SunCatcher
PASSIVE SOLAR GREENHOUSES

Helping You Harness the Sun to Grow Year-Round

SunCatcher Passive Solar Greenhouses is dedicated to improving global food security at the family and community levels. We do this through research, education and the development of an energy efficient, off-grid, greenhouse design which allows local, year-round food production even in most cold climates. SunCatchers are designed and built to be used for generations, despite climate extremes, energy costs and availability of energy resources.

An investment in a SunCatcher today is like buying a greenhouse with all the propane (at today's low prices) you will need to heat your greenhouse for the next 50+ years, regardless of propane cost and availability (even if the propane runs out as predicted)!

A passive solar greenhouse is a controlled environment agricultural structure where the energy for cold weather warmth is provided by solar radiation. Energy collected during the day is stored in strategically placed thermal mass units which then radiate that energy at night via a natural passive cycle.

How Does a SunCatcher Differ from a Typical Greenhouse?

At SunCatcher, we designed an off-the-grid, self-contained passive solar greenhouse **to help you grow the way you want** – using only seeds, soil, sun and water. We focus on what plants need and designed around maximizing the basic plant needs: heat, sunlight, humidity, CO_2 and protection from extreme weather. This approach reduces your distractions so you can focus on what you want to do – gardening and growing food. A few of the key differences to reduce your cost and headaches:

SunCatchers

- **Free solar heat** stored during the day and released at night by thermal mass, to passively maintain an optimal temperature year round.
- **Strong, well-engineered and permanent,** the SunCatcher is built to last for generations with formidable materials, rated for heavy snow loads and hurricane-level winds.
- **Better growing conditions naturally** with ambient CO_2 and humidity maintained with passive ventilation.

Conventional Greenhouses

- **Expensive heating and cooling** with heaters, fans and fuel/power source required, along with maintenance and replacement.
- **Fragile or temporary structure** may not withstand strong weather, polyethylene replacement every few years, and expected life span of less than 10 years.
- **Stagnant air is worse for plants** with less CO_2 and uncomfortable humidity that may cause plant disease, or expensive exhaust fans and CO_2 enrichment.

SunCatcher PSG offers engineer-quality blueprints and instructions for building your own SunCatcher. The package includes three 18" x 24" copies of your plans which will be printed and mailed to you. We also offer consulting services for customization, construction and operation of your very own SunCatcher greenhouse. Our website is full of helpful educational information on passive solar greenhouse design and operation! Check it out!

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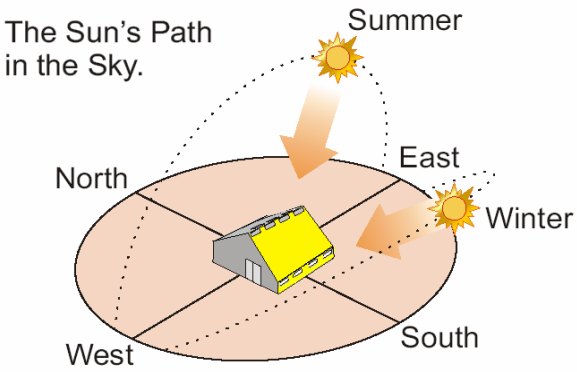
The 5 Elements of the SunCatcher PSG

SunCatchers have the ability to directly harness the sun's light energy and make it available for heating the SunCatcher at night and on overcast winter days. Collecting, converting, and storing the low-angle winter sun's energy for heating the structure 24 hours a day is accomplished through the use of: **orientation, glazing, thermal mass, insulation, and ventilation.**

