# Practice A Teacher Instructions

## Investigation: Plant Growth

**Objective**: Each student will be able to explain the relationship of abiotic and biotic factors in a healthy ecosystem through a model investigation on plant growth.

Students anchor learning in phenomena, plan and conduct an investigation, and develop and communicate explanations and findings in a 3D learning trail. They connect observations and questions of phenomena to develop an explanation and plan an investigation. They collect, analyze and interpret data in a model investigation. Finally, they develop and communicate explanations and findings in a variety of formats and settings.

Previously, students have worked with 3rd and 4th grade concepts of ecosystems without the terms biotic or abiotic. In 5th grade, students now apply the terms biotic and abiotic to the living and nonliving components ecosystems, respectively. In 6th grade, students further investigate these terms and how organisms rely and may compete for biotic and abiotic factors in ecosystems.

- Students achieve the following 'I can' statement, "I can measure how water affects plant growth."
- Students will complete a model investigation anchored in phenomena to help answer the research question, "How does water affect plant growth?"
- Students will make connections between scientific and engineering practices, asking questions anchored in phenomena, collecting data, graphing, analyzing and interpreting data, communicating explanations, and recurring themes of cause-and-effect relationships and system models.
- An optional STEAM Art Extension is included.
- Academic Terms: No new content-related terms are introduced in this segment. Students should be familiar with the components of data tables, x- and y-axes, and ordered pairs.

### Print Materials

### Custom Investigation Handout

*Printable PDF Handout*

The *Custom Investigation Handout* (CIH) is an optional printed template for students who complete their own open-ended investigation. The CIH can be used to differentiate students who will plan and conduct individual or small group investigations. The steps and slide numbers of the investigation are the same on the CIH and the *Digital Student Journal.*

Print this double-sided handout in advance for all or some students. Since the slide numbers are synched with the *Digital Student Journal*, students can use their own handout or the *Digital Student*

*Journal* with guided investigation m. The instructions for the investigation begin on Slide 11's *Investigation: Plant Growth*.

## Develop an Explanation Handout

*Printable PDF Handout*

The *Develop an Explanation Handout* (DEH) is an optional printed template for students to begin on Slide 7 and reference throughout the whole Practice A segment.

Print this single-sided sheet in advance for all or some students, including those who may complete their own investigation using *Custom Investigation Handout* (CIH).

## What Is Happening?

*Digital Student Journal Slide 4*

**Description:** Students observe phenomena, or observable events. Then, they record as many observations as they can. This discrepant event anchors 3D learning regarding the interaction of living and nonliving factors in ecosystems, scientific and engineering practices, and recurring themes and concepts including patterns.

### Scientific & Engineering Practice Spotlight

5.1A Ask questions based on observations or information from text, phenomena, models, or investigations.

- This is the first opportunity for students to record their observations of a phenomenon. This metacognitive process begins in the form of questions.

**Anchor Learning in Phenomena:** As students begin the model investigation, the phenomenon anchors the concept of interdependence as evident in a plant's self-watering strategy. This is the first point in the 3D learning trail in Practice A. The learning of phenomena is anchored in the following steps:

- Observe and/or read information about phenomena.
- Find patterns.
- Ask questions.
- Develop explanations about phenomena using systems models and/or mathematical calculations.
    - Identify components of the system model.
    - Use connections between parts of the system to describe and make predictions about the phenomena.
    - Identify and describe a scientific cause.
- Determine how to test the model.

**Addressing Misconceptions:** As students record their observations of the phenomenon in this section, some of them may note how water droplets are on the leaves of the plant. A misconception is that water is absorbed by the leaves of a plant. Another potential misconception is that plants intake water to breathe just like animals - except in reverse - through the leaves. Students revisit this phenomenon after the investigation in the *What Happened?* section, where it will be imperative to emphasize that the droplets pool together and drain down to the plant's roots. Water is absorbed in plant roots. To counteract this misconception throughout the segment, emphasize that the air and water the plants are interacting with are part of a healthy ecosystem.

At this point, students may not understand that plants get water from the roots, not the leaves. This does not have to be clarified at this time of exploration, but will be revisited after the investigation. Be sure to provide uninterrupted time for students to make observations about the image before moving on. Encourage writing in full sentences.

**Answer Key**

> There is no correct or uniform answer for these connections. Students may note there are droplets of water that are "stuck" in the veins of the green leafy plant. The plant does not appear to be tall and is not woody, so it's not a tree. Students should be able to relate information from 3rd, 4th, and possibly 5th grade to these terms. They may use examples they have either directly observed or learned about previously.

## Observe Patterns

*Digital Student Journal Slide 5*

**Description:** Students continue to observe the image of the phenomenon. They will do so more intently by identifying patterns they notice and recording quantitative (numerical) and qualitative (descriptive) terms.

### Scientific & Engineering Practice Spotlight

5.1A Ask questions based on observations or information from text, phenomena, models, or investigations.

- Students continue to connect their observations to patterns and their personal experiences with the phenomenon of a plant's leaves collecting water.

### Recurring Themes & Concepts Spotlight

5.5A Identify and use patterns to explain scientific phenomena or to design solutions.

- Students approach any phenomenon with a consistent approach of making observations and recording any patterns they observe along the way to developing a model of understanding.

Students connect their observations to questions they may have about the phenomena. Ideally, students are experiencing phenomena with all senses (except taste) and recording what they see, smell, and feel. In this format, students record what they see, but consider adding more details about what students might also observe if they were outside in a field of grass or perhaps a farm.

Students identify and use patterns to explain scientific phenomena. Encourage recording quantitative (numeric) and qualitative (descriptive) observations to reinforce the practice of describing all observable events empirically. Consider the following questions to deepen student thinking throughout this section:

- What structures are found in the phenomenon or system after careful observation?
- How could these patterns be represented using the senses?
- How could patterns be used to classify or organize objects and events?

**Answer Key**

There is no correct or uniform answer for these observations, but anticipated student responses should include more detail than the previous observations. An anticipated student response should note there are dozens of water droplets (quantitative) and the water is clear and the plant is green (qualitative). The plant's structure seems to be "holding" several water droplets in the many folds of the leaves, and the roots or ground are not visible.

## Ask Questions

*Digital Student Journal Slide 6*

**Description:** Students continue their scientific exploration by asking driving questions about what they wonder about the phenomenon. Students connect their observations to questions they may have about the phenomena.

### Scientific & Engineering Practice Spotlight

5.1A Ask questions based on observations or information from text, phenomena, models, or investigations.

- Using the close-up image of the phenomenon, students are encouraged to use their observations to record questions they have about the observable event.

Questions might include wonderings about a plant's structure and its ability to hold water.

**Answer Key**

There is no correct answer for this slide, and students should be encouraged to write as many questions as possible. Examples include “Where does the water go?” and “How does the plant get the water it needs?”

## Develop an Explanation

*Digital Student Journal Slides 7-8*

**Description:** Students use a model to develop an explanation of the phenomenon based on the driving question, “Why is water present on the leaves of the plant?” A series of prompts are provided to guide students through the process of developing an explanation. As students work collaboratively to determine a driving question from their observations, provide a sheet of paper, chart paper, or the general *Develop an Explanation Handout* as they enter the next process in the 3D learning method. They use systems models to explain the phenomenon. In this model investigation, a driving question is provided.

**Scientific & Engineering Practice Spotlight**

5.1G Develop and use models to represent phenomena, objects, and processes or design a prototype for a solution to a problem.

- Students begin to connect the components and identify a scientific cause of the observable event.

### Scientific & Engineering Practices Spotlight

5.2E Construct appropriate simple graphs, tables, maps, and charts using technology, including computers, to organize, examine, and evaluate information.

- As students use a model to develop an explanation to connect their observations of phenomena and to cause-and-effect relationships, encourage collaboration in a variety of settings or formats, such as in small groups or partners and sketches on paper. Students may choose tables or charts to organize their thoughts when identifying components, relationships, or connections in their system.

### Recurring Themes & Concepts Spotlight

5.5B Identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems.

- Students identify that the phenomena is an example of cause and effect because plants need water to live.

## Scientific & Engineering Practices Spotlight

5.3B Communicate explanations and solutions individually and collaboratively in a variety of settings and formats.

- Students individually or collaboratively reflect on their working model as they begin developing explanations. The explanations will be communicated upon completion of the investigation. Differentiation by group can be done at this stage or after the investigation.

Ask students the question, "Why is water present on the leaves of the plant?" It is important to note that the driving question is not the research question for this investigation. The driving question is a connection between observations of the phenomenon and planning and conducting an investigation to test the model derived in this step. Further connections are made between the content and cause-and-effect relationships**.**

This process of developing an explanation on Slide 8 is in three steps:

1. Identify the system and its components and their relationships to each other;
2. Use the model to describe and make predictions about the phenomenon; and,
3. Identify and describe a scientific cause.

Students identify the parts of the system and their interdependence in the function of the system. To complete Slide 8, either give students a blank sheet of paper or a copy of the *Develop an Explanation Handout.* Students follow the steps provided and enter their responses in this slide. You do not need to collect this sheet before the investigation begins. It is designed to be referenced throughout the investigation until the *What Happened? s*ection after the investigation.

