THINKING AND ACTING LIKE A SCIENTIST

TEACHER'S GUIDE

What Plants Need, Part 2 of 2

Do Wisconsin Fast Plants need water to grow?

GRADE K

Life Science

VAN ANDEL EDUCATION INSTITUTE

VAEI.ORG

INQUIRY-BASED SCIENCE

Life Science

What Plants Need, Part 2 of 2

Grade Level/ Content	K/Life Science
Lesson Summary	In this lesson, students will conduct an investigation to determine if plants need water to grow. This is Part 2 of a 2-part lesson. In Part 1, students conduct an investigation to determine if plants need light to grow.
Estimated Time	1, 45-minute class period (10 minutes on Day 1, 5 minutes on Day 5, and 30 minutes on Day 10)
Materials	Young, fast-growing plants (we used Wisconsin Fast Plants available at Wisconsin Fast Plants); watering system (this can be manual or you can use a build-your-own deli container watering system); light box (available at Carolina Biological) or other consistent light source (like a lamp); Observation Form; journal
Secondary Resources	• Wisconsin Fast Plant Life Cycle diagram • Magic School Bus-How a Plant Makes Food • *Oh Say Can You Seed?: All About Flowering Plants* (Cat in the Hat's Learning Library), by Bonnie Worth • *A Handful of Sunshine,* by Melanie Eclare
NGSS Connection	**K-LS1-1** Use observations to describe patterns of what plants and animals (including humans) need to survive.
Learning Objectives	• Students will make observations and organize data to determine that plants need water in order to live and grow.
Cross-Curricular Project Connections	No More Grocery Store!, World Class Menu

Do Wisconsin Fast Plants need water to grow?

Plants are all around us. They are used for decoration, medicines, wood, food, and so much more. Scientists are continually looking for ways to improve the disease resistance of plants to protect them as a vital resource. Wisconsin Fast Plants were developed by Professor Emeritus Paul H. Williams at the University of Wisconsin. He bred these plants as a research tool for improving similar crops such as mustard, radish, cabbage, broccoli, and more.

He selected plants that had characteristics most suitable for laboratory and classroom use, such as short life cycles, easy to grow, and small size. After 20 years of development, Dr. Williams had reduced the 6-month life cycle of the plant to just 5 weeks! The shortened life cycle has proven effective in research and has led to advances in cellular and molecular plant research. Now your students can use these plants to plan and conduct their own investigations!

Investigation is based on the Van Andel Education Institute (VAEI) Instructional Model for Inquiry-Based Science. In all investigations:

Students don't know the "answer" they are supposed to get.

Students play a driving role in determining the process for learning.

Teachers and students construct meaning together by journaling.

Students are working as hard as the teacher.

Part 1

INVESTIGATION SETUP

Students will need the following:

- Fast-growing young plants (such as Wisconsin Fast Plants available at Wisconsin Fast Plants)
- Watering system (we recommend build-your-own deli container watering system, but there are several systems described on the Wisconsin Fast Plant website and available for purchase)
- Light box (available at Carolina Biological) or other consistent light source (like a lamp)
- Observation Form
- Journal

Part 2

INVESTIGATION FACILITATION

Question

Introduce the investigation question.

Do Wisconsin Fast Plants need water to grow?

STUDENT ENGAGEMENT

Show a time lapse video of the Wisconsin Fast Plants life cycle. Ask students to describe what is happening in the video (*plants grow, then flower, then go to seed*). Then, introduce the investigation question.

Personal Knowledge

Students capture what they already know about what plants need to grow.

- Find out what students already know about what plants need to grow.
- Write "What Plants Need to Grow" on the board.
- Ask students to think about what plants need in order to grow. As they share ideas, write them on the board.
- Review the ideas shared and explain that in this lesson we are going to test whether or not plants need water to grow.

