

Green Our Planet's Hydroponic STEM Curriculum K-5

Hands-On STEM Teaching Curriculum, K-5

First Grade Lessons (First Edition)



**VIDEO LESSONS
MATCHING OUR
CURRICULUM ARE IN OUR
VIRTUAL ACADEMY AT:
greenourplanet.org**

GREEN OUR PLANET'S

K-5 HYDROPONIC STEM CURRICULUM

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Green Our Planet is a nonprofit, 501(c)(3) conservation organization established in 2013 and that runs the largest and one of the most comprehensive STEAM (science, technology, engineering, arts, and math) school garden programs in the United States. The organization's mission is to increase student academic performance in STEAM subjects as well as to conserve and protect the environment through project-based STEAM education, which includes nutrition, financial literacy, and conservation education in PreK-12 schools. In 2013, Green Our Planet launched its Outdoor Garden Classroom Program in Las Vegas, Nevada, which is designed to help schools fund and use outdoor vegetable gardens as "hands-on" classrooms. In 2018, Green Our Planet launched its K-5 STEM Hydroponics Program, which allows for hands-on STEM education using hydroponic systems. Green Our Planet published Nevada's first K-5 STEM hydroponics curriculum (this one!) in 2019. For more information on Green Our Planet and its programs, or to view Green Our Planet's hydroponic video tutorials, please visit www.greenourplanet.org.

TEACHER FEEDBACK—LET US HEAR FROM YOU!

Teacher feedback is welcome—we want to hear from you about your experiences using this curriculum so that the lessons can be continually improved! Please send your feedback to: feedback@greenourplanet.org

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IN First Grade,



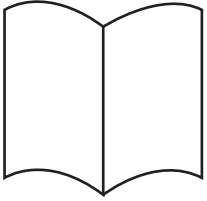
Students will investigate and understand what parts make a plant. This concept is taught through participation in the process of germinating seeds. Students also gain an understanding of how plants use their external parts to meet their needs, which helps plants to survive and grow. Students will address the simple problem of growing plants without soil by making observations, asking questions, and conducting experiments that will allow them to design and engineer a simple hydroponic system to solve the problem. Students will read texts and use media to determine patterns of behavior between parents and offspring that help offspring survive.

Lessons:

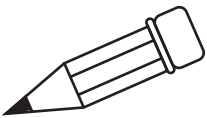
1. **Is It A Plant?** - Discovery based activity that compares a variety of objects and has students focus on answering 3 questions about each object: Is it a plant? Is it alive? How do you know?
2. **Beans!** - Read Jack and the Beanstalk and use it as an example of how plants grow and identifying plant parts. Students describe major events in the story including how the plant changes over time.
3. **What makes a seed?** (part 1) - Observe and investigate the outer portion of a variety of seeds. Draw and label the outside of the seeds.
4. **What makes a seed?** (part 2) - Dissect seeds and investigate the inside portion of different seeds. Have students label all the parts of a seed and identify how each part helps the plant grow.
5. **Who needs soil?** - Investigate what a plant needs to grow: water, light, and nutrients, then introduce students to the idea of hydroponic growing. Students participate in a simple experiment to compare a soil grown plant to a hydroponically grown plant and answer the question: Do plants need soil to grow?
6. **Roots, Stems, Leaves... Oh My** - This lesson focuses on identifying plant parts and understanding the function of each plant part.
7. **What is Hydroponics?** - Introduces students to the process of growing plants in a hydroponic system.
- Env.8. **Conserve Our Water!** - Students will identify how water waste affects the environment and explore how hydroponic systems address this problem.
9. **No Soil?** - Examine different types of hydroponic planting media, test their ability to retain water, and identify their purpose in a hydroponic system, and describe how they are different from soil.
10. **Let's Germinate Seeds!** - Students germinate lettuce seedlings for a hydroponic system, make predictions based on prior knowledge, observe and record the way seeds grow over a 2 - 3 week period.
11. **Let's Build a Hydroponic System** - Students will learn about the Kratky method, a passive hydroponic system with no pumps or moving parts. They will then design and build one using recycled materials and plant the seedlings germinated in the previous lesson into their Kratky systems and grow the plant until harvest.
- Env.12. **Reduce, Reuse, Recycle - Build** - Students will identify the problems associated with excessive trash production and explore solutions to decrease trash production by reducing, reusing and recycling materials, specifically in the building of DIY hydroponic systems.
- H1. **Eat the Rainbow** - Students identify fruits and vegetables in the hydroponic system and learn about the related health benefits. Students also set a personal health goal focused on the consumption of fresh fruits and vegetables.
- H2. **Sharing Healthy Habits** - Students use their knowledge about eating healthy fruits and vegetables from the hydroponic system to teach others. Students design a class project and work together to inform an audience of their choice about healthy eating.