**Slide 8, Answer Key**

**1 Identify the system and its components and their relationships to each other.**

1A System name: Ecosystem
If needed, provide students this system name. Consider discussions on other ideas, such as water cycle or evapotranspiration, in guiding students. The system name of ‘ecosystem’ most closely aligns to demonstrate interaction of living and nonliving things in a system. At this point, students may not understand that the interactions are balanced in a healthy and stable ecosystem

1B Identify the components of the system.
Use a sketch to support your response.
The ecosystem has living and nonliving parts. Have students share their sketches. If needed, students can use the blank side of the *Develop an Explanation Handout.*

1C Identify and describe the relationship between the components.
Students identify and describe the relationship of living and nonliving things in an ecosystem, such as living things relying on non living things to survive.

**2 Use the model to describe and make predictions about the phenomenon.**
When changes occur in an ecosystem, all other factors are affected. This is because all factors are interconnected in a system. We are only looking at one plant and some water in this ecosystem, so it is a very limited view of the actual more complicated system.

**3 Identify and describe a scientific cause.**
There must be a cause-and-effect relationship between the water and the plant in a healthy ecosystem. Since a plant requires water to grow, water must be the cause and the effect is its growth.

## Determine How to Test the Model

*Digital Student Journal Slides 9-10*

**Description:** Students determine the type of investigation that *could* best test the model used to develop an explanation about the phenomenon. While the model investigation provided is experimental, students are provided context for how both descriptive and experimental investigations are significant when studying a healthy ecosystem.

### Scientific & Engineering Practice Spotlight

5.1B Use scientific practices to plan and conduct descriptive and simple experimental investigations and use engineering practices to design solutions to problems.

- Students begin to plan how they could investigate and collect evidence in lab or field science.

### Recurring Themes & Concepts Spotlight

5.5B Identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems.

- Students explain how the relationship of cause and effect relates to the phenomena of plants and water in a healthy ecosystem.

Based on the process of constructing explanations in the *Developing an Explanation* phase of the 3D learning trail, students are engaged in this step of inquiry by developing and using a model. The steps followed in the previous slide extend students' thinking by investigating the phenomenon and moving from "What is Happening?" to "What do you think?" during an investigation. They are not yet provided the research question, but are decided on the type of investigation they'd complete and the evidence

they would collect to explain plant growth. Students are given more context on the Recurring Theme & Concept of cause-and-effect relationships.

**Slide 9, Answer Key**

Since students could conduct their own investigation starting on Slide 11, they complete this slide as an exercise to select one they think could be best suited for the model investigation. Either answer will be accepted. This is a non-graded slide.

**Slide 10, Answer Key**

Anticipated student responses should be in a list of as many possible causes for plant growth, soil type, amount of sunlight, temperature, etc.

## Investigation: Plant Growth

*Digital Student Journal Slides 11-12*

**Description:** Before students are provided the option to plan and conduct their own investigation or continue with the one provided in the *Digital Student Journal*, they complete a drag and drop sort of observable variables. Students then complete a brief reading passage on the scientific concept without gaining too much information to complete the investigation itself. Finally, they are provided with the research question for the model investigation, “How does water affect plant growth?”

### Recurring Themes & Concepts Spotlight

5.5D Examine [the parts of a system's] interdependence in the function of the system

- Students connect the measurements of plant growth based on the amount of water added to a system to the concept of interdependence.

**Plan and Conduct Investigations:** As students transition from phenomenon to investigation in the progression of Practice A, they determine how to test the model and begin the steps below. These steps are the second point of the 3D learning trail for Practice A. They are the key lever for driving learning and student mastery of disciplinary knowledge and skills.

- Establish the cause.
- Identify variables.
- Develop a procedure.
- Identify tools and materials.
- Demonstrate safe practices and use safety equipment.
- Use tools to observe, measure, test and analyze information.
- Collect evidence.
- Construct organizers used to collect data.

After the exercise on this slide, students can either continue through the guided investigation provided in the *Digital Student Journal* or use the *Custom Investigation Handout* to plan and conduct their own student-driven investigation.

**Slide 11, Answer Key**

- Cause
    - Abiotic factor
    - The amount of water provided per day (mL)
- Effect
    - Biotic factor
    - The amount of plant growth (mm)

## Custom Investigation Handout

*Printable PDF Download*

**Description:** After constructing an explanation about the phenomenon, students may choose to conduct their own investigation with materials and tools available to them in the classroom. The purpose of the *Custom Investigation Handout* (CIH) is to differentiate instruction and allow for individual, small group, or whole class hands-on investigating using descriptive or experimental investigations. The *Investigation: Plan* through *Investigation: Conclusion* slides are specific to the model investigation and can guide students through the more open-ended steps in the CIH. Alternatively, the CIH can be used separately without the prompts in the *Digital Student Journal.*

The materials provided in the *Investigation: Materials & Tools* section of the *Digital Student Journal* are suggested but can vary based on individual student investigations. For each section of the CIH, be sure to remind students that they are steering their own investigation. Students need to collect evidence during the investigation, identify a claim and link the two with a line of reasoning.

### ELPS Spotlight

**STRATEGY: Connecting to the Real World**

Making Predictions: Students will use new vocabulary and prior knowledge to make predictions.

Instructions:

1. Pair students to read the research question.**(Reading)**
2. Ask students to predict the outcome of the investigation, based on what they know about plants and what the prompt says. They can complete the following sentence frames:
    a. I think the plant will grow more when it gets _____ sunlight because _____.
    b. I think the plant will grow more when it gets _____ water because _____.
    c. I predict that the plant will grow _____ centimeters over the 5 days because _____.
3. Once students have made their predictions, have them share with a partner or small group and discuss their reasoning. **(Listening and Speaking)**
4. As a class, compile a list of the different predictions and have students write about which ones seem most likely based on the information provided in the prompt. **(Writing)**

5. Finally, tell students that they will be conducting the investigation to see if their predictions were correct.

**ELPS Tips for Beginning EB students:**

- Provide visual aids, such as pictures or diagrams, to help with comprehension of new vocabulary and the research question.
- Simplify the sentence frames by using familiar words and sentence structures.
- Model making predictions by providing examples and scaffolding the thought process.

**ELPS Tips for Intermediate and Advanced EB students:**

- Encourage the use of sentence frames to support writing and speaking skills.
- Allow for partner or small group discussion to give students the opportunity to practice language skills and receive feedback.
- Provide sentence stems or prompts to guide the discussion.

## Investigation: Plan

*Digital Student Journal Slide 13*

**Description:** Students use their knowledge of a hypothesis, independent variable and dependent variable, and constants and move the statements into the correct box.

### Scientific & Engineering Practices Spotlight

5.1B Use scientific practices to plan and conduct experimental investigations.

- Students using the *Digital Student Journal* will be conducting an experimental investigation as they observe and collect data to help answer a research question. Students preview the procedure of the experimental investigation in order to measure variables associated with water and plant growth.

Experimental science is an interactive way for students to observe and document natural phenomena by manipulating variables and measuring resulting changes. There is a hypothesis in an experimental investigation. When discussing the answers with students, point out that the hypothesis:

- includes both a living (biotic) and nonliving (abiotic) component of the ecosystem, and
- connects the investigative design back to the central concept in which organisms interact with other living and nonliving parts of the ecosystem.

The independent variable is the amount of water (nonliving factor) and the dependent variable is plant growth, or a living factor of the ecosystem. In a healthy ecosystem, plant growth is affected by the amount of water it receives.

**Answer Key**

| Hypothesis | Independent Variable | Dependent Variable | Control Variable |
|---|---|---|---|
| C. Plants that receive enough water will grow more than those that don't. | A. The cause, or amount of water (abiotic factor), provided to the plants. | B. The effect of how much does the plant (biotic factor) grow each week. | D. A third plant is not watered to prove water is growth mechanism. |

## Investigation: Procedure

*Digital Student Journal Slide 14*

**Description:** Students read the steps for this model experimental investigation. They preview a procedure explaining how data will be observed and collected on how plants grow. Students are introduced to the research question for the model investigation, "How does water affect plant growth?" This set of procedures can also serve as the steps followed for students completing the *Custom Investigation Handout*, as needed.

## Investigation: Materials & Tools

*Digital Student Journal Slide 15*

**Description:** Students read the comprehensive list of materials and select measurement tools used in the model investigation. Then, they provide descriptions of the measurement tools that will be used. Students are prompted to describe the purpose of using each listed tool as it applies to this investigation.

### Scientific & Engineering Practices Spotlight

5.1D Use tools to observe, measure, test, and analyze information.

- Students are introduced to the simulation to measure liquid volume with a graduated cylinder in mL, plant growth (distance) in mm, and a hand lens or loupe to make qualitative observations about the plants in general. They may use different materials and tools available if they plan and conduct their own investigation in the *Custom Investigation Handout.*

Students identify and describe how tools are used to make observations and record qualitative and quantitative data.

