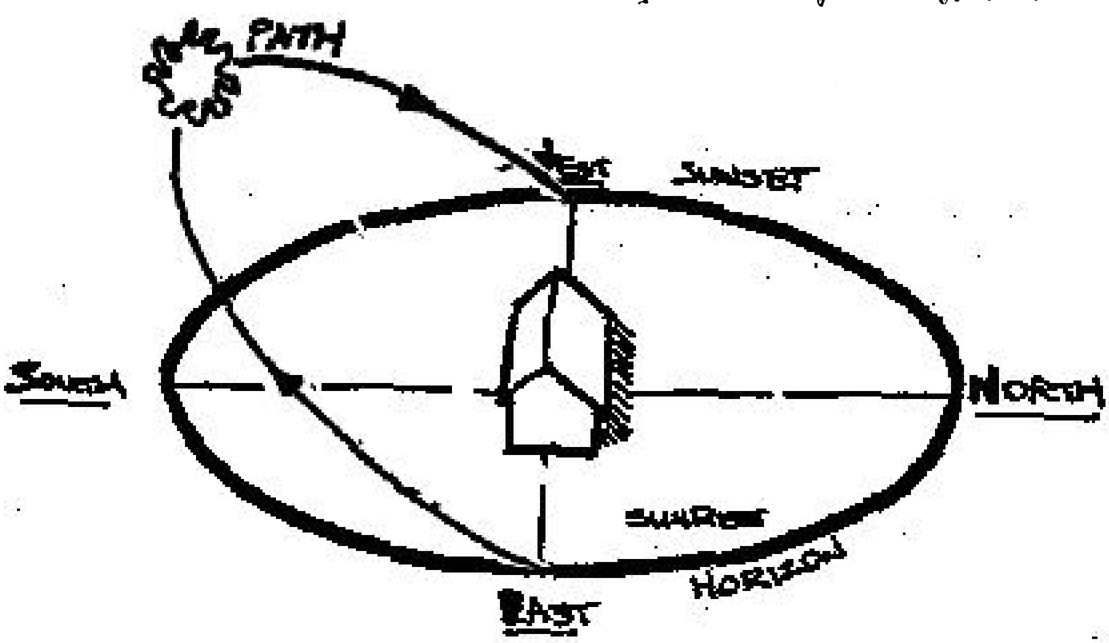
Plans and experiments for the Energy House can be found at Design Coalition's website at **www.designcoalition.org**

the Energy House Sun Angles

by: Lou Host-Jablonski, AIA



Maybe you know about the Energy House.

Here are some more ideas for leaning about the sun and the seasons

Design Coalition Inc., Architects
Madison, WI, 53704 USA

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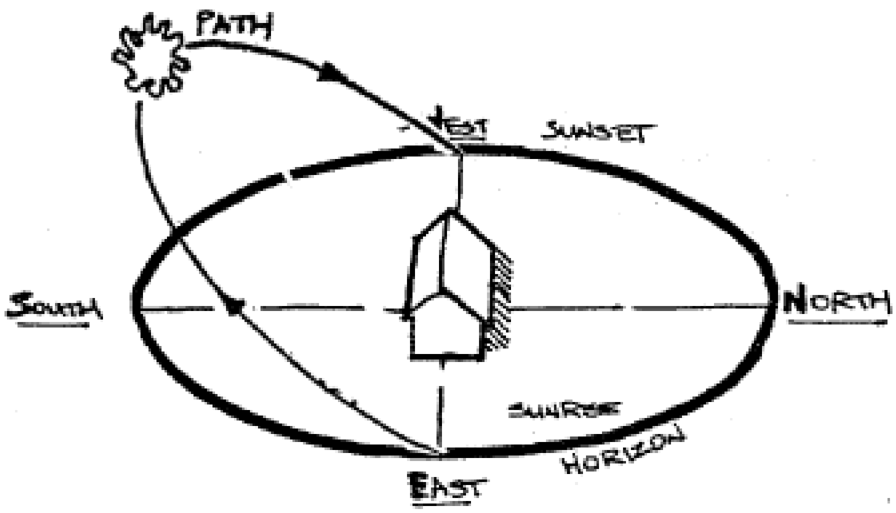


Here are some ideas to study the seasons and the sun's motions in the sky.