OVERVIEW



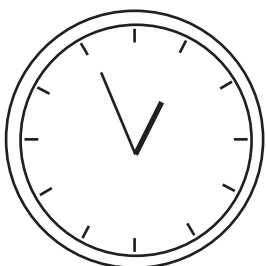
OBJECTIVE(S)



STANDARDS



TIME



Check for the matching curriculum at www.greenourplanet.org
(<https://video.link/w/ZSBrb>)

This lesson will introduce students to hydroponic systems by learning about and building small Kratky Hydroponic Systems using recycled containers.

Question: How can we build a Kratky Hydroponics System to grow lettuce?

Students will:

- understand how plants grow in a water.
- build a Kratky Hydroponic System.
- record how plants grow and survive in hydroponics.

Nevada State Academic Content Standards:

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

SL1.1 Participate in collaborative conversations with diverse partners about topics and texts with peers and adults in small and larger groups.

W.2.8 Recall information from experiences or gather information from provided sources to answer a question.

This lesson will take 20 –30 minutes of instruction time to complete.

TEACHER
BACKGROUND



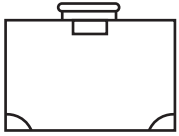
The Kratky method is just a variation of the Deep Water Culture. What is different is that the Kratky does not use electricity to run. So no pump, no timer needed. The way the Kratky method works is simple:

- Start with a reservoir/container, or anything that holds water. Fill it with water and nutrients. (You will want to follow the instructions on the fertilizer package for mixing nutrients into water, and may want to mix nutrients into a one gallon pitcher to make following the instructions easier. Then, the gallon of nutrient solution you mixed can be used to fill several smaller containers. Green Our Planet has had good luck using MaxiGrow fertilizers for hydroponics) Then cover it with a lid. Drill/cut the lid so that you can place a net pot in the hole. Place plants in the net pot with growing media so that their roots are hung by the lid. They are partly exposed to the air while parts of them are sunk into the water. That means plants are able to take up sufficient oxygen, water, and nutrients
- Over a period of time, plants grow. They will drain the water, still leaving parts of their bare roots to come in contact with the air.
- When the reservoir runs out of the water, your plants also have reached the end of their growth phase. Otherwise, you can fill with water and nutrient solution, and allow plants continue its growth phase.

So, in theory, the Kratky system requires little care and comes at little cost. That makes it one of the easiest systems to set up, and well-suited for children.



MATERIALS



- Several clean, empty yogurt containers with lids (or any other small plastic container)
- Net cups
- Hydroton
- Hydroponic nutrient
- Germinated seedling
- Water

PROCEDURES



1. Refer to Part 2 of the Introduction to Hydroponics PPT

<https://docs.google.com/presentation/d/11-DMBn1X1aEnLmWRioqyEQaUC2CVw8ZSCcGLb4hecYw>

ASSESSMENT



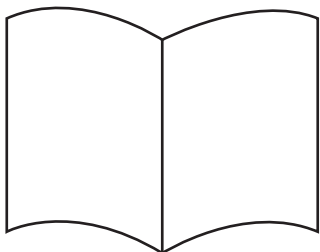
- Student systems and science notebook recordings



Lesson 12

Reduce, Reuse, Recycle - Build

OVERVIEW



LESSON DESCRIPTION: Students will identify the problems associated with excessive trash production and explore solutions to decrease trash production by reducing, reusing and recycling materials, specifically in the building of DIY hydroponic systems.