**Answer Key**

| | |
|---|---|
| Graduated cylinder | To measure the liquid volume of water given to each plant (in mL) |
| Metric Ruler | To measure the distance of daily growth of each plant (in mm) |
| Hand lens or loupe | Look at plants up close and make qualitative observations. |

## Investigation: Lab & Field Safety

*Digital Student Journal Slides 16-17*

**Description:** Every investigation begins with a review of safety practices and equipment, whether in the classroom lab or field. Students are provided with a comprehensive list to select the appropriate grade-appropriate safety equipment and materials. They are also provided with practices used for this experimental investigation.

### Scientific & Engineering Practices Spotlight

5.1C Demonstrate safe practices and the use of safety equipment during classroom and field investigations as outlined in Texas Education Agency-approved safety standards.

- Students completing the *Digital Student Journal* will identify and demonstrate safe practice and the use of lab equipment for this investigation.
- Students planning and conducting their own investigation will complete the “Safety Practices & Equipment” section on the printed *Custom Investigation Handout.*

From the list, students select those items that apply to this particular investigation. They then describe specific safety procedures.

**Slide 16, Answer Key**
Example provided below. Some answers may vary. This is a manually graded slide.

| | | | |
|---|---|---|---|
| Wash hands before and after handling materials | Dry and safe electrical outlets for equipment | Wear lab or field gloves | Fire blanket nearby |
| Ensure proper ventilation | Transportation Plan | Fire extinguisher nearby | Wear protective clothing and closed-toed shoes |
| Do not enter chemical storage room | Handle glassware carefully to avoid breaking | Repellant and allergy kit | Paper towels to clean lab station |
| Inform teacher if materials spill or are broken | Do not touch broken glass | Sunscreen, sun protection | Electrical equipment is safely in place to not cause injury or fire |
| Wear safety goggles | Eyewash station nearby | Wear a lab coat/apron | Get instructions before handling ANY materials |
| Do not pour chemicals down the drain | First Aid Kit | Appropriate waste disposal can nearby | Individual water bottle |
| | Make sure area is clear of tripping hazards | Pull back long hair, wear short sleeves, secure loose clothing and jewelry | |

**Slide 17, Answer Key**

| | |
|---|---|
| How will you place the lamp within the experiment area to avoid personal injury? | Make sure the electrical cord is not placed anywhere someone can trip on it. |
| How will you help make sure the lamp does not cause a fire? | Make sure it is plugged in properly and that there is nothing (especially things that can catch fire easily, like paper) touching the bulb. |

## Skills Practice: Observations

*Digital Student Journal Slide 18*

**Description**: Students are introduced to a hand lens, or loupe, and how it can be used to look at objects up close.

### Scientific & Engineering Practices Spotlight

5.1D Use tools to observe information.

- Students use a hand lens to make qualitative observations of a plant and record as many observations as they can.

This activity is not the same experience as the initial *What is Happening?* activity since students are using a tool to observe objects up close. Observations are the first part of science, and using tools helps us see details in objects. Tools such as telescopes and microscopes help us see objects that are too far away or too small to be seen with the regular eye, respectively.

**Answer Key**

There are no wrong answers for this slide. Encourage as many full sentences as possible.

## Skills Practice: Measure Height

*Digital Student Journal Slide 19*

**Description**: Students practice reading a metric ruler to measure plant height after two weeks.

### Scientific & Engineering Practices Spotlight

5.1D Use tools to measure information.

- Students use a metric ruler to measure plant growth over time and compare growth of two plants over two weeks.

Measuring distance (in meters) is an important skill in any investigation. The unit of measure for this activity is millimeter, mm.

**Answer Key**

1. 41 mm
2. 21 mm
3. 8 mm

## Skills Practice: Measure Volume

*Digital Student Journal Slide 20*

**Description**: Students practice reading a graduated cylinder. They are provided with a basic comparison of using this tool as a ruler for liquid.

### Scientific & Engineering Practices Spotlight

5.1D Use tools to measure information.

- Students use a graduated cylinder to measure two different liquids by reading the grids on the cylinder.

Measuring volume (in liters) is an important skill in working with liquids. The unit of measure for this activity is milliliter, mL.

**Answer Key**

1. 40 mL
2. 20 mL

## Skills Practice: Collect Data

*Digital Student Journal Slide 21*

**Description**: Students practice placing data into a data table based on changes in plant growth over time.

### Scientific & Engineering Practices Spotlight

5.1F Construct appropriate graphic organizers used to collect data, including tables, bar graphs, line graphs, tree maps, concept maps, Venn diagrams, flow charts or sequence maps, and input-output tables that show cause and effect.

- Students are instructed to complete a data table with step-by-step instructions prior to empirical data collection. They connect the observations in a system based on changes to the plants.

As students continue the practice of applying empirical observations in a data table, they see how a natural system is recorded logically.

**Answer Key**

| **Data Table 1: Plant Growth Comparison Over Time (Trial 1)** | | | | |
|---|---|---|---|---|
| | **Plant 1** | | **Plant 2** | |
| **End of Each Week** | **Amount of Water (mL)** | **Growth (mm)** | **Amount of Water (mL)** | **Growth (mm)** |
| **1** | 20 | 20 | 40 | 20 |
| **2** | 20 | 21 | 40 | 29 |

# Skills Practice: Line Graphs

*Digital Student Journal Slides 22-23*

**Description**: Students use their prior knowledge of line graphs to label the axes. They select the correct data set using the line graph.

## Scientific & Engineering Practices Spotlight

5.1F Construct appropriate graphic organizers used to collect data, including tables, bar graphs, line graphs, tree maps, concept maps, Venn diagrams, flow charts or sequence maps, and input-output tables that show cause and effect.

- Students practice constructing a line graph using ordered pairs.

## Math Spotlight

5.8C Graph in the first quadrant of the coordinate plane ordered pairs of numbers arising from mathematical and real-world problems, including those generated by number patterns or found in an input-output table.

- Students practice constructing a line graph using ordered pairs.

If students struggle to distinguish between the two types of variables and which axis they are on, use the following reference, DRY MIX:

DRY - Dependent, Responding variable on Y-axis, and
MIX - Manipulated Independent variable on X-axis.

**Slide 22, Answer Key**

1.

| | |
|---|---|
| X | Time (days) |
| Y | Plant Height (mm) |

2. Set A corresponds to the line graph

| A | X | 1 | 3 | 5 |
|---|---|---|---|---|
| | Y | 20 | 40 | 65 |

**Slide 23, Answer Key**

3. Set C corresponds to the line graph

| C | X | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | Y | 30 | 52 | 60 | 80 | 90 |

## Investigation: Collect Data

*Digital Student Journal Slide 24*

**Description**: Students collect data based on the practice they have previously completed.

When reviewing the data table with students, point out that data was collected from both the living (biotic) and nonliving (abiotic) components of the ecosystem. This method connects the data collection back to the central concept that organisms interact with other living and nonliving parts of the ecosystem. Data was collected on the amount of water and sunlight, the nonliving factors, and the amount of plant growth, the living factor, of the ecosystem.

**Answer Key**

| Data Table 1: Plant Growth Comparison Over Time (Trial 1) | | | | | | |
|---|---|---|---|---|---|---|
| | Plant 1 | | Plant 2 | | Plant 3 | |
| End of Each Week | Amount of Water (mL) | Growth (mm) | Amount of Water (mL) | Growth (mm) | Amount of Water (mL) | Growth (mm) |
| 1 | 20 | 20 | 40 | 20 | 0 | 0 |
| 2 | 20 | 21 | 40 | 29 | 0 | 0 |
| 3 | 20 | 26 | 40 | 41 | 0 | 0 |
| 4 | 20 | 30 | 40 | 52 | 0 | 0 |
| 5 | 20 | 35 | 40 | 60 | 0 | 0 |

## Investigation: Graph Data

*Digital Student Journal Slide 25*

**Description**: Students plot data from a table into a line graph for three plants. They match the correct set of data to the graph.

## Scientific & Engineering Practices Spotlight

5.2E Construct appropriate simple graphs, tables, maps, and charts using technology, including computers, to organize, examine, and evaluate information.

- Students plot data from their trial of the simulated experimental investigation.

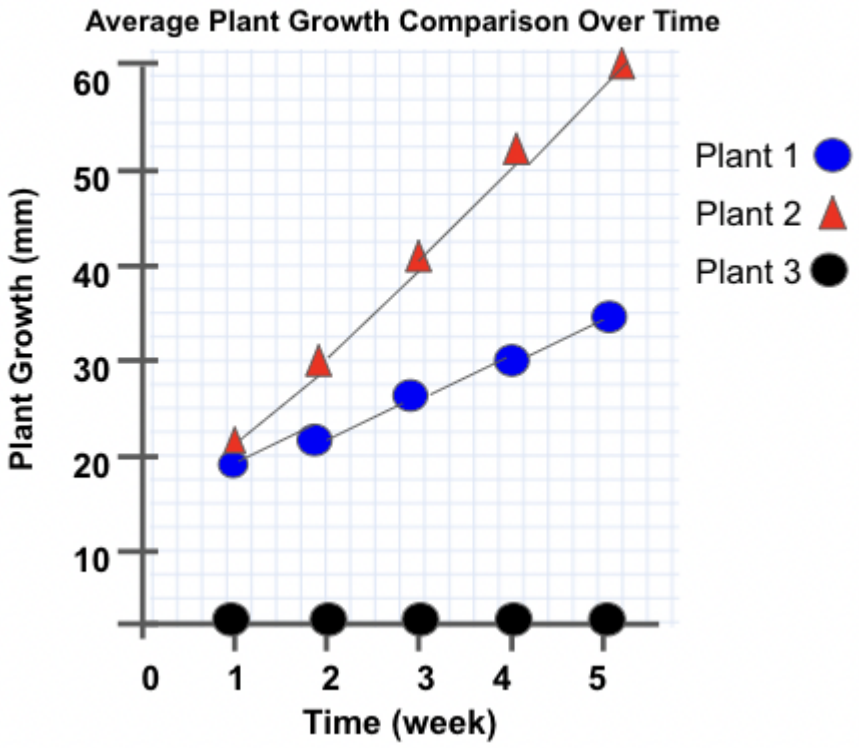
## Math Spotlight

5.1D Communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.

