# HYDROPONIC LED GrowLight™

by HamiltonBuhl®

## Teacher's Guide

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Never-Ending Learning Innovation

HYDROPONIC LED GrowLight™

Learn the Fundamentals of Healthy Plant Growth – Perfect for STEAM Curriculum!

## HB Hydroponic LED GrowLight™ Kit

HamiltonBuhl's Hydroponic LED GrowLight™ is set up perfectly for almost any school. Its tabletop design demonstrates growing plants with LED lights easily – with easy portability to share with others.

The Hydroponic LED GrowLight™ allows for countless experiments using scientific methods ranging from comparing plant growth under the GrowLight versus using sunlight to experimenting to find just the right light balance for your plant, the right water levels and temperatures. This is the foundation of environmental science and botany – Improve critical thinking skills, problem solve, and watch as children learn through trial and error.

Not every school can accommodate a gardening space, but now every school can easily provide these critical child development experiences, bringing more STEAM education to their students.

This kit includes everything needed to get started creating a community garden, anywhere. It uses the latest LED light and hydroponic technology to increase yield and speed up growth.

## Standards Addressed with GrowLight™

### Next Generation Science Standards

- ❒ Interdependent Relationships in Ecosystems . . . . . K, 2, 3, MS, HS
- ❒ Weather and Climate. . . . . K, 3, MS, HS
- ❒ Waves . . . . . 1, 4, MS
- ❒ Matter and Energy in Organisms and Ecosystems . . . . . 5, MS, HS
- ❒ Human Impacts . . . . . MS
- ❒ Human Sustainability . . . . . HS
- ❒ Engineering Design . . . . . K-2, 3-5, MS, HS

### Common Core State Standards (CCSS) Math

- ❒ Common Core State Standards (CCSS) Math
- ❒ Measurement and Data . . . . . K, 1, 2, 3, 4, 5
- ❒ Expressions and Equations . . . . . 6, 7, 8
- ❒ Algebra . . . . . HS
- ❒ Mathematical Modeling . . . . . All Grades

### ISTE

Knowledge Constructor

Innovative Designer

Computational Thinker

### (CCSS) English Language Arts

- ❒ Writing: Research to Build and Present Knowledge . . . . . .All Grades
- ❒ Speaking and Listening: Comprehension and Collaboration . . . . . .All Grades
- ❒ Speaking and Listening: Presentation of Knowledge and Ideas . . . . . .All Grades



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## Elementary

# Growing Plants with Hydroponic LED GrowLight™ Kit

| Topic: | Grade Level: | Estimated Unit Time: |
|---|---|---|
| **Planting Seeds to Watch them Grow** | K-4 | One Semester |

### Unit Objectives

. . . to understand the relationship between light, seeds, nutrients and water
. . . to compare plant seeds grown under different conditions
. . . to chart the growth of plants in a table
. . . to log the growth of plants in a journal

### Materials

- Hydroponic LED GrowLight™ Kit
- Plant seeds, water, nutrients
- Ruler
- Camera or markers/colored pencils

*Optional: The HB AirComfort is ideal for testing temperature and air quality*

### Vocabulary

**Organism:** Any living thing. (ex. person, cat, strawberry plant)

**Plant:** Living thing that uses energy from the sun to make its own food. (ex. oak tree, seaweed, rose, grass)

**Mineral:** A non-living material found on earth. It is not an animal or a plant. It has properties such as hardness, color and texture. (ex. chalk, clay, diamonds, rocks, gold)

**Compost:** Decomposed (broken down, rotted) organisms (plant and animal) that are used to make soil better for plants.

**Decompose:** Decay, rot or break down into small pieces. (ex. Worms help decompose organisms into compost)

**Organic Matter:** Material that comes from something that was once alive. (ex. Decayed leaves, dead animals and rotting plants). Compost is made up of organic matter.

**Soil:** Mixture of minerals, organic matter, air and water. We also call it "dirt".

**Control:** A subject that has not been changed by an independent variable used as comparison for checking the results of an experiment.

