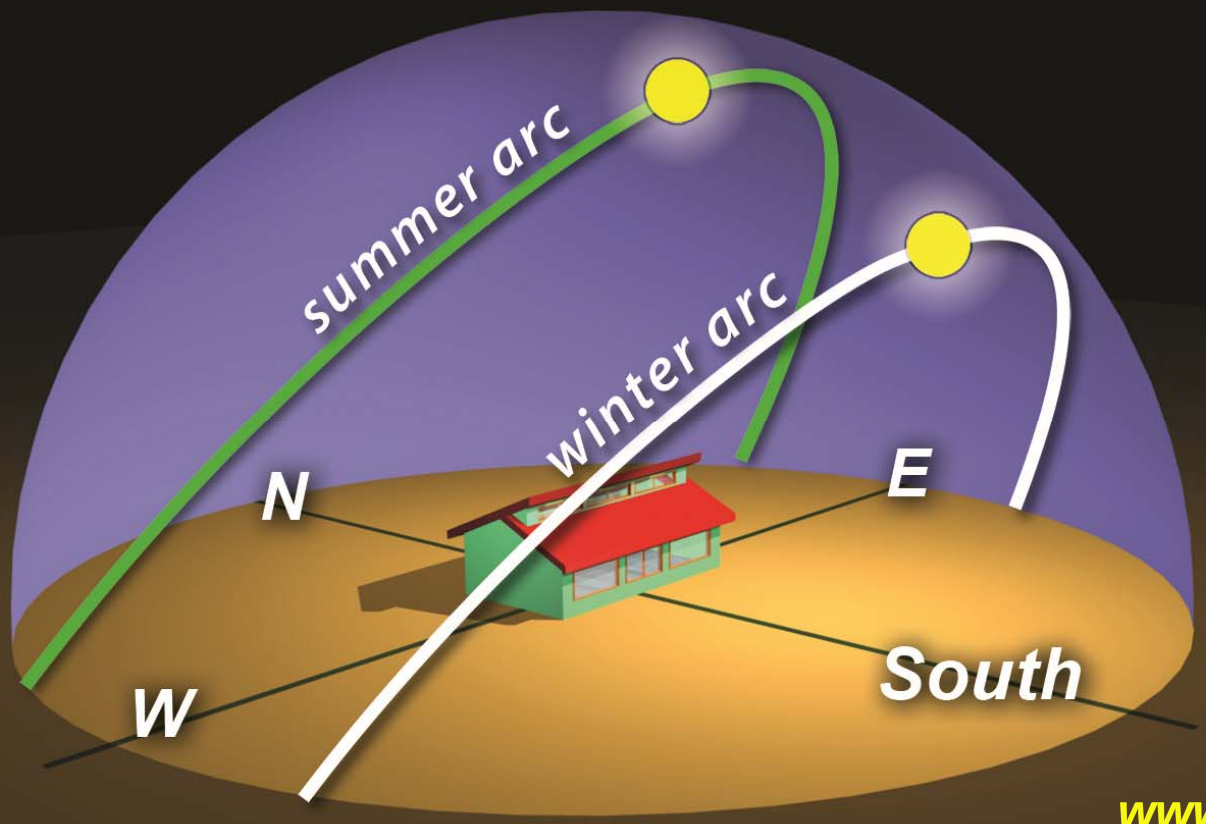
Solar Orientation:

Using Solar Energy in Any Season



Clay Atchison
Media Director
Rahus Institute

www.solarschoolhouse.org

Key Concepts

1) What is Solar Orientation?
2) Reasons for the Seasons
3) Measuring Solar Position
4) The Two North Poles
5) Teaching Tools

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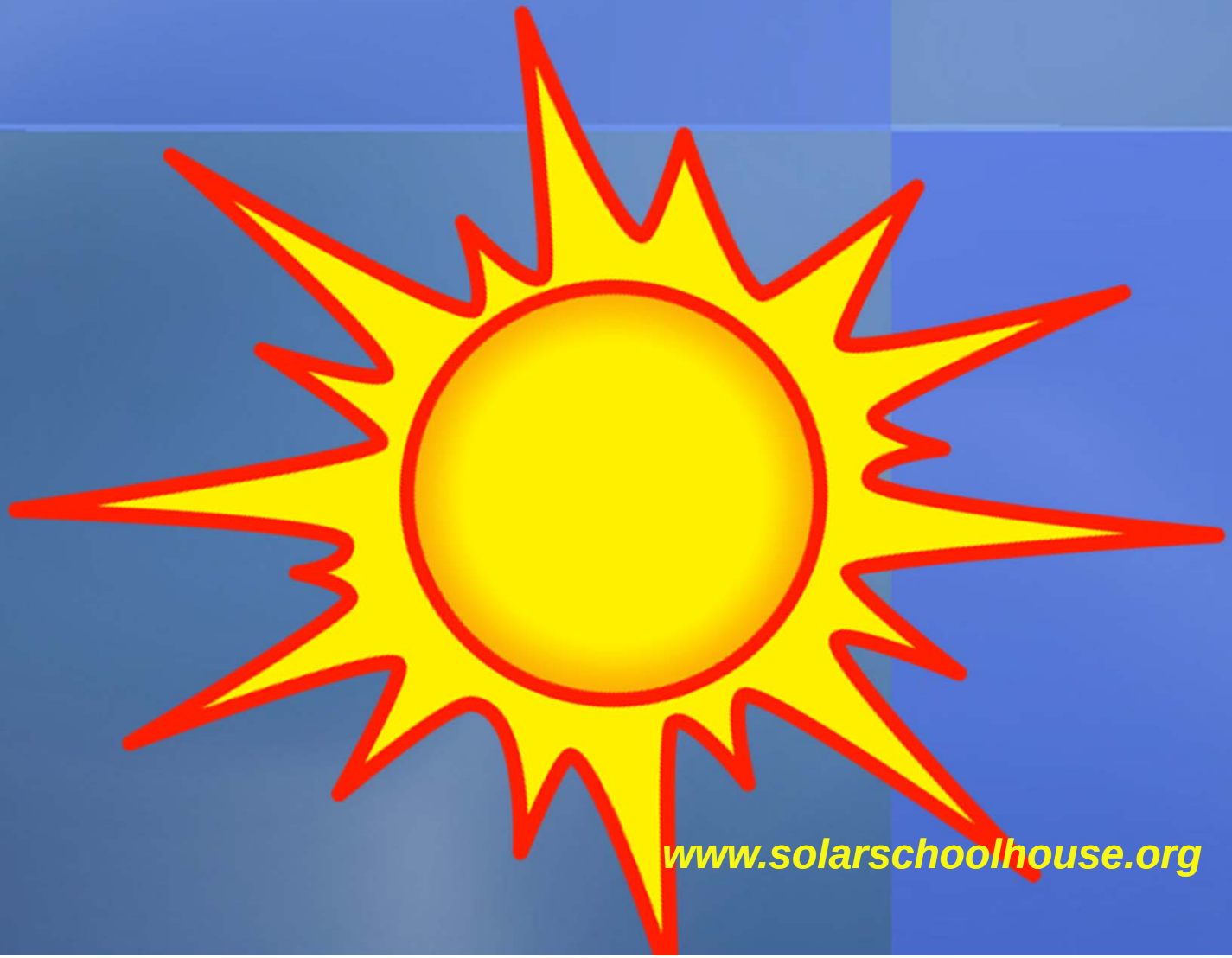
What is Solar Orientation?



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Solar Orientation…

the position of
an object…

…in relation
to the sun.

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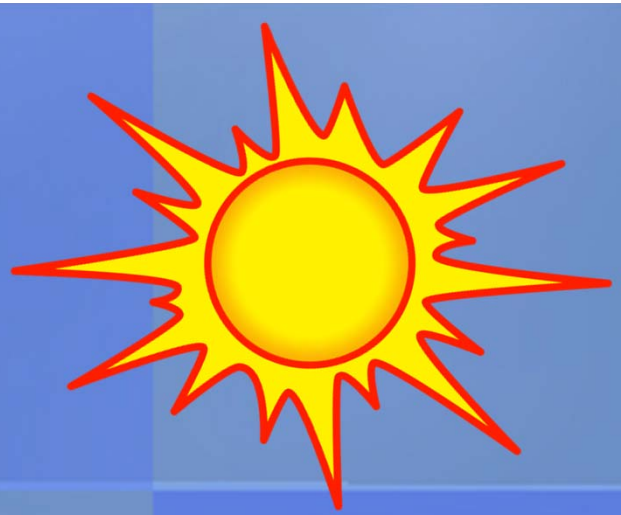
Solar Orientation…



…positioning a structure to MAXIMIZE the amount of sunlight it receives…

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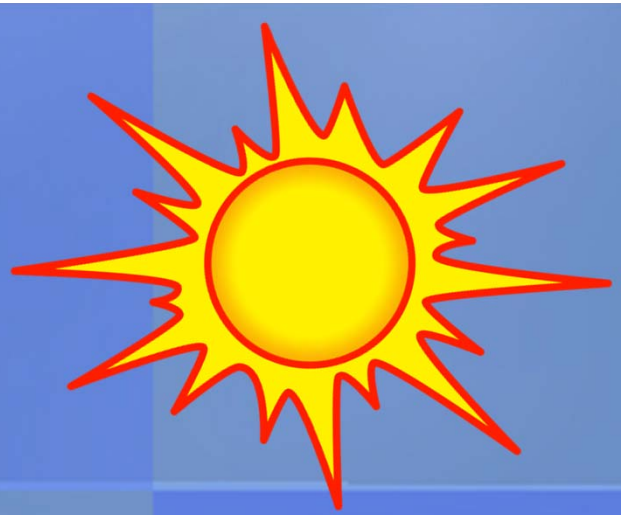
Solar Orientation…



…positioning a structure to MAXIMIZE the amount of sunlight it receives…

…over time.

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The Sun is always "moving."

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Sun Ovens

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Stationary Systems

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Stationary Systems

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What apparent movements does the Sun make?

What apparent movements does the Sun make?

Daily?

What apparent movements does the Sun make?

Daily?

Seasonally?

The Reasons for the Seasons

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Why is it hotter in the summer?

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Why is it hotter in the summer?

Because the Sun is higher in the sky

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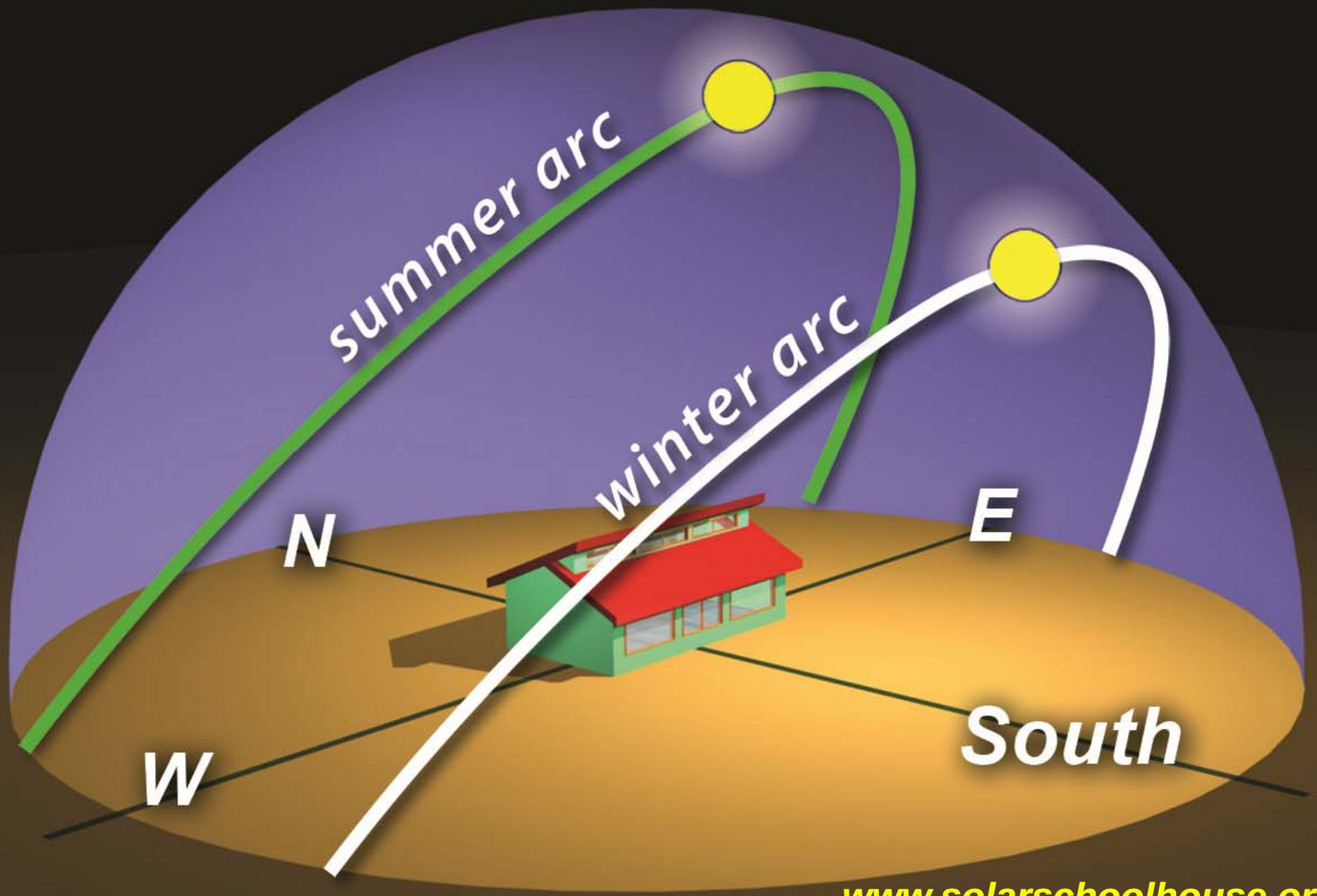
Seasonal Sun Paths



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When the sun is higher in the sky:

When the sun is higher in the sky:

1. Sunlight is more intense.

When the sun is higher in the sky:

1. Sunlight is more intense.

2. Days are longer.

Why is summer sunlight more intense?