OPENNESS TO NEW IDEAS

Remind students that even when they think they are sure of something, they should still be open to new ideas. If students list water as something plants need to grow, ask probing questions: *Are you sure? How do you know? What's your evidence?* Explain that it's always best to use evidence to support our ideas.

Secondary Knowledge

Students learn the life cycle of the Wisconsin Fast Plant.

- Tell students that the Wisconsin Fast Plant is easy to grow and has a short life span, so it is often used in research.
- Show students the Wisconsin Fast Plant Life Cycle diagram. Ask questions to make sure all students understand the life cycle of the Wisconsin Fast Plant.
  - How many days is the life cycle?
  - On what day does the plant start to flower?
  - On what day do leaves start to grow?
  - What happens after Day 28?

STUDENT ENGAGEMENT

You may want to engage students by having them act out the life cycle of a plant based on the diagram. They can do this as a whole class, with you calling out "Day 1" and the class acting out what the plant looks like on that day. Or you can cut the images from the diagram out, have students stand in a circle, then give the Day 1 image to the 1st person in the circle, the Day 2 image to the 2nd person, and so on. This way all students can "see" how many days are between each pictured stage.

Prediction

Students predict what the results will be, based on their prior knowledge.

- Ask students to predict the answer to the investigation question using the "I predict _____ because _____" prompt. (An example student response might be: *I predict plants do need water because otherwise they will die.*)

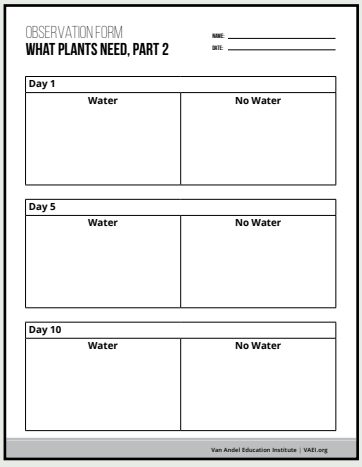
RISK-TAKING

It's important that students not feel that there is a "correct" prediction. When they return to their prediction in their explanation, they will have the opportunity to see how their prediction is supported or challenged by their evidence.

Investigation Plan

Students conduct an investigation to determine if Wisconsin Fast Plants need water to grow.

- Select what type of plant you want to use (if not using Wisconsin Fast Plants). The plant should be young and fast-growing to collect evidence in a reasonable amount of time. You will need 6 plants, 3 for the "water" and 3 for the "no water."
- Decide what watering system you want to use for the "water" plants. Some ideas for watering system could be 2TBSP of water every 2 days or an automatic watering system such as the deli container watering system.
- Show students all 6 plants. Explain that they are the same age, type of plant, and will be given the same amount of light. Label 3 plants "water" and 3 plants "no water."
- Hand out the Observation Form and have students draw what they observe about the plants on Day 1.


OBSERVATION FORM
WHAT PLANTS NEED, PART 2
NAME: _____
DATE: _____

Day 1	
Water	No Water

Day 5	
Water	No Water

Day 10	
Water	No Water

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Observation Form

Continued

- Create a class chart that matches the **Observation Form**. In addition to a drawing, model how to observe the plant, looking for quantitative data (height, number of leaves, number of flowers, etc.) and qualitative data (color, shape, sturdiness of stem, etc.). Record this data on the class chart.
- After 5 days, bring the plants out briefly and have students draw on their **Observation Form** what they observe about the plants on Day 5. Add data to your class chart.
- After 10 days, bring the plants out briefly and have students draw on their **Observation Form** what they observe about the plants on Day 10. Add data to your class chart.

CRITICAL THINKING

Use the Fair Test checklist to help students think critically about the investigation plan. Help them understand that a good investigation plan must include a test that is repeatable, generates quality data, and minimizes error. The more critically students think about their investigation plan, the more confident they can be in their results.

STUDENT CHOICE

Let students decide how much water to add to their "water" plants. Offering students choice within parameters lets them take a leadership role in their learning without losing focus of your learning objectives.