**Variable:** What the scientist changes in each trial. Also called an "independent variable."

### Activities and Assessments

Plant Journal
Data Charts
Lab Report
Summary of the Learnings

**Opportunities to Differentiate Instruction**

- Allow students to work individually or in groups
- Add additional variables
- Have students take photos instead of drawing

**HB Tools Integrated:**

- Hydroponic LED GrowLight
- AirComfort

**Subjects Integrated:**

- Science
- Technology
- Engineering
- Art
- Mathematics

**ISTE Standards met:**

- Knowledge Constructor
- Innovative Designer
- Computational Thinker

**Next Gen Science Standards met:**

- K-2 Engineering Design
- 3-5 Engineering Design
- Interdependent Relationships in Ecosystems [K, 2, 3, MS, HS]
- Weather and Climate [K, 3, MS, HS]

**Common Core State Standards (CCSS) Math:**

- Measurement and Data [K, 1, 2, 3, 4, 5]

**English Language Arts (CCSS):**

- Writing: Research to Build and Present Knowledge [All Grades]
- Speaking and Listening: Comprehension and Collaboration [All Grades]
- Speaking and Listening: Presentation of Knowledge and Ideas [All Grades]

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# Growing Plants with Hydroponic LED GrowLight™ Kit

## Lesson 1: Planting Seeds

Students will spend the day getting acquainted with the materials used for growing plants: The Hydroponic LED GrowLight™, seeds, nutrients, water, and learning the vocabulary except control and variable which will be discussed in the second lesson.

## Lesson 2: Controls versus Variables

Students will learn about controls and variables. They will choose a variable to test against the control. They can change the LED light duration, water, temperature, number of seeds, etc. Set up the experiment.

## Lesson 3: Watch Them Grow

Using the data charts, record the changes you see as your seeds grow. This will take place over a number of weeks. Introduce the lab report and have students complete it as the experiments take place.

| **Plant Journal** | Every day you make observations about your plant, draw a picture in your plant journal. |
|---|---|
| Draw what you observe in each plant: | |
| **Control** | **Test Plant** |

# Growing Plants with Hydroponic LED GrowLight™ Kit

## Data Charts

### Control Plant

| Observation | Height (inches) | Color | Description | Anything Else? |
|---|---|---|---|---|
| 1. Date | | | | |
| 2. Date | | | | |
| 3. Date | | | | |

### Variable Plant

What variable (e.g. light, water, nutrients) are you testing?

| Observation | Height (inches) | Color | Description | Anything Else? |
|---|---|---|---|---|
| 1. Date | | | | |
| 2. Date | | | | |
| 3. Date | | | | |

### Lab Report

Growing Plants Lab  Name:  Date:

| |
|---|
| **Question:** *What are you wondering about the plants?* |
| **Hypothesis:** *What do you think is going to happen? Make a prediction.* |
| **Methods:** *What are the steps you will take to complete the experiment? There may be more than 3 steps.*<br>1.<br>2.<br>3. |
| **Materials:** *What will you use to complete the experiment?*<br>•<br>•<br>• |

# Growing Plants with Hydroponic LED GrowLight™ Kit

| |
|---|
| **Procedure:** *Write your plan in sentences.* |
| **Results:** *Draw a picture to show your results.* |
| **Conclusion:** *What happened? Was your hypothesis correct?* |

## Summary of the Learnings

*After the experiment, answer the following questions:*

What were you testing?
Which treatment (the control or the variable) had the tallest plants?
What was the height of the tallest plant?
What was the height of the shortest plant?
Which treatment had the most leaves?
Which treatment had the most flowers or fruit?
What was the strangest thing you observed?
Why do you think this happened?

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## Middle School

# Growing Plants with Hydroponic LED GrowLight™ Kit

| Topic: | Grade Level: | Estimated Unit Time: |
|---|---|---|
| **Scientific Method and GrowLight™** | 5-8 | Varies |

### Unit Objectives

. . . to understand the relationship between light, seeds, nutrients and water
. . . to think like a scientist
. . . to tract data and chart results
. . . to implement the scientific process

### Materials

- LED GrowLight™ Kit
- Plant seeds, nutrients, water
- Ruler
- Camera

*Optional: Use AirComfort for testing temperature and air quality*

### Vocabulary

| | |
|---|---|
| **Organism:** | Any living thing. (ex. person, cat, strawberry plant) |
| **Organic Matter:** | Material that comes from something that was once alive. (ex. Decayed leaves, dead animals and rotting plants). Compost is made up of organic matter. |
| **Control:** | A subject that has not been changed by an independent variable used as comparison for checking the results of an experiment. |
| **Variable:** | What the scientist changes in each trial. Also called an "independent variable." |
| **Scientific Method:** | Process by which scientists evaluate a theory including questioning, hypothesizing, experimenting, evaluating, and sometimes adapting a trial to ensure the validity of a conclusion. |
| **Inquiry:** | Asking questions and performing experiments to reach the truest possible result |