PERFORMANCE EXPECTATION(S): K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

THREE DIMENSIONS OF SCIENCE LEARNING

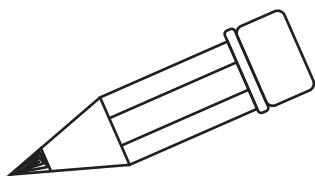


SCIENCE & ENGINEERING PRACTICES: *Asking Questions and Defining Problems*

DISCIPLINARY CORE IDEAS: *ETS1.A Defining and delimiting engineering problems*

CROSSCUTTING CONCEPTS: *Systems and system models*

SPECIFIC LEARNING OUTCOMES



- ✿ Students will become aware of the abundance of trash humans create and where it goes.
- ✿ Students will identify the need to minimize trash production.
- ✿ Students will learn how they can reduce, recycle, and reuse trash.

BACKGROUND INFORMATION



PRIOR STUDENT KNOWLEDGE:
Students should

- Understand what “trash” consists of.
- Be able to identify a problem and create a solution.

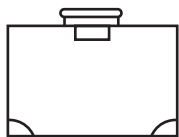
TEACHER BACKGROUND:

A landfill is a disposal site where waste is buried. While landfills are convenient for humans to dispose of their waste around the world, the impacts on the environment are severe. Not only does waste contaminate the land, but it can also contaminate waterways and the air we breathe. Waste in landfills releases harmful gases into the atmosphere that contribute to global warming. Reducing the use of disposable waste and practicing recycling is the best way to decrease the harmful impacts of landfills on the environment.

If you find that students have little understanding of how solid waste is handled in your area, many waste management companies have resources that explain the processes they employ. It may be helpful for students to engage with these resources.

POSSIBLE PRECONCEPTIONS/MISCONCEPTIONS: Students may not be aware of where trash goes after they dispose of it at home or school. Students may not realize that landfills can run out of room. Students may not be familiar with how to reduce, reuse and recycle different materials.

MATERIALS



Science Notebook/Pencils

Quantity: 1 per student

Access to Full Lunchroom or Classroom Trash Can

Quantity: Enough per class

Chart Paper or Whiteboard

Quantity: Enough per class

PROCEDURES



ENGAGE: OPENING ACTIVITY - PRIOR LEARNING & GENERATE QUESTIONS

1. Take students to the lunchroom after all lunches are over. Instruct students to observe, without touching, all of the items they see in the trash cans. Instruct students to identify 3 items each.
2. Return to the classroom and record all of the items that the students identified.
3. Ask students: *Where does all of our lunchroom waste go after it leaves the school?*
4. Show students the picture of a landfill:
https://ensia.com/wp-content/uploads/2016/10/feature_landfill_methane_main.jpg
5. Ask students: *What materials do you see?*
6. Make a list of all the different materials in the landfill (ex. paper, plastic, glass, food waste, rubber, soil).
7. Ask students: *What happens to all these items once they are in the landfill? Does it disappear? What happens when the landfill is filled up?* Allow students to make predictions and discuss thoughts.



EXPLORE: LESSON DESCRIPTION - PROBING OR CLARIFYING QUESTIONS

1. Read *Here Comes the Garbage Barge* by Jonah Winter.
2. Discuss what happened in the book and ask clarifying questions to make sure students understand the problem.
3. Ask students: *What is the problem with landfills?* (The landfills get too full, and there is nowhere to take all the garbage).

4. Ask students: *How can we solve this problem?* Record initial ideas for solutions. This is a good point to stop the lesson and complete the next day.



EXPLAIN: CONCEPTS EXPLAINED & VOCABULARY DEFINED

1. Introduce students to the 3 R's- reduce, reuse, recycle by watching the video Reduce, Reuse and Recycle, to enjoy a better life | Educational Video for Kids:
<https://environmental-conscience.com/reduce-reuse-recycle-and-waste-hierarchy/>
2. Instruct students to record the 3 R's in their Science Notebooks, along with an example from the video or one they can think of on their own.
3. Elaborate on the concept of reuse, using examples of materials that have been re-used for a new purpose. The website One Good Thing has several ideas:
<https://www.onegoodthingbyjillee.com/repurposing-disposable-household-items/>
4. To build student knowledge of reuse, have them generate examples of when they have reused something for a new purpose at home or school.
5. Remind students where our garbage goes if we don't recycle or reuse it—the landfill.
6. Ask students: *How can reusing things reduce the amount of waste that goes into landfills?* Allow students time to respond.
7. In their Science Notebooks, have students complete a sentence: I can reuse _____. This will help the environment by _____.

