

## ITEEA *STEL* LESSON PLAN

Lesson Title: KSB 1. Welcome to Fresh Food Engineers

**STEL:** *Standards for Technological and Engineering Literacy: The Role of Technology and Engineering in STEM Education*

**KSB:** Knowledge and Skill Builder

Author: EbD™

**STEL Context(s):** The Built Environment, Agricultural and Biological Technologies

**Name of Course:** *Engineering for All: Food and Water*

**Intended for In-School or At-Home:** In-School

**Grade Level:** 8-9

**Lesson Overview:** Students are informed that they have been hired to work in a small engineering company that specializes in hydroponic systems design. One day they will be asked to design a large vertical farm, but first they need to learn about hydroponics and CAD. The KSB then introduces students to the need to feed a rapidly growing population, the pros and cons of hydroponics for solving the food problem and describes four different hydroponic systems.

**Big Idea:** Sustaining the supply of food is a great engineering challenge, especially as the world's population grows.

**Instructional Time:** Two 45-minute periods.

# STANDARDS/BENCHMARKS

| <i>Standards for Technological and Engineering Literacy (STEL)</i> |  |                  |                    |
|--|--|------------------|--------------------|
| STEL-4O  | Hypothesize what alternative outcomes (individual, cultural, and/or environmental) might have resulted had a different technological solution been selected. |                  |                    |
|  | <b>Cognitive</b>   | <b>Affective</b> | <b>Psychomotor</b> |
|  | Create   | Responding       |                    |
| STEL-7S  | Create solutions to problems by identifying and applying human factors in design.  |                  |                    |
|  | <b>Cognitive</b>   | <b>Affective</b> | <b>Psychomotor</b> |
|  | Create   |                  | Practicing         |
| <i>Next Generation Science Standards (NGSS) Benchmarks</i>         |  |                  |                    |
| MS-ESS3-4  | Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.    |                  |                    |

**Applicable STEL Practices:** Creativity, Making and Doing, Critical Thinking, Collaboration, Communication, Attention to Ethics

**Learning Objectives:**

- Explain how “food deserts” impact people who live in low-income neighborhoods.
- Explain that increased population and reduction in freshwater and land suitable for farming put the world’s food supply at risk. Define hydroponics and explain how some representative hydroponic systems function.
- Make a case for how hydroponics can help provide fresh food for people in cities.

## 6E MODEL LEARNING HIGHLIGHTS

### **ENGAGE:** (experience, question, stimulate)

Hand out KSB 1 (or open on computer or tablet). Ask the students to imagine they have just been hired as an engineer, working for a company called Fresh Food Engineers, Inc. Explain that the purpose of the company is to help people who live in cities in the U.S. and around the world have access to fresh, nutritious, and affordable foods. Discuss the idea of food deserts, pointing out that in many low-income neighborhoods in the U.S. people have difficulty obtaining affordable fresh fruits and vegetables, which often contributes to poor health.

### **EXPLORE:** (predict, experiment, observe, discover, record, retest, discuss)

Have students access the U.S. Department of Agriculture’s Food Access Research Atlas on the internet. The assignment is for students to zoom in on the area where they live, or other areas they know personally, and use the key to see if it is a food desert (Page 2).

Discuss with students the global problem of feeding a growing world population with dwindling land and water supplies suitable for farming (Page 3).

### **EXPLAIN:** (develop, progress, grow)

Introduce the concept of vertical farming by having students read about it in KSB 1 (Page 4), and/or by having them research the concept on the internet and report their findings. Buildings constructed for vertical farming have been designed, but it is expensive to construct new buildings in cities. However, growing food on the surface of existing buildings is a very promising idea.

Explain that the students’ grand challenge will be to design such a vertical farm. First, however, they will need to learn to grow foods hydroponically and learn to use Computer Aided Design.

Have the students read “What Do Plants Need?” (Page 5) and discuss the rather surprising idea that plants do not get most of their mass from the soil or nutrient solution—but rather from the air! Plants take in carbon dioxide and, with the help of energy from sunlight, break it down into carbon and oxygen. They release the oxygen to the air and use the carbon to build stems, leaves, roots, and other plant parts. This means that plants do not need soil to grow. They just need air, sunlight, and water with some dissolved minerals.

Have students read and discuss the concept of hydroponics, and the pros and cons of hydroponics (Pages 6 and 7). Then show the five-minute video, Hydroponic Lettuce, and invite students to discuss their impressions. Explain that as engineers for this company they will be asked for their advice about where hydroponics should be used and where it should not be used. Have them work in pairs to answer the questions on Page 8.

### **eNGINEER:** (apply, conceptualize, informed design, modeling, create)

Use a video projector to show and discuss the diagrams of the four hydroponic systems (Pages 9-12). Have students research these and other hydroponic systems online.

### **ENRICH:** (interact, question, hypothesize, experiments, record observations, draw conclusions)

Have students search for and view videos about agricultural engineering and vertical farming. Challenge them to find examples in which food is grown on the walls of buildings.

### *EVALUATE:* (analysis, synthesis, re-visit)

Have the students work individually to complete Check Your Understanding and What's the Big Idea? Then have the students work in pairs to discuss their answers. Facilitate a class discussion, asking students to share what they learned from the KSB, and what questions they may have. Pick up the students' papers to conduct your own assessment.

## TEACHER RESOURCES

### Required Tools/Materials/Equipment:

- Projector
- Computer
- YouTube Video
- Student Companion, KSB 1 for every student (online or printed)

### Student Resources:

- Food KSB 1 Student Companion Doc

### Vocabulary:

- **Aeroponics:** A hydroponic system in which the plant roots are suspended in a chamber, which is constantly misted with nutrient-rich solution.
- **Agricultural Engineer:** A person who develops new and improved technologies for growing and processing food. **Food Desert:** A low-income community located more than a mile from a source of fresh fruits and vegetables. **Vertical Farming:** Using tall buildings to grow food.
- **Ebb and Flow:** A hydroponic system in which the plants are placed in cubes of an absorbent material (Rockwool) and a nutrient-rich solution is pumped into the chamber and then drained periodically.
- **Hydroponics:** A method of growing plants in a water (hydro) solution, without soil.
- **Sustainable Development:** A way to meet the needs of the present without sacrificing the needs of future generations.

### Supporting Files:

Include attachments as both Word and PDF files.

Include a Design Brief