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90 degree angles give more light & heat per unit of area.

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Oblique angles give less light & heat per unit of area.

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Why is the Sun higher in the summer sky?

…& why are summer days longer?

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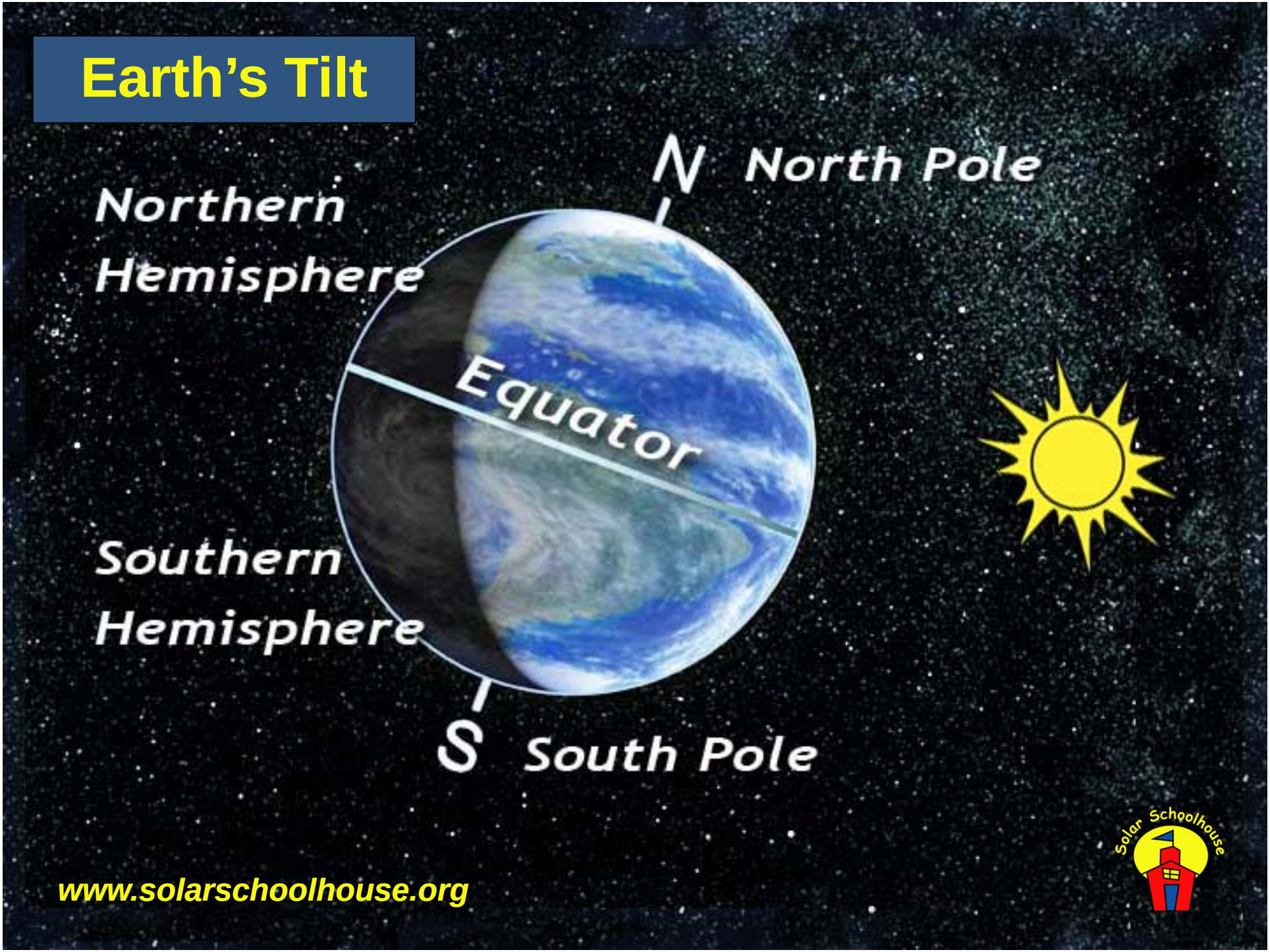
Earth's Tilt



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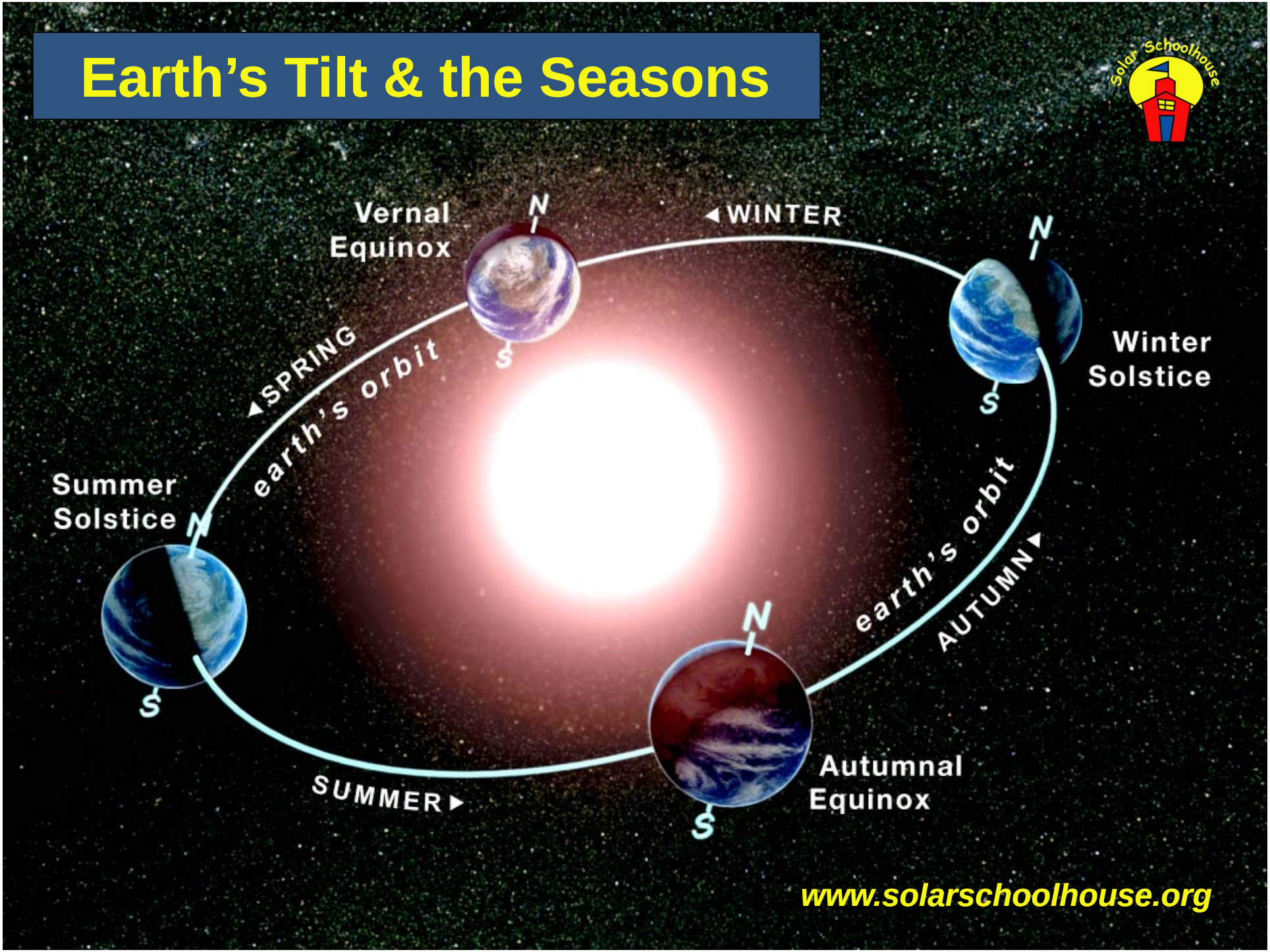
Earth's Tilt & the Seasons



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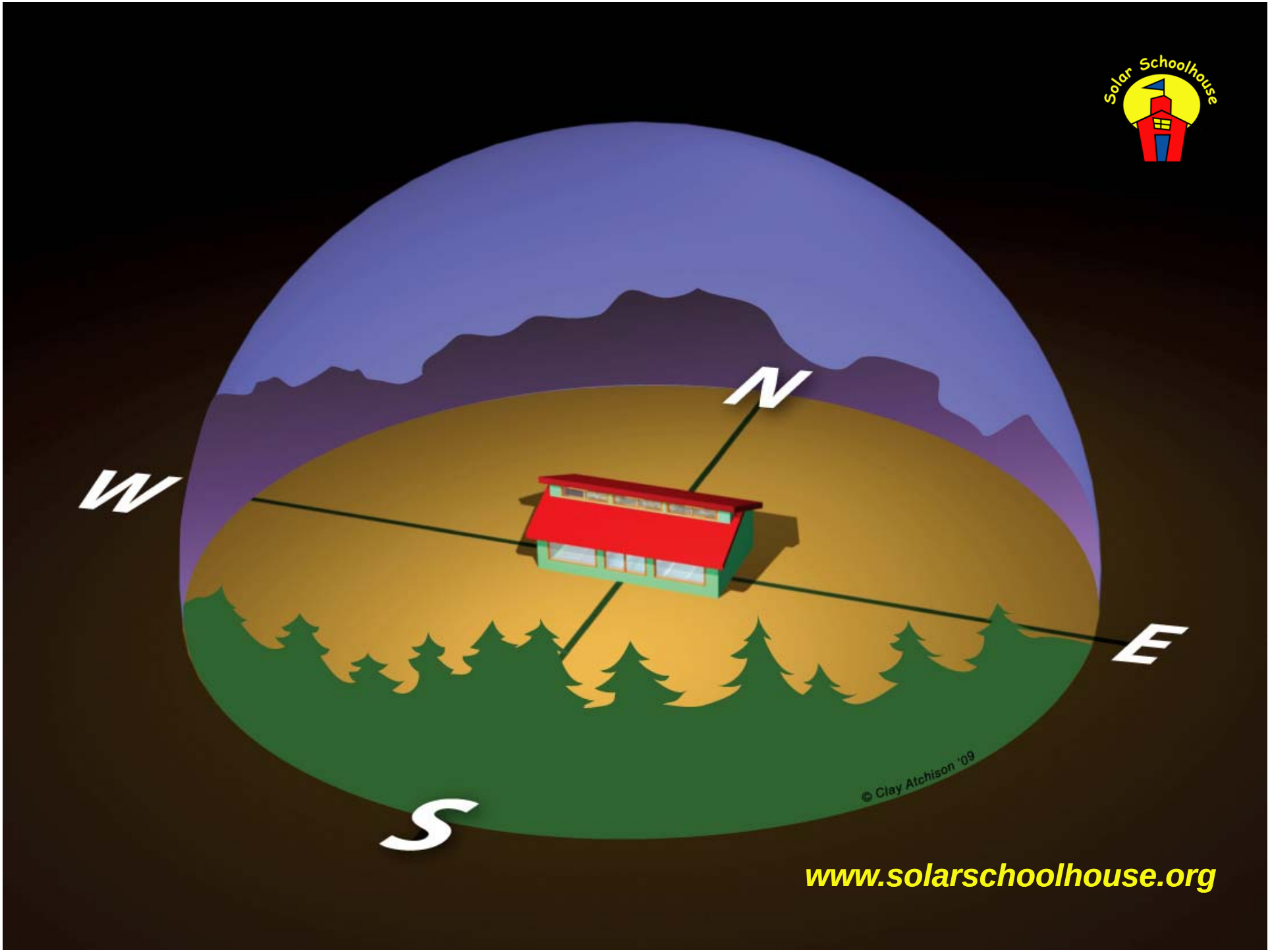
Solar Schoolhouse
N
W
E
S
© Clay Atchison '09
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Solar Schoolhouse
Jun 21st Sun Path
N
W
E
Dec 21 st Sun Path
© Clay Atchison '09
S
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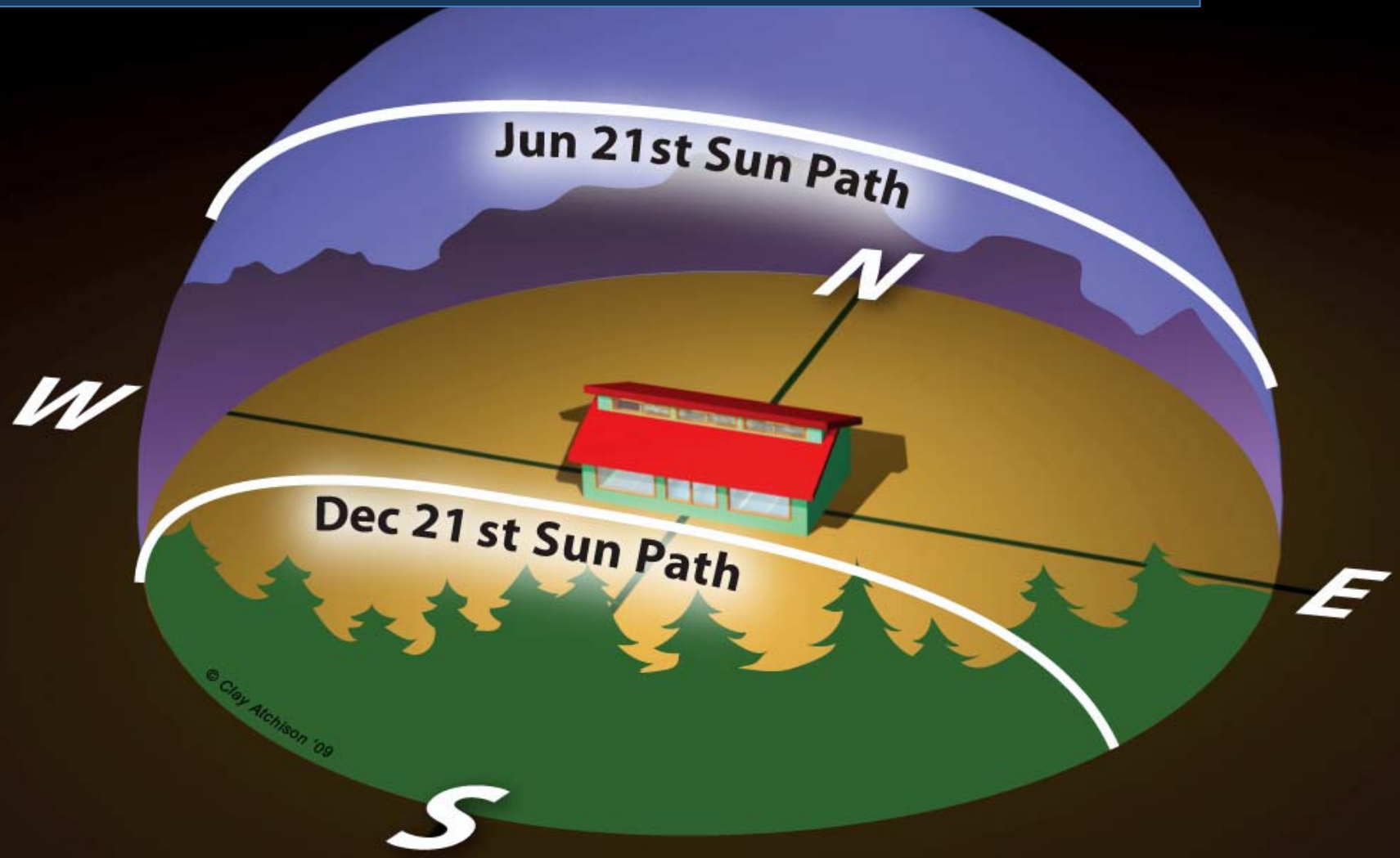
Summer sun path is longer



