Aeroponics in Your Classroom

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Concerning our food supply, what limitations do we have when we need to produce MORE?

Arable land

Water

Nutrients

Could the following exist?

- A farm that can be located in any climate and still produce food year-round.
- A farm that can be located in a large, urban city with very little open space.
- A farm that uses no soil for plant growth.
- A farm farm that uses 95% less water than a traditional farm.

Farm of the Future video

Could the following exist?

Supplies:

- **Per group of 3-4 students:**
  - 5 gallon bucket, with lid
  - 5-7 seedling plants (ideally plants that are edible)
  - 150-300 gph submersible water pump
  - 360° shrub sprinkler head (½", threaded)
  - 6" x ½" threaded sprinkler riser
  - 5-7 net pots and foam collars (2" or 3")
  - Hydroponic nutrient solution
  - Grow lights or greenhouse

- **Assorted tools**
  - Drill hole saw (2" or 3" to match net pot size)
  - Drill
  - Electrical timer that can be programmed in 30 minute increments
  - Extension cords and/or power strip to plug in the pump in each bucket

Design:

Name_____

Aeroponic Garden Design Challenge

Objective: You will design and construct an aeroponic vertical garden and grow a food crop.

Assignment Description: You are an agricultural engineer who has been hired to develop a small-scale vertical garden for families living in urban areas. Your team has been tasked with designing an inexpensive, self-contained vertical garden unit that can produce food for a family. Use the *Engineering Design Process* to complete this challenge.

You will be provided a 5-gallon bucket, a pump, 1 or more sprinkler heads, and plastic pipe. You will need to design the vertical garden so that the roots of all the plants in the system can be evenly sprinkled with nutrient-rich water every 30 minutes. Your goal is to maximize both the number of plants that can be grown, and the rate of growth of the plants (determined by averaging the height of all the plants at the end of a predetermined period of time). The plants will be provided.

Step 1

Ask: Identify the Problem and Constraints

A technological problem is a problem that may be solved through the development or improvement of technology.

1. What is the problem?

2. What will solving this problem accomplish?

Criteria

Criteria = a set of standards that determines whether a solution is successful or not.

- Your solution must be contained within a 5-gallon bucket.
- You may only use the supplies listed.
- Your solution must be able to grow at least 5 plants.
- Plants must be an edible food crop.