Build the Sun Path Model and use it to model each month (see below)

Measure the angle of the Sun above the horizon, and see how it changes with the seasons.
Using the Sun you can even measure the height of anything that casts a shadow, like tall buildings, with nothing but a ruler and your mind! (OK, maybe with a calculator too...)

Make a graph of daily average temperatures for a year or two. Look them up in the Local Climatological Data. It would have a shape something like this...

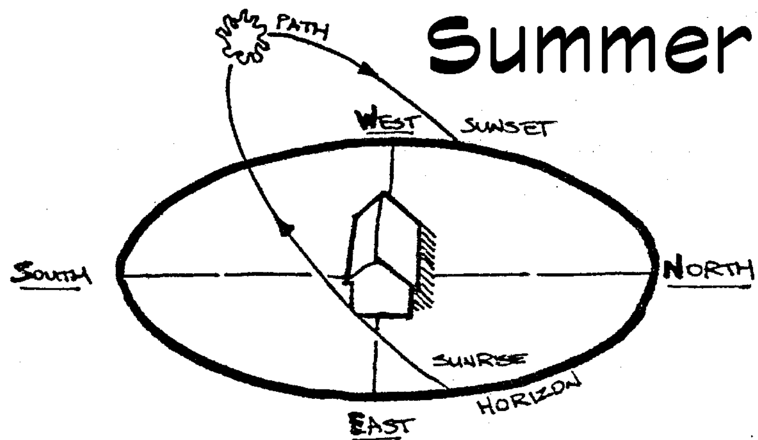
Sun Paths

The Earth orbits around the Sun. But from the Earth, it looks like the Sun rises in the East, travels across the sky, and then sets in the West.

You can make a model of sun paths. Use the list of materials in the Energy House Plans section.

Use the **Local Climatological Data** that you can find in the library. It’s the National Oceanic and Atmospheric Administration's yearly summary, and you can use it to make a monthly "snapshot" of the climate where you live:

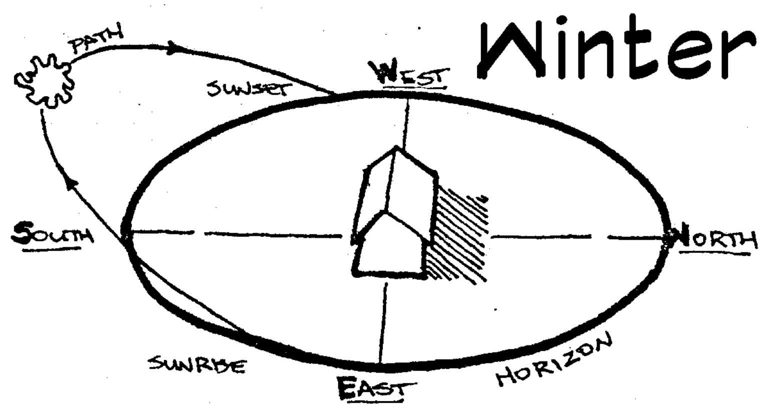
- Show prevailing wind directions and speed with paper arrows
- Show the number of sunny and cloudy days
- Show the amount of precipitation (rain, snow, sleet, and so on)
- Make movable thermometers to show average and extremes of temperature
- Take photos of each month as you model it, and then put them on the wall in order.



• Look in the Farmer's Almanac for sunrise and sunset times

• Measure the height of the sun in the sky using shadows. Do this every week throughout the year.