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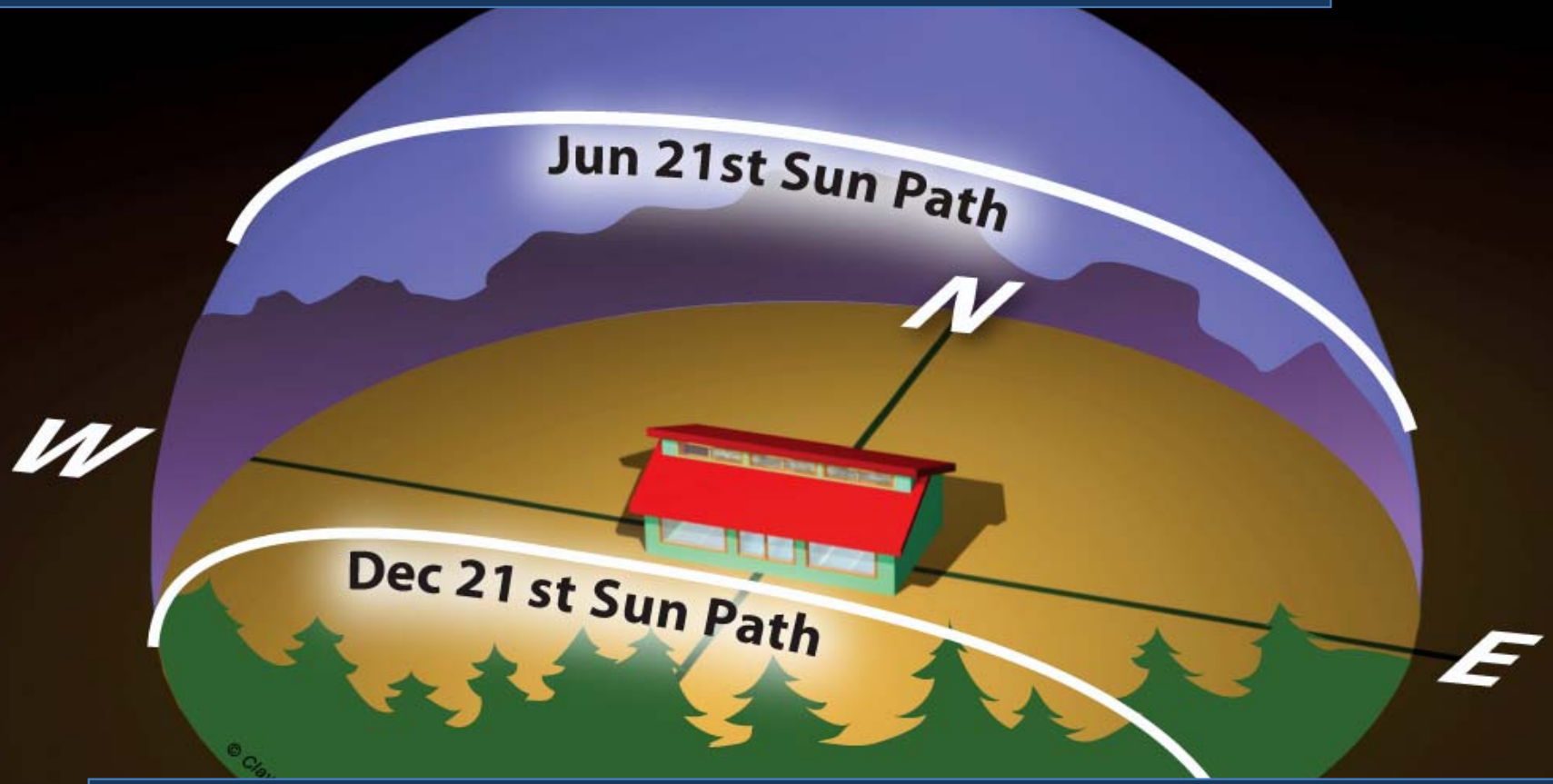
Summer sun path is longer



The Sun is up for more hours

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SOLAR WINDOW

www.solarschoolhouse.org

Solar Schoolhouse
Jun 21st Sun Path
N
W
9AM
Dec 21 st Sun Path
E
© Clay Atchison '09
S
www.solarschoolhouse.org

Solar Schoolhouse
Jun 21st Sun Path
3PM
9AM
N
W
E
S
Dec 21 st Sun Path
© Clay Atchison '09
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Solar Window

www.solarschoolhouse.org

SOLAR WINDOW…

…provides the majority of the day's energy

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Measuring the Sun's Position

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Altitude & Azimuth

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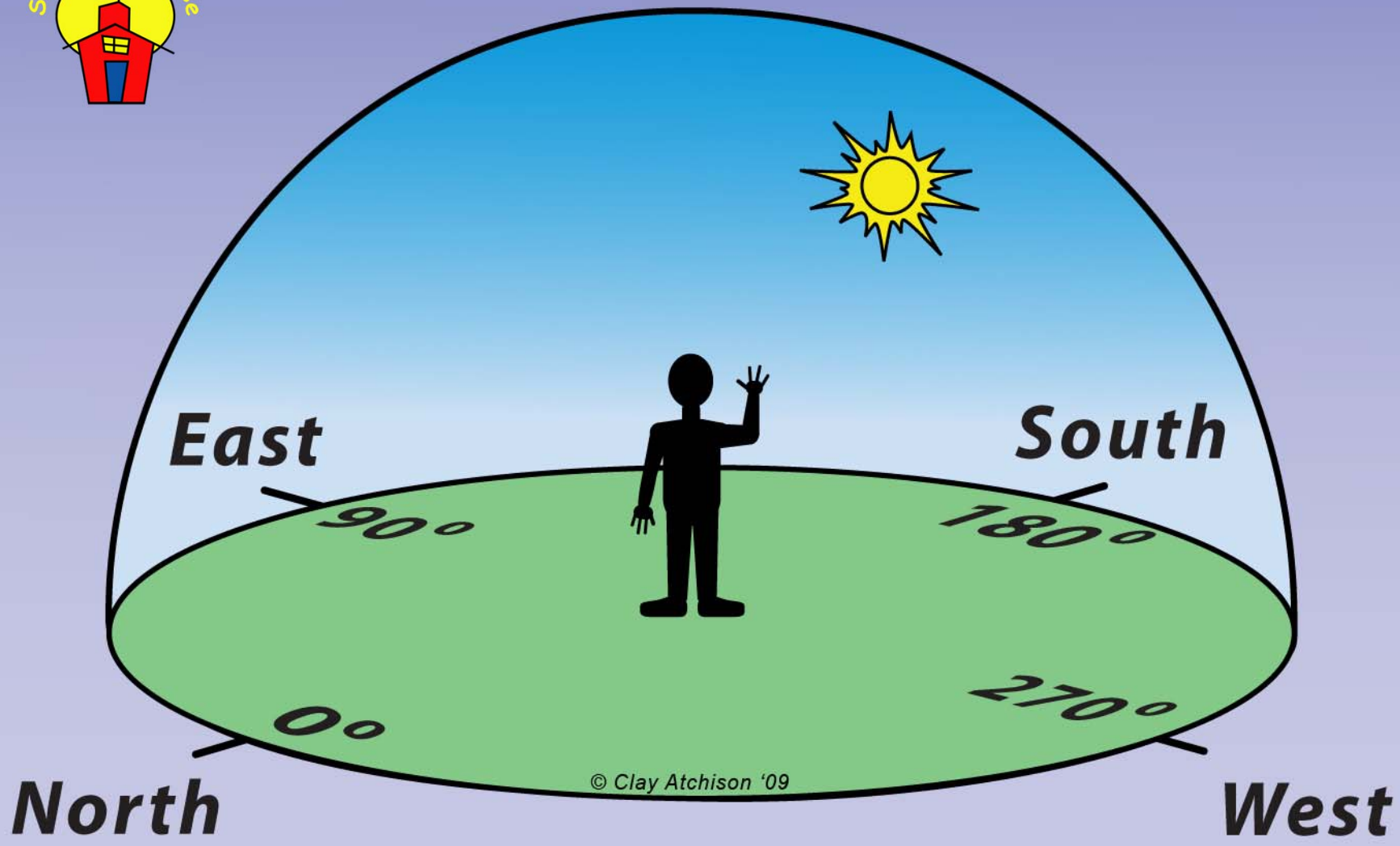
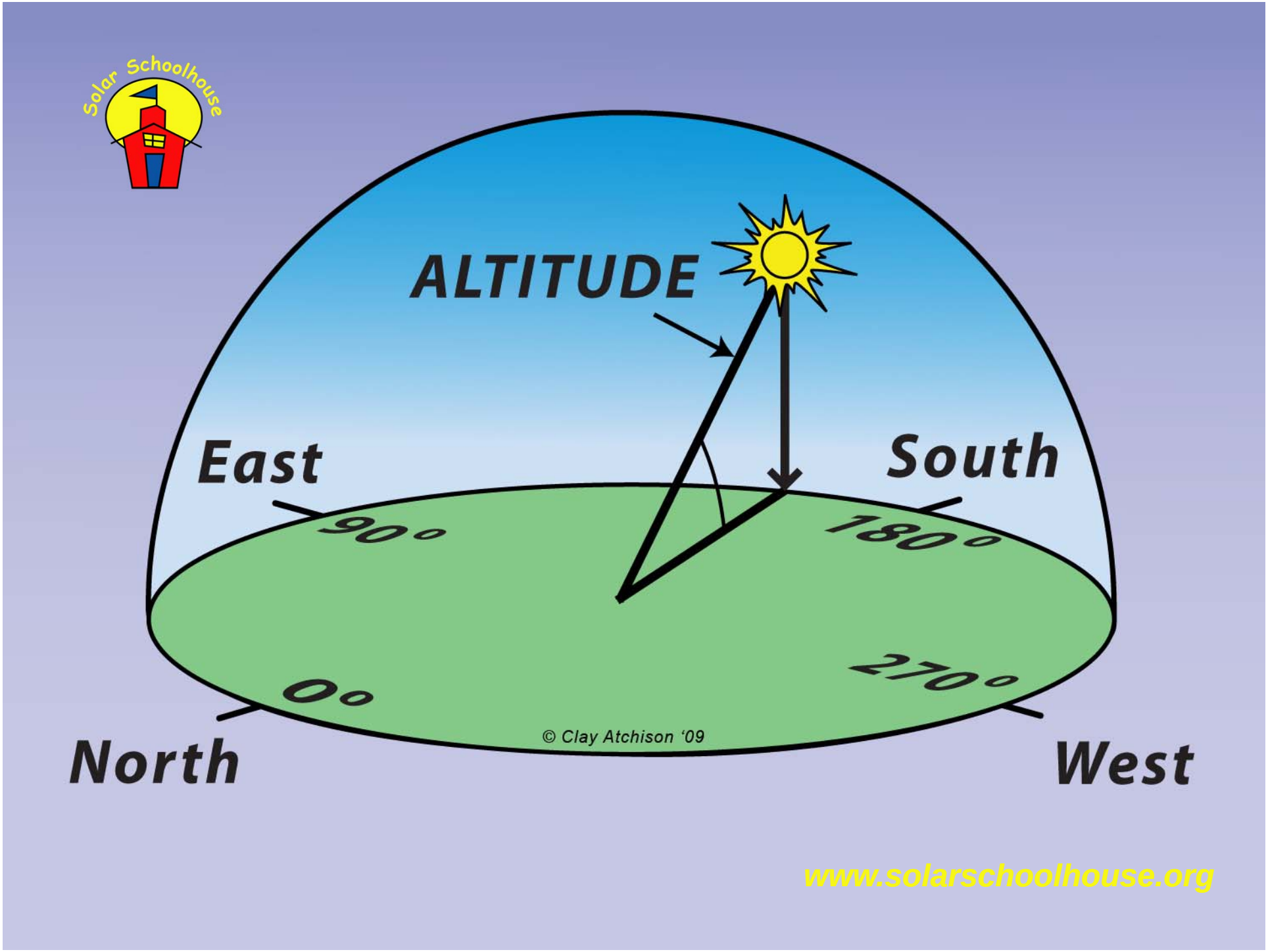


www.solarschoolhouse.org


Solar Schoolhouse
ALTITUDE
East
South
90°
180°
270°
0°
North
West
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www.solarschoolhouse.org