### Resources:

BrainPop: Scientific Method

AMNH-- How to Plan an Experiment

### Activities:

Data Charts

**HB Tools Integrated:**

- Hydroponic LED GrowLight
- AirComfort

**Subjects Integrated:**

- Science
- Technology
- Engineering
- Art
- Mathematics

**ISTE Standards met:**

- Knowledge Constructor
- Innovative Designer
- Computational Thinker

**Next Gen Science Standards met:**

- MS Engineering Design
- Interdependent Relationships in Ecosystems [K, 2, 3, MS, HS]
- Weather and Climate [K, 3, MS, HS]
- Waves [1, 4]
- Matter and Energy in Organisms and Ecosystems [5, MS, HS]
- Human Impacts [MS]

**English Language Arts (CCSS):**

- Writing: Research to Build and Present Knowledge [All Grades]
- Speaking and Listening: Comprehension and Collaboration [All Grades]
- Speaking and Listening: Presentation of Knowledge and Ideas [All Grades]

**Common Core State Standards (CCSS) Math:**

- Expressions and Equations [6, 7, 8]

**Opportunities to Differentiate Instruction**

- Allow students to work individually or in groups
- Add additional variables
- Have students take photos instead of drawing

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# Growing Plants with Hydroponic LED GrowLight™ Kit

## Lesson 1: Steps of the Scientific Method

Students will learn the steps of the scientific method and be introduced to the Hydroponic LED GrowLight™. Promote inquiry by having students ask questions about using the light and how it can most effectively help them grow plants. They will plan an experiment using the Hydroponic LED GrowLight™in the next lesson.

*Suggested Resource:* BrainPop: Scientific Method

## Lesson 2: Create a Plant Growth Experiment

Students will create an experiment using the Hydroponic LED GrowLight™. They will choose a variable to test against a control plant. They can change the LED light exposure, water, nutrients, temperature, number of seeds. Set up the experiment.

*Suggested Resource:* AMNH-- How to Plan an Experiment

## Lesson 3: Communicate the Results

Using the data charts, record the changes you see as your seeds grow. Compare the results to your hypothesis. Reflect on the changes each time you make an observation. Encourage students to take pictures of the plants and place them in an album to see the changes over time. This will take place over a number of weeks. Introduce the lab report and have students complete it as the experiments take place.

*Suggested:* Data Charts, Lab Report, Summary of the Learnings

## Data Charts

### Control Plant

| Observation | Soil | Height (cm) | Color | Description | Anything Else? |
|---|---|---|---|---|---|
| 1. Date | | | | | |
| How does this align with your hypothesis? | | | | | |
| 1. Date | | | | | |
| How does this align with your hypothesis? | | | | | |
| 1. Date | | | | | |
| How does this align with your hypothesis? | | | | | |

# Growing Plants with Hydroponic LED GrowLight™ Kit

## Variable Plant

What variable (e.g. light, water, nutrients) are you testing?

| Observation | Height (cm) | Nutrients | Color | Description | Anything Else? |
|---|---|---|---|---|---|
| 1. Date | | | | | |
| How does this align with your hypothesis? | | | | | |
| 1. Date | | | | | |
| How does this align with your hypothesis? | | | | | |
| 1. Date | | | | | |
| How does this align with your hypothesis? | | | | | |

## Lab Report

Growing Plants Lab Name: Date:

| |
|---|
| **Question:** *What are you wondering about the plants?* |
| **Hypothesis:** *What do you think is going to happen? Make a prediction.* |
| **Methods:** *What are the steps you will take to complete the experiment? There may be more than 3 steps.*<br>1.<br>2.<br>3. |
| **Materials:** *What will you use to complete the experiment?*<br>•<br>•<br>• |

# Growing Plants with Hydroponic LED GrowLight™ Kit

| |
|---|
| **Procedure:** *Write your plan in sentences.* |
| **Results:** *Show your results in a graph or chart.* |
| **Conclusion:** *What happened? Was your hypothesis correct?* |

## Summary of the Learnings

*After the experiment, answer the following questions:*

What were you testing?
What did you notice about the growth of your plant?
Did this align with your hypothesis?
What was the strangest thing you observed?
Why do you think this happened?
How would you perform the experiment differently in the future?