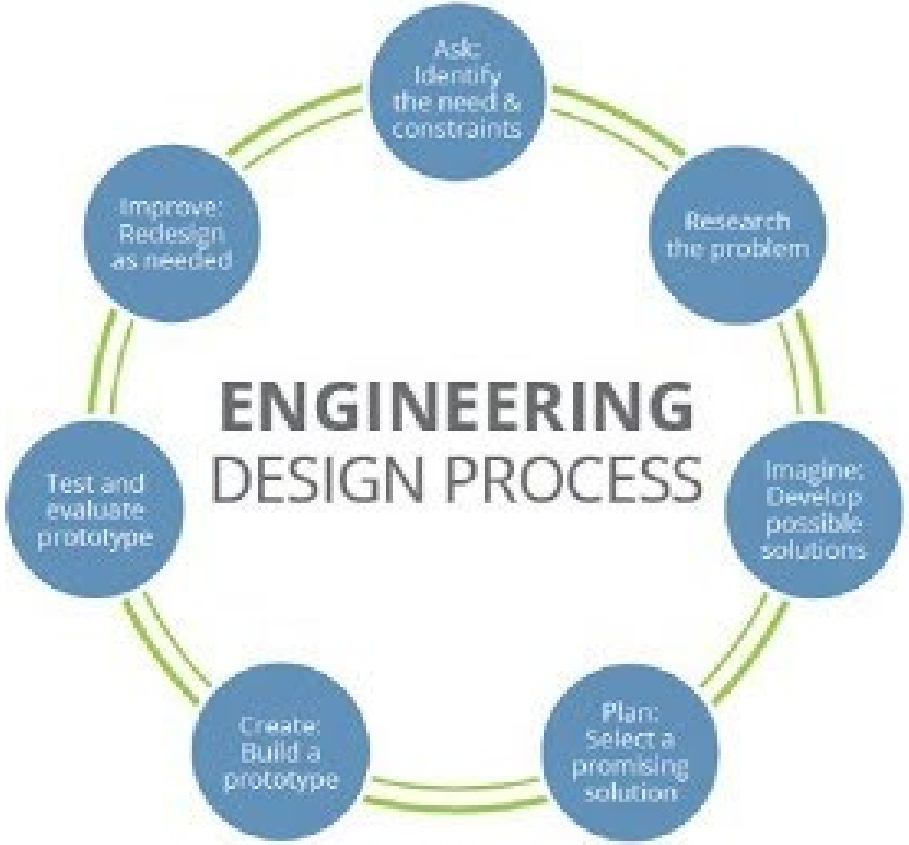
Constraints

Constraint = limitations on the solution

- You will be provided with:
  - 5-gallon bucket, with lid
  - 1 water pump
  - 1 sprinkler head and fittings
  - Plants
  - Timer or Arduino board with necessary accessories (including a solid-state relay)
  - Hydroponic nutrient solution
  - Tools as needed
- You may also ask for:
  - More plastic pipe or pipe fittings, up to 2 additional sprinkler heads, or a different style of sprinkler head, or other supplies as approved by your teacher.

Engineering Design Process:

[redacted]



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Construction:

Construction:

Selecting and Adding Plants:

Purchase starts from a garden center:

- **Pros:**
  - Less preparation time
  - Plants may be a little stronger starting out
- **Cons:**
  - Potentially more expensive

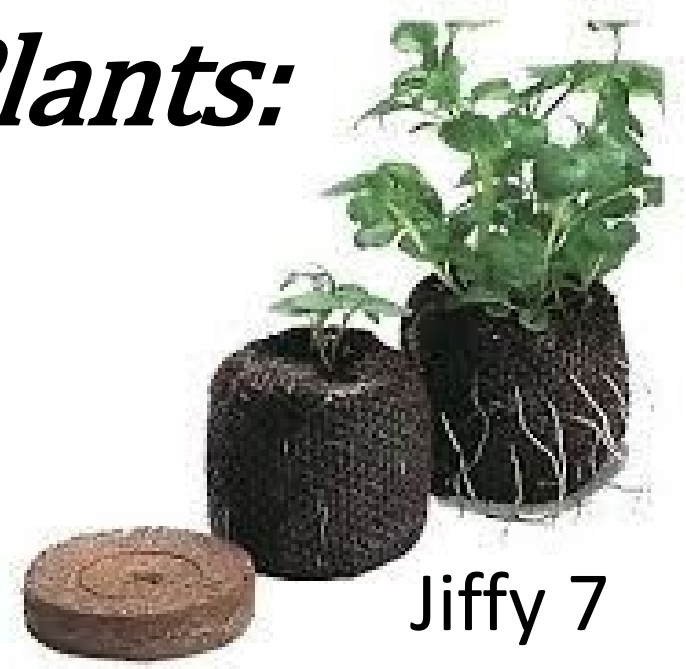
Selecting and Adding Plants:

Start Plants From Seed:

- **Pros:**
  - Potentially less expensive

Cons:

- More preparation time



Jiffy 7

Rockwool Cubes

Selecting and Adding Plants:

Cuttings:

- Tomato cuttings root very quickly

Managing Aeroponic Gardens:

Nutrients:

- Watch for signs of nutrient deficiency.

- Change water and add nutrient solution as needed

Managing Aeroponic Gardens:

Timer:

Optional Coding Opportunity:

6ft extension cord

Wall adapter power supply*

Arduino and breadboard holder*

Breadboard*

Screwdriver*
Craft knife
Wire stripper/cutter/ crimping tool

USB mini-B cable*

Solid state relay*

Electrical tape or shrink tube

Arduino microcontroller – Sparkfun RedBoard*

Hook-up wire – black & red (22 AWG)*

Copper wire ends (6)*

Jumper wires*

*These items are included in the Arduino Relay Kit, which is available for purchase from agclassroomstore.com.

Tie it all together

- Engage students in the *Engineering Design Process*

- Evaluate solutions for sustainability.
  - What are the benefits?
  - What are the limitations?

Tie it all together

- How much food can be harvested from each team's garden?