- Students translate data's meaning in a table to a line graph of changing variables over time.

The y-axis represents plant growth in millimeters. The x-axis represents time in weeks. The amount of water and sunlight is different for each plant, which is reflected in each plant's line, respectively. Note this test does not reflect if there is causation, only if there is a correlation. We cannot say the reason plants grow is solely because of nonliving factors in the ecosystem; we can say that plant growth is affected by nonliving factors such as water and sunlight.

**Answer Key**
Pictured below.



## Investigation: Analyze Data

*Digital Student Journal Slide 26*

**Description**: Students analyze data represented in graphic organizers.

### Scientific & Engineering Practices Spotlight

5.2B Analyze data by identifying any significant features, patterns, or sources of error;

- Students record their first observations based on quantitative data organized in a graph. They may observe that plants receiving water and sunlight grow taller. Sources of error could include using different kinds of plants that have different tolerances for water vs. sunlight, not plotting data accurately on the graph, or using incorrect units of measure.

**Analyze and Interpret Data:** As students transition to the next point of the 3D learning trail in Practice A, they move from conducting an investigation to analyzing and interpreting the results..

- Analyze data.
- Identify significant features, patterns or sources of error.
- Use mathematical calculations.
- Identify advantages and limitations of models.
- Evaluate experimental designs.

Recall the rate of growth cannot be implied by the graph generated from the data collected in this model investigation. Only length can be inferred from this data. There is no correlation to plants growing faster with more water, just taller.

**Answer Key**

Student answers may vary, but anticipated responses should include a general observation that one plant grew more than another.

1. Plant 2. It received more water than Plant 1.

## Investigation: Interpret Data

*Digital Student Journal Slide 27*

**Description**: Students interpret their empirical data to answer questions.

**Answer Key**

1. No, they would not go as high and they would be flatter.
2. Plant 3's growth would be less than both of the other plants. It would probably be pretty flat and wouldn't go very high (tall).

## Investigation: Conclusion

*Digital Student Journal Slide 28*

**Description**: Students use evidence from their experiment to help answer the research question.

### Scientific & Engineering Practices Spotlight

5.3B Communicate explanations and solutions individually and collaboratively in a variety of settings and formats.

- In addition to answering if there is enough data to support the hypothesis, students answer a research question on the cause-and-effect relationship of water and plant growth. They used empirical data collected, then analyzed it in a line graph. Finally, they interpreted data and how the results help answer the research question.

### Recurring Themes & Concepts Spotlight

5.5B Identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems.

- Students measure the results of plant growth with varying amounts of water and answer a research question on the cause-and-effect relationship of nonliving factors on living factors in a system.

A conclusion is an answer to the research question, not an explanation of the phenomena. The opportunity to write a conclusion is provided in this segment to help answer the research question regardless of the type of investigation conducted. It is intended to complete the scientific practice of experimentation prior to constructing an explanation in the following activity.

Recall a hypothesis is not a value statement; there is no such thing as a right or wrong hypothesis. A hypothesis is either supported or not supported by data. A hypothesis that is not supported by data is equally helpful in research as we can determine a logical conclusion to the research question.

**Answer Key**

In the investigation the biotic factor, the plant, was dependent on the water, which is the abiotic factor. During weeks 2, 3 and 5, the plant received at least 10 mL of water and the result was plant growth. In week 4, the plant received less than 10 mL of water and the result was no plant growth. The plant's growth is dependent on the amount of water, the abiotic factor. Organisms rely on plants, or the living things in environments, and also need abiotic things like water to grow.

When the plant received more than 10 mL of water, there was growth. In weeks when the plant did not receive more than 10 mL of water, there was no growth. There was enough data to support the hypothesis that plants which receive enough water will grow more than those that do not.

## Investigation: Explanation

*Digital Student Journal Slide 29*

**Description**: Students construct an explanation based on investigation and the scientific principles. The explanation reflects the claim-evidence-reasoning model. The prompt for claim is directly aligned to the content standard. Students use evidence from their investigation and identify appropriate reasoning. All students complete this section even if they completed their own investigation using the *Custom Investigation Handout.*

The prompt for the claim, "How do organisms survive in healthy ecosystems?" applies knowledge from the investigation to the content standard, or how organisms survive in healthy ecosystems.

### Scientific & Engineering Practices Spotlight

5.3A Develop explanations and propose solutions supported by data and models.

- Students use a prompt to write a claim, provide evidence, and identify reasoning to complete a scientific explanation.

5.3C Engage respectfully in scientific discussion.

- Mirroring the process of peer-review in the scientific community, the Claim-Evidence-Reasoning activity engages students in discussion with their own explanations. This is an opportunity for students to learn and participate in supportive discourse when sharing their ideas and promoting rich-discourse among all other students' ideas. Be sure to provide norms for respectful, accountable, and on-topic discussion.

**Develop and Communicate Explanations and Findings:** As students transition to the final point of the 3D learning trail for Practice A, they complete explanations.

- Claim-Evidence-Reasoning model
- Communicate explanations in a variety of settings and formats
- Listen to others' explanations
- Engage in respectful scientific discussion

Before beginning a whole-class discussion, be sure to bring all students back together, especially if some complete their own investigation using the *Custom Investigation Handout.* After regrouping, develop new small groups to differentiate discussion by mixed ability and language knowledge level. Consider using strategies such as a Think-Pair-Share, gallery walk, random partner/reader, or other collaborative learning activity to engage students as active communicators.

To help students share their explanations, refer to this model explanation of healthy ecosystems:

An ecosystem is a natural system of living and nonliving parts interacting when energy from the Sun is input into the system. All organisms interact in an ecosystem, and not just with each other. All organisms interact with the living and nonliving parts of the ecosystem, such as animals breathing oxygen that plants produce and plants using the carbon dioxide that animals produce. Systems are stable when all its parts keep interacting. In a healthy ecosystem, a variety of organisms interact with biotic (living) and abiotic (nonliving) parts to survive.

**Answer Key**

> Claim: Organisms rely on abiotic factors in ecosystems, like oxygen and water. If the system is unhealthy, it affects the biotic and abiotic factors and organisms.
>
> Evidence: Plants rely on water for growth, animals rely on plants to live and breathe.
>
> Reasoning: A. Organisms interact with both living (biotic) and nonliving (abiotic) factors in ecosystems.

## Investigation: Evaluation

*Digital Student Journal Slide 30*

**Description**: Students reflect on the methods they used in the investigation. They also reflect on the Recurring Theme & Concept of system models and cause-and-effect relationships.

**Answer Key**

> Student answers will vary but anticipated student responses should reflect on how changing variables could result in uncertainty in the cause of the result. Correlation is not causation. There may be measurement errors, or more trials are needed. They were able to measure changes to a responding variable when the independent variable is changed, which is an aspect of cause-and-effect relationships of plant growth and water.

## What Happened?

*Digital Student Journal Slides 31-32*

**Description:** Students build understanding of disciplinary knowledge and skills as they make observations anchored in phenomena, plan and conduct investigations, collect, analyze and interpret data, and develop and communicate explanations and findings relative to the phenomenon.

### Recurring Themes & Concepts Spotlight

5.5B Identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems.

- Students connect the cause-and-effect relationship of water and plant growth based on the data collected, analyzed, and interpreted.

Students connect the cabbage plant's ability to store water on its leaves to funnel to its roots in a self-watering process.

**Slide 32, Answer Key**

> Student answers may vary but anticipated student responses should include connections between the growth measured in the investigation to the water collected by plants in the cabbage family. They may connect that the plant gets the water to its roots and grows as a result.

## Pulling It Together

*Digital Student Journal Slides 33-34*

**Description**: Students apply what they have learned to the new STAAR® question types.

Here are some additional tips for administering accessible formative assessments.

### Assessments Accessibility Recommendations

**Oral Administration:**

- Preparation: For students who require more personalized assistance, consider offering oral administration of the assessment. Prior to the assessment, identify the students who will benefit from this accommodation.
- Quiet Environment: Ensure the testing environment is quiet and free from distractions to facilitate a comfortable setting for oral administration.

- Read Aloud: Sit with the student individually or in a small group and read the assessment questions and answer choices aloud. Remain neutral in tone and pace to provide consistency across all students.
- Clarifications: Be prepared to provide clarifications or rephrase questions if students request further explanation. Avoid giving away answers but offer support in understanding the content.