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High School

# Growing Plants with Hydroponic LED GrowLight™ Kit

| Topic: Scientific Inquiry Investigations with GrowLight™ | Grade Level: 9-12 | Estimated Unit Time: Varies |
|---|---|---|

## Unit Objectives

. . .to use inquiry-based learning to draw conclusions to a scientific question
. . .to understand the difference between the scientific method and scientific inquiry.
. . .to understand the relationship between light, nutrients, seeds, and water
. . .to think like a scientist, to track data and chart results, to implement the scientific process

## Materials

- Hydroponic LED GrowLight™ Kit
- Plant seeds, water, nutrients
- Camera or markers/colored pencils

*Optional: AirComfort for testing temperature and air quality*

## Vocabulary

**Scientific Method:** Process by which scientists evaluate a theory including questioning, hypothesizing, experimenting, evaluating, and sometimes adapting a trial to ensure the validity of a conclusion.

**Inquiry:** Asking questions and performing continued investigations to reach the truest possible result.

| Scientific Method | Scientific Inquiry |
|---|---|
| Linear/defined order | Non-linear/fluid |
| Answers a single posed question | May end up generating more questions |
| Results may be communicated at the conclusion of the experiment | Communication is a key component throughout |
| Source: http://www.curriki.org/oer/What-is-inquiry-vs-the-scientific-method-/ | |

## Resources

Growing with LED lights-- Al Jazeera (Clip: Begin at 17:17)

AMNH-- How to Plan an Experiment

**HB Tools Integrated:**

- Hydroponic LED GrowLight
- AirComfort

**Subjects Integrated:**

- Science
- Technology
- Engineering
- Art
- Mathematics

**ISTE Standards met:**

- Knowledge Constructor
- Innovative Designer
- Computational Thinker

**Next Gen Science Standards met:**

- HS Engineering Design
- Interdependent Relationships in Ecosystems [K, 2, 3, MS, HS]
- Weather and Climate [K, 3, MS, HS]
- Matter and Energy in Organisms and Ecosystems [5, MS, HS]

**English Language Arts (CCSS):**

- Writing: Research to Build and Present Knowledge [All Grades]
- Speaking and Listening: Comprehension and Collaboration [All Grades]
- Speaking and Listening: Presentation of Knowledge and Ideas [All Grades]

**Common Core State Standards (CCSS) Math:**

- Algebra [HS]

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HYDROPONIC GrowLight™

High School

# Growing Plants with Hydroponic LED GrowLight™ Kit

**Activities and Assessments**

Data Charts

Lab Report

**Opportunities to Differentiate Instruction**

- Allow students to work individually or in groups
- Add additional variables
- Use guided inquiry instead of the current open inquiry model

## Lesson 1: What is Scientific Inquiry?

Students will be introduced to the Hydroponic LED GrowLight™. After watching the video on growing with LED lights, have students list out their questions about growing plants with the Hydroponic LED GrowLight™. Encourage discussions on "light recipes" and promote inquiry by having students challenge each other to research possibilities for growing plants under LED lights. They will be planning scientific inquiry investigations using the Hydroponic LED GrowLight™ in the next lesson.

*Suggested Resource:* Growing with LED Lights-- Al Jazeera

## Lesson 2: Design an Investigation using Scientific Inquiry

Students will continue to engage with the Hydroponic LED GrowLight™ and choose a particular question to explore. Students should know that as the investigation plays out, their findings may shift their focus and bring them closer to the evidence-based answer they are seeking. If students are struggling, have them consider adjusting LED light duration, water, nutrients, temperature and number of seeds. Set up the initial investigation.

*Suggested Resource:* AMNH-- How to Plan an Experiment

## Lesson 3: Implementation and Communication

As the investigation unfolds, encourage constant exploration and research into concepts at play in the investigation. Possible areas to explore include light waves, light emissions, growing seasons, growing patterns, geographic locations, geotechnical studies in the area, alternate ideas about answering the same scientific question, to name a few.

Using the data charts, record the changes as they occur. Compare the results to your hypothesis. Reflect on the changes each time you make an observation and discuss where the knowledge gaps are in the experiment. What does the team need to learn more about? This will take place over a number of weeks. Introduce the lab report and have students complete it as the experiments unfold.

