UDL Teacher Guide: Beginning Plants

Plants: The structures of life

"Nature will bear the closest inspection. She invites us to lay our eye level with her smallest leaf and take an insect view of its plain."
— Henry David Thoreau

Driving Question: What do plants eat?

Introduction

Using the UDL approach, students actively explore the science of plant structures and how they produce their food in multiple ways: from a fictional story to data collection with probes, and from hands-on inquiry to using computer models and simulations. Data collection, using probeware, is displayed using smart graphs, allowing students to dissect the elements of the graph to enhance their understanding. A variety of scaffolding helps are provided throughout the unit. The scaffolding allows students and teacher to work together so that students can demonstrate what they have learned through text and/or drawings. Coaches give prompts, hints, and models to engage students in the science content.

Each activity includes a discovery question to help students refine their understanding as they progress through the unit. They are:

- What are the parts of a plant, and what are they for?
- Why do plants look the way they do?
- Why do plants have stems, roots, and leaves?
- Can plants survive without water and sunlight?
- What do plants need to stay alive?
- How can bar graphs show how a plant grows?

The discovery questions are located at the top of each page of the activity, so students can refer to them often. Point them out occasionally if students need reminding about the focus of the activity.

Technology

The technology used in the plants unit is designed for students to discover the story told by the data as they investigate plants. A light probe is used in the activity "Water and Sunlight." The probes allow students to collect and view data in real time on smart graphs. Smart graphs allow students to analyze data in a meaningful and supported way. The graphing tools are the same, regardless of the activity.

The technology in UDL does not supplant the teacher. Instead, students are individually supported throughout the unit. One example of this support is that students can highlight the text and the computer will vocalize the words. Definitions for highlighted words (in blue) are also built into the program. A complete glossary for the unit can be found at the bottom each page using the book icon. In some of the units you will also find three robot helpers. These robots help the student understand the material by asking them to make predictions, asking guided questions, and by clarifying or predicting what will happen next.

The teacher can manage certain features of the units for both the class and individual students. Once a class is set up the teacher can go to the UDL Portal-Info page and click on the "View a report on this class" icon. At the top of the report page there are two options, one that allows you to configure the parameters for students. This allows you to control the font size and set the initial scaffolding level for students. The option on the class report page allows you to enable/disable activities within the units.

The default setting for lesson order when setting up your classes will be a sequenced order of lessons. When students enter the menu page they will complete the Pre-test. When they have submitted the Pre-test they will be able to access the next lesson in the sequence. If you want to allow students to choose their own sequence you can set up your class so that once they have completed the Pre-test and Introduction they can move between lessons in whatever order they like. (A more detailed explanation can be found at http://udl.concord.org/share/teacher-guides/Dashboard.pdf)

Scaffolding in UDL Units

Scaffolding in education has traditionally been done by the teacher as a way to assist students as they are learning new skills or content. The scaffolding is done not to provide answers or do the work for them but as a way for the students to gain confidence and develop understanding of skills and concepts. The goal of scaffolding is that over time the level of assistance that a student needs will gradually be reduced until the minimal amount of support is needed and used. To use a cooking analogy: a chef will use a recipe the first few times he makes a dish. After he has made it several times, he may have the recipe out for reference and then after more time, it becomes so natural he no longer needs the recipe.

In the UDL units different levels of support are offered to students when answering questions. As with the cooking analogy, the scaffolding is intended to provide support for those students who need it with the goal that with time they will be able to work with minimal scaffolding. When scaffolding prompts are available they are accessed by clicking on the green question mark icon. Students may answer the open-ended question as presented. Or, if they are unable to do so, they can click on the question mark and access the first level of support. At this level they are given a hint that may lead them to the correct response. If the student is still unable to answer the question, they can click the question mark again for the answer with key words left out and they can fill in the blanks. If they need additional help, they receive a multiple-choice list. The final level of scaffolding offers the student a model response; they are given the answer and asked to provide their own ideas about the response.