Observation

Students record their observations as they monitor their Wisconsin Fast Plant growth.

- Have students observe the plants and draw what they see on Day 1, Day 5, and Day 10.
- They should record their observations on the **Observation Form**.
- Record your observations, including quantitative and qualitative data on the class chart.
- If desired, you may also want to take photos of the plants on data collection days.

INTEGRITY

Encourage students to draw what they see objectively. Discourage them from trying to represent their data visually too soon. Disciplined researchers collect data first and then analyze it. This helps to avoid biased data.

Part 3 INVESTIGATION ANALYSIS AND DEVELOPMENT OF CLAIM

Data Analysis

Students make sense of their data by organizing it and representing it visually.

Have students analyze the data on the class chart. You may wish to use the Data Analysis prompt as a guide.

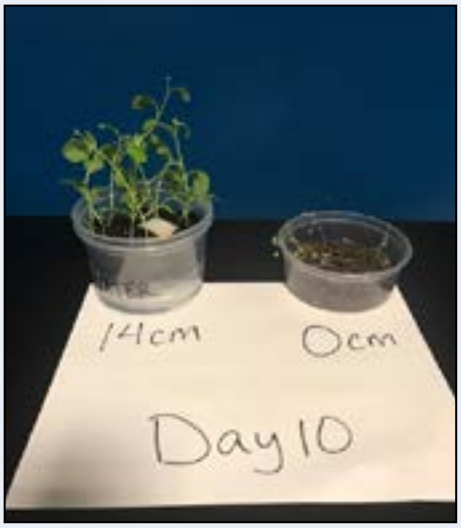
- Have students **evaluate** the data for trustworthiness. Did we conduct a fair test?
- Then, have them analyze the data to find patterns and trends. You may **organize** the data and/or **represent** it visually to construct meaning. For example, you may want to graph the growth of the plants in the water vs. those without water. Or you may want to use the drawings or photos as evidence organize them under "water" and "no water" labels.

Continued

- Have students **interpret** what the identified patterns mean. They should see that the plants need water in order to grow.
- Ensure students have enough data that it can be used as evidence to support a claim.

RICH LANGUAGE

In this investigation, the qualitative data is as informative, if not more informative, than the quantitative data. Have students use specific and varied language to describe their observations accurately. You may want to introduce rich vocabulary words to describe what the students saw during their observations (e.g., *rapid, sturdy, vibrant, sluggish, withered, limp,* etc.) Don't hesitate to teach vocabulary that seems sophisticated. If a student knows the concept for a word (e.g, *fast*), then they can learn a label (e.g., *rapid*).



Plants in Water and No Water After 10 Days

Secondary Knowledge

Students use secondary sources to help learn more about how plants need water in order to grow.

- Use these resources (or your own) to help develop students' understanding of what plants need to grow.
  - Magic School Bus-How a Plant Makes Food
  - *Oh Say Can You Seed?: All About Flowering Plants* (Cat in the Hat's Learning Library), by Bonnie Worth
  - *A Handful of Sunshine,* by Melanie Eclare

After reviewing the books and videos, students should glean the idea that plants need three things to grow: air, water, and light. Students use this information in the reasoning portion of their explanation.

CURIOSITY

When curious people learn new information, they continue to ask questions and make connections. Develop curiosity by encouraging students to share their learning from secondary resources using a *Fact-Question-Connection* format. They should share one fact they learned, one question they still have, and one connection from what they learned to something they already know, something they are interested in, or something another classmate said.

Explanation

Students develop a claim and provide evidence and reasoning to support it.

- Have students use what they've discovered from the analyzed data to develop an explanation that answers their investigation question. Students may wish to use the Explanation prompt as a guide. Create a class explanation as a Shared Writing activity.
- Have students review the investigation question: Do Wisconsin Fast Plants need water to grow?
- Develop a **Claim** to answer the investigation question.
- Then, have them provide the **Evidence** that supports their claim.
- Finally, have them add **Reasoning** to their claim. Reasoning should include the information obtained from this investigation as well as science principles they have learned.