Altitude

…angular height above horizon

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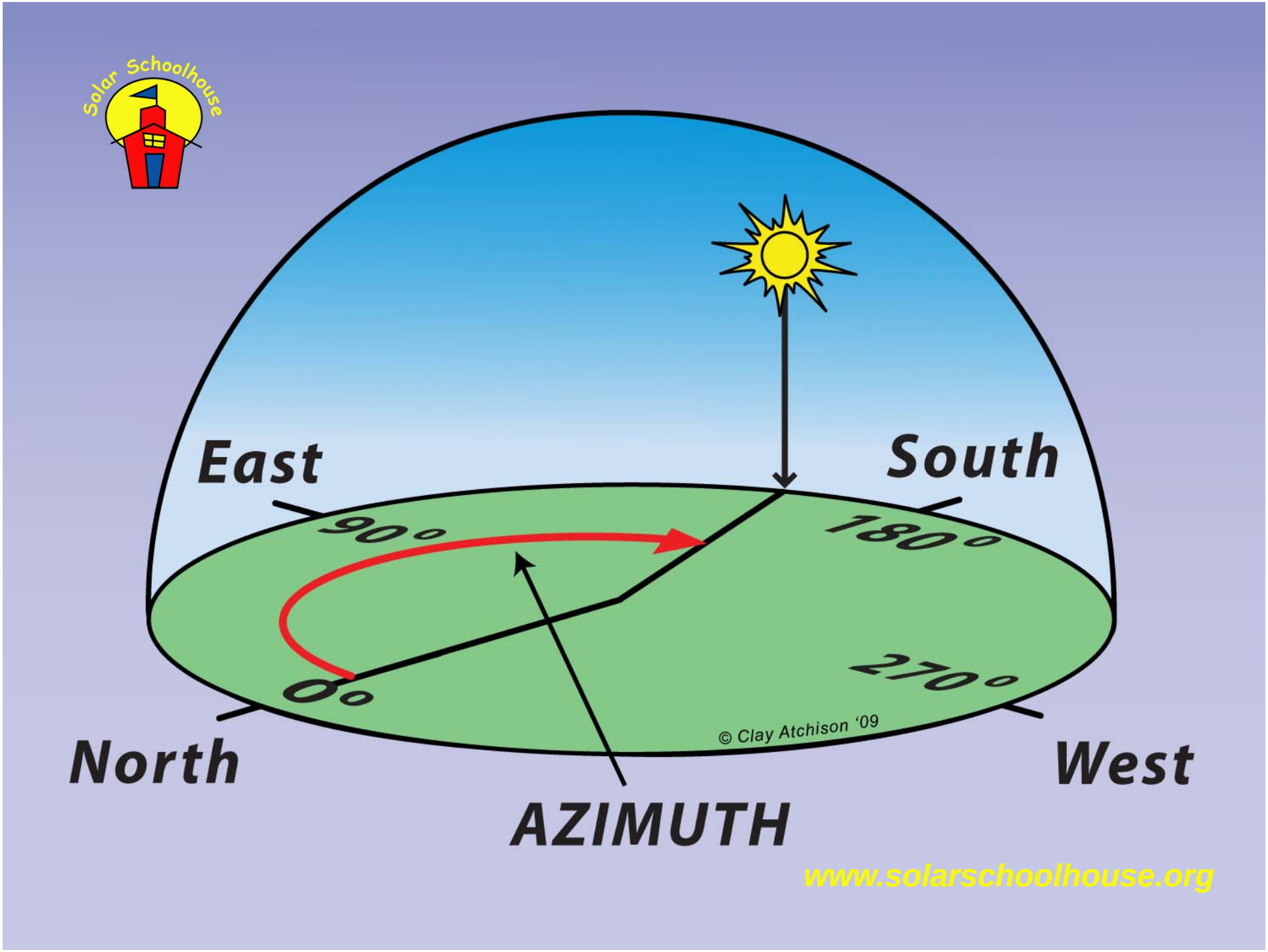
Solar Schoolhouse
East
South
90°
180°
270°
0°
North
West
AZIMUTH
© Clay Atchison '09
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Azimuth

…direction on a compass

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There are TWO NORTH POLES!

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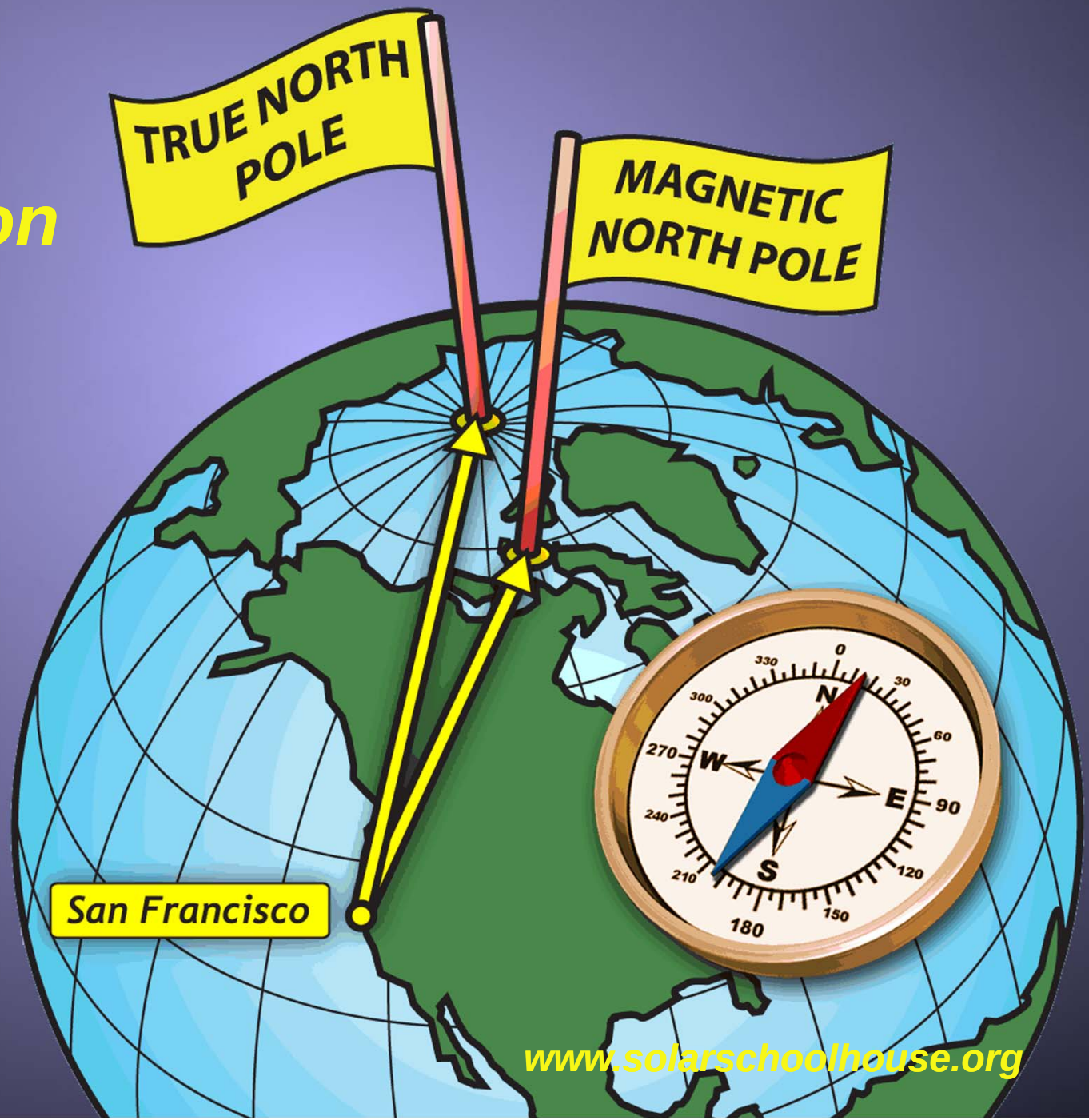
Magnetic Declination



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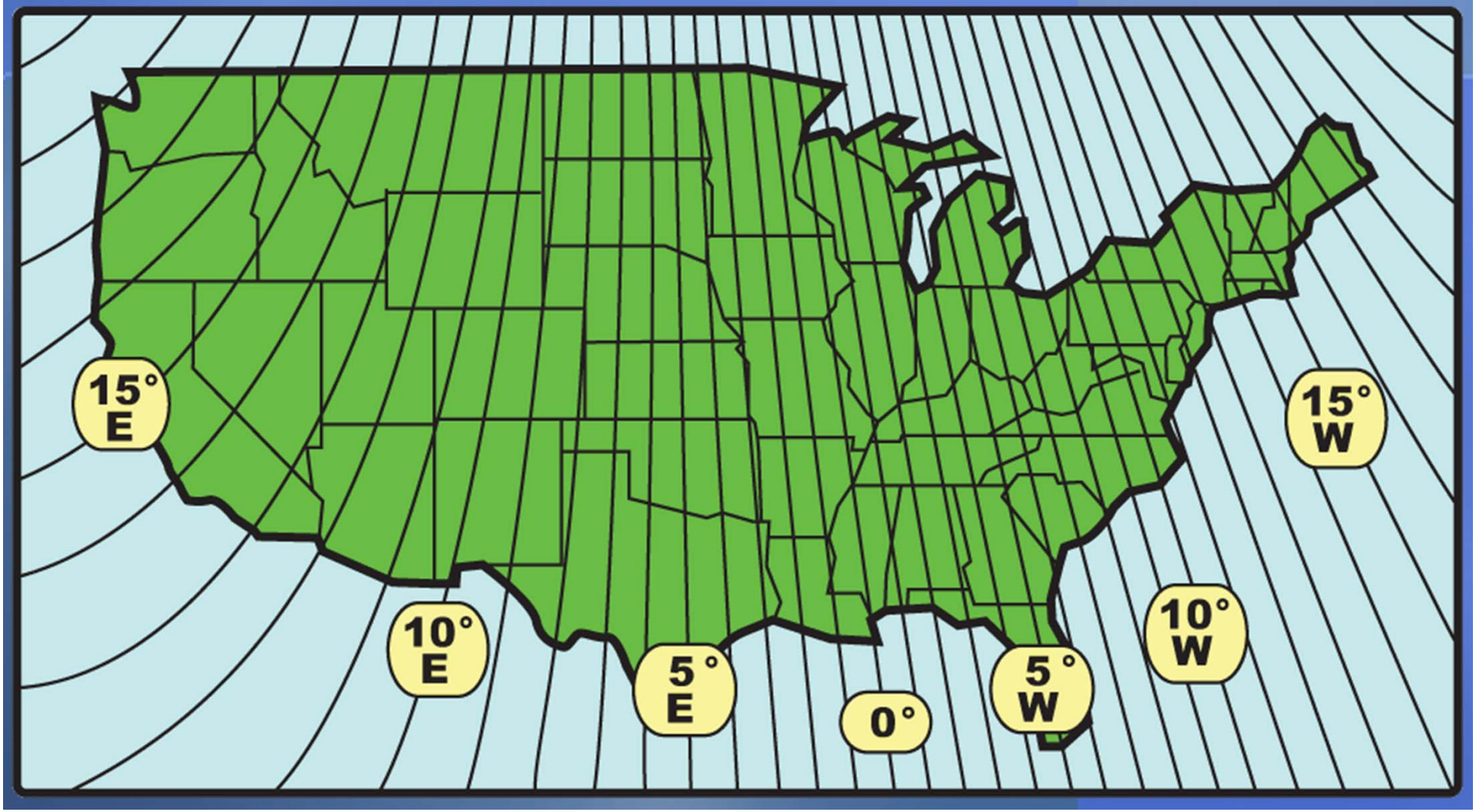
Magnetic Declination Map

www.ngdc.noaa.gov



Point the Needle to the Declination Amount…

…and the ‘N” Points to True North

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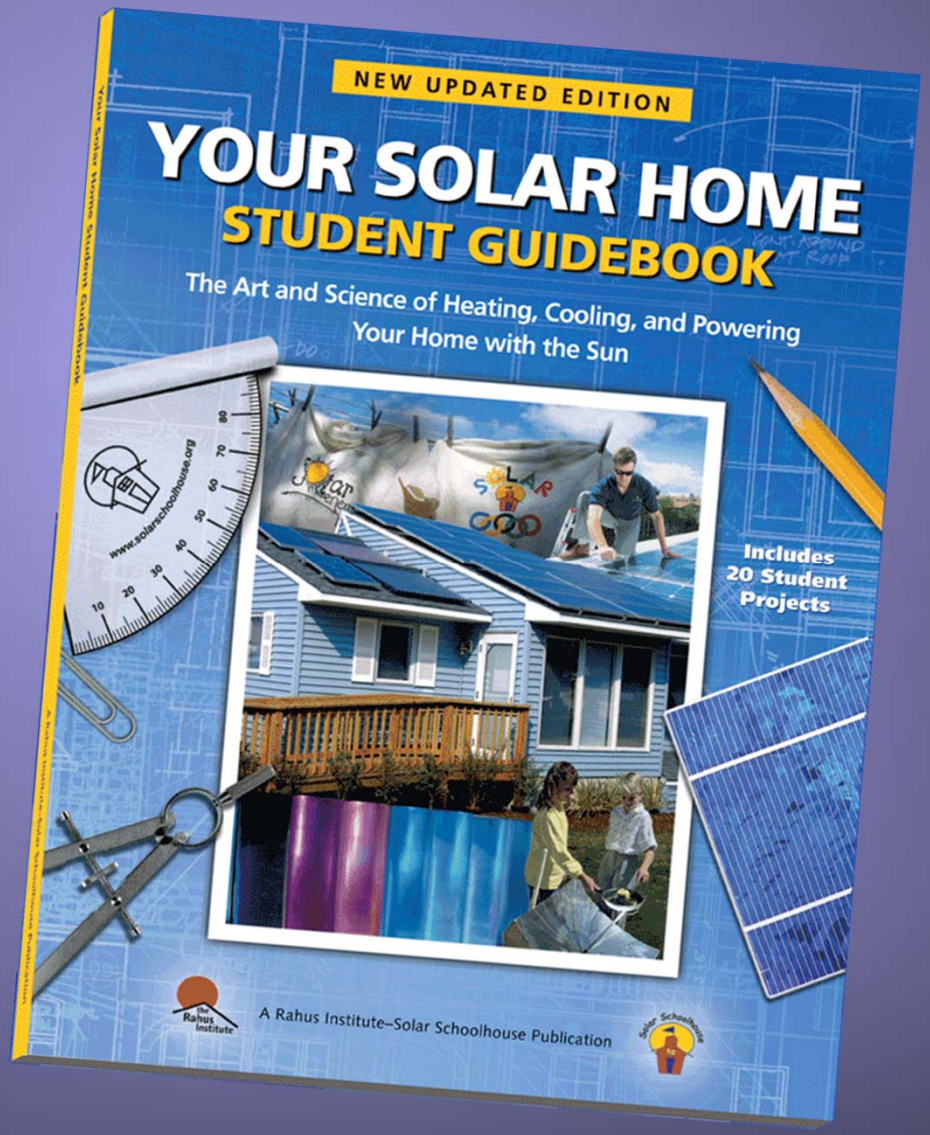
Magnetic Declination