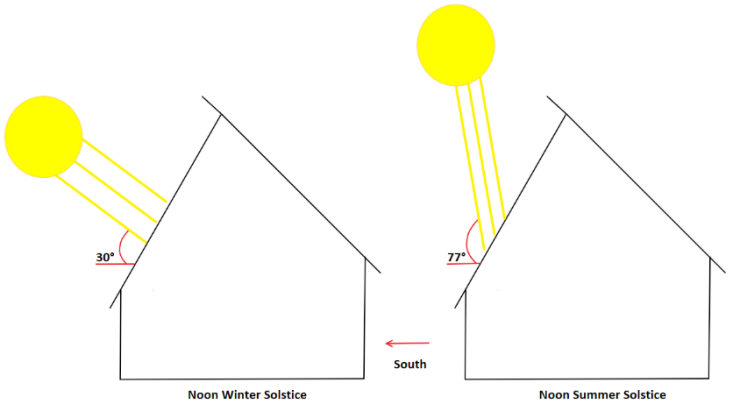
Orientation and Glazing



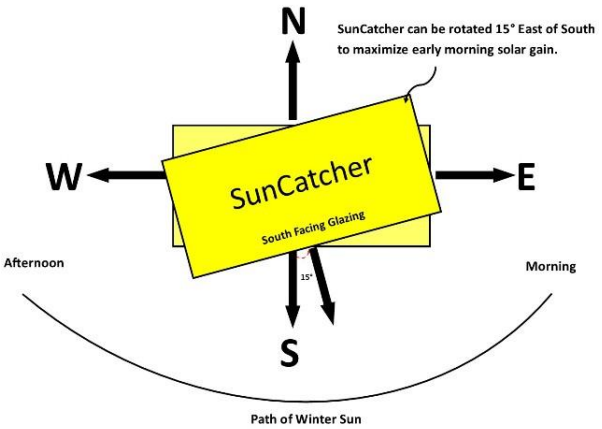
The path of the winter sun will always be lower in the sky with a shorter path than the summer sun.

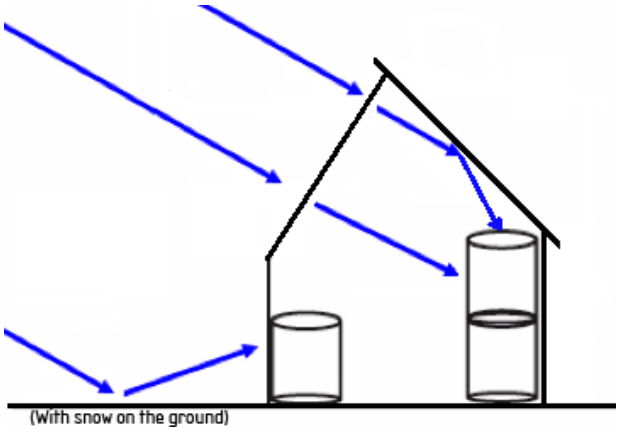
The sun rises in the east, sets in the west, and travels in the southern portion of the sky during winter months. Therefore, it is important to select a site for your passive solar greenhouse with a clear southern exposure that receives sunlight all day during the winter months. This configuration maximizes winter sun penetration into the greenhouse space. This means that the long side of the greenhouse should be placed along the east-west axis and the side that will be glazed will face toward the south.

The glazing should be south facing to maximize the SunCatcher's winter solar gain. Solar gain is the incoming sun rays that enter the SunCatcher, used for photosynthesis by the plants and to heat the structure. The most effective angle of the SunCatcher's glazing to maximize solar gain is 60° up from horizontal.

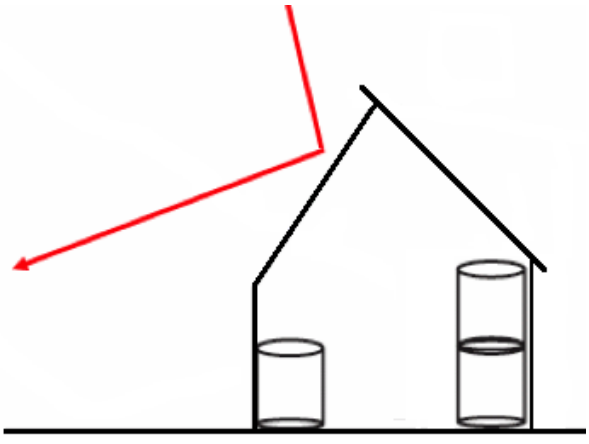


At 36º N Latitude





Winter sun rays diagram with sun being captured for photosynthesis and heat.



Summer sun rays diagram with much of the sunlight being reflected to reduce overheating.

Thermal mass

The SunCatcher is a highly insulated structure that captures sunlight and converts most of that light to heat. The heat is stored in the SunCatcher's thermal mass. The most efficient forms of thermal mass for absorbing and storing solar heat are water-filled metal containers or phase change materials (PCM). During a sunny day, the thermal mass prevents the SunCatcher from overheating by absorbing most of the heat while venting excess heat and moisture.