Standards

NSES Content Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry.
    - Identify questions that can be answered through scientific investigation.
    - Design and conduct a scientific investigation.
    - Use appropriate tools and techniques to gather, analyze, and interpret data.
    - Develop descriptions, explanations, predictions, and models using evidence.
    - Think critically and logically to make the relationships between evidence and explanations.
- Understandings about scientific inquiry.
    - Mathematics is important in all aspects of scientific inquiry.

- Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

NSES Content Standard C: Life Science

- The characteristics of organisms.
  - Organisms have basic needs. For example, animals need air, water, and food; plants require air, water, nutrients, and light.
  - Each plant or animal has different structures that serve different functions in growth, survival, and reproduction.

Benchmarks for Science Literacy—AAAS

- The Living Environment
  - Diversity of Life
    - Plants and animals have features that help them live in different environments.
  - The Living Environment
    - Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful.
- The Mathematical World
  - Numbers
    - Simple graphs can help to tell about observations.

Alaska state standards (http://udl.concord.org/share/teacher-guides/TG_Plants34-AK-Standards.pdf)

California state standards (http://udl.concord.org/share/teacher-guides/TG_Plants34-CA-Standards.pdf)

Learning Goals

Plants need sunlight, water, and carbon dioxide to make food.

Students should be able to:

- Identify the structures of a plant (root, stem, leaves) and their functions:
  - Roots take in water.
  - Stems transport water to the leaves and food (sugars) from the leaves to other parts of the plant.
  - Leaves take in sunlight and carbon dioxide.
- Understand that plants don't eat as animals do. They make their own food for growth by the process of photosynthesis.
- Read bar graphs to compare the growth of plants over time.

Background

Plants are found in almost all environments on our planet. They come in many forms and have developed to survive in their particular niche. Even so most plants have some common characteristics. They are critical to our survival since they can produce their own food and so are at the base of most food chains.

The basic structure of flowering plants can be divided into two systems. The root system includes the primary root and the root hairs. There may also be lateral roots coming off the primary root. This system serves several functions. First the roots act as an anchor for a plant. They help hold the plant in place. They also absorb water that the plant uses as part of the process of photosynthesis and trace nutrients (minerals like nitrogen, phosphorus, or sulfur) that the plants use for their own growth and health. The roots also act as a storage system for the food (sugars) produced by the plants. For example, a carrot is the stored food in the root of the carrot plant.

The other system in most plants is the shoot system. This includes the stem, leaves, and flowering bodies. The stem (trunk) is a support system for the leaves and flowering bodies. The stem also contains tube-like structures that help transport water and nutrients. The shoot system also includes the leaves. The leaves take in carbon dioxide (CO_2) from the air and release oxygen (O_2) through small pores. They also absorb light energy and transform it into chemical energy. The carbon dioxide, along with water that is absorbed by the roots and the chemical energy, is converted into sugars (food). The flowering bodies on the shoot system are the primary reproductive system of the plant. Through the interaction of the various reproductive parts plants produce seeds, which will carry the species forward to the next generation.

Photosynthesis is the process that plants use to take in minerals (H_2O and CO_2) and light energy to produce sugars (food) that the plant uses to support its own life processes, as well as the organisms that consume plants. The process of photosynthesis takes place primarily in the leaves of the plant. The process takes place in two reactions. The first is the light reaction. Light reactions occur when light energy is coming into the plant (usually from the sun). The light energy is converted and stored as chemical energy. Dark reactions don't require light, but aren't inhibited by it either. During the dark reactions the stored chemical energy and the minerals the plant has taken in are used to produce sugars. This process is called photosynthesis and involves chlorophyll in the chloroplasts, which are found mainly in the leaves of the plant.

Misconceptions about Plants

When students enter school they come with a set of understandings about science. Some of these ideas are well developed and accurate. Others may be just as well developed, but fail to accurately reflect true understanding about science concepts. There are a variety of reasons that students develop misconceptions about science and it is important to have some ideas about what some of these misconceptions might be. One reason for these misconceptions is that students are introduced to vocabulary without having a connecting experience. They may have also built these misconceptions through life experiences before entering the school setting. Misconceptions may also be held on to extremely tightly, with students giving the "correct" answer on a test, but when pressed they will fall back on the misconceptions that they held prior to instruction. While recognizing common misconceptions is important, it is also critical that teachers take the time to help students address these misconceptions through inquiry-based activities.