Continued

Claim

Wisconsin Fast Plants need water in order to grow.

Evidence

We planned and conducted an investigation over 10 days.

With water: All plants that were given water are dark green, have thicker stems, and grew every day. Plants grew to a height of 25 cm.

Without water: All plants that were not given water turned a yellow-ish color, had droopy stems, and did not grow much at all. Plants grew to a height of 5 cm tall on Day 5, but then they died and ended up 0 cm tall.

Reasoning

Investigation: We conducted a fair test. We had a routine for taking measurements and recording observations. We analyzed our data and it showed that the "no water" plants grew a little bit but then died. The "water" plants grew tall and had thick stems and green leaves.

Science: The video and books explained that plants need air, water, and light to grow. Without water, they cannot grow.

Evaluation

Students reflect on the investigation.

Ask students:

- What surprised you?
- If we did this investigation again, what would you like to do differently?

Part 4

INVESTIGATION ASSESSMENT AND EXTENSION

Application

Students demonstrate understanding of how plants need water to grow.

- Purchase a class plant for the class to take care of for the remainder of the year. Determine a watering schedule where all students participate in the care of the plant.
- If not done already, conduct the investigation, What Plants Need, Part 1, where students investigate whether or not Wisconsin Fast Plants need light in order to grow.

Assessment

Evaluate for how well:

- Students make observations and organize data to determine that plants need water in order to live and grow.
- Ask students: Would a plant naturally grow better:
  - In a desert or a tropical rain forest?
  - Under an open sky or under a covered porch?
  - Inside or outside?

Take This Lesson Across the Curriculum

No More Grocery Store!

Imagine you wake up one day and there are no more grocery stores. None. How would you make sure you and your family had food to eat? How would you make sure the community survives?

Reading/Language Arts	Math	Science	Social Studies
Be Informed Read *From Seed to Plant,* an informational text by Gail Gibbons. CCSS.ELA-LITERACY.RI.K.10	**Do the Math** One plant of lettuce will make a salad for one person. How many lettuce plants will you need to plant for your class? CCSS.MATH.CONTENT.K.OA.A.1	**What Plants Need** Students plan and conduct an investigation to determine how water affects the growth of Wisconsin Fast Plants. NGSS: K-LS1-1	**Supply and Demand** Once the crops come in, there will be buyers and sellers. Divide the class equally into buyers and sellers. Give the sellers six mock apples. Give the buyers six mock dollars. Sellers can charge whatever they want for the apples. Buyers can shop around. They have 10 minutes to buy and sell apples. NCSS: D2.Eco.4.K-2

World-Class Menu

The best menus use the freshest ingredients. Learn about what foods are native to what areas of the world to design a world-class menu and invite your friends!

Reading/Language Arts	Math	Science	Social Studies
You Are Cordially Invited Develop a menu that features food from all over the world. Write and design an invitation for all your friends. CCSS.ELA-LITERACY.W.K.2	**Calorie Count** Some of your guests are counting calories. Research the calorie count for each menu item and include a total calorie count on your menu. CCSS.MATH.CONTENT.K.CC.A.1	**What Plants Need** Students plan and conduct an investigation to determine how water affects the growth of Wisconsin Fast Plants. NGSS: K-LS1-1	**Where It Grows?** Research what foods are native to certain areas of the world to develop your menu with the freshest ingredients. NCSS: D2.Geo.11.K-2

For additional lessons or to customize this lesson, go to www.nexgeninquiry.org.

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OBSERVATION FORM

WHAT PLANTS NEED, PART 2

NAME: _____

DATE: _____

Day 1	
Water	**No Water**

Day 5	
Water	**No Water**

Day 10	
Water	**No Water**

WHAT PLANTS NEED, PART 2