**Transcribing for Student Access:**

- Identify Needs: Identify the students who will require transcription support through the dictation tool. These are students who have difficulty typing and need their spoken responses transcribed.
- Designate a Scribe: Assign a scribe who can transcribe the student's spoken responses onto the digital platform. This could be the instructor, a teaching assistant, or a peer.
- Clear Communication: Ensure that the scribe understands the importance of accurately transcribing the student's responses without altering their meaning.
- Review with Student: Once the assessment is transcribed, review the answers with the student to confirm accuracy and make any necessary corrections.

**Using a Dictation Tool:**

We recommend the use of the Microsoft Edge®  browser for dictation.

- Identify Needs: For students who may have difficulty typing their responses, identify those who require transcribing of their answers.
- Implementation:  Before the assessment begins, ensure that each student's computer is set up with the Microsoft Edge browser.  Instruct the students to navigate to the assessment using the Edge browser.
- Opening the Dictation Tool: Once students are on the assessment page, direct them to the text box where they need to input their response.  Instruct the students to press the Windows key and the H key simultaneously to open the dictation tool.
- Dictating Responses for Transcription: Students will see a microphone icon. Instruct them to click on the microphone icon to start dictating their response for transcription.  Remind students to speak clearly and at a normal pace to ensure accurate transcription.
- Completing the Assessment: Once the response is transcribed and edited, students can proceed to the next question or task as usual. Provide support if any technical issues arise or if students encounter challenges during the process.

**Slide 33, Answer Key**

1. A. Water and B. Sunlight

**Slide 34, Answer Key**

2. Water. Students may choose shelter or food but explain to students that water is essential to all living things. Organisms may go days without shelter and food but not without water.

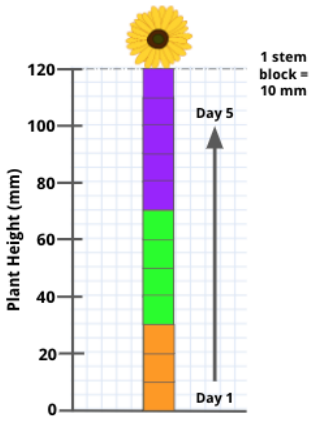
## STEAM Extension: Art

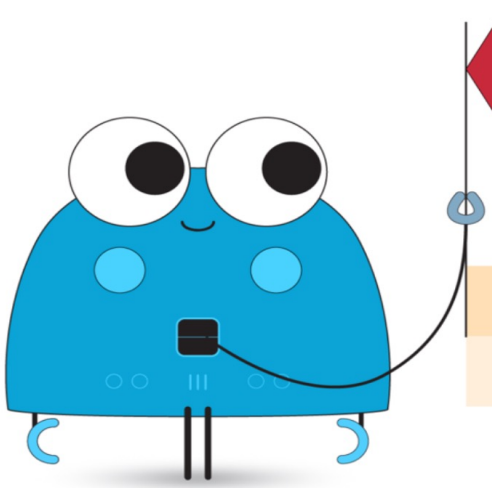
*Digital Student Journal Slide 35*

**Description:** This is an optional differentiated optional activity for non-linguistic representation of data. As some students complete the investigation, they may continue with this Extension.

### Answer Key

Example key pictured below.





R P A

TREKs™

## 5.12A Interdependence

## Overview

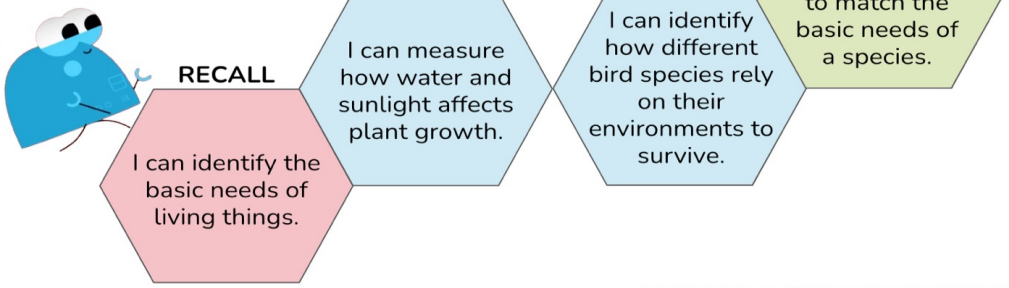
Slide1



1 / 3

# TREK Goals

**5.12A: Interdependence**
Observe and describe how a variety of organisms survive by interacting with biotic and abiotic factors in a healthy ecosystem.



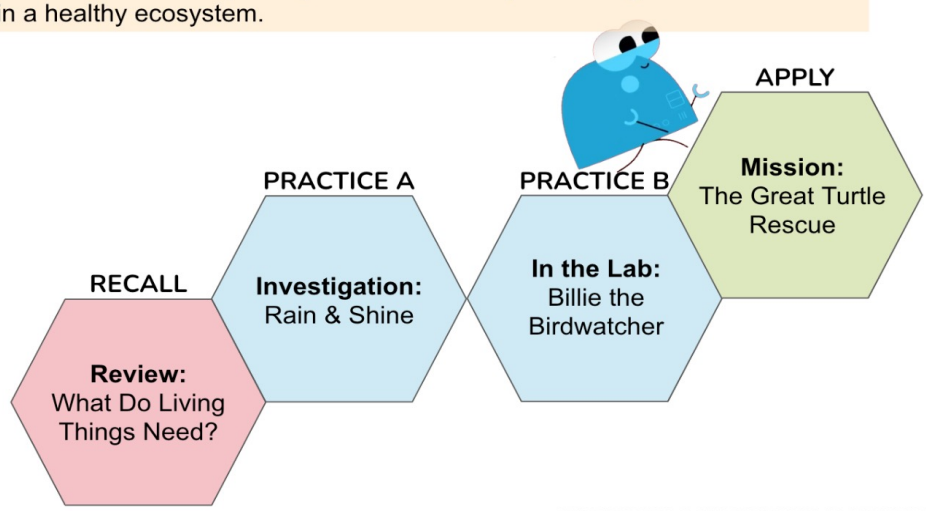

Slide 2



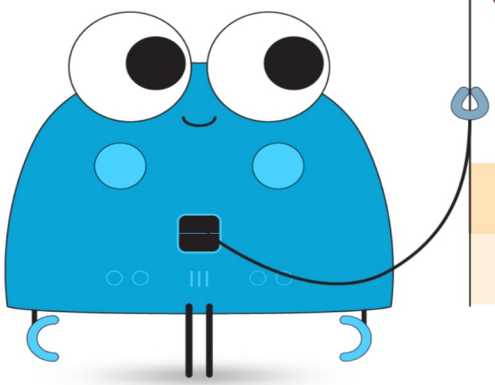
2 / 3

# TREK Segments

**5.12A: Interdependence**
Observe and describe how a variety of organisms survive by interacting with biotic and abiotic factors in a healthy ecosystem.




Slide 3



R P A

TREKs™

## 5.12A Interdependence

## Practice A

Slide 1



1 / 37

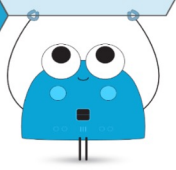
# TREK Goals

**5.12A Interdependence**
Observe and describe how a variety of organisms survive by interacting with biotic and abiotic factors in a healthy ecosystem.

## Practice A

**Investigation:**
Plant Growth

I can measure how water affects plant growth.



Slide 2



2 / 37

# Integrating Concepts, Practices, and Themes

## What You Learn

All organisms interact with living and nonliving things in healthy ecosystems.

SEP

## How You Learn

- Ask Questions
- Collect Data in Data Tables
- Graph, Analyze, and Interpret Data
- Communicate Explanations

RTC

## How You Think

- Cause-and-Effect Relationships
- System Models

Practice A

Slide 3






# What Is Happening?

## Observe Phenomena

Sometimes scientists learn concepts through ***phenomena***, or observable events.

**Instructions:** Observe this image. Record as many observations as you can.

WRITE HERE

Submit

Slide 4


# Observe Patterns

**Instructions:** Now, take another, closer, look at this image. Use qualitative and quantitative terms as you describe patterns you notice.

WRITE HERE

Submit

Slide 5



5 / 37


# Ask Questions

**Instructions:** Based on your observations, formulate questions about the image. What do you wonder?

WRITE HERE

Submit

Slide 6



6 / 37

PRACTICE A

# Construct an Explanation

**"Why is water present on the leaves of the plant?"**

To answer this question, you'll develop and use a model to construct an explanation to represent what you think about the phenomenon. You may communicate this individually or collaboratively with your peers on a sheet of paper or chart paper.

1. Identifying the components of the system and their relationships to each other,
2. Using connections between the components to describe and predict,
3. Identifying a scientific cause.

Before identifying the components of the system, you need to review what a system is and how systems work. A system is closed set of components that interact with each other. For example, a computer is a system of hardware and software interacting as electricity is added to the system.

An ecosystem is a natural system of living and nonliving parts interacting when energy from the Sun is input into the system. All organisms interact in an ecosystem, but not just with each other. They interact with the living and nonliving parts of the ecosystem, such as animals breathing oxygen that plants produce and plants using the carbon dioxide that animals produce. Systems are stable when all its parts keep interacting. In a healthy ecosystem, a variety of organisms interact with biotic (living) and abiotic (nonliving) parts to survive.

