**Technology Education  
Career & Technical Education  
Desert Hills Middle School  
  
Countertop Hydroponics Design Challenge**

**Objectives:**

* Apply the elements of the design process to produce and/or develop a product or system
* Document the design process and communicate it to different audiences using appropriate communication tools
* Explain and apply basic engineering concepts

**Description:**

Your team has been hired by a small company which specializes in designing and selling backyard hydroponic systems for sustainably growing edible and/or decorative plants. The company wants to expand their operation by creating a new market for indoor, “countertop” hydroponic systems which will sustain a small amount of herbs or decorative plants. The company has hired your engineering team to design and develop a system using readily available products which can then be sourced, packaged, and sold by the company as a countertop hydroponic system for indoor use. The company has given you the following design criteria and constraints:

Criteria:

* Your system must sustain at least 50% of the plants you add for at least two weeks

Constraints:

You may only use the following materials:

* 1 x 12 quart container (lid included)
* 1 x 20 quart container (lid included)
* 4’ of food-grade flexible tubing
* 3’ of 1 ½” PVC pipe
* 2 hose clamps
* 1 drain kit from an evaporative cooler
* 1 small fountain pump
* One 3’ strip of LED grow lights (with wall adapter)
* One 8’ 2x4 stud
* One 2’x2’x1” piece of foam
* 2 net pots
* 12 quarts of grow media (natural cinders)
* Any recyclable waste materials you bring from home (e.g., soda bottles)

You may modify any of the materials as needed using available tools for which you have passed the safety test.

**Directions:**

1. Begin with a date entry at the top of the first open page of your design notebook. Title this entry “Hydroponic System Design Challenge.” If you use multiple pages, be sure to date each page. At the end of each day’s work, you will also need to summarize that day’s activity in your design notebook.
2. Identify the problem:
   1. In your design notebook, list the **criteria and constraints** for your design.
   2. Investigate any **existing solutions** and summarize them in your design notebook.
   3. List the **engineering principles** you will have to apply
   4. List any **design tradeoffs** you will have to make (e.g., speed vs. torque, weight vs. strength, etc.)
3. Brainstorm solutions:
   1. With your design team, **list at least 5 possible solutions** in your design notebook
   2. For each potential solution, make a **list of pros and cons** in your design notebook
   3. Narrow the list to the **top two solutions** and write these in your design notebook.
   4. With your design team, discuss which of the two solutions to choose. Select one solution to pursue and **write in your design notebook which solution you chose and why.**
4. Build a Prototype
   1. Use sketches and mathematical **models** to plan your prototype in your design notebook
   2. Create an **orthographic projection** of your prototype in your design notebook
   3. Include in your plan a **Standard Operating Procedure** (SOP) for managing the daily, weekly, and monthly tasks to maintain your hydroponic system.
   4. **Get your plan approved by the instructor before beginning any construction.**
   5. From your plans, use the materials provided and the available tools to create your prototype
5. Test the prototype
   1. In your design notebook, **record failures and successes** of your prototype
   2. Write in your design notebook **how your design did or did not meet the criteria** you listed at the beginning
6. Redesign & Optimize
   1. In your design notebook, write and/or draw **how you will address failure points**
   2. Use your plans to improve your prototype and retest it
7. Turn in your Design Notebook for evaluation.