The misconceptions below relate to the topics explored by students in the plant unit.

Photosynthesis and Respiration:

a. Plants get their food from the environment rather than manufacturing it internally.
b. Food for plants is taken in from the outside. Soil supplies most of the "raw materials" for photosynthesis. (Students have difficulty accepting that plants make food from water and air and that this is their only source of food.)
c. Water and minerals are food for plants.
d. Soil is the plant's food. People put food (fertilizer) in the soil for plants to eat.
e. Respiration and photosynthesis are not seen as energy transfer processes.
f. Plants take their food in through the roots and then store it in their leaves. Plants convert energy from the sun directly into matter.
g. Plants change water and carbon dioxide into sugar (instead of plants convert carbon dioxide from air and hydrogen atoms from water into sugar).
h. Plants only give off oxygen.
i. Photosynthesis is a plant process and respiration is an animal process.
j. Respiration means breathing (not energy release).

A plant can be viewed as a manufacturing plant. The raw materials for manufacturing are water and carbon dioxide. The energy that runs the manufacturing process is light energy, primarily from the sun. The water provides the hydrogen that makes up the sugars, and the carbon dioxide provides the rest of the atoms that make up the sugar molecules.

http://dese.mo.gov/divimprove/curriculum/science/SciMisconc11.05.pdf

Unit Overview

Activity	Activity Length	Materials	Overview
Pre-test	20 minutes	▪ Computer with Internet access	Students begin with a short pre-test that allows the teacher and student to assess prior knowledge.
Introduction	30-40 minutes	▪ Computer with Internet access	Students are introduced to plant growth by watching a time-lapse video showing the growth of radish seeds. They write a short description of what they see happening in the video. Teachers should have students share their stories.
A Plant Story	Two-three 45-minute sessions	▪ Computer with Internet access ▪ Printout of story (optional) (http://udl.concord.org/share/teacher-guides/Plants34_v7.pdf)	Students read a story about Maria and Chen and the plants they grow.
Parts of a Plant	Two 30-40-minute sessions	▪ Computer with Internet access	Students identify the structures found in two types of plants and begin to identify how these

			structures help the plant make its own food.
Leaves, Stems, Roots	Two 30-40-minute sessions	▪ Computer with Internet access ▪ Newspaper to cover tables ▪ House plants (one for each group of 3 students) ▪ Hand lens ▪ Scissors ▪ Celery stalks ▪ 300 ml (10 oz)clear plastic cup or beaker ▪ 240 ml (8 oz) water	Students extend their understanding of various plant parts and their functions. They will work in teams with each member of the team becoming an expert on the leaf, stem, or root.
Water and Sunlight	Six or more 10-15-minute observations over 2-3 weeks and one 30-minute follow-up session	▪ Computer with Internet access For each group of 4: ▪ 4 small potted plants (viney like ivy) ▪ Light sensor ▪ Tape measure ▪ 250 ml beaker or measuring cup ▪ Permanent marker ▪ Scissors ▪ Water ▪ Sunny window ▪ Dark location ▪ Plant Observation Chart (http://udl.concord.org/artwork/plant_34/plant_chart/pl_34_plant_chart.pdf) ▪ Light Level Chart (http://udl.concord.org/artwork/plant_34/light_chart/pl_34_light_chart2.pdf)	Students investigate what happens to plants when the amount of sunlight and water are changed.
The Food-o-Meter	30-40 minutes	▪ Computer with Internet access	In a series of simulations students look at how changing the amount of light, water, and carbon dioxide affect plant growth.
Graph it Growing	30-40 minutes	▪ Computer with Internet access	Students look for trends in bar graphs to explain the best conditions for plant growth.
Wrapping Up	Ongoing	▪ Computer with Internet access	Students can visit and revisit “Wrapping Up” during their completion of the unit activities. In Wrapping Up they have the opportunity to review and clarify their thinking.

Post-test	20 minutes	▪ Computer with Internet access	Students complete the post-test, which contains the same set of question as the pre-test, as well as student feedback questions.

