

Vertical Garden Unit Outline Content Area: Life Science Grade Level: 9-12

Lesson Title	Lesson 1: Introduction to Vertical Farming	Lesson 2: Plant Selection	Lesson 3: Nutrition and Growing Media	Lesson 4: Experimental Design and Careers in Crop Production	Lesson 5: Go With the Flow	Lesson 6: Cashing in on Cash Crops	Lesson 7: Introduction to Product Marketing	Lesson 8: Healthy Plants for Healthy Humans	Lesson 9: Plant Genetics and Biotechnology	Lesson 10: Planting Seeds for Agricultural Education	Lesson 11: Is a Bigger Garden Always Better
Timeframe	3 days (40 minutes periods)	2 days (40 minutes periods)	3 days (40 minutes periods)	3 days (40 minutes periods)	3 days (40 minutes periods)	3 days (40 minutes periods)	4 days (40 minutes periods)	2 days (40 minutes periods)	3 days (40 minutes periods)	2 days (40 minutes periods)	3-4 days (40 minutes periods)
Standards Addressed	HS-ETS1-3	HS-LS1-2	HS-LS 1-6	HS-LS 1-3	HS-LS 1-3	HS-LS 2-5	HS-ETS 1-3	HS-LS 1-2	HS-LS 1-1	HS-ETS 1-3	HS-LS 2-1
Lesson Objectives	1. Define vertical farming and describe its purpose. 2. Compare and contrast various vertical garden designs.	1. Determine which crops would be best suited for vertical gardens based on economic, social, and environmental factors. 2. Explain basic plant parts, plant physiology, life cycle	1. Define and identify essential elements necessary for plant growth. 2. Select growing media for seeds.	1. Design an experimental procedure to test students’ chosen independent variable following proper experiment development guidelines	1. Describe agricultural practices and analyze the value of sustainability in agriculture. 2. Create a model of a garden system and justify why it is the best choice.	1. Describe the effects of historical events on the global wheat market 2. Identify important characteristics of agricultural products that impact consumer choice 3. Read and evaluate food package labels	1. Describe the role of each member of a marketing team 2. Collaborate with team members to create a marketing presentation	1. Evaluate plant growth data from student experiments 2. Describe the causes and identify the symptoms of nutrient deficiencies 3. Identify careers in the field of agriculture	1. Extract plant DNA using laboratory procedures 2. Define genetic modification and biotechnology 3. Create an infographic about GMOs	1. Evaluate plant experiment results 2. Develop and teach a lesson about agriculture to elementary school students 3. Complete a RAFT about the importance of agricultural education	1. List the advantages and disadvantages of different farm sizes and be able to define economies of scale 2. Calculate and compare the output of a tower garden versus the output of a traditional garden bed 3. Develop a scaled model of a garden bed that will meet consumer demand in the school setting 4. Define food insecurity and share resources within the community
Essential Question	1. How can we address the need for greater food production for a rising global population? 2. What are the essential components of a vertical garden? 3. Which vertical design will be most practical and why?	1. What crops can we successfully grow in our vertical garden?	1. What types of growing media are best for vertical gardens?	1. How does our experiment design affect plant growth? 2. What careers are related to plant nutrition and growth? 3. Who has made a significant impact on the field of agriculture?	1. How do nutrients flow in our garden system? 2. How do I learn best? How can I share my knowledge with others? 3. What happens when crops can’t absorb nutrients? 4. How can farming practices impact the ecosystem? 5. How can we sustainably feed the world’s growing population?	1. How do we choose plants that benefit the environment, human health, and the economy? 2. What do consumers need to know about agricultural products in order to make well-informed decisions?	1. How does the food industry successfully market its products? 2. How can we work as a team to successfully develop our brand?	1. How do we know our plants are healthy?	1. What is DNA and how is it extracted from cells? 2. Why should we care about GMOs and biotechnology? 3. What is safe for us to eat? 4. How can we teach the public about biotechnology?	1. How can we use what we learned from our project to teach the community about agriculture?	1. Why does the size of the farm matter? 2. How can we design a garden that will feed our school? 3. How can we cultivate hope in our community?
