

Future Engineers Think Green

Activities for students to demonstrate their engineering skills
and develop real world solutions to environmental issues



Solar Greenhouses



Hydroponics

Program is sponsored by:
The College of New Jersey and
The Boys & Girls Club of Trenton/Mercer



The College of New Jersey



BOYS & GIRLS CLUB
OF TRENTON & MERCER COUNTY

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Challenge: Hydroponically growing plants.

There are two parts to this challenge:

1. Create compost to generate nutrients for growing plants.
2. Grow a plant in water without soil using your composted materials for nutrient in the water.

Requirements:

- Team designs the seed holder.
- Students must select the materials for composting to supply nutrients.
- The compost container must be designed from a soda bottle.
- The composting must be started before building the hydroponic plant holder.
- This activity is to be logged by each team.
- The following information must be gathered:
 - ❖ Record in the log every step of the design, recording of all measurements and the dates.
 - ❖ If possible include pictures of the work.
 - ❖ Draw your design and have it checked by the teacher before building the composting device. Include measurements, identify the parts and what they are made out of.
 - ❖ Design and build the hydroponic plant holder (same requirements as the composter).
 - ❖ Have the documentation, composter and hydroponic plant holder ready for display at the Expo for all centers.

Materials:

- Each team needs two 2 liter soda bottles, or one 2 liter bottle and one 20 oz bottle
- Seeds
- Water - distilled (let tap water sit out for 48 hours to allow the chlorination to escape)
- Composting materials (examples listed below)
- Plastic straw - to blow air into the water compartment to oxygenate the water.
- Tubing – to connect bottles
- Cloth - (t-shirt) to use as a wick
- Net Pot - a platform to hold paper towel and seed
- Rapid Rooter - to hold seed
- pH testers

Tools:

- Scissors
- Xacto Knife
- Permanent marker to label bottles

Background information for successful plant growth:

Hydroponic Nutrients & pH

Hydroponic nutrients are a key factor in indoor gardening. A complete and balanced formula is an essential consideration in getting the most from your hydroponic system. In soil, it's hard to know how much or how little of the essential elements exist or if they are present at all. Since your plants will be growing in an inert medium that doesn't provide any nutrients, your hydroponic nutrient solution must contain not only nitrogen, phosphorous and potassium, but also include all the trace elements.

Nutrients ratios are commonly noted as N-P-K numbers representing different percentages of Nitrogen, Phosphorous, and Potassium, the three main elements (but not the only ones) required for plant growth.

pH Monitoring:

pH is a measure of how acidic or alkaline your hydroponic nutrient solution is. The pH scale goes from 0-14, with 0-7 being acid, 7.0 being neutral, and 7-14 alkaline. Most plants prefer the pH to be in the 5.5 to 7.5 range; beyond this, some nutrients become less available for your plants to absorb.

Most tap water is in the 7.0 to 8.0 range. Hydroponic nutrients are typically acidic and, when mixed in tap water, usually drop the solution into the proper range. Monitoring pH periodically is a good idea to help ensure optimum nutrient availability.

Resources:

<http://www.planetnatural.com/site/xdpy/kb/indoor-gardening-hydroponics.html>

<http://images.google.com/images?hl=en&source=hp&q=soda+bottle+hydroponics&btnG=Search+Images&gbv=2&aq=f&oq=&aqi=>

<http://www.gm.com/experience/education/blog/entry/25.jsp>

Example:



Composting information:

Plants need nutrients to be present in the water for the plants to grow well.

<http://www.planetnatural.com/site/how-to-compost.html>

From the above site: Dos and Don'ts

YES	NO
Vegetable scraps	Meat or animal products (bones, fish, eggs, butter, yogurt etc.)
Egg shells	Coal ash
Yard waste (lawn clippings, leaves)	Weeds or weed seeds
Newspaper	Colored paper
Manure (from vegetarian animals)	Pet droppings
Coffee grounds and filters	Synthetic chemicals

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Challenge: Solar Greenhouses

Construct two greenhouses to meet the attached plans. One is a basic solar greenhouse and the other is “**passive solar.**” There are variables that can be designed into your greenhouses. The objective is find how much better a passive solar greenhouse is over a standard one.

Requirements:

- Work with only the materials listed.
- The greenhouses must be the same size.
- There are variables that you can design into the projects. The type, amount and size of insulation to reduce heat loss will be chosen by the students.
- The greenhouses must be able to hold the required plant.
- Research basic greenhouses (homeowner) and commercial designs.