Slide 7





PRACTICE A

# Develop an Explanation

**Driving Question:** "Why is water present on the leaves of the plant?" **Instructions**: Complete the steps provided to develop an explanation of the phenomenon to address the driving question. You may use the *Develop an Explanation Handout* or blank paper. Communicate individually or collaboratively with your peers.

1A. System name:

1B. Identify the components of the system. Use a sketch to support your response.

1C. Identify and describe the relationship between the components.

Submit

2. Use the model to describe and make predictions about the phenomenon.

3. Identify and explain a scientific cause.

Submit

Slide 8

PRACTICE A

# Determine How to Test the Model

You will plan and conduct an investigation to test your model that represents the *What Is Happening?* phenomenon. Investigations can be descriptive or experimental depending on if variables are being recorded or compared. **Instructions:** Read the investigation descriptions. Move the one to the yellow box that could most accurately help to investigate your ideas about the phenomenon.

**Descriptive Investigation**

Does not compare variables and involves the systematic measurement of a variety of qualitative and quantitative characteristics.

Example: Describing how different plants look as they grow.

**Experimental Investigation**

Compares variables to determine if a relationship exists between them as they change or are changed. A fair test helps identify the causes of change if possible.

Example: Measuring plant growth in the shade vs. direct sunlight.

Submit

Slide 9





PRACTICE A

# Determine How to Test the Model

Causation is if one variable can cause another variable to change. You cannot say if the variable changed BECAUSE of the changed variable, but you can determine if there were effects to the change. You are about to test a cause and effect relationship based on our observations of phenomena. In this investigation, we will compare variables to see if there is a cause and effect relationship between them. Let's review the difference between cause and effect.

**Instructions:** List as many causes of plant growth as you can think of.

| **Cause** Things that could make a plant grow. | **Effect** Results of the cause. |
|---|---|
| WRITE HERE | Plant Growth (mm) |

Submit

Slide 10

PRACTICE A

# Investigation: Plant Growth

You will plan and conduct an investigation on the variables involved with plant growth. You will measure, compare, and describe the amount of plant growth for the plants with different amounts of water over time.
**Instructions:** Move the variables of this investigation to the correct category.

RTC **Cause-and-Effect Relationships, Systems**

**VARIABLES**

| Cause | Effect |
| --- | --- |
| The amount of water provided per day (mL) | The amount of plant growth (mm) |
| Abiotic factor | Biotic factor |

At this point, you may conduct the investigation in this journal or plan and conduct your own investigation using the printed *Custom Investigation Handout* from your teacher.

Submit

Slide 11





PRACTICE A

# Investigation: Plant Growth

Image Credit: Unsplash / Darren Richardson

SEP

**Why are we studying this?**

In a healthy ecosystem, a variety of organisms interact with biotic (living) and abiotic (nonliving) parts to survive. Water and sunlight are nonliving things that living things need, especially plants.

To understand how plants interact with abiotic factors like water in an ecosystem, you will measure how much they grow. Your experimental investigation is a 5-week simulation and multiple trials will be compared. You will observe and measure variables by watering plants and comparing their growth. You will analyze, graph, and interpret data to determine which plants grow when they receive enough water.

Your hypothesis is that plants which receive enough water will grow more than those that do not. To control the experiment, all plants will receive the same amount of simulated sunlight using a grow lamp.

**Research Question: "How does water affect plant growth?"**

Slide 12

PRACTICE A

# Investigation: Plan

How will you investigate the Research Question: "How does water affect plant growth?" **Instructions:** Move the matching part of this **experimental investigation** to its term and definition.

| **Hypothesis**<br>A testable statement to investigate or test. | **Independent Variable**<br>What is changed in an investigation to test. | **Dependent Variable**<br>What changes as a result of the independent variable. | **Controls**<br>Unchanged or separate to conduct a fair test. |
|---|---|---|---|
| B. The effect - how much the plant (biotic factor) grows each week. | A. The cause - the amount of water (abiotic factor) provided to plants. | C. Plants that receive enough water will grow more than those that don't. | D. A third plant is not watered to prove water is a growth mechanism. |
| PARTS OF THIS INVESTIGATION | | | |
| | | | |

Submit

Slide 13





PRACTICE A

# Investigation: Procedure

You will follow this procedure in the simulated experimental investigation:

1. Plant each seed in its own pot and add enough water to each pot so the soil is saturated.
2. Every day, add 20 mL of water to Plant 1, 40 mL of water to Plant 2, and no water to Plant 3.
3. At the end of each week, measure (in mm) the total height of each plant.
4. Subtract the current height of each plant from its height the week before to calculate how much each plant grew over that week.
5. Record the calculation in a data table.

Slide 14

PRACTICE A

# Investigation: Materials & Tools

For this simulated classroom investigation, you will use the following materials and tools to observe, measure, test, and analyze information.
**Instructions:** Based on what you know about the research question and procedure, describe the purpose of each tool.

| Materials |
|---|
| • 2 Seedlings, the same<br>• 2 Pots<br>• Enough soil to fill each pot with one seedling<br>• Grow lamp<br>• Water |

| Tools | Purpose: What will each measure and test? |
|---|---|
| Graduated cylinder | WRITE HERE<br>Submit |
| Metric ruler | WRITE HERE<br>Submit |
|  Hand lens or loupe | WRITE HERE<br>Submit |

Slide 15





PRACTICE A

# Investigation: Lab & Field Safety

You will use safety practices and safety equipment in all classroom lab and field investigations.
**Instructions:** Select all the safety practices and equipment you will need use during this lab investigation.

| | | | |
|---|---|---|---|
| Appropriate footwear | Dry and safe electrical outlets for equipment | Fire extinguisher nearby | Fire blanket nearby |
| Ensure proper ventilation | Transportation Plan | Repellant and allergy kit | Wear lab/field gloves |
| Do not enter chemical storage room | Handle glassware carefully to avoid breaking | Sunscreen, sun protection | First Aid kit nearby |
| Inform teacher immediately if items spill or are broken | Eyewash station nearby | Wear a lab coat/apron | Wear protective clothing |
| Wear safety goggles | Do not touch broken glass | Appropriate waste disposal can nearby | Paper towels to clean lab station |
| Do not pour chemicals down the drain | Individual water bottle | Pull back long hair, wear short sleeves, secure loose clothing or jewelry | Lamp is safely placed to not cause injury or fire |

Submit

Slide 16

PRACTICE A

# Investigation: Lab & Field Safety

A grow lamp will be used to control the amount of light needed for all plants to receive about the same amount of light. How will you safely do the following in your procedure? **Instructions:** Answer each question to describe how you will demonstrate safety as you complete this investigation.

| Safety Practice | How will I demonstrate safety? |
|---|---|
| How will you place the lamp within the experiment area to avoid personal injury? | WRITE HERE<br>Submit |
| How will you help make sure the lamp does not cause a fire? | WRITE HERE<br>Submit |

Slide 17

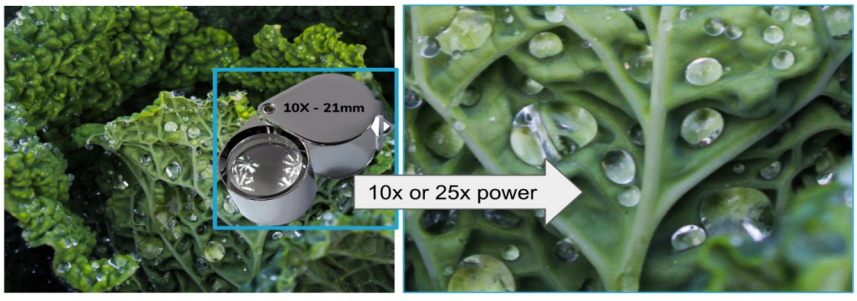




PRACTICE A

# Skills Practice: Observations

In lab and field science, looking at objects up close results in even more observations, and often more questions. A hand lens, loup, or magnifying glass are all ways to make handheld close-up observations without having to use a microscope. Most are in powers of ten (10x), but sometimes you'll find 25x. What do you observe in the images when looking closer? **Instructions:** Record as many quantitative or qualitative observations of the close-up image as you can.




WRITE HERE

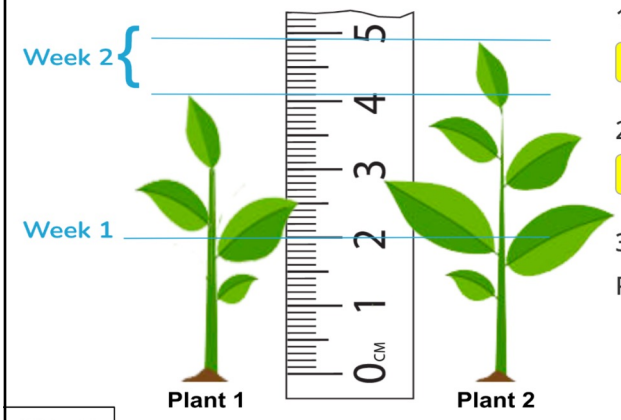
Submit

Slide 18

PRACTICE A

# Skills Practice: Measure Height

Each plant is measured using a metric ruler. For every measurement, the ruler's 0 will be placed at the base of the plant. Then measure the height of plant at its top leaf. To calculate the each week's growth, subtract previously measured growth from the most current measurement. At the end of Week 1, both Plant 1 and Plant 2 have grown 20 mm, or 2.0 cm. **Instructions:** Answer the questions below, using the unit of measure of mm.