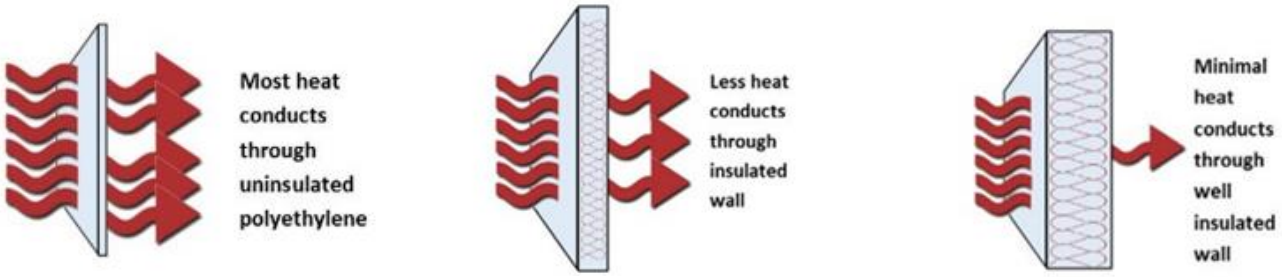
During the night or cloudy days, when the interior temperature drops, the thermal mass radiates this heat and helps maintain a suitable plant environment inside the SunCatcher. The thermal energy stored in the SunCatcher's thermal mass keeps the interior temperature well above the outdoor (ambient) temperature. This thermal mass reduces temperature fluctuations inside the SunCatcher, greatly reducing the need for daytime venting and nighttime heating.

Insulation

Insulation reduces heat loss through surfaces like the walls, floor, roof, and glazing. Like all energy efficient structures, SunCatchers are well insulated and designed to trap and store heat for as long as possible. The SunCatcher roof and walls are well insulated with waterproof insulating material. We suggest using polystyrene insulation (blue board).

Batt insulation can absorb moisture and lose it insulating properties, and therefore should NOT be used.

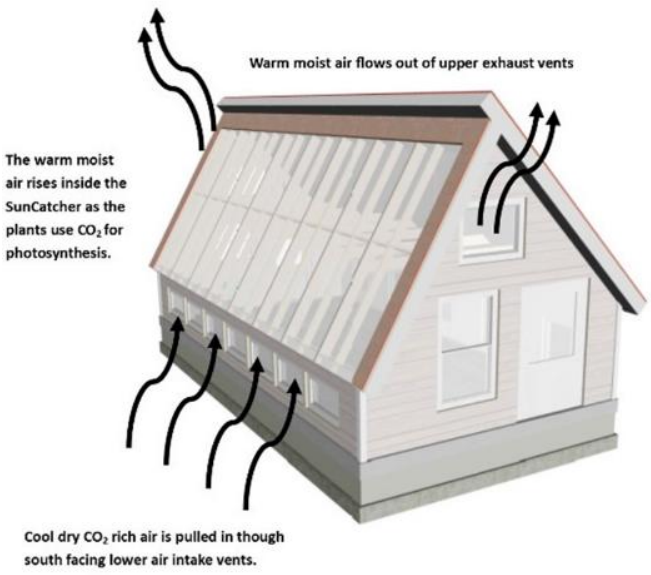
Using triple polycarbonate glazing with an R-value of 2.5 for south-facing glazing reduces heat loss through the glazing on cold days and nights. A reflective insulation "blanket" may be used to cover the glazing at night to further reduce the SunCatcher's heat loss.



Ventilation

Ventilation allows temperature control while bringing in fresh air with renewed CO_2 levels for the plants. The lower air intake vents are opened in conjunction with the upper exhaust vents to create a natural convective air flow. This releases excess heat and humidity out of the upper exhaust vents while drawing in fresh drier, CO_2 rich air through the lower vents when needed during active photosynthetic periods.

The rate of air exchanges is controlled by varying the amount the upper and lower vents are opened.