Vocabulary: reduce, reuse, recycle, landfill



ELABORATE: APPLICATIONS & EXTENSIONS

1. Look back at the lunchroom list and sort the items into groups.
2. Sort items into possibly reusable (rigid containers, plastic silverware, boxes) and not reusable (torn wrappers, food waste, etc.)
3. Have students think about their current Kratky hydroponic systems.
4. Ask students: *Is there anything here that could be used to build a hydroponic system to grow a plant or sprout a seed?* Allow students time to respond.

5. Instruct students to choose one item from the possibly reusable list, and devise a way to use it in a hydroponic system. Have students record the plan in their Science Notebooks, using diagrams and explanations.
6. Encourage students to “rescue” items before they go into the trash that could be reused for other purposes.

Possible Extensions:

- 🦋 Create a classroom reuse box where students can place items they think could be reused and encourage students to design new types of hydroponic systems.



EVALUATE: DISCUSSION & ASSESSMENT

1. Discussion Questions:

- *What materials do you see in the landfill?* (Students should observe paper, plastic, glass, food waste, rubber, soil, etc.).
- *What happens to all these items once they are in the landfill? Does it disappear? What happens when the landfill is filled up?* (Students should formulate individual predictions.)
- *What is the problem with landfills?* (The landfills get too full, and there is nowhere to take all the garbage).
- *How can we solve this problem?* Record initial ideas for solutions.
- *What is something you have reused for another purpose at home or at school? How does reusing things help our landfills?*

2. Science Notebooks:

- Students should record the 3 R's along with an example of each.
- Have students complete a sentence: *I can reuse _____.* *This will help the environment by _____.*
- Instruct students to draw a diagram that uses a reusable material in a hydroponic system. Have students write a brief explanation of their design.

3. Project:

- Students clearly identify at least one item or type of material they can reuse in a specific way. (Ex. I can reuse a glass bottle as a flower vase.) Students design a hydroponic system using an item they see in the lunch room trash that could grow a plant or sprout a seed. Students can explain how the item can be used.

4. Elaborate Further / Reflect: Enrichment:

- Have students explore the concepts of reduce and recycle.
- Have students brainstorm solutions for the items they can't reuse—can they be reduced/recycled?

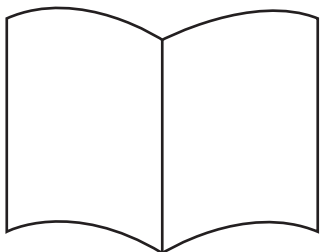
Health Lesson 1

Eat the Rainbow

Health



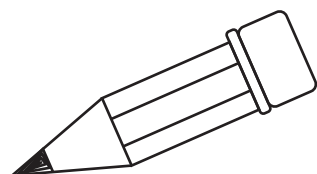
OVERVIEW



LESSON DESCRIPTION: Students will identify fruits and vegetables in the hydroponic system and learn about the related health benefits. Students will also set a personal health goal focused on the consumption of fresh fruits and vegetables.

NATIONAL HEALTH EDUCATION STANDARDS: 6.2.1. Identify a short-term personal

SPECIFIC LEARNING OUTCOMES



- ✿ Students will identify the fruits and vegetables growing in the school hydroponic system.
- ✿ Students will learn about the benefits of eating a variety of fruits and vegetables.
- ✿ Students will determine a personal health goal related to consuming fresh fruits and vegetables.

