THINKING AND ACTING LIKE A SCIENTIST

TEACHER'S GUIDE

# Needy Plants, Part 2 of 2

**How does water affect the growth of Wisconsin Fast Plants?**

GRADE 2

Life Science

VAN ANDEL EDUCATION INSTITUTE
VAEI.ORG

INQUIRY-BASED SCIENCE

Life Science

# Needy Plants, Part 2 of 2

| | |
|---|---|
| **Grade Level/ Content** | 2/Life Science |
| **Lesson Summary** | In this lesson, students will plan and conduct an investigation to determine if plants need water to grow. This is Part 2 of a 2-part lesson. In Part 1, students plan and conduct an investigation to determine if plants need light to grow. |
| **Estimated Time** | 1, 45-minute class period to set up; 10 minutes per day to record observations (for at least 5 days) |
| **Materials** | Young, fast-growing plants (we used Wisconsin Fast Plants available at Wisconsin Fast Plants); watering system (this can be manual or you can build-your-own deli container watering system); light box (available at Carolina Biological) or other consistent light source (like a lamp); Investigation Plan; Observation Form; journal |
| **Secondary Resources** | • Wisconsin Fast Plant Life Cycle Diagram<br>• Magic School Bus-How a Plant Makes Food<br>• *Oh Say Can You Seed?: All About Flowering Plants* (Cat in the Hat's Learning Library), by Bonnie Worth<br>• *A Handful of Sunshine*, by Melanie Eclare |
| **NGSS Connection** | **2-LS2-1** Plan and conduct an investigation to determine if plants need sunlight and water to grow. |
| **Learning Objectives** | • Students will collaboratively develop an investigation plan to test the effect of water vs. no water on Wisconsin Fast Plants.<br>• Students will conduct an investigation to test the effect of water vs. no water on Wisconsin Fast Plants.<br>• Students will collect data and describe evidence to explain the effect of water vs. no water on Wisconsin Fast Plants. |
| **Cross-Curricular Project Connections** | **No More Grocery Store!, World Class Menu** |

## How does water affect the growth of Wisconsin Fast Plants?

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 five 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 (this can be manual or you can build-your-own deli container watering system).
- Light box (available at Carolina Biological) or other consistent light source (like a window or lamp)
- Investigation Plan
- Observation Form
- Journal

## Part 2

## INVESTIGATION FACILITATION

### Question

*Introduce the investigation question.*

**How does water affect the growth of Wisconsin Fast Plants?**

#### 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. Give them sticky notes and ask them to write one thing that plants need to grow on a sticky note and post it on the board.
- Review all the sticky notes and group them as appropriate.

#### RISK-TAKING

Add all ideas, even misconceptions to the class list. If students challenge ideas from their peers, place a question mark next to it and explain that the class will come back to it later in the investigation. Resist telling students that their personal knowledge is incorrect as it is unlikely that they will change their basic understanding of the ideas or concepts being discussed. Instead, confront misconceptions at a time in the investigation that students are directly observing or analyzing data or formulating an explanation that is in conflict with their personal knowledge.

## 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?


Wisconsin Fast Plant Life Cycle

### CRITICAL THINKING

As you ask questions, challenge students to make connections to ensure comprehension. For example, when you ask how many days the life cycle is, when they answer 28 days, ask them what else takes 28 days? This helps them think critically about their answers rather than just read off the chart.

## 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 that the plant that gets water will live and the plant that doesn't will die.*)

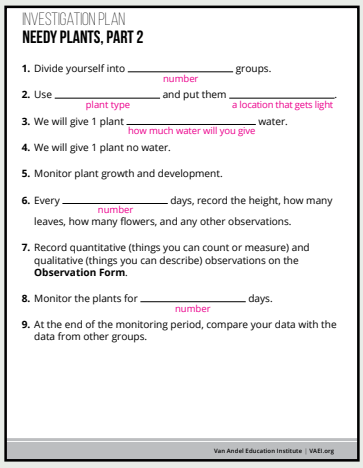
### RISK-TAKING

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 plan and conduct an investigation to determine how water affects the growth of Wisconsin Fast Plants.*

- As a class, collaboratively plan an investigation. Display the Investigation Plan. Explain that this is a sample investigation plan but that the class needs to make some decisions to finalize the plan.
- Review the plan, and as a class, write in your class choices for the options that are blank. *(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.)*
- Distribute copies of the finalized **Investigation Plan** and guide students in following the plan.


INVESTIGATION PLAN
NEEDY PLANTS, PART 2

1. Divide yourself into _____ (number) groups.
2. Use _____ (plant type) and put them _____ (a location that gets light)
3. We will give 1 plant _____ (how much water will you give) water.
4. We will give 1 plant no water.
5. Monitor plant growth and development.
6. Every _____ (number) days, record the height, how many leaves, how many flowers, and any other observations.
7. Record quantitative (things you can count or measure) and qualitative (things you can describe) observations on the **Observation Form**.
8. Monitor the plants for _____ (number) days.
9. At the end of the monitoring period, compare your data with the data from other groups.

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Investigation Plan

### 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 will be in their results.

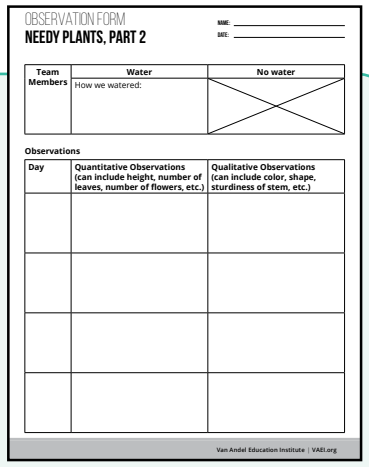
## Observation

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

- Have students monitor and observe the plants according to the **Investigation Plan**.
- They should record their observations on the Observation Form. Provide as many copies as needed throughout the investigation period.
- Guide students as they make their observations.