Careers Addressed	Biosystems engineer, Equipment and Ag Systems Sales Representative, Crop Consultant, Food Processing Plant Manager, Precision Ag Specialist, Irrigation Consultant, Grain Operation Manager, Research and Development Engineer, Water Resource Engineer	Plant Scientist, Soil Scientist, Plant Physiologist, Weed Scientist, Botanist, Plant Geneticist	Biochemist, Precision Ag Specialist, Hydrologist	Climatologist, Conservationist, Environmental Scientist	Agronomist, Hydrologist	Data Analyst, Food Scientist, Nutritionist	Business Manager, Project Manager	Entomologist	Biosystems Engineer, Genetic Engineer, Food Scientist	Agricultural Educator, Extension Agent	Food Processing Plant Manager, Economist
Materials/ Resources Needed	• Paper/notebooks for t-charts and exit slips • Paper copies of the article Vertical Farming- no longer a futuristic concept (1 per student) • Paper copies of the Frayer Model graphic organizer (1 per student) • Projector/computer to show the video “Vertical Farming: Growing in New Directions” • Paper copies of the Vertical Garden Design Listening Chart (1 per student)	• Poster paper or electronic device for students to do choice board • Electronic device or resource for students to read • Paper/notebook for bell ringer and exit ticket • Paper copies of choice board • Paper copies of pages 53-77 of the Kansas garden guide	• Plant nutrient test kit • Bowl/plate for media samples • Electronic device for students to access handouts if needed • Small whiteboards (optional) • pH test strips • paper/notebook for bell ringer • Media samples (clay pellets, Rockwool, potting mix, perlite, peat moss, vermiculite) • Paper copies of part one and part two growing media notes • Plant nutrients note handout	• Experiment Design Template • Data Journal Template • Class Vertical Garden Data Template • Various supplies are needed for student projects based on their designs ◦ Fertilizer ◦ Growing media ◦ Seeds ◦ Containers ◦ Etc. • Agriculture personality portrait example and worksheet • Ag Personality Portrait Listening chart	• Projector or individual device to watch the Dust Bowl video • Paring knife • Paper plate or cutting board • Paper • Vocabulary pre-test • Apple • Plant soil interactions handout (NAITC lesson) • Black Blizzards video • Journey 2050 Lesson 3: Water	• Paper • Ukraine wheat article • CropLife article • Wheat samples • Crop notes chart • Wheat class cards • Kansas Wheat Sector Report • BBC article “Bread’s environmental costs are counted” • Lesson 6 slides • non-GMO milk label video • Looking under the Label (NAITC) • 10 products with labels • Corn and wheat tortilla recipes • Ingredients and supplies for tortillas • Electric griddles or oven with skilletts	• Lesson 7 slides • Food Science Lab Reflection • Shark Tank US Uprising Food Drives Mark Nuts Video • Strengths/skills inventory • Marketing Team Project Description • Food Product Presentation Listening Chart	• Lesson 8 slides • Humanity Against Hunger interactive • Diagnose the plant case studies (NAITC) • Career Cards • Paper • Career Kahoot	• “What is DNA for Kids” video • Science video review • DNA extraction procedure • Plant pieces for DNA extraction • Mortar and pestle or blender • Masking tape and markers • Plastic cups (150 ml or more) • Fine mesh metal strainer • Dish detergent (Dawn) • Non-iodized salt • 91% isopropyl alcohol (very cold) • Ice • Popsicle stick or coffee stir stick • Evaluating Perspectives about GMOs (NAITC)	• Lesson plan template • RAFT writing template • RAFT writing template	• “The Big Deal About Ag” (NAITC) • Garden yield calculator • Posters • Cultivating Hope Project instructions • Cultivating Hope poster template • Cultivating Hope presentation template