More Info: Page 19-20

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Finding TRUE NORTH Without a compass

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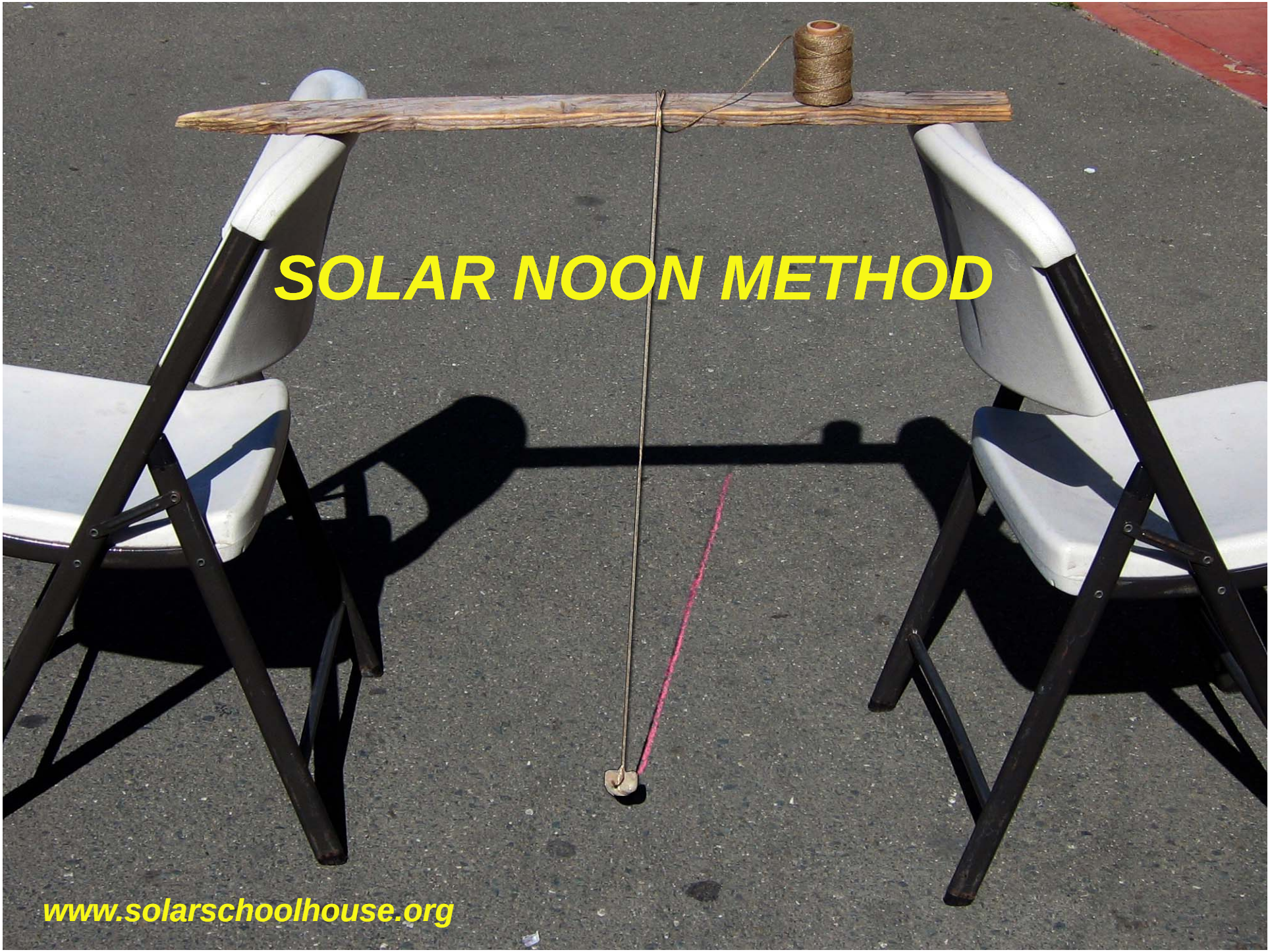
SOLAR NOON METHOD
www.solarschoolhouse.org

AT SOLAR NOON: The String's Shadow Is TRUE NORTH SOUTH

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Cup & Stick Method

Mark Tip of Shadow

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Teaching Solar Page 83

Cup & Stick Method

- Wait an Hour
- Mark Tip Again

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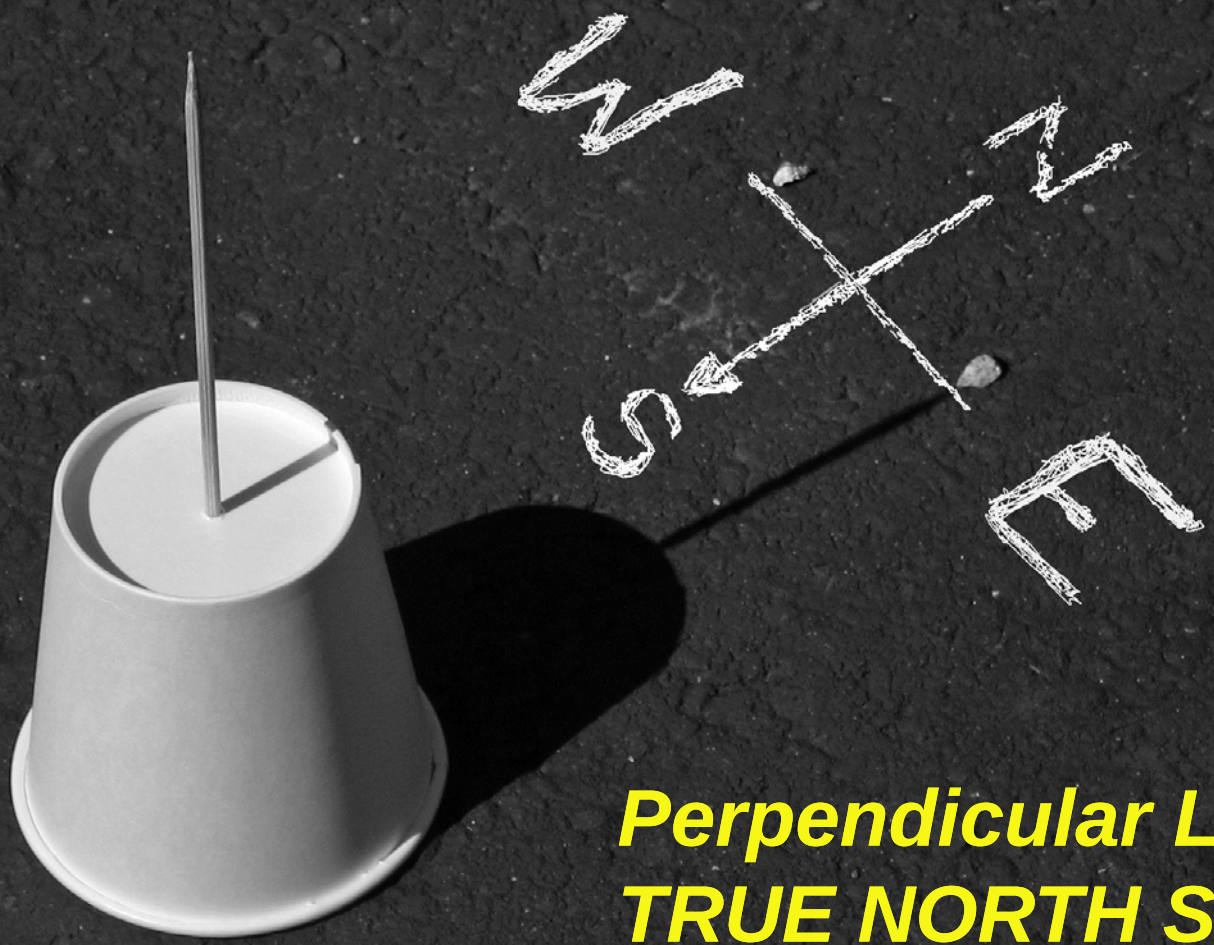
Cup & Stick Method



Perpendicular Line is TRUE NORTH SOUTH

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Teaching Tools & Methods

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Shadow Tracing

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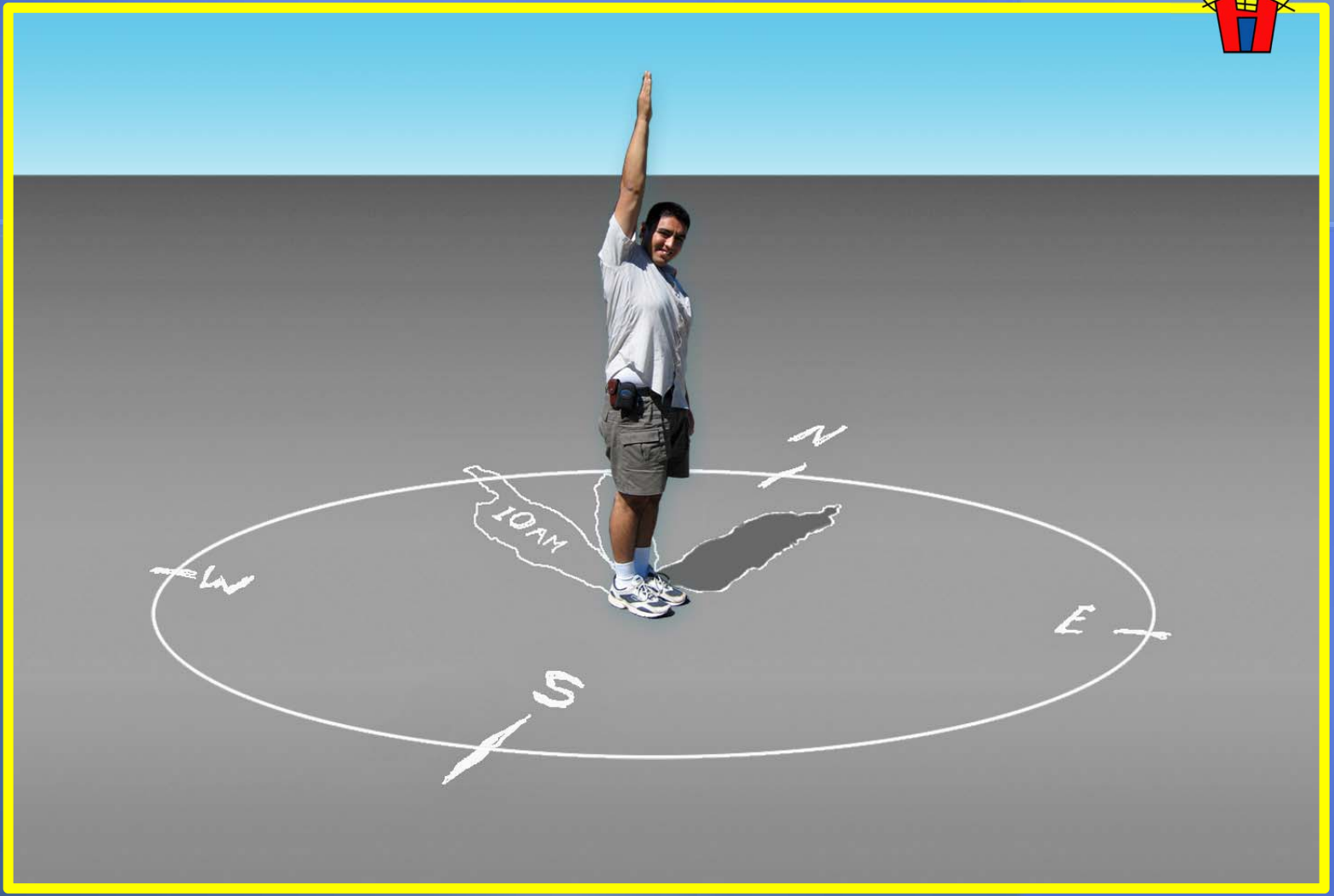
Human Sundials



