic seesaw. An example is provided in the list below, or these can be obtained in other ways.
3. Place a ruler on one side of the magnetic seesaw. This will be used to measure the maximum height of travel on each side.
4. Students make a table to record their results. There should be at least 10 rows with the columns shown.

Magnetic See-Saw Results

Trial	Number of Magnets Under Board (Left)	Number of Magnets Under Board (Right)	Mass on Left Side (g)	Mass on Right Side (g)	Maximum Travel Height (cm)	Time Needed to Reach Maximum Travel Height (sec)	Speed (number of times a side reaches maximum height in 10 sec)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

5. Add a small magnet to one side of the seesaw and measure the maximum height the seesaw travels, as well as the time needed to reach the maximum height. Add an identical magnet to the other side and repeat the measurements. Continue adding magnets to each side, one at a time, and making the height and time measurements.
6. Have the students identify criteria for an optimal design, and then make adjustments to the setup until the criteria are met.

References:

Toy Kit Magnetic Seesaw

Magnetic Seesaw Animation

Examples of Weights for Magnetic Seesaw Investigation

Appendix A

Performance Level Descriptors Set 1 Durian Trees

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. **[Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]**	
Integrated Statement Levels	**Performance Level Descriptor**
Level 2	The student constructs an argument, based on a simple data set, that the conditions within a particular environment cause differences in whether an organism can survive well or not at all in that environment, in relation to a phenomenon.
Level 3	In addition to the proficiencies described for Level 2, the student interprets two or more pieces of evidence or data to construct a scientifically sound argument to test and explain the cause and effect relationship that the conditions in a particular environment cause some kinds of organisms to survive well, some to survive less well, and some to not be able to survive at all in that environment.
Level 4	In addition to the proficiencies described for Level 3, the student chooses the evidence or data needed in relationship to an argument and then constructs an argument based on the appropriate evidence or data. The student may also refine arguments, based on an evaluation of the evidence, that predict whether and how changes to a particular environment will cause a change in whether an organism can survive well, survive less well, or not survive at all.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

[Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

DCI: LS4.C: Adaptation

For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

Levels	DCI Statements
Level 2	The student identifies organisms that survive well or cannot survive at all in a particular environment in relation to a phenomenon.
Level 3	In addition to the proficiencies described for Level 2, the student uses evidence to explain that for any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.
Level 4	In addition to the proficiencies described for Level 3, the student predicts how changes to a particular environment will affect whether an organism can survive well, survive less well, or not survive at all.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

[Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

SEP: Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

Construct an argument with evidence.

Levels	SEP Statements
Level 2	The student constructs an argument based on a small, simple data set.
Level 3	In addition to the proficiencies described for Level 2, the student interprets two or more pieces of evidence or data to construct a scientifically sound argument.
Level 4	In addition to the proficiencies described for Level 3, the student chooses the evidence or data needed in relationship to an argument and then constructs an argument based on the appropriate evidence or data and/or refines arguments based on an evaluation of the evidence presented.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

[Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

CCC: Cause and Effect

Cause and effect relationships are routinely identified and used to explain change.

Levels	CCC Statements
Level 2	The student uses cause and effect relationships to explain change.
Level 3	In addition to the proficiencies described for Level 2, the student identifies, tests, and uses cause and effect relationships to explain change.
Level 4	In addition to the proficiencies described for Level 3, the student determines whether events that regularly occur together are due to a cause and effect relationship.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

[Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.]

[Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

Integrated Statement Levels	Performance Level Descriptor
Level 2	The student identifies evidence that is relevant to the claim that populations live in a variety of habitats and that change in those habitats affects the populations living there, in relation to a phenomenon.
Level 3	In addition to the proficiencies described for Level 2, the student makes a claim about the merit of a solution to a problem caused by changes in a habitat and how those changes affect populations living there by citing relevant evidence about how the solution meets the criteria and constraints of the problem.
Level 4	In addition to the proficiencies described for Level 3, the student evaluates and/or revises a claim about the merit of a solution to a problem caused by changes in a habitat and how those changes affect populations living there by citing relevant evidence about how the solution meets the criteria and constraints of the problem.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

[Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.]

[Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

	DCI: LS4.D: Biodiversity and Humans **Populations live in a variety of habitats, and change in those habitats affects the organisms living there.**	**DCI: LS2.C: Ecosystem Dynamics, Functioning, and Resilience** **When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (secondary)**
Levels	**DCI Statements**	**DCI Statements**
Level 2	The student describes that populations live in a variety of habitats and that change in those habitats affects the populations living there, in relation to a phenomenon.	The student identifies changes to an environment's physical characteristics, temperature, or availability of resources as changes that can lead to some organisms surviving and reproducing, others moving to new locations, and others dying.
Level 3	In addition to the proficiencies described for Level 2, the student uses evidence to explain how change in a habitat affects populations living there.	In addition to the proficiencies described for Level 2, the student uses evidence to explain that when the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.
Level 4	In addition to the proficiencies described for Level 3, the student predicts how change in a habitat could affect populations living there.	In addition to the proficiencies described for Level 3, the student predicts how changes to a place's physical characteristics, temperature, or availability of resources will affect different populations of organisms.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

[Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.]

[Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

SEP: Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Levels	SEP Statements
Level 2	The student identifies evidence that is relevant to a claim.
Level 3	In addition to the proficiencies described for Level 2, the student makes a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.
Level 4	In addition to the proficiencies described for Level 3, the student evaluates and/or revises a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

[Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.]

[Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

	CCC: Systems and System Models **A system can be described in terms of its components and their interactions.**	**CCC: Interdependence of Engineering, Technology, and Science on Society and the Natural World** **Knowledge of relevant scientific concepts and research findings is important in engineering.**
Levels	**CCC Statements**	**CCC Statements**
Level 2	The student identifies that systems are made up of parts.	The student describes the importance of science and engineering concepts and research findings in engineering.
Level 3	In addition to the proficiencies described for Level 2, the student explains that a system can be described in terms of its parts and their interactions.	In addition to the proficiencies described for Level 2, the student applies important science and engineering concepts and research findings to engineering problems.
Level 4	In addition to the proficiencies described for Level 3, the student predicts how changes to one of the system's parts affects the rest of the system.	In addition to the proficiencies described for Level 3, the student applies important science and engineering concepts and research findings to generate solutions to design problems and to evaluate designed products and solutions.

Appendix B

Performance Level Descriptors Set 2 Pendulum

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

[Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.]

[Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

Integrated Statement Levels	Performance Level Descriptor
Level 2	The student makes an observation or measurement related to an object's motion and describes the pattern that is present.
Level 3	In addition to the proficiencies described for Level 2, the student decides which data needs to be collected in order to analyze the pattern of an object's motion and/or to compare patterns of the motion of an object.
Level 4	In addition to the proficiencies described for Level 3, the student designs a fair and controlled investigation that can be used to establish the patterns in the motion of an object, sorts or groups the patterns based on similarities or differences, and predicts the future motion of an object based on patterns of motion.

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

[Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.]

[Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

DCI: PS2.A: Forces and Motion

The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Levels	DCI Statements
Level 2	The student makes an observation or measurement related to an object's motion (e.g., distance traveled, time).
Level 3	In addition to the proficiencies described for Level 2, the student analyzes the pattern of an object's motion in order to make predictions.
Level 4	In addition to the proficiencies described for Level 3, the student predicts future motion of an object based on the patterns of the object's motion.

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

[Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.]

[Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

SEP: Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.

Levels	SEP Statements
Level 2	The student makes an observation or measurement as directed.
Level 3	In addition to the proficiencies described for Level 2, the student decides which data need to be collected as evidence to explain the phenomenon and/or which methods are used to collect that data.
Level 4	In addition to the proficiencies described for Level 3, the student designs an investigation that can be used to provide evidence that supports or refutes an explanation of a phenomenon, including planning fair tests, controlled variables, variables to be changed and measured, and the number of trials considered. The student also makes predictions about what would happen if a variable changes.

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

[Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.]

[Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

CCC: Patterns

Patterns of change can be used to make predictions.

Levels	CCC Statements
Level 2	The student identifies the importance of patterns in relation to explanations of phenomena.
Level 3	In addition to the proficiencies described for Level 2, the student compares patterns of phenomena.
Level 4	In addition to the proficiencies described for Level 3, the student sorts or groups based on similarities or differences in patterns and uses these patterns to make predictions.

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.

[Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

Integrated Statement Levels	Performance Level Descriptor
Level 2	The student defines a simple design problem related to the identification of electric and magnetic forces between pairs of objects that are not in direct contact.
Level 3	In addition to the proficiencies described for Level 2, the student identifies criteria for success and constraints on properties of materials that affect the sizes of electric and magnetic forces between them; the student may also ask questions that demonstrate understanding of how the forces between two objects would be affected by changing the distance between them and, for forces between two magnets, their orientation relative to each other.
Level 4	In addition to the proficiencies described for Level 3, the student predicts what would happen if a variable in the design is changed, evaluating arrangements of objects designed to affect electric or magnetic forces in a desired way and proposing changes in the arrangements of objects.

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.

[Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

PS2.B: Types of Interactions

Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.

Levels	DCI Statements
Level 2	The student identifies electric and magnetic forces between pairs of objects that are not in direct contact.
Level 3	In addition to the proficiencies described for Level 2, the student analyzes and compares the sizes of electric and magnetic forces, which depend on the properties of the objects and the distance between them, and for forces between two magnets, their orientation relative to each other.
Level 4	In addition to the proficiencies described for Level 3, the student evaluates arrangements of objects designed to maximize or minimize electric and magnetic forces between objects and proposes revisions to the arrangement of the objects with the aim of altering the forces in a desired way.

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.

[Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

SEP: Asking Questions and Defining Problems

Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

Define a simple problem that can be solved through the development of a new or improved object or tool.

Levels	SEP Statements
Level 2	The student defines a simple design problem that can be solved.
Level 3	In addition to the proficiencies described for Level 2, the student identifies criteria for success and constraints on materials, time, or cost and/or asks questions about what would happen if a variable in the design is changed.
Level 4	In addition to the proficiencies described for Level 3, the student describes what would happen if a variable in the design is changed and predicts reasonable design solutions based on evidence.

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets. **[Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]**	
CCC: Interdependence of Science, Engineering, and Technology **Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.**	
Levels	**CCC Statements**
Level 2	The student describes the importance of scientific discoveries in leading to new and improved technologies.
Level 3	In addition to the proficiencies described for Level 2, the student applies important science and engineering concepts and research findings to engineering problems.
Level 4	In addition to the proficiencies described for Level 3, the student predicts the application of scientific discoveries in terms of new and improved technologies they may lead to.