Unit Activities

Pre-Test

Time: 20 minutes

Materials: computer with Internet access

This unit begins with a short pre-test. The pre-test allows students to share what they already know about the learning goals. Students must complete the pre-test and press the "Submit" button before proceeding to any activity. The post-test at the end of the unit contains the same set of questions. Based on student responses to the multiple-choice questions, teachers are able to make recommendations about which activities each student should complete.

Introduction

The driving question "What do plants eat?" is introduced. In the unit students learn about the parts of the plant and are introduced to the process of photosynthesis. As members of Dr. Green's "Green Team," Chen and Margaret discuss whether or not plants actually eat. This discussion is based on their understanding that eating is one part of what defines "living." Having students identify the characteristics of a living organism using a sheet of chart paper will allow you to begin to identify misconceptions and make sure that these misconceptions are addressed.

Time: 30-40 minutes

Materials: computer with Internet access

A Plant Story *Story*

Discovery Question: What are the parts of a plant, and what are they for?

Chen and Maria, who are neighbors, plant some radish seeds to see if they can find out how they grow. They are surprised that it takes more than a day for them to grow. Elvira, a family friend, comes to visit and uses magic tools that allow Chen and Maria to see what the radish plant looks like underground. She also "rewinds" the plants' growth so the children can see the plants grow.

Time: two or three 45-minute sessions (or can be read in chapters as time allows)

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    - Each plant or animal has different structures that serve different functions in growth, survival, and reproduction.

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- The Living Environment
    - Diversity of Life
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    - The Living Environment
        - Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful.

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California state standards (http://udl.concord.org/share/teacher-guides/TG_Plants34-CA-Standards.pdf)

Materials:

- Computer with Internet access
- Printed copies of chapters (available as PDF files) to read offline (optional)

Student Activity:
Students read the six chapters that make up the story of Chen and Maria as they grow radish seeds. Elvira uses special tools to help the children get a better look at how plants grow. At the end of Chapters 1 and 6, students are asked to respond to the story by writing and/or drawing.

Scaffolding is available using the "robot" helpers, which provide prompts to help students understand the story.

Discovery Question: Why do plants look the way they do?

In this activity students use a video of radish seeds growing over a nine-day period to identify structures found in plants and begin to figure out how those structures help plants make food.

 **Time:** two 30-40 minute sessions

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 **Materials:** computer with Internet access

Student Activity:

Engage:

Students begin by watching a video that shows the growth of radish seeds over a period of nine days. The video allows the students to watch what happens multiple times as well as pausing the video to get a better look at various changes. They are then asked to write a short story describing their observations.

Students should be given an opportunity to share their stories with a partner.

Explore:
Having done general observations, students begin to use the video to more closely investigate the roots, stems, and leaves of the growing radish. They first look at the growth of the roots over time, making and modifying drawings of their observations. Then they move on to the stems and leaves.


Teacher Notes: If you are using science notebooks having students make hard copies of their drawings and observations will allow you and your students to share observations.

Explain:
Students are now given a diagram of a plant. As they scroll over the parts of the plant, the functions of the roots, stem, and leaves, are explained in text boxes. Students are then asked to explain in their own words the function of each part.

Elaborate:
Now that students have observed a "typical" plant, they are shown a cactus and using text boxes have the functions of the parts of the cactus plant explained. Then they are asked to explain how the cactus works and explain the differences between the cactus and the plant in the Explain section.


Quick Check for Understanding: Ask students to explain the advantage of the different structures they observed as they answer the question—Why do plants in the desert look different than non-desert plants?

Evaluate: Students can make a T-chart in which they compare and contrast the structures of two plants, the cactus and the plant with leaves.


Teacher Notes:
One of the questions that may come up while working on this activity is what makes a plant a plant and where plants are found. It will be important to explain that while we usually think of plants as having roots, leaves, and living on land, that there is much variety in the kingdom of plants.

Plants can be found in a wide variety of environments and their structures have adapted to the environments where they live. The key is that no matter what their structure, they have the ability to make their own food, using water and carbon dioxide, with light providing the energy source. Plants range from the small water-borne algae to the large redwoods growing on land.