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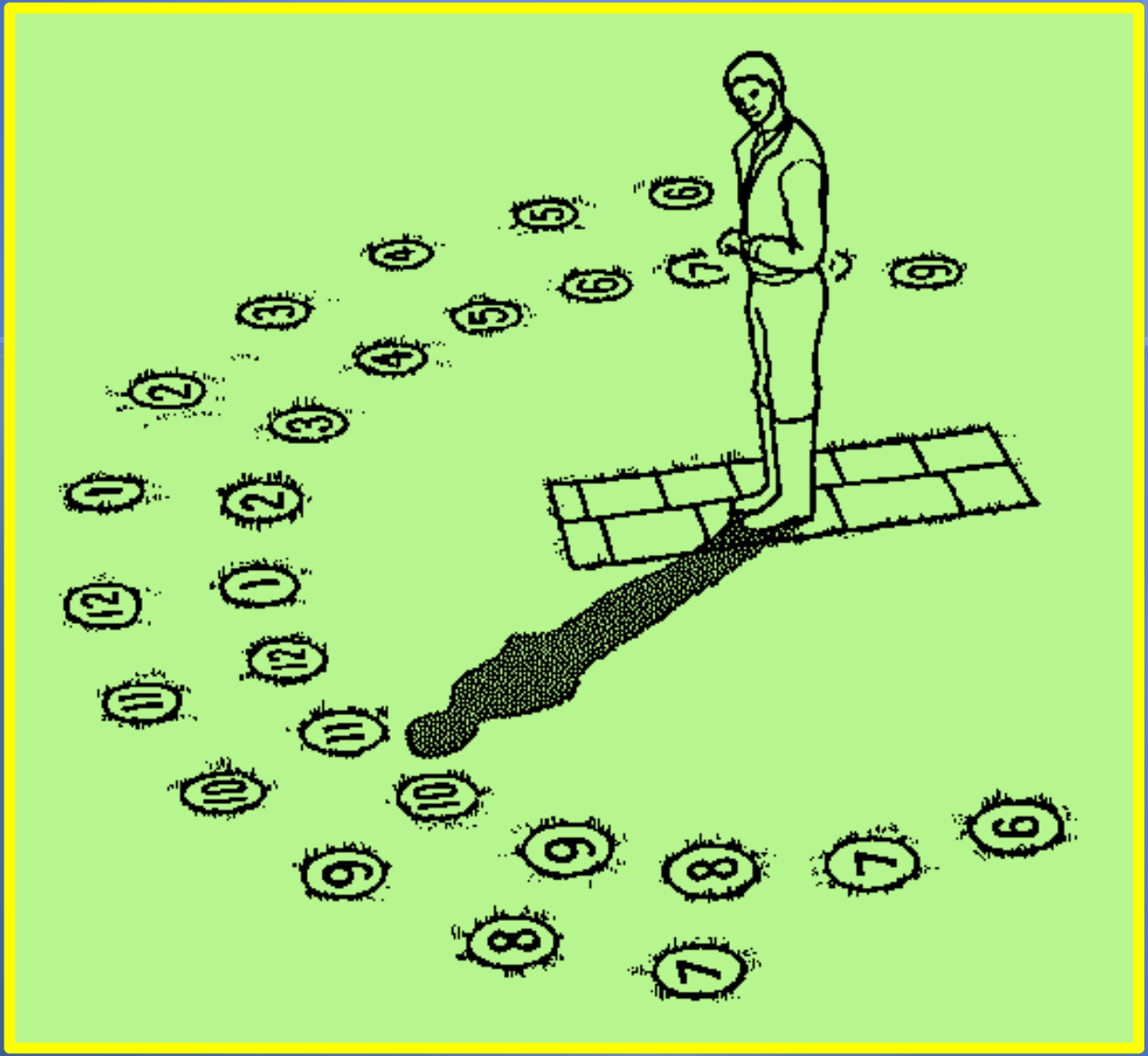

Human Sundials

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Solar Schoolhouse Human Sundial

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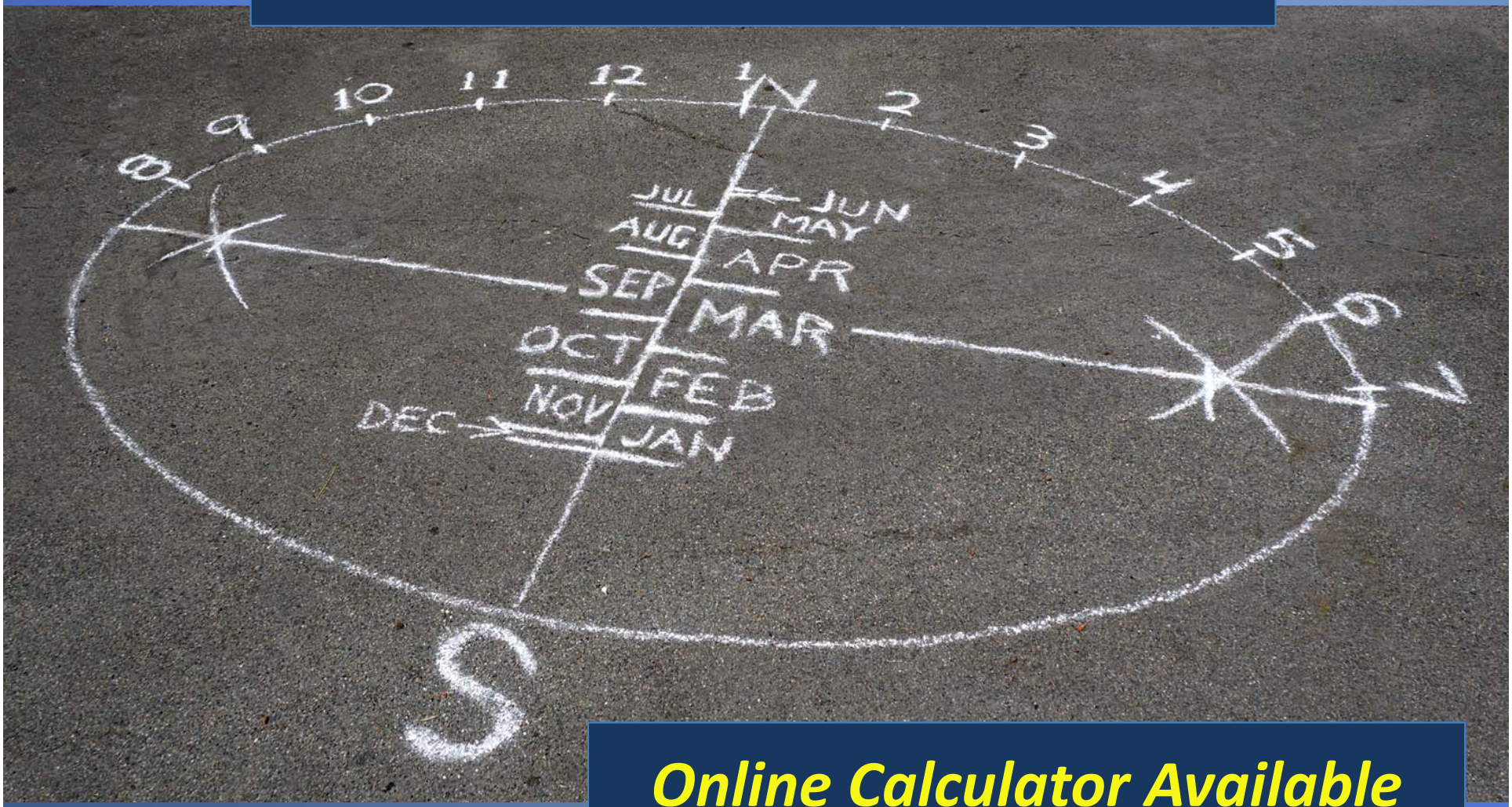
Solar Schoolhouse Human Sundial



Online Calculator Available

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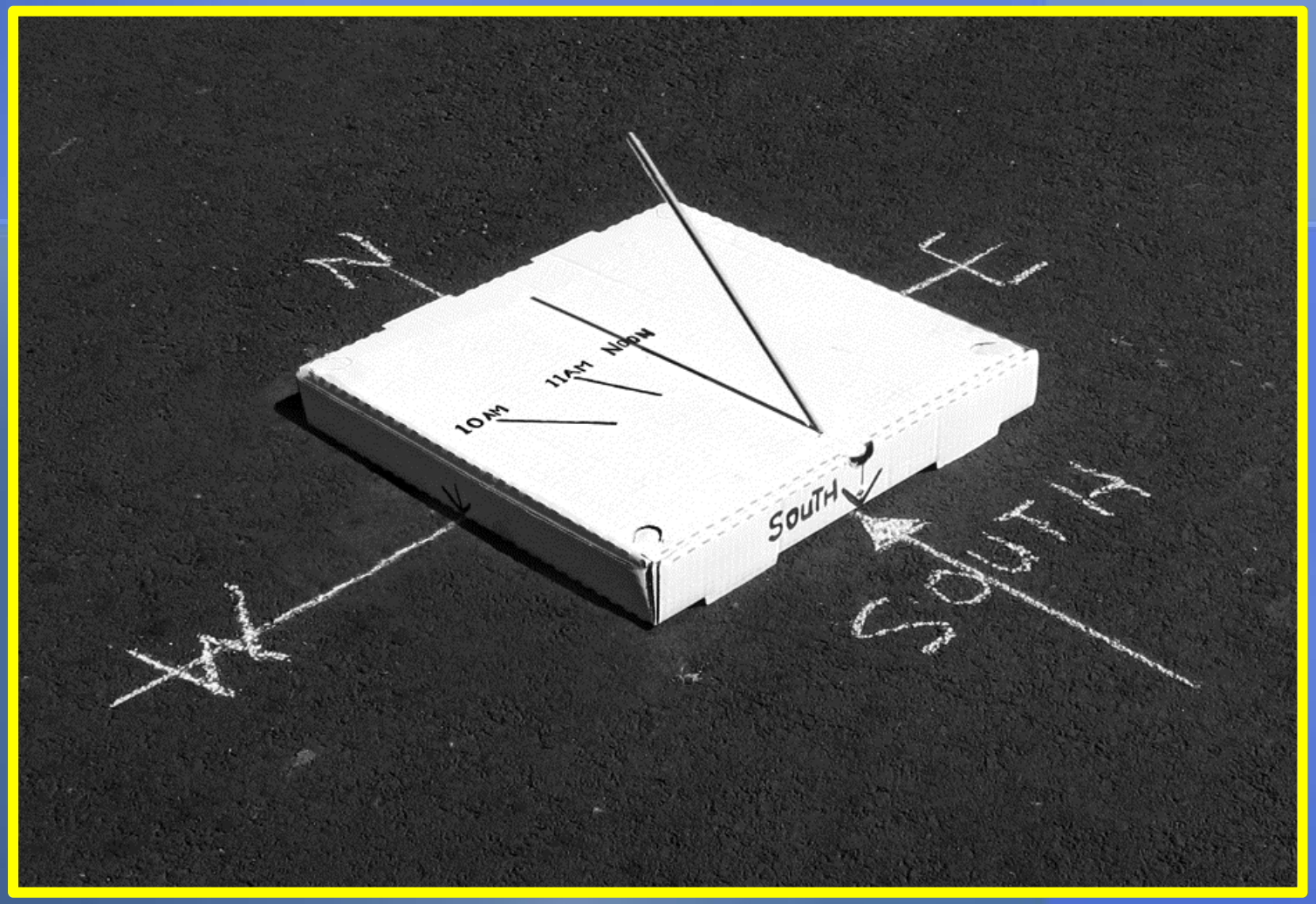
Pizza Box Sundials



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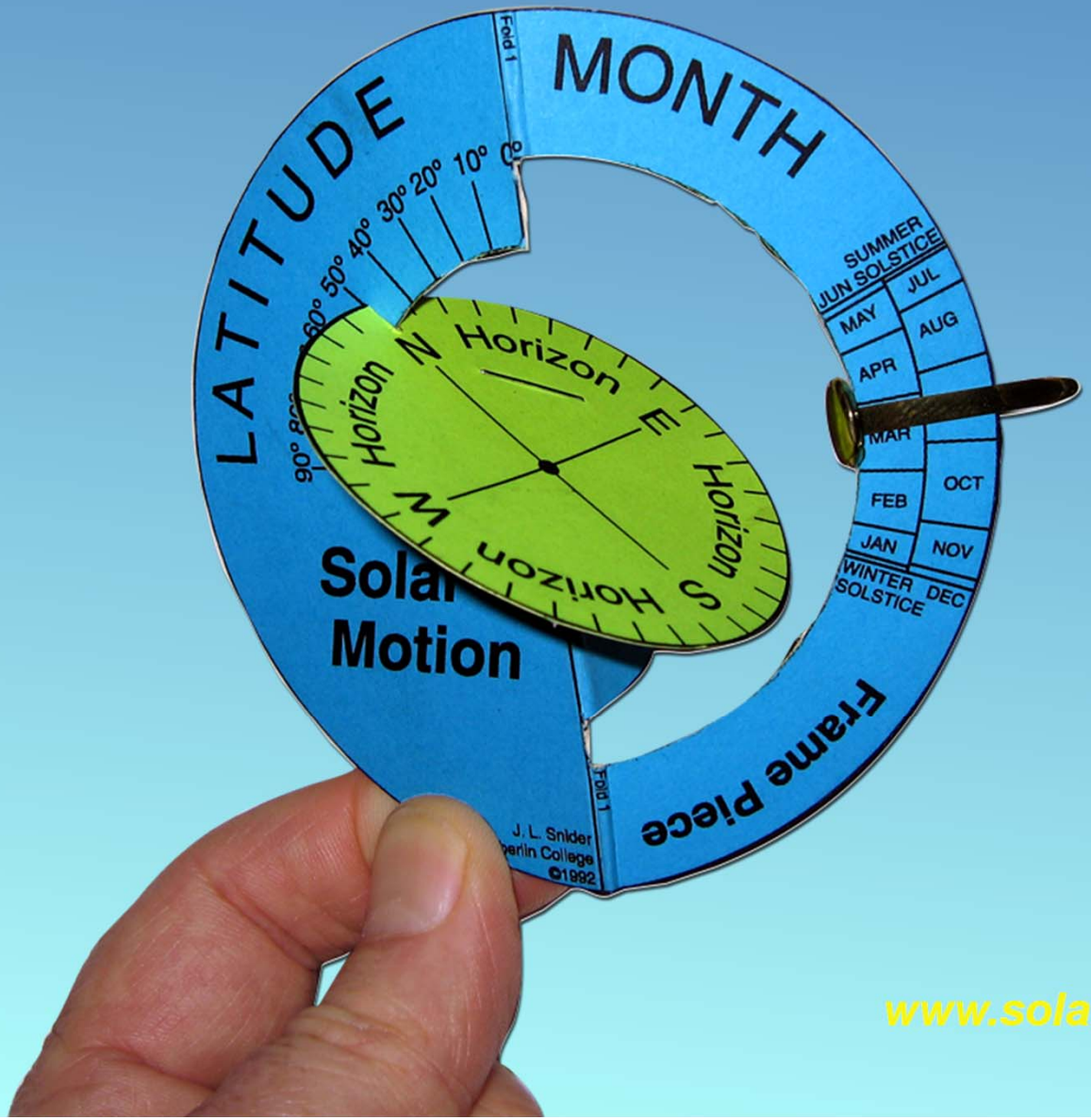
Solar Motion Demonstrator