BACKGROUND INFORMATION



PRIOR STUDENT KNOWLEDGE:

Students should

- be familiar with common fruits and vegetables
- be familiar with what it means to set goals

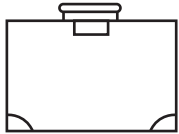
TEACHER BACKGROUND:

Common Garden Plant	Nutrients it provides humans when consumed
Broccoli	Vitamin K and C /Bones and Energy
Spinach	Vitamin K, A, C, B2, folate, manganese, magnesium, iron /Bones, Muscles and Energy
Carrot	Vitamin A, antioxidants /Skin and Eyes

Cauliflower	Vitamin B and Fiber /Heart
Kale	Vitamin K, A, C, fiber, antioxidants /Bones and Energy
Tomato	Vitamin C, K, Potassium, folate, antioxidant lycopene /Immune system and Heart
Purple Cabbage	Vitamin C /Brain (memory) and Aging

POSSIBLE PRECONCEPTIONS/MISCONCEPTIONS: Students may not understand different fruits and vegetables contain different vitamins and minerals.

MATERIALS



Science Notebook

Quantity: 1 per student

Pencils

Quantity: 1 per student

Eat More Colors by Breon Williams

Quantity: 1 per class

Fruit and Vegetable Card Game (see last page)

Quantity: 1 set per pair

PROCEDURES



ENGAGE: OPENING ACTIVITY - PRIOR LEARNING & GENERATE QUESTIONS

Discuss behaviour and learning expectations prior to going to the hydroponic system. Students will gather at the designated classroom.

1. Instruct students to explore the hydroponic system to locate and identify as many fruits and vegetables as they can. Students should record findings with drawings and labels in their science notebooks.
2. On chart paper or a whiteboard, list all the fruits and vegetables that the students found in the hydroponic system.
3. Ask students:
 - Did all of the fruits and vegetables in the hydroponic system look the same? (Discuss color, shape, size, texture.)
 - Are they all good for you? Let's find out!



EXPLORE: LESSON DESCRIPTION - PROBING OR CLARIFYING QUESTIONS

1. Prior to the lesson, print out one copy of the fruit and vegetable matching game per pair of students.
2. Read a book, such as *Eat More Colors* by Breon Williams, that explains the health benefits (vitamins, minerals, etc.) of each fruit and vegetable on the class chart. You could also show this short video: <https://www.pbs.org/video/fit-kids-25-eat-rainbow/>
3. Fill in the chart with the vitamins, minerals and health benefits that each fruit and vegetable provides.
4. Pose the question again after reading the book and filling in the chart, *Are all the vegetables in the hydroponic system good for you?*
5. Introduce the fruit and vegetable matching game by modeling with students how the game is played. Students will work with a partner to play concentration matching the vegetable and fruit cards with the card showing how the vegetable or fruit is good for their body. Students should refer to the class chart checking for accuracy.
6. Allow students time to play two or three rounds of the game.



EXPLAIN: CONCEPTS EXPLAINED & VOCABULARY DEFINED

1. Have students choose one fruit or vegetable from the matching game and explain to a partner what they learned about it.
2. Ask students to complete the sentence stem in their science notebooks: "I found out the vegetable/fruit _____ is good for my body because _____"

Vocabulary: vitamins, minerals, health benefits, nutrition



ELABORATE: APPLICATIONS & EXTENSIONS

1. Instruct students to think of one healthy goal related to consuming fresh fruits and vegetables they learned about. Example: *I will try one new vegetable a week. I will try to eat a green fruit or vegetable every day.*
2. Students will keep a log in their science notebooks to record the progress of their goal.

Possible Extensions:

- Have students design their own fruit or vegetable and explain which vitamins it has and how it will help their body.










EVALUATE: DISCUSSION & ASSESSMENT

1. Discussion Questions:

- *Did all of the fruits and vegetables look the same?* (Students should respond with science observations from notebook entries.)
- *Are all the vegetables in the hydroponic system good for you?* (After the fruit and vegetable memory game, students should be able to name at least two vegetables and their benefit.)

2. Science Notebooks:

- Students explore the hydroponic system to locate and identify as many fruits and vegetables as they can. (Students should record 3 vegetables with drawings and labels.)
- *I will try one new vegetable a week. I will try to eat a green fruit or vegetable every day.* (Students will decide on a goal, record it in their notebook and keep a log of their progress.)
- "I found out the vegetable/fruit _____ is good for my body because _____". (Students should respond with one fruit or vegetable and one benefit.)

	<p>Heart and skin health</p> 
	<p>Eye and skin health</p> 
	<p>Antioxidants and brain health</p> 
	<p>Immune system health and energy</p> 