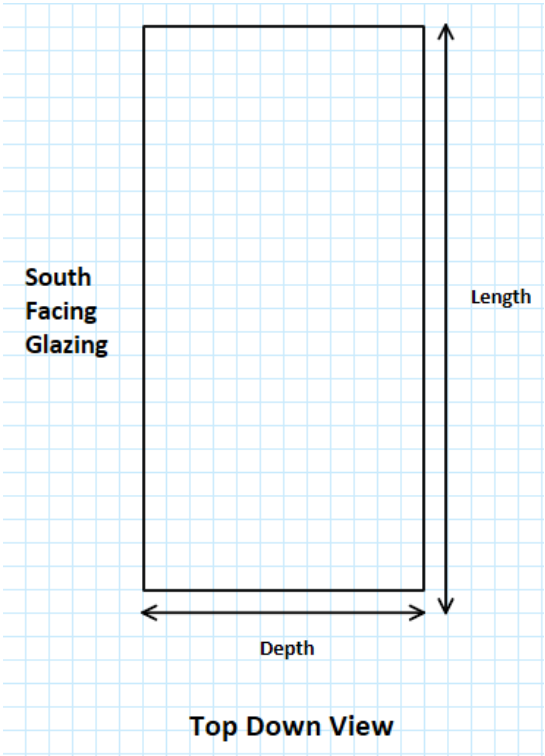


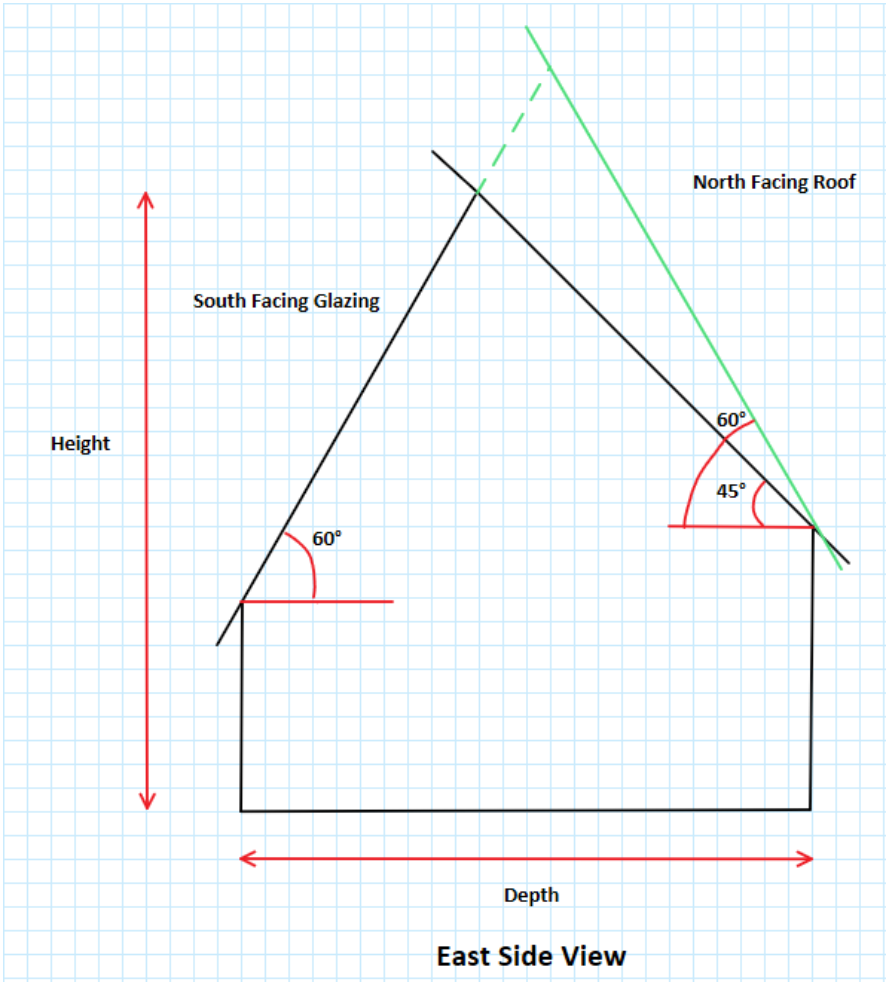
Design Considerations to Maximize Your SunCatcher's Performance

1. As previously stated, the glazing should be at a 60° angle up from horizontal.

2. The north facing roof should be angled a minimum of 45° to as much as 60° up from horizontal. The larger angle makes the south glazing higher and is better for not only capturing more energy (larger aperture to increase incoming sunlight), but also helps reflecting more incoming winter sunlight down on to the plants thus helping reduce plant phototropism.

3. The SunCatcher depth will be roughly equal to the height of the SunCatcher.





4. Colors for interior insulated surfaces are best white, silver or other very light colors. Exterior walls and the roof are best very light colors.

5. The length of your SunCatcher should be at least twice the depth to insure that all the interior gets direct sunlight for at least half the day. The longer the SunCatcher the more the area in the middle gets light all day (is not shaded by the east wall in the morning nor by the west wall in the afternoon).

Links to other resources:

SunSeeker App - http://www.ozpda.com/applications.php
Solar Pathfinder - http://www.solarpathfinder.com/PF
SUN-LITE® THERMAL STORAGE TUBES - http://solar-components.com/tubes.htm
Netatmo Weather Station - http://www.netatmo.com/en-US/product/weather-station
GrowerNode Greenhouse Automation - http://growernode.com/

Reference Books:

- Fisher R., & Yanda B., 1980. *The Food and Heat Producing Solar Greenhouse: Design, Construction, Operation*. John Muir Publications, Inc.
- Mazria E., 1979. *The Passive Solar Energy Book*. Rodale Press.
- McCullagh J., 1978. *The Solar Greenhouse Book*. Rodale Press.