Available from Lawrence Hall of Science



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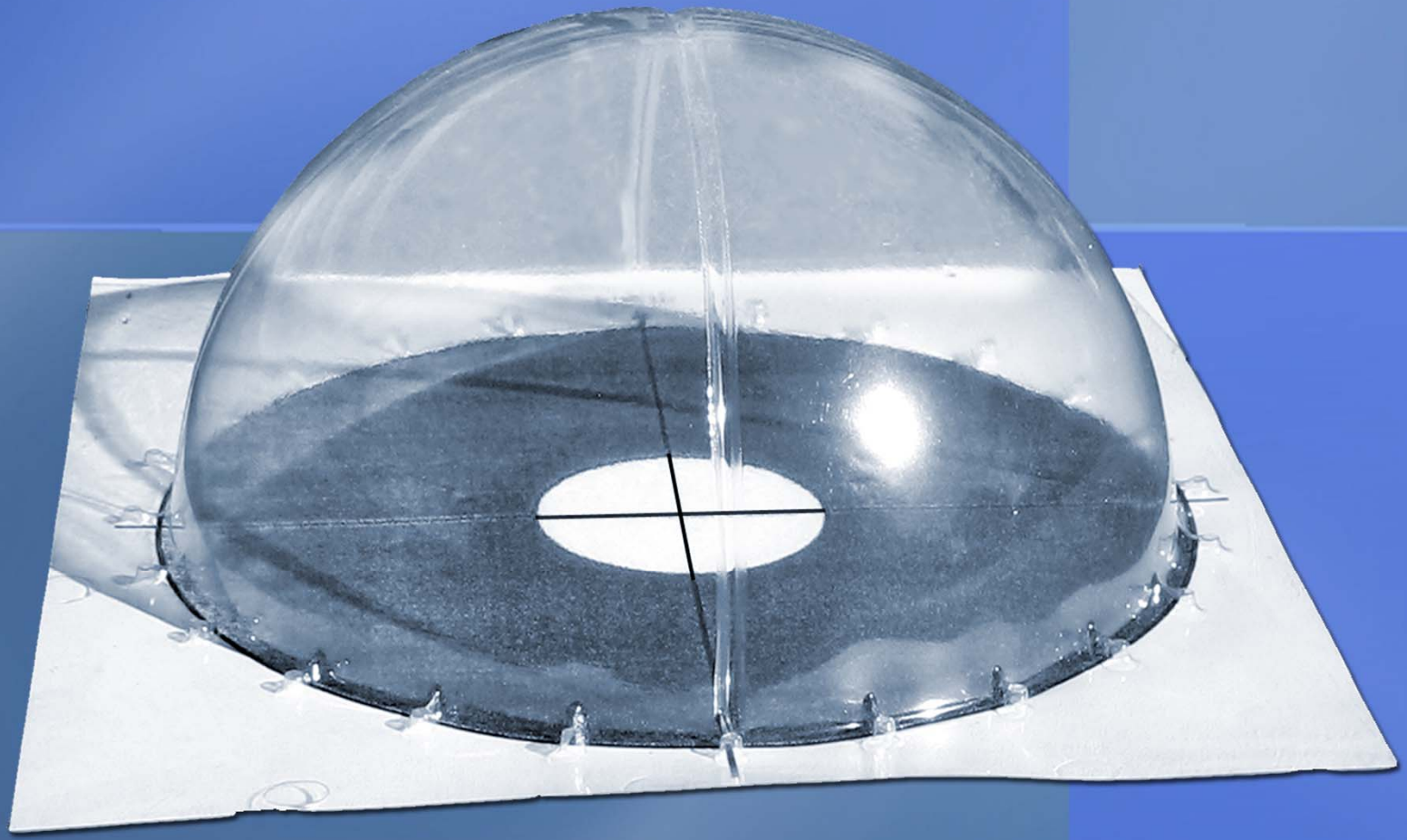
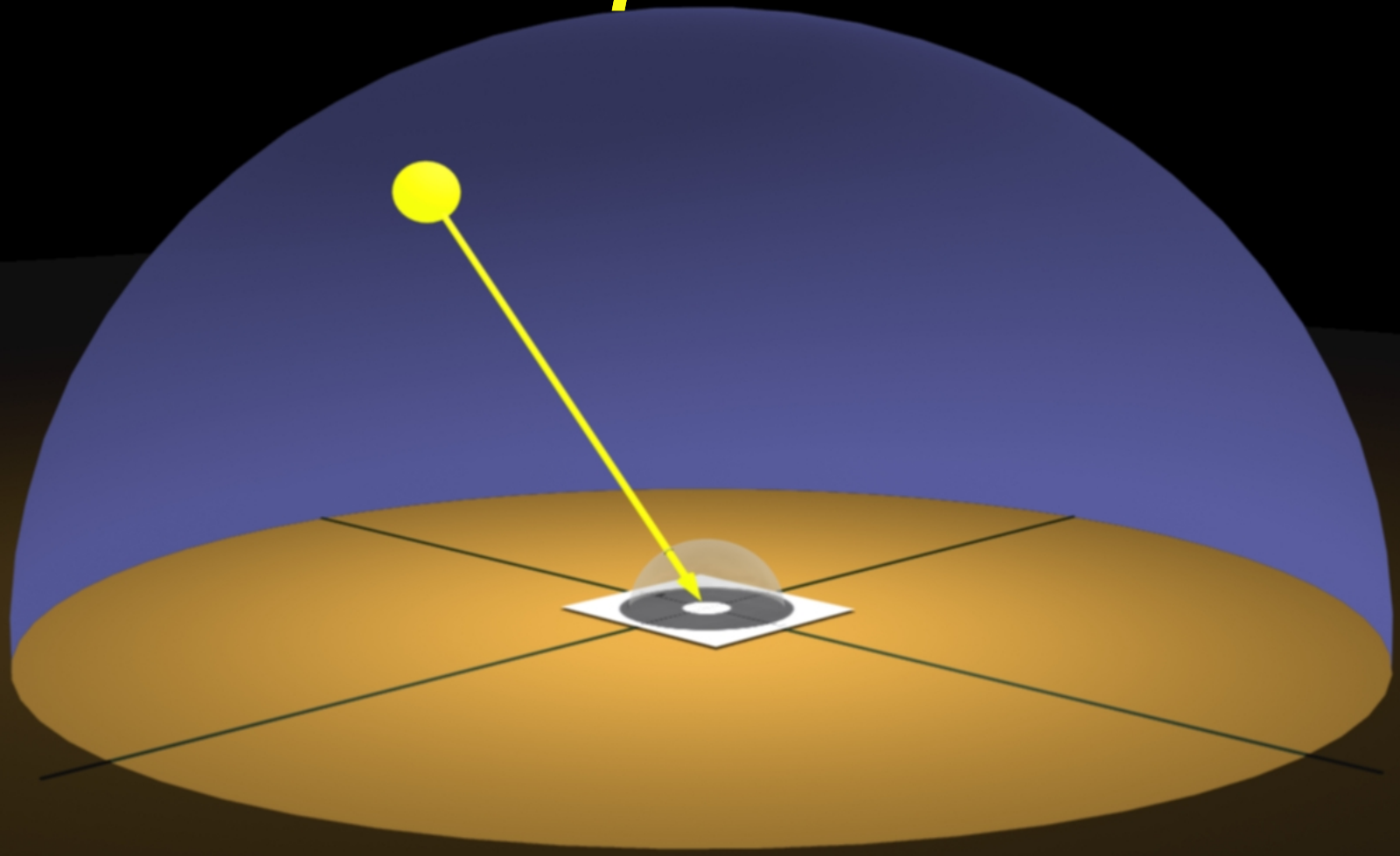
Plastic Hemispheres



Available from www.starlab.com

www.solarschoolhouse.org

Plastic Hemispheres



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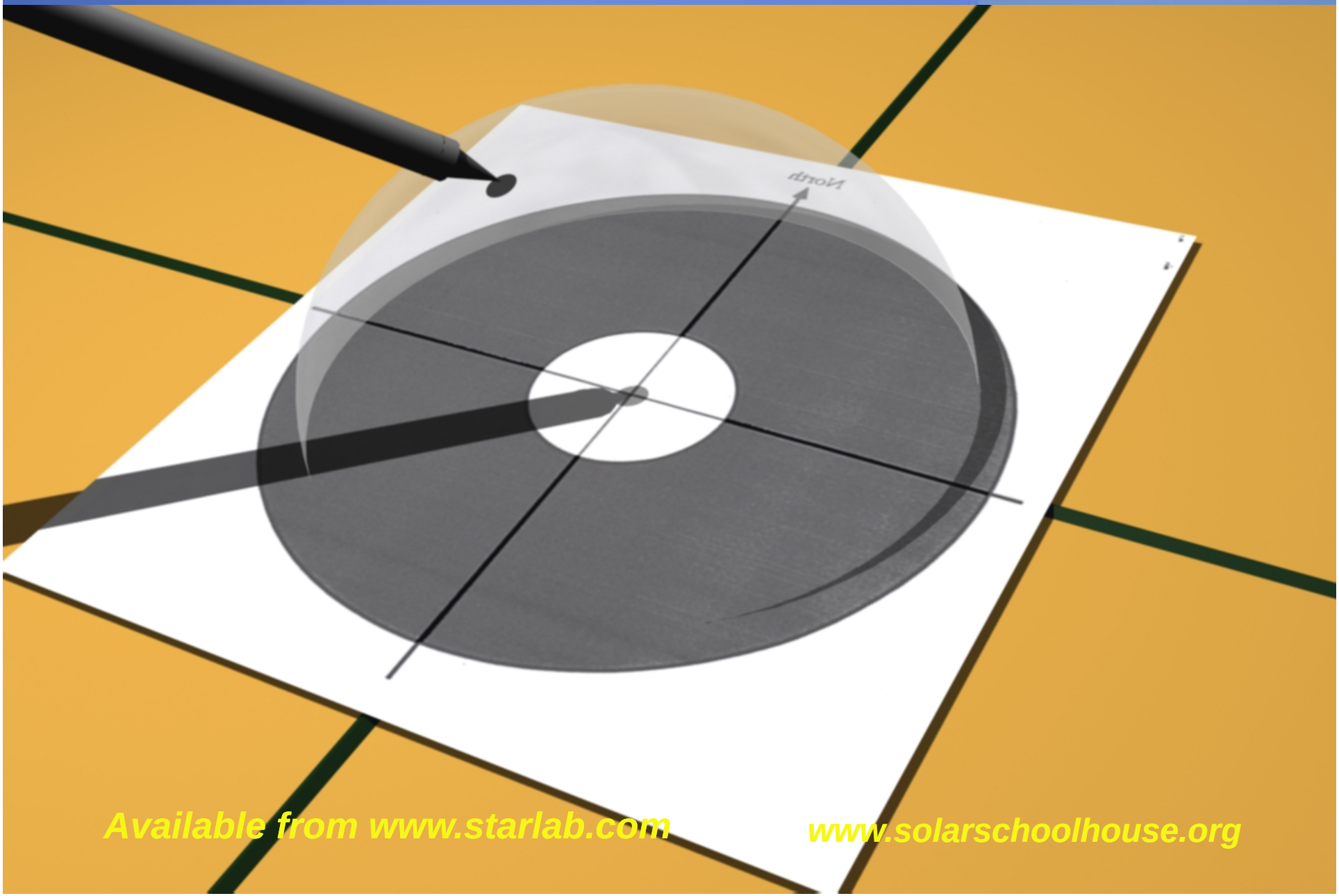
Plastic Hemispheres