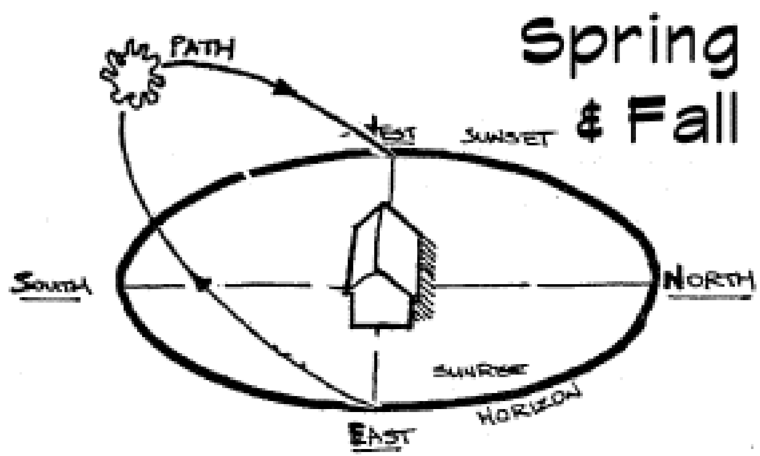
Things to find out....



As the seasons change, see if the Sun rises and sets in different places on the horizon.

Why doesn't the Sun just rise and set in the same place?

The days are shorter in Winter, and longer in Summer. Why? What causes that?



On a certain day in Spring, and a certain day in Fall, the Sun rises exactly due East, and set exactly due West. These days have a special name -- Equinox -- because on those days, the length of the day and the length of the night is exactly equal.

Do you know which day the next Equinox is?

Can you guess what "Summer Solstice" means? How about "Winter Solstice"?

Measuring Sun Angles

How high is the Sun above the horizon? Does it change from season to season?

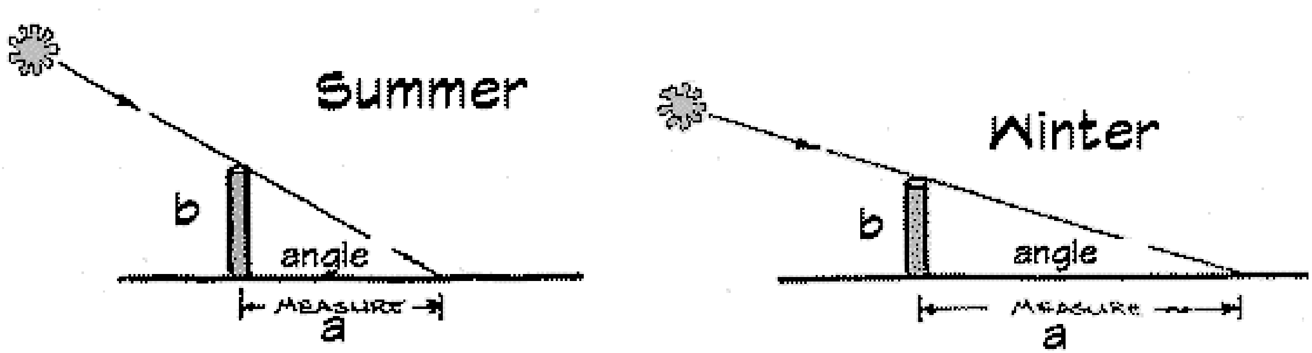
To measure the angle of the sun above the horizon, you just measure the length of the shadow of an object.

Here's how:

1. Pick a vertical object that is easy for you to measure and that is relatively permanent, like a sign post or fence post.
2. Measure it's height. Write it down.
3. Right at noon on a bright sunny day, measure the length of it's shadow on the ground.
4. Take the vertical measurement and divide it by the shadow measurement. ('b' divided by 'a'). The result is the TANGENT of the angle
5. Use a scientific calculator or look up the TANGENT in the chart below to find the angle.
6. You've just done basic Trigonometry!

If you want to compare the sun's height for different seasons, here's how:

1. Make a measurement on a sunny day near the Summer Solstice (the longest day of the year) or the Winter Solstice (the shortest day of the year).
2. You can also make shadow measurements on the Equinoxes, the times in Spring and Fall when the length of the days and nights is equal. This is great if you're making a Sun Path model, and you want to do your own measurements instead of looking them up in a book.
3. Write down your measurements and put them in a place that you won't forget.
4. Then wait for the seasons to change until you can make another measurement. Enjoy life!
5. When you have at least a Winter shadow measurement and a Summer shadow measurement, you're ready to do the math and discover how the height of the sun changes in the sky.