Procedures for the technological study:

- All greenhouses must be placed facing the sun for the same amount of time **each day**.
- A thermometer must be displayed clearly in each greenhouse.
- The recording of the temperatures must be done at the same time of day **each day**:
 - Record the “cool down” (overnight) temperature as early in the morning as possible.
 - The second temperature must be recorded several hours after sitting in the direct sunlight.
- The plant must be thoroughly watered before being placed in the green house.
- Observe the growth of the plants and take notes of comparisons.
- Note: size, color, which greenhouses grow the plants faster.
- All plants must be watered the same amount on the same days.

Results:

- Record findings in a log.
- Log must be well kept and attractively designed. (Can be done on a computer then printed.)
- Greenhouses and documentation to be put on display.

Resources:

Solar Greenhouse Resources Horticulture Resource List

<http://attra.ncat.org/attra-pub/solar-gh.html>

Free Solar Greenhouse Plans <http://www.hobby-greenhouse.com/FreeSolar.html>

Basic Greenhouse information <http://www.doityourself.com/scat/basicinformation>

Greenhouse supplies

1 roll 3.5 mil. clear polyethylene sheeting

1 small roll for each center - clear food wrap

6 tin cans for each passive solar greenhouse

1 thermometer for each project (can't be opened and changed)

6 rubber bands for cans in each solar project

Insulation materials - cardboard, newspaper, styrofoam

3 can each center -Flat Black spray paint

3 cans each center -White spray paint

Corrugated plastic - for walls of greenhouses, approximately 6 sq ft per greenhouse.

Hot glue and guns

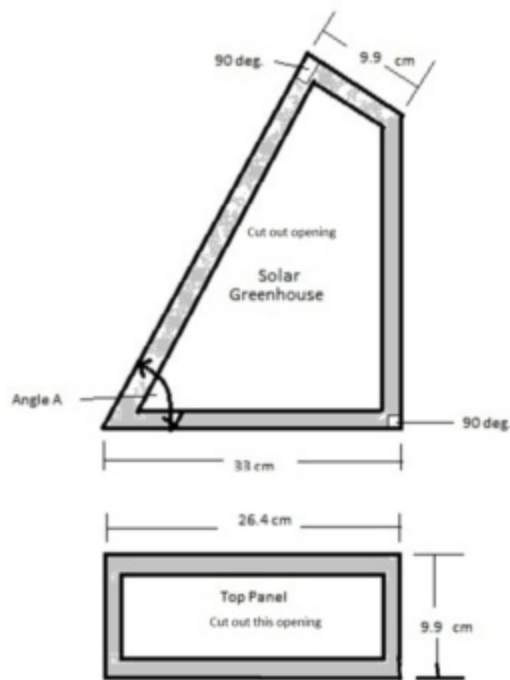
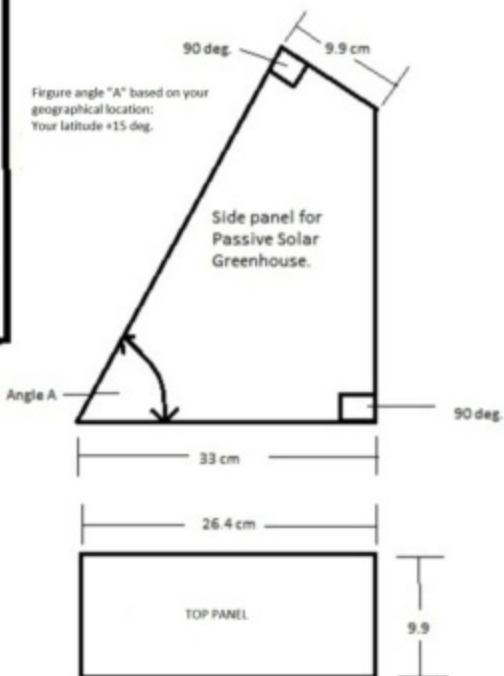
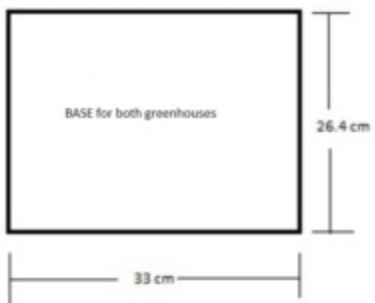
Duct tape

How much better is a Passive Solar House than a Solar Greenhouse at keeping a steady Temperature?

Materials

- Corrugated cardboard
- Clear plastic 3 or 4 mil.
- Flat black spray paint
- White spray paint
- 2 thermometers
- Plastic wrap
- Tape
- String or thread
- Tin cans
- Rubber bands
- Insulation materials - (Stryfoam, cardboard, newspaper, etc.)

Build a solar greenhouse and a passive greenhouse according to these drawings (be sure to cut 2 of each side panel.)



Add insulation to back, top and sides. Place a thermometer inside

Add insulation to back, top and sides
Place a thermometer inside.
Cover all openings with 3 or 4 mil. plastic

