GrowLight

GrowLight™ Kit

LED GrowLight™ is set up perfectly for school use. On wheels, it can demonstrate growing plants with LED lights from classroom to classroom. Each light blue, red, and white can be dialed up or down with a digital meter on the side of the device letting students test and learn for themselves which combinations work the best.

LED GrowLight™ allows for countless experiments using the scientific method ranging from comparing plant growth under the GrowLight versus using sunlight to soil testing and experimenting to find just the right "light recipe" for your plant. Any classroom that deals with interdependent relationships in ecosystems would benefit from using LED GrowLight™ for hands-on science inquiry.

The most unique feature of the HamiltonBuhl LED GrowLight™ is the ability to select the wavelength regions presented to your plant during the stages of growth. Three knobs allow the user to select lighting settings in blue, full spectrum white, and red. Features of a plant can change depending on the light spectrum used at a given time during the growing stages. The LED GrowLight™ allows you to experiment with many spectrums of light or just use as a high bright LED grow light.

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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GrowLight LED

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GrowLight LED

Elementary

Growing Plants with 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, soil, seeds, and water
. . . to compare plant seeds grown in different conditions
. . . to chart the growth of plants in a table
. . . to log the growth of plants in a journal

Materials

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

Optional: AirComfort 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:

- 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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GrowLight LED

Elementary

Growing Plants with LED GrowLight™ Kit

Lesson 1: Planting Seeds

Students will spend the day getting acquainted with the materials used for growing plants: LED GrowLight™, seeds, and soil, 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 combination, water, soil-type, temperature, number of seeds. 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**

GrowLight LED

Elementary

Growing Plants with LED GrowLight™ Kit

Data Charts

Control Plant

Observation	Soil	Height (cm)	Color	Description	Anything Else?
1. Date					
2. Date					
3. Date					

Variable Plant

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

Observation	Soil	Height (cm)	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.* 1. 2. 3.
Materials: *What will you use to complete the experiment?* • • •

GrowLight LED

Elementary

Growing Plants with 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?

GrowLight

Middle School

Growing Plants with LED GrowLight™ Kit

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

Unit Objectives

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

Materials

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

Optional: 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:

- 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

GrowLight LED

Middle School

Growing Plants with LED GrowLight™ Kit

Lesson 1: Steps of the Scientific Method

Students will learn the steps of the scientific method and be introduced to the 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 be planning an experiment using the 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 LED GrowLight™. They will choose a variable to test against a control plant. They can change the LED light combination, water, soil-type, 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?					

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Growing Plants with LED GrowLight™ Kit

Variable Plant

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

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?					

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.* 1. 2. 3.
Materials: *What will you use to complete the experiment?* • • •

GrowLight LED

Middle School

Growing Plants with 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?

GrowLight

High School

Growing Plants with 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, soil, seeds, and water
. . .to think like a scientist, to track data and chart results, to implement the scientific process

Materials

- LED GrowLight™ Kit
- Plant seeds, soil, water
- 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:

- 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]

GrowLight LED

High School

Growing Plants with 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 LED GrowLight™. After watching the video on growing with LED lights, have students list out their questions about growing plants with the 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 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 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 changing the LED light combination, water, soil-type, temperature, 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 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 LED GrowLight™ Kit

Variable Plant

What variable (eg light, water, soil) 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 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.* 1. 2. 3.
Materials: *What will you need to complete the investigation?* • • •

GrowLight LED

High School

Growing Plants with 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 with "Rock and Wrap it Up" and LED GrowLight™ Mini-Unit

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

Unit Objectives

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

Materials

- Rock and Wrap it Up Curriculum
- 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 an 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:

- 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