1. What was the height of Plant 1 at the end of Week 2?

2. How much did Plant 1 grow between Week 1 and Week 2?

3. What is the difference in heights between Plant 1 and Plant 2 at the end of Week 2?

Submit

Slide 19

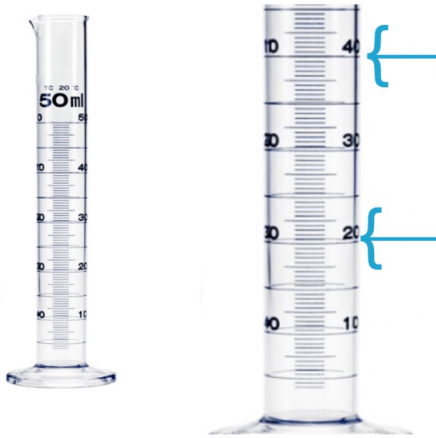




PRACTICE A

# Skills Practice: Measure Volume

A common tool in labs is a graduated cylinder, which is used to measure volume. It's like a ruler for liquids, but instead of measuring in millimeters or centimeters, you use it to measure liquid volume in milliliters (mL) or cubic centimeters ($cm^3$). When measuring the amount of liquid, it's important to set the graduated cylinder on a stable table and read the marks at eye level. **Instructions:** Record the amount of liquid for each measurement, using the unit of measure mL.




Plant 2 will receive _____ of water each week.

Plant 1 will receive _____ of water each week.

Submit

Slide 20

PRACTICE A

# Skills Practice: Collect Data

You will collect observations of a system and record data in a data table. Each week, you will observe and record the results of plant growth when water is added to the system. Each plant receives the same amount of light and does not need to be watered daily. You will measure the plant growth in millimeters (mm) on Fridays. Plant 1 will receive 20 mL of water each week. Plant 2 will receive 40 mL of water each week. **Instructions:** Practice collecting data for Week 1. Assume both plants start at 20 mm (2.0 cm) tall.

**Data Table 1: Plant Growth Comparison Over Time (Trial 1)**

| | Plant 1 | | Plant 2 | |
|---|---|---|---|---|
| End of Each Week | Amount of Water (mL) | Growth (Height in mm) | Amount of Water (mL) | Growth (Height in mm) |
| 1 | | | | |
| 2 | | | | |

1. Write in the amount of water each plant gets for Week 1.
2. Measure the height of each plant each Friday. They both started at 20 mm (2.0 cm).
3. Write in the height of each plant. Remember 10 mm = 1 cm.

Submit


Plant 1 Plant 2

Slide 21

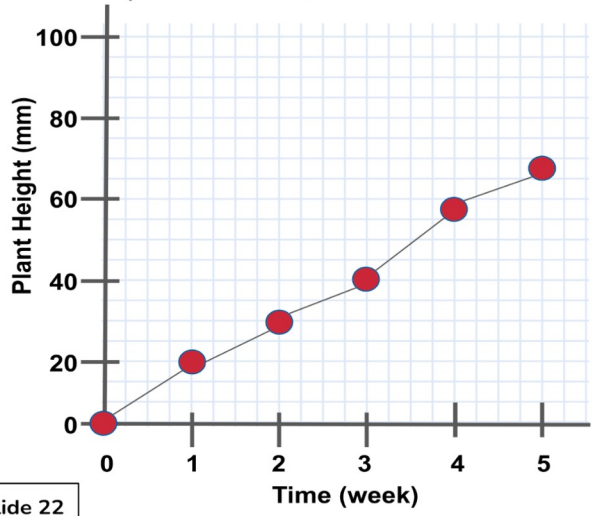




PRACTICE A

# Skills Practice: Line Graphs

A graph exhibits data of variables as they change. It has an X-axis and a Y-axis. Points are plotted on the graph based on a pair of numbers, one for X and one for Y. Together, the pairs are called coordinates.




**Instructions:** Complete the activities below.

1. Write the label that corresponds to its matching axis.

| | |
|---|---|
| X | |
| Y | |

2.

| A | X | 1 | 3 | 5 |
|---|---|---|---|---|
| | Y | 20 | 40 | 65 |

| B | X | 20 | 40 | 65 |
|---|---|---|---|---|
| | Y | 1 | 3 | 5 |

Move your answer here:

Submit

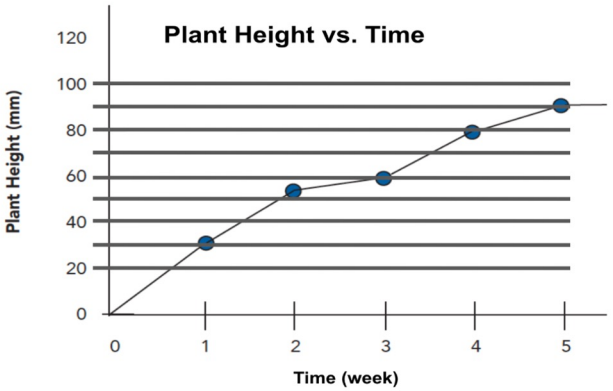
Slide 22

PRACTICE A

# Skills Practice: Line Graphs

**Instructions:** Read and analyze the information below. Then, select the correct answer.

3. A student did an experiment and generated the graph below. Examine the possible data sets. Which data set best represents the graph?




| | | | | | | |
|---|---|---|---|---|---|---|
| A | X | 1 | 2 | 3 | 4 | 5 |
| | Y | 5 | 5 | 10 | 35 | 40 |

| | | | | | | |
|---|---|---|---|---|---|---|
| B | X | 0 | 2 | 4 | 6 | 8 |
| | Y | 30 | 52 | 60 | 80 | 90 |

| | | | | | | |
|---|---|---|---|---|---|---|
| C | X | 1 | 2 | 3 | 4 | 5 |
| | Y | 30 | 52 | 60 | 80 | 90 |

| | | | | | | |
|---|---|---|---|---|---|---|
| D | X | 1 | 2 | 3 | 4 | 5 |
| | Y | 25 | 47 | 52 | 65 | 95 |

Submit

Slide 23





PRACTICE A

# Investigation: Collect Data

Collect observations and measurements as evidence to complete a data table. You will use a graduated cylinder to measure 20 mL water for Plant 1 each week and 40 mL water for Plant 2 each week. Plant 3 is not watered as a control.

**Instructions:** Follow the lab procedure to complete the data table for your trial.

**Lab Procedure**

1. Record the the amount of water Plant 1 and Plant 2 received each week. Plant 3 is a control and is not watered.
2. Measure the growth of each plant, or the height in mm each week. Since this is a simulation, these values have been recorded for you.

**Data Table 1: Plant Growth Comparison Over Time (Trial 1)**

| | Plant 1 | | Plant 2 | | Plant 3 | |
|---|---|---|---|---|---|---|
| End of Each Week | Amount of Water (mL) | Growth (mm) | Amount of Water (mL) | Growth (mm) | Amount of Water (mL) | Growth (mm) |
| 1 | | 20 | | 20 | 0 | 0 |
| 2 | | 21 | | 29 | 0 | 0 |
| 3 | | 26 | | 41 | 0 | 0 |
| 4 | | 30 | | 52 | 0 | 0 |
| 5 | | 35 | | 60 | 0 | 0 |

Slide 24

PRACTICE A

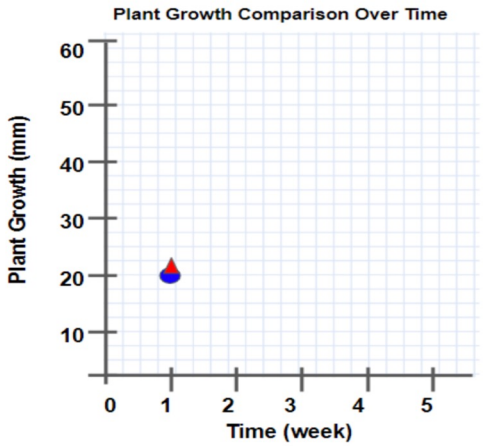
# Investigation: Graph Data

**Instructions:** Use the Plant Growth data table to plot the Plant 1 blue circle data point along the y-axis of the graph for each week. Week 1 has been done for you. Repeat this for Plant 2 using the triangles.

| Data Table 1: Plant Growth Comparison Over Time (Trial 1) | | | |
|---|---|---|---|
| | Plant 1 | Plant 2 | Plant 3 |
| End of Each Week | Growth (mm) | Growth (mm) | Growth (mm) |
| 1 | 20 | 20 | 0 |
| 2 | 21 | 29 | 0 |
| 3 | 26 | 41 | 0 |
| 4 | 30 | 52 | 0 |
| 5 | 35 | 60 | 0 |

Plant 1

Plant 2




Submit

Slide 25

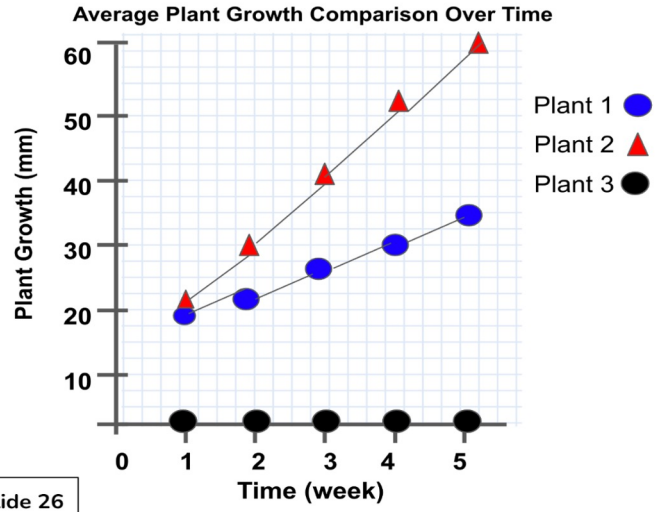




PRACTICE A

# Investigation: Analyze Data

Each student had their own trial and the average results were compiled into one graph. **Instructions:** Review the completed graph of the data and answer the question below.