### INTEGRITY

Encourage students to record data 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.



OBSERVATION FORM

NEEDY PLANTS, PART 2

NAME: _____

DATE: _____

| Team Members | Water<br>How we watered: | No water |
|---|---|---|
| | | |

Observations

| Day | Quantitative Observations (can include height, number of leaves, number of flowers, etc.) | Qualitative Observations (can include color, shape, sturdiness of stem, etc.) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

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Observation Form

# 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 their data. They may wish to use the Data Analysis prompt as a guide.

- Have students **evaluate** their data for trustworthiness.
- Then, have them analyze their data to find patterns and trends. They may **organize** the data and/or **represent** it visually to construct meaning. Have them use math as appropriate, for example calculating the total growth of the plants, graphing the growth of the plants, etc. They may also want to use photos as evidence.
- Have students **interpret** what the identified patterns mean.
- Ensure students have enough data that it can be used as evidence to support a claim.


Plants with and without Water After 5 Days

### 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*).

## 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.

### 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. Students use this information in the reasoning portion of their explanation.

## Explanation

*Students write a claim and provide evidence and reasoning to support it.*

- Have students use what they've discovered from the analyzed data to write an explanation that answers their investigation question. Students may wish to use the Explanation prompt as a guide. Have them write their explanation in their journal.
- Have students review the investigation question: How does water affect the growth of Wisconsin Fast Plants?
- Have students develop a **Claim** to answer the investigation question.
- Then, have them write down 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.

### Claim

*Water definitely affects how the Wisconsin Fast Plants grow. Plants grown with water grew quickly and were vibrant. Plants that didn't get water stopped growing and started to die.*

### Evidence

*We planned and conducted an investigation over 10 days.*

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

*Without Water: All plants that did not get water turned a yellow-ish color, had droopy stems, and did not grow much at all. Plants grew to a height of 8 cm.*

***Continued***

**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 did not grow very tall and looked weak and yellow. The "water" plants grew tall and had thicker stems and big, green leaves.*

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

- Once the explanation is written, have students discuss their results using a Present and Defend.

**DISCOURSE**

Have students conduct a Present and Defend to develop presentation skills as well as audience participation. Research teams present a summary of their investigation to the class. The class analyzes the information presented and asks clarifying questions, challenges and/or supports the arguments made, and even presents alternative explanations as appropriate. Research teams defend their explanation with evidence and reasoning. If students are doing the same investigation plan, choose 1 or 2 groups to share.

## Evaluation

*Students reflect on the investigation.*

Ask students:

- What surprised you?
- How confident are you in your results?

# Part 4

## INVESTIGATION ASSESSMENT AND EXTENSION

## Application

*Students demonstrate understanding of how water affects the growth of Wisconsin Fast Plants.*

- 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, Needy Plants, Part 1, where students investigate how light affects the growth of Wisconsin Fast Plants.

**Assessment**

Evaluate for how well:

- Students collaboratively developed an investigation plan to test the effect of water vs. no water on Wisconsin Fast Plants.
- Students conducted an investigation to test the effect of water vs. no water on Wisconsin Fast Plants.
- Students collected data and described evidence to explain the effect of water vs. no water on Wisconsin Fast Plants.

## 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**<br>Read *From Seed to Plant,* an informational text by Gail Gibbons.<br>CCSS.ELA-LITERACY.RI.2.1. | **Do the Math**<br>One plant of lettuce will yield 3 individual salads. How many lettuce plants will you need to plant to have salad for your class for 1 week.<br>CCSS.MATH.CONTENT.2.OA.A.1 | **Needy Plants**<br>Students plan and conduct an investigation to determine how the amount of water affects the growth of Wisconsin Fast Plants.<br>NGSS: 1-LS2-1 | **Supply and Demand**<br>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.<br>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**<br>Develop a menu that features food from all over the world. Write and design an invitation for all your friends.<br>CCSS.ELA-LITERACY.W.2.8 | **Calorie Count**<br>Some of your guests are counting calories. Research the calorie count for each menu item and include a total calorie count on your menu.<br>CCSS.MATH.CONTENT.1.MD.A.2 | **Needy Plants**<br>Students plan and conduct an investigation to determine how the amount of water affects the growth of Wisconsin Fast Plants.<br>NGSS: 1-LS2-1 | **Where It Grows?**<br>Research what foods are native to certain areas of the world to develop your menu with the freshest ingredients.<br>NCSS: D2.Geo.11.K-2 |

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

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INVESTIGATION PLAN

# NEEDY PLANTS, PART 2

1. Divide yourself into _____ groups.
   number
2. Use _____ and put them _____.
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3. We will give 1 plant _____ water.
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   number
9. At the end of the monitoring period, compare your data with the data from other groups.

# OBSERVATION FORM
# NEEDY PLANTS, PART 2

NAME: _____

DATE: _____

| Team Members | Water | No water |
|---|---|---|
| | How we watered: | |

**Observations**

| Day | Quantitative Observations (can include height, number of leaves, number of flowers, etc.) | Qualitative Observations (can include color, shape, sturdiness of stem, etc.) |
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# OBSERVATION FORM
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# NEEDY PLANTS, PART 2