Discovery Question: Why do plants have stems, leaves and roots?

In this activity students continue to investigate the parts of the plant. They look at leaves, stems, and roots, and try to determine why many plants have these parts.

 **Time:** two 30-40 minute sessions

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Materials:

- Computer with Internet access
- Newspaper to cover tables
- House plants (one for each group of 3 students)
- Hand lens
- Scissors
- Celery stalks
- 300 ml clear plastic cup or beaker
- 240 ml water

Student Activity:

Note: Students work in groups of three to investigate the roots, leaves, and stems of plants. Each student will become the expert on one of these plant parts.

Engage:
Students are shown a diagram of three different plants and are asked to respond to the question, "What do these three pictures of plants have in common?"

Explore:
Students now begin working in groups of three. Each student in the group will be asked to become an expert on one of the three parts of a plant: roots, stem, or leaf.

> Root Expert: The root expert carefully takes a plant out of its pot and separates the soil and roots. They then describe the structure of the plants roots in response to prompts.
>
> Stem Expert: The stem expert carefully observes the stem(s) of the group's plants. They respond to questions that help them describe how the stems work.
>
> Leaf Expert: The leaf expert makes careful observations of the leaves on the plant, counting the leaves, recording where the largest and smallest leaves are located. The leaf expert then looks at and learns about the structure of the leaf itself.

Explain:
Having explored the structure of the leaves, stem, and roots, the group experts are now asked to respond to questions and explain how these plant parts function.

> Root Expert: Using observations and drawings, the root expert explains why the roots are located where they are and how their function is connected to their location.
>
> Stem Expert: Using observations of plant stems, the stem expert explains why plants need strong stems.
>
> Leaf Expert: Using observations and drawings, the leaf expert explains how the function of leaves is related to their appearance.

When student experts are done with this section, they should share their discoveries with the other members of their group. It is each member's job to communicate what they have learned about the function of the various parts.

Elaborate:
Students use a drawing of a plant to show how matter in the form of water, carbon dioxide, and oxygen move through the plant. In addition they are to show how and where sunlight enters the plant.

 **Teacher Notes:**
When student groups have completed their tasks in the Explore sections, one way to make sure that all experts are prepared to share in their group is to have them meet as Expert groups. For example, have all the "Root" experts meet and make a list of the most important things for the "Leaf" and "Stem" experts to know about roots. This will give them a chance to practice what they are going to share about what they learned and to make sure that there is agreement on what was learned. Students often do a better job helping their peers recognize if they are missing some of the pieces.

Discussion:
Lead the whole class in a discussion using the questions below to start the conversation. Allow students time to clarify their ideas and encourage them to explain their thinking.

"What are some other parts of the plant that you did not find in your investigation of plant parts?"

"How do the parts of a plant make it different from other living things?"

Water and Sunlight *Hands-on (light sensor) & Computer model*

Discovery Question: Can plants survive without water and sunlight?

In this investigation students observe how plants react when the amount of light or the amount of water is changed. This investigation is designed to take place over a period of two to three weeks so that students can predict and observe long-term changes in the plants.

 **Time:** 6 or more 10-15 minute observations over 2-3 weeks, plus one 30-minute follow-up session

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Materials:

- Computer with Internet access

For each group of 4:

- 4 small potted plant (with vines, like ivy)
- Light sensor
- Tape measure
- 250 ml beaker or measuring cup
- Permanent marker
- Scissors
- Water
- Sunny window
- Dark location
- Plant Observation Chart (PDF file)
- Light Level Chart (PDF file)

Advance Preparation:

Make sure that you have access to suitable locations for students to place their plants for the duration of the investigation. Print copies of the charts for student use.

Teacher Notes:
If you do not have access to enough plants for each student, you may have groups of students observe a single plant receiving the various treatments.

Student Activity:
Students will be setting a controlled investigation to see what happens when either light or water are withheld or provided to a plant. Talk with students about how this is one of the ways that scientists try to find the answer to a question so students begin to understand that there are multiple ways to approach a question.

Engage:
Students are asked to make predictions about what they think will happen if the amount of light or water is changed for a plant. They answer a series of multiple-choice questions that focus their thinking on the various parts of the plant.