*Suggested:* Data Charts, Lab Report

# Growing Plants with Hydroponic LED GrowLight™ Kit

## Data Charts

### Control Plant

| Observations | Category A | Category B | Category C | Category D |
|---|---|---|---|---|
| 1. Date | | | | |
| How does this align with your hypothesis? | | | | |
| *What new information do you need after this observation? Where are the knowledge gaps?* | | | | |
| 1. Date | | | | |
| How does this align with your hypothesis? | | | | |
| *What new information do you need after this observation? Where are the knowledge gaps?* | | | | |
| 1. Date | | | | |
| How does this align with your hypothesis? | | | | |
| *What new information do you need after this observation? Where are the knowledge gaps?* | | | | |

# Growing Plants with Hydroponic LED GrowLight™ Kit

**Variable Plant**
What variable (eg light, water, nutrients) are you testing?

| Observations | Sample Category A | Sample Category B | Sample Category C | Sample Category D |
|---|---|---|---|---|
| 1. Date | | | | |
| How does this align with your hypothesis? | | | | |
| *What new information do you need after this observation? Where are the knowledge gaps?* | | | | |
| 1. Date | | | | |
| How does this align with your hypothesis? | | | | |
| *What new information do you need after this observation? Where are the knowledge gaps?* | | | | |
| 1. Date | | | | |
| How does this align with your hypothesis? | | | | |
| *What new information do you need after this observation? Where are the knowledge gaps?* | | | | |

# Growing Plants with Hydroponic LED GrowLight™ Kit

## Lab Report

Scientific Inquiry Investigation  Name:  Date:

| |
|---|
| **Question:** *What are you investigating?* |
| **Abstract:** |
| **Introduction:** |
| **Hypothesis:** *What do you think is going to happen?* |
| **Methods:** *What are the steps you will take to approach this investigation? Continue to add on as your work unfolds.*<br>1.<br>2.<br>3. |
| **Materials:** *What will you need to complete the investigation?*<br>•<br>•<br>• |

## Growing Plants with Hydroponic LED GrowLight™ Kit

| |
|---|
| **Procedure:** *Explain your process. Why are you using the methods you chose?* |
| **Results:** *Show your results using a graph or chart.* |
| **Conclusion:** *What happened? Was your hypothesis correct?* |
| **Continued Study:** *Explain how this investigation informs future research and testing that you could do.* |

# Social Sustainability "Rock and Wrap it Up" and Hydroponic LED GrowLight™ Mini-Unit

| Topic: | Grade Level: | Estimated Unit Time: |
|---|---|---|
| **Sustainability and You** | All ages | One Week |

## Unit Objectives

. . . use the Hydroponic LED GrowLight™ to fight global climate change
. . . encourage donation of food grown with GrowLight™
. . . understand how food waste is converted to CO2e

## Materials

- Rock and Wrap it Up Curriculum
- Hydroponic LED GrowLight™ Kit
- Whole Earth Calculator

This material is meant to supplement the 3-Day Curriculum from "Rock and Wrap it Up" (rockandwrapitup.org).

### Day 1 Additions: Introducing Rock and Wrap it Up

- Discuss the carbon footprint of an outdoor farm versus an indoor farm. What foods are better produced indoors instead of outside? Where might this growing system be useful geographically?
- Consider: How could growing food help to decrease poverty?

### Day 2 Additions: Opportunities for Increasing Social Impact

- Determine how much food can be produced in the classroom with the LED GrowLight™. What is the potential to donate or compost this food?
- Use the Whole Earth Calculator to determine how many meals you could donate with the food grown at your school.
- What else can you do to reduce your carbon footprint?

### Day 3 Additions: Decreasing Your Carbon Footprint

- Experiment with the Whole Earth Calculator. What if every class had a Hydroponic LED GrowLight™? How much CO2e could be saved if the food is composted? How many meals could be donated?
- Consider CO2e savings from using LED lights instead of other lights to grow indoors.

**HB Tools Integrated:**

- Hydroponic LED GrowLight

**Subjects Integrated:**

- Science
- Technology
- Art
- Mathematics

**ISTE Standards met:**

- Knowledge Constructor
- Innovative Designer
- Computational Thinker

**Next Gen Science Standards met:**

- Interdependent Relationships in Ecosystems [K, 2, 3, MS, HS]
- Weather and Climate [K, 3, MS, HS]
- Human Impacts [MS]
- Human Sustainability [HS]

**Common Core State Standards (CCSS) Math:**

- Measurement and Data [K, 1, 2, 3, 4, 5]

**English Language Arts (CCSS):**

- Writing: Research to Build and Present Knowledge [All Grades]
- Speaking and Listening: Comprehension and Collaboration [All Grades]
- Speaking and Listening: Presentation of Knowledge and Ideas [All Grades]

**Opportunities to Differentiate Instruction**

- Work in groups
- Take excess cateteria food to a shelter