b divided by a = TANGENT

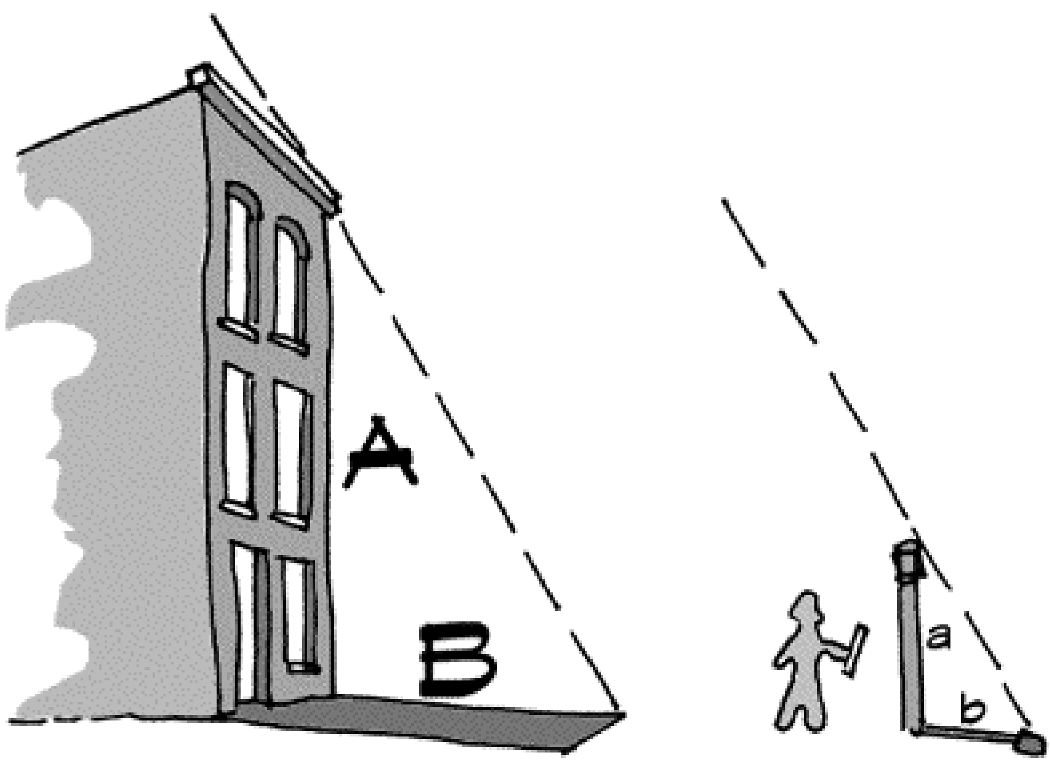
Angles and their TANGENTS

if tangent is	then angle is	if tangent is	then angle is	if tangent is	then angle is
0.088	5	0.7	35	2.14	65
0.176	10	0.84	40	2.75	70
0.268	15	1	45	3.73	75
0.364	20	1.19	50	5.67	80
0.466	25	1.43	55	11.43	85
0.577	30	1.73	60		

Measuring a tall object using the Sun

You can use sun angles to measure very tall things, like buildings, trees and cliffs using just a ruler!

You don't even have to climb up anything, or use trigonometry.



Here's how:

On a sunny day, first measure something that you can reach that is standing upright, such as a pole or stick. Then measure how long it's shadow is.

Then measure the shadow of the tall thing who's height you're trying to discover. To make it easier, you can use a longer measuring tool, such as a yardstick, meterstick or tape measure. You have to make your measurements without wasting too much time, because the sun is moving!

Now you have all the information you need!

SOLUTION: The height of the building or tree or cliff is PROPORTIONAL to the length of it's shadow, exactly as much as the shorter pole or stick is to it's shadow. Can you do the math?

a is to b = A is to B

Here's an example:
Say the post height of 'a' is 2 meters, and the shadow 'b' is 3 meters. That's 2 over 3, or 2/3

You measure the shadow 'B' as 18 meters.
Then the height 'A' must be 12 meters, because two-thirds of 18 is 12

2 is to 3 = 12 is to 18