Explore:
Students begin by meeting in groups of four. Each group will need four plants. Following the directions students will remove all the ivy stems except the longest. The extra stems can be rooted if desired (see note below). Once the stems have been removed, students then follow directions based on what treatment their plant is going to receive. There are a total of four treatments based on water and light levels (lots of water and light; no water, lots of light; lots of water, no light; no water, no light). They can record their data on paper and/or electronically. Along with recording their data for their plant they also respond to questions that help them focus their observations.

Teacher Notes:

Rooting Cuttings in Water
Ivies root very readily in water. Strip all of the leaves that will be below the waterline. Water should be no more than three inches deep. Place the cuttings in indirect light or a north-facing window. After roots form care is needed in establishing the new plants in a potting media. Roots formed in water lack root hairs that are necessary for the cuttings to absorb water from soil or other media. Use a mixture of one part soil-less media and two parts horticultural grade perlite. Water well and place in a plastic storage bag for a few days and then gradually open the bag to acclimate them to the outside air. This gives time for new root hairs to form.

Reprinted with permission from The American Ivy Society: http://www.ivy.org/clon.html

Explain:
Using the data collected from the group's four plants, which is combined on a single chart, students analyze the data. Based on their analysis, students support their conclusions with evidence to decide what conditions allow a plant to grow the most successfully.

Elaborate:
Students have made observations about the effects of varying light and water level; they now quantify the amount of light the plants receive by using the light sensors. Over a period of five days students take light measurements at the same time each day. The light levels should be

measured at a time when the "average" amount of light is available at the location of their investigation.

Quick Check for Understanding: As a class discuss the following questions: What seems to be the most important thing for plant growth, light or water? What evidence do you have to support that? Thinking about what you know about a cactus, do you think that you would have the same results if you were to do the same investigation with a cactus?

The Food-o-Meter *Computer model*

Discovery Question: What do plants need to stay alive?

In this investigation students use a computer model of a growing plant, called a "Plant Food-o-Meter." It will help students understand the effect of water, sunlight, and carbon dioxide on the health of the plant.

Time: 30-40 minutes

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Student Activity:

Engage:
Students are introduced to the Food-o-Meter, which allows them to model how changes in water, light, and carbon dioxide change the plant's production of sugars. They begin by answering prediction questions, such as "What do you think will happen to the plant if it is cloudy instead of sunny?" They are given directions on how to run the Food-o-Meter and how to read the graphs. They then run a practice series.

Explore:
Students run their investigation three times, each time changing the light level, but leaving the water and carbon dioxide levels the same. After the model has run they use the data collected to answer questions.

Teacher Notes: Remind students to include the evidence (data) to support their answers to the questions in this section. It is very easy for them to just say, "It made more sugar." They should include information about the amounts of sugars produced compared to sugars used, health of the plant, etc.

After completing their investigation with light, they move on to water, using the same process. When they have completed the light investigations, they investigate carbon dioxide.

Explain:
Having run the Food-o-Meter tests, students now are asked three questions requiring them to explain what happened in their investigations. These questions encourage students to process the information and look for patterns in the data they collected.

Elaborate:
Using what they have discovered in this investigation, students are asked to apply the information to two questions, "What do plants need to stay alive?" and "What does the plant produce from the water, light, and carbon dioxide?"

These questions focus the students on requirements for life and the process of photosynthesis.

Discussion:
Lead the whole class in a discussion using the questions below to start the conversation. Allow students time to clarify their ideas and encourage them to explain their thinking.

"Since plants are making their own food, why are they important to animals, including humans?"

"What would happen if there were no plants?"

Graph it Growing! — *Math*

Discovery Question: How can bar graphs show how a plant grows?

Using data and graphs, students look at trends in the growth of plants under varying conditions. As a part of their analysis students begin to look at general trends in data over time.