1. Analyze the data to identify any significant features, patterns, or sources of error.

WRITE HERE

Submit

2. In this investigation, the amount of water is an abiotic factor. The growth of plants are biotic factors. Even though both plants started at the same height, they did not grow the same. Which plant grew more and why?

WRITE HERE

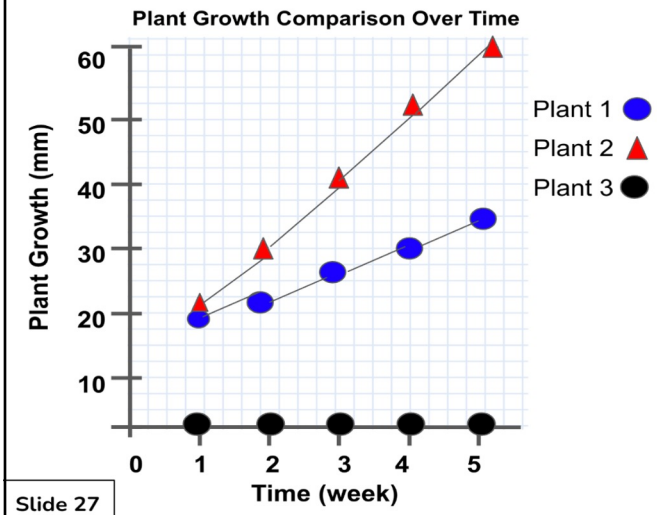
Submit

Slide 26

PRACTICE A

# Investigation: Interpret Data

Like other scientists, you constructed a graph using data from observations collected in a table through a experimental investigation! Now let's interpret the data. **Instructions:** Answer the questions.




1. If both plants received 5 mL less water per week, would the growth rates be the same?

WRITE HERE

Submit

2. If there were more plants that received 10 mL of water each week, would their growth rate be more or less than the others? (Assume Plant 1 received 20 mL and Plant 2 received 40 mL.) How would their graph line be different than the others?

WRITE HERE

Submit

Slide 27

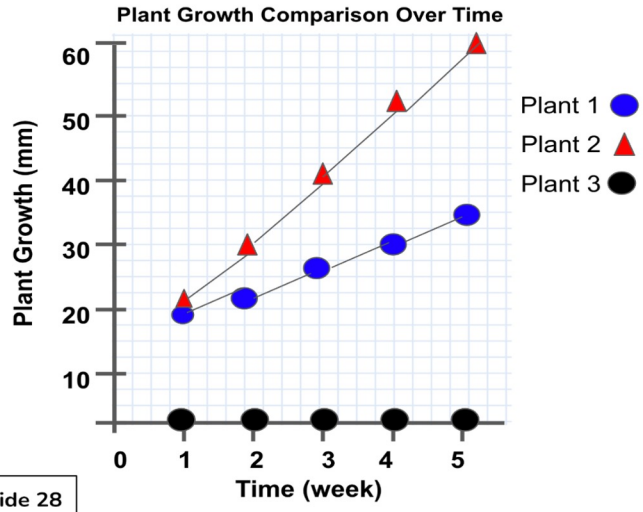




PRACTICE A

# Investigation: Conclusion

**Congratulations!** You've now completed the experiment and analyzed the data! This system model helped you visualize the interdependence of biotic and abiotic factors in a healthy ecosystem, and plants need water!




**Instructions:** Review and answer the initial research question. For your conclusion, describe if there was enough data to support the hypothesis that if plants receive enough water, they will grow more than those that don't.

**Research Question:**
**"How does water affect plant growth?"**

WRITE HERE

Submit

Slide 28

PRACTICE A

# Investigation: Claim & Evidence

**Instructions:** Based on the data you observed and recorded about how water affects plant growth, write in your Claim and the Evidence. Then, move the best Reasoning Description into the Reasoning box. You may discuss this with your peers and actively listen to each other as you share scientific explanations.

| | |
|---|---|
| **Claim**<br>How do organisms survive in healthy ecosystems? | WRITE HERE<br>Submit |
| **Evidence**<br>What evidence from the investigation supports your claim? | WRITE HERE<br>Submit |

**Reasoning**
How does the evidence support your Claim?

**REASONING DESCRIPTIONS**

A. Organisms interact with both living (biotic) and nonliving (abiotic) factors in ecosystems.

B. Organisms only interact with living things, like plants.

C. Organisms only interact with nonliving things, like water.

Submit

Slide 29





PRACTICE A

# Investigation: Evaluation

Reflect on the design and results of this classroom investigation on a system model. Models like watering plants help us understand ecosystems with variables that we can observe and measure. They also help us understand and describe relationships as variables change in the model, like plant growth in response to the amount of water in an ecosystem. **Instructions:** Write your evaluation of the scientific and engineering practices and concepts like cause-and-effect relationships and system models you utilized in the yellow box below.

WRITE HERE

Submit

Slide 30


# What Happened?

**Instructions:** How did this phenomenon support the development of your understanding of the cause-and-effect relationship between biotic and abiotic factors as evidenced in this system model?

WRITE HERE

Submit

Slide 31






# What Happened?

## These plants are self-watering!

Plants in the “cabbage family” include vegetables like broccoli, cauliflower, chard, bok choy, arugula, kale, radish, and - you got it - cabbage. All plants need water, but these plants need almost 3 liters of water a day! They get it by using their super-textured leaves to collect water droplets. The droplets slowly drain down to the plant’s roots instead of quickly evaporating or being splashed away. All plants need air and water, just like animals. Every time plants and animals breathe (yes, plants breathe too!), we are interacting with a system of nonliving things like air and water.

What other questions do you have about how plants grow?

WRITE HERE

Submit

Slide 32

PRACTICE A

# Pulling It Together

Image Credit: Unsplash / Kiyoshi

1. In a healthy desert ecosystem, like the one shown in the photo, relatively few plant species can survive. Based on what you learned in this investigation, which abiotic factors are needed to support plant growth here?

Select **TWO** correct answers.

- [ ] Water
- [ ] Sunlight
- [ ] Rocks
- [ ] Insects

Submit

Slide 33





PRACTICE A

# Pulling It Together

Image Credit: Unsplash / Benjamin Balázs

2. All living things rely on biotic and abiotic factors to survive in healthy ecosystems.

What is the one specific abiotic factor that every living thing on Earth needs? Enter your answer and explanation in the box provided.

Enter your answer in the box.

Submit

Slide 34

PRACTICE A

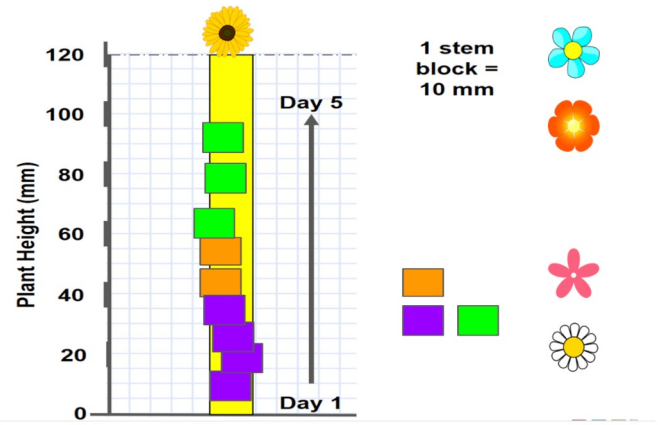
# STEAM Extension: Art

**Instructions:** To show the plant's growth, build a plant with a stem and flower on the **VERTICAL BAR on the graph**. Use the pre-collected data from the experiment in the data table below.

**Step 1**: Move the plant stem blocks to stack up each day's correct stem growth (one color for each day). All blocks will be used.

**Step 2**: Choose a flower to top it off!

| Time (day) | Growth (mm) |
|---|---|
| 1 | 0 |
| 2 | 30 |
| 3 | 40 |
| 4 | 0 |
| 5 | 50 |




Submit

Slide 35