 **Time:** 30-40 minutes

 **Standards:**

NSES Content Standard A: Science as Inquiry

- Abilities necessary to scientific inquiry.
  - Identify questions that can be answered through scientific investigation.
  - Use appropriate tools and techniques to gather, analyze, and interpret data.
  - Develop descriptions, explanations, predictions, and models using evidence.
  - Think critically and logically to make the relationships between evidence and explanations.
- Understandings about scientific inquiry.
  - Mathematics is important in all aspects of scientific inquiry.
  - Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

NSES Content Standard C: Life Science

- The characteristics of organisms.
  - Organisms have basic needs. For example, animals need air, water, and food; plants require air, water, nutrients, and light.

The Benchmarks for Science Literacy—AAAS

- The Living Environment
  - Diversity of Life
    - Plants and animals have features that help them live in different environments.
  - The Living Environment
    - Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful.
- The Mathematical World

- Numbers
  - Simple graphs can help to tell about observations.

Alaska state standards (http://udl.concord.org/share/teacher-guides/TG_Plants34-AK-Standards.pdf)

California state standards (http://udl.concord.org/share/teacher-guides/TG_Plants34-CA-Standards.pdf)

Materials: computer with Internet access

Student Activity:

Engage:
Students begin by looking at a table and the resulting bar graph showing the growth of 10 been seeds over a two-week period. They are asked to explain why a bar graph might be an easier way to look at the data that was collected.

Explore:
Students now use the bar graph to identify specific information that could be used to analyze growth. For example, they use the graph to identify the period of greatest growth for the bean plants.

Explain:
Now that students have had practice reading a bar graph they are shown a new graph showing the number of leaves a plant has. They are given baseline data and asked to finish a table and bar graph using the pattern described.

Elaborate:
Students are now given four graphs that represent data from four possible sets of growing conditions. Using the graphs as evidence, students answer questions based on the graphs.

Teacher Notes: This activity can be difficult for some students since they are going to be asked to describe trends and make comparisons in bar graphs. Because there may be variations over the length of time (ups and downs), it is important to talk about what happens generally from beginning to end and not just focus on some minor fluctuations.

Wrapping Up

Driving Question: What do plants eat?

Time: Ongoing

 **Materials:** computer with Internet access

Having completed the investigations in this unit, students review what they have learned about plants and respond to the discovery question for each activity with text, drawings, snapshots, or data they have collected. Students can revisit any activity except the pre-test. When students are ready, they need to input a password to unlock the post-test.

The password is: **plants**

Post-test

 **Time:** 20 minutes

 **Materials:** computer with Internet access

In the post-test students have an opportunity to rethink their answers to the same set of questions as the pre-test. Once the post-test has been unlocked, students will not be able to revisit any previous activities.

Note: When the students finish the post-test, a box comes up saying they have finished and should tell the teacher. At that moment, their data is *not yet saved*. They must close the unit for the data to be saved. The student cannot just walk away. Students can close the unit by going to the File menu and selecting Exit or by simply clicking the red circle (upper left).

Additional Resources

Vocabulary

Average: the middle of a set of values. To calculate it, add up the values and divide by how many there are.

Computer model: a program that runs on a computer and imitates the real world in some way.

Energy: a property of materials that can be used to heat things. The total amount of energy in a system doesn't change.

Evidence: what you observe or measure to support an idea.

Leaf (Leaves): captures energy from sunlight which the plant uses to produce its food (sugars) from water brought to it from the roots and the carbon dioxide the plant takes in. The leaf has tiny holes **(stoma)** on the bottom that allow carbon dioxide in. In addition to taking in carbon dioxide, the leaves release oxygen from the water molecules that aren't used in the sugar production.

Monitor: to observe something carefully over a period of time.

Photosynthesis: the process by which plants take matter (carbon dioxide, CO_2, and water, H_2O) and light energy to produce sugars. The plant uses carbon and oxygen from the carbon dioxide and the hydrogen from the water. The plant releases oxygen molecules O_2 into the atmosphere.

Roots: the part of the plant that absorbs water and trace nutrients. In addition the roots help anchor plant in the soil.

Root hairs: threadlike extensions that grow from a plant root and take in water and minerals from the soil.

Stem: the main support structure of the plant. The stem also moves water and nutrients from the roots to the leaves.

Stoma: small holes in the leaf that allow carbon dioxide in and release oxygen. (**Stomata** — plural form of stoma.)