Available from www.starlab.com

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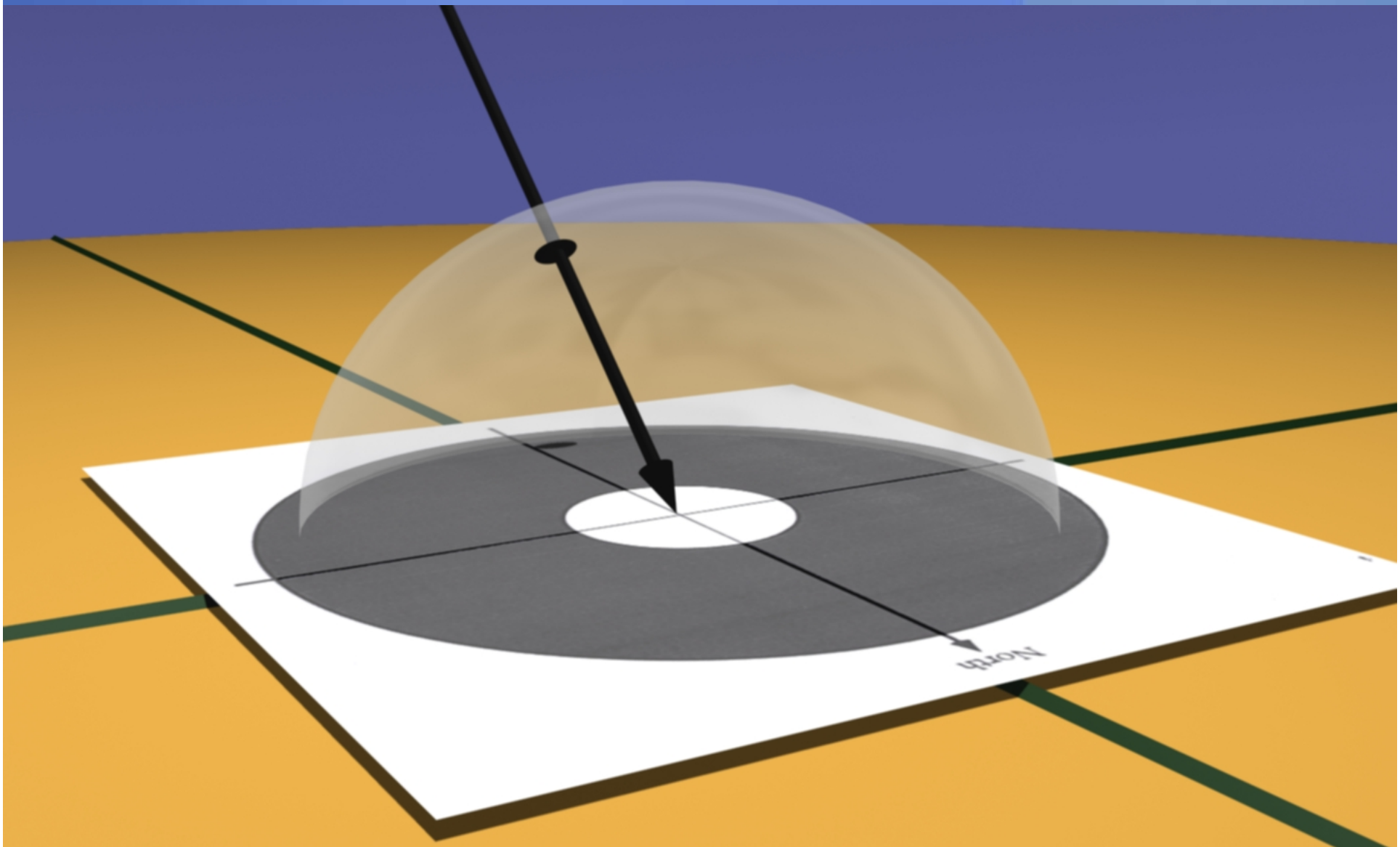
Plastic Hemispheres



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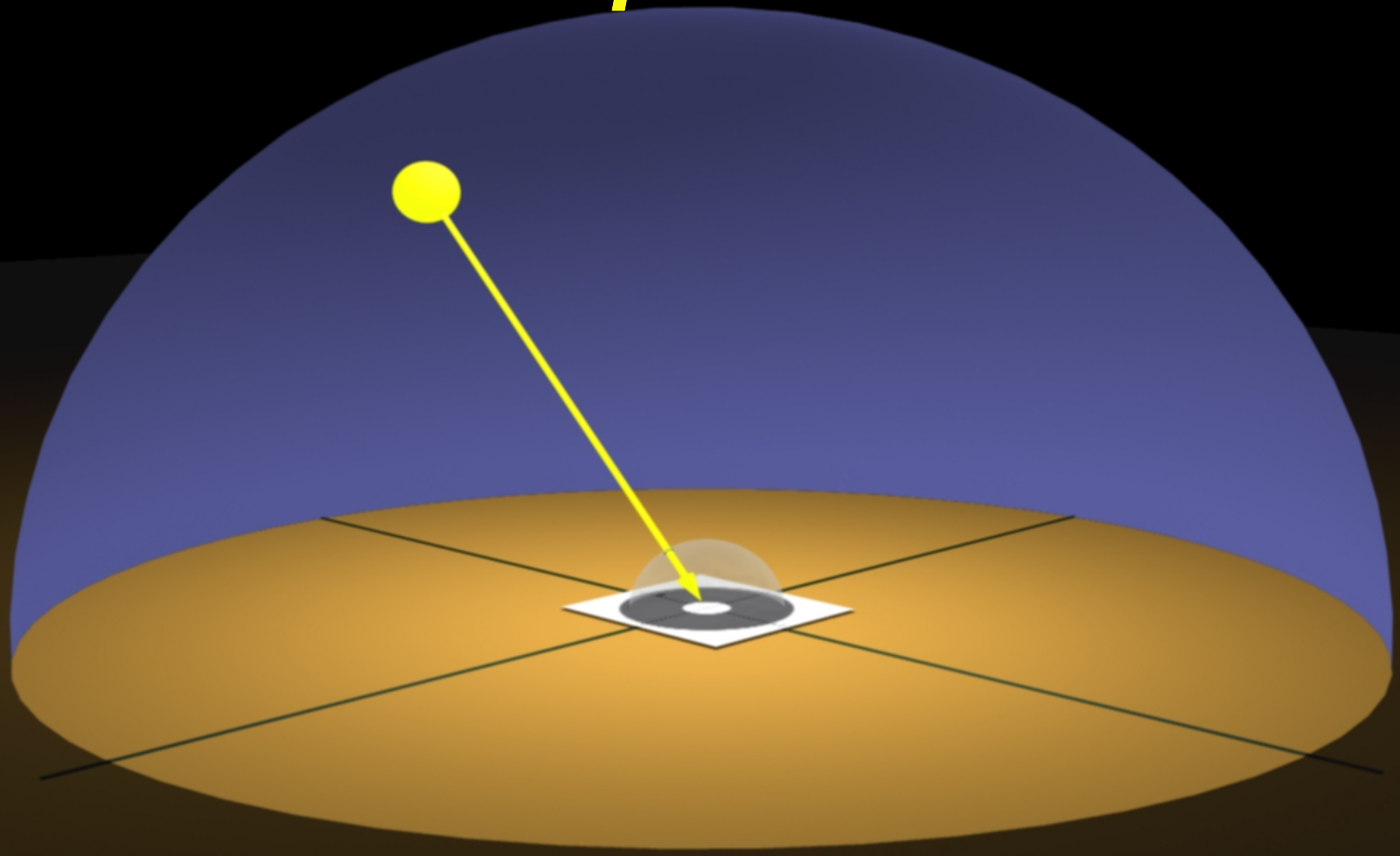
Plastic Hemispheres



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Plastic Hemispheres

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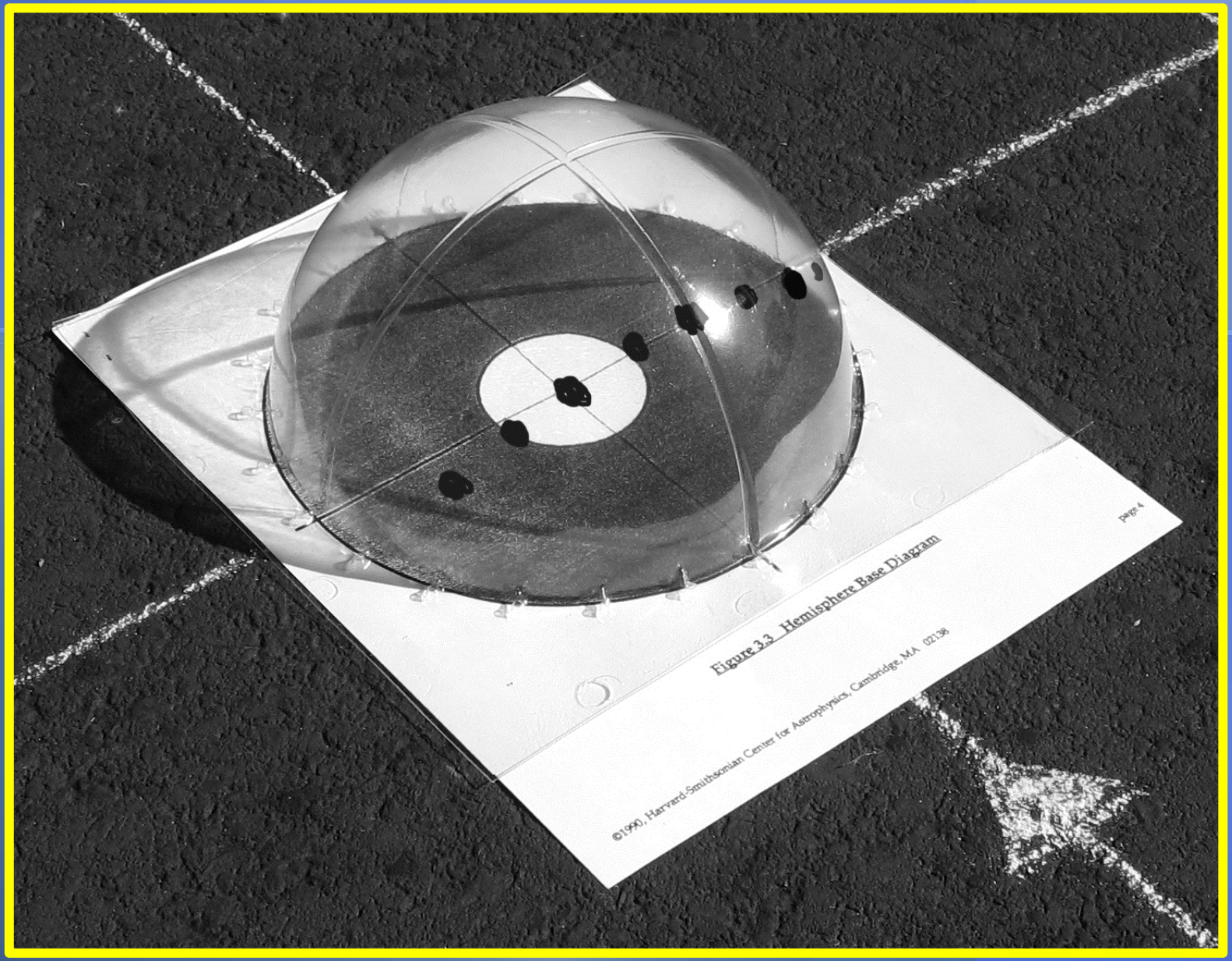

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Site Analysis

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SOLAR PATHFINDER

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SOLAR PATHFINDER

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SOLAR PATHFINDER

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SOLAR PATHFINDER

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SUNEYE

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SUNEYE

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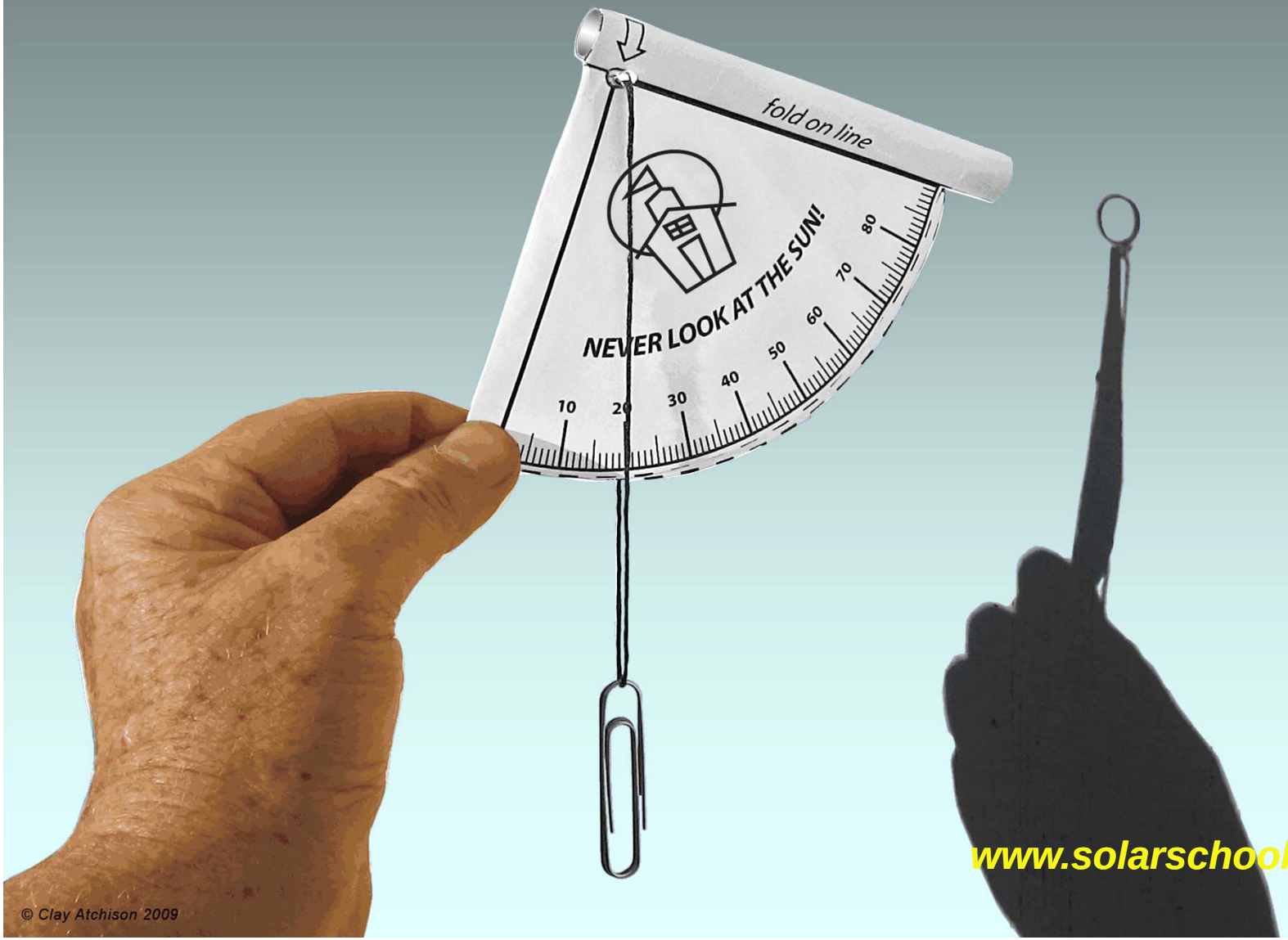
Solar Schoolhouse
Sun Angle Quadrant
www.solarschoolhouse.org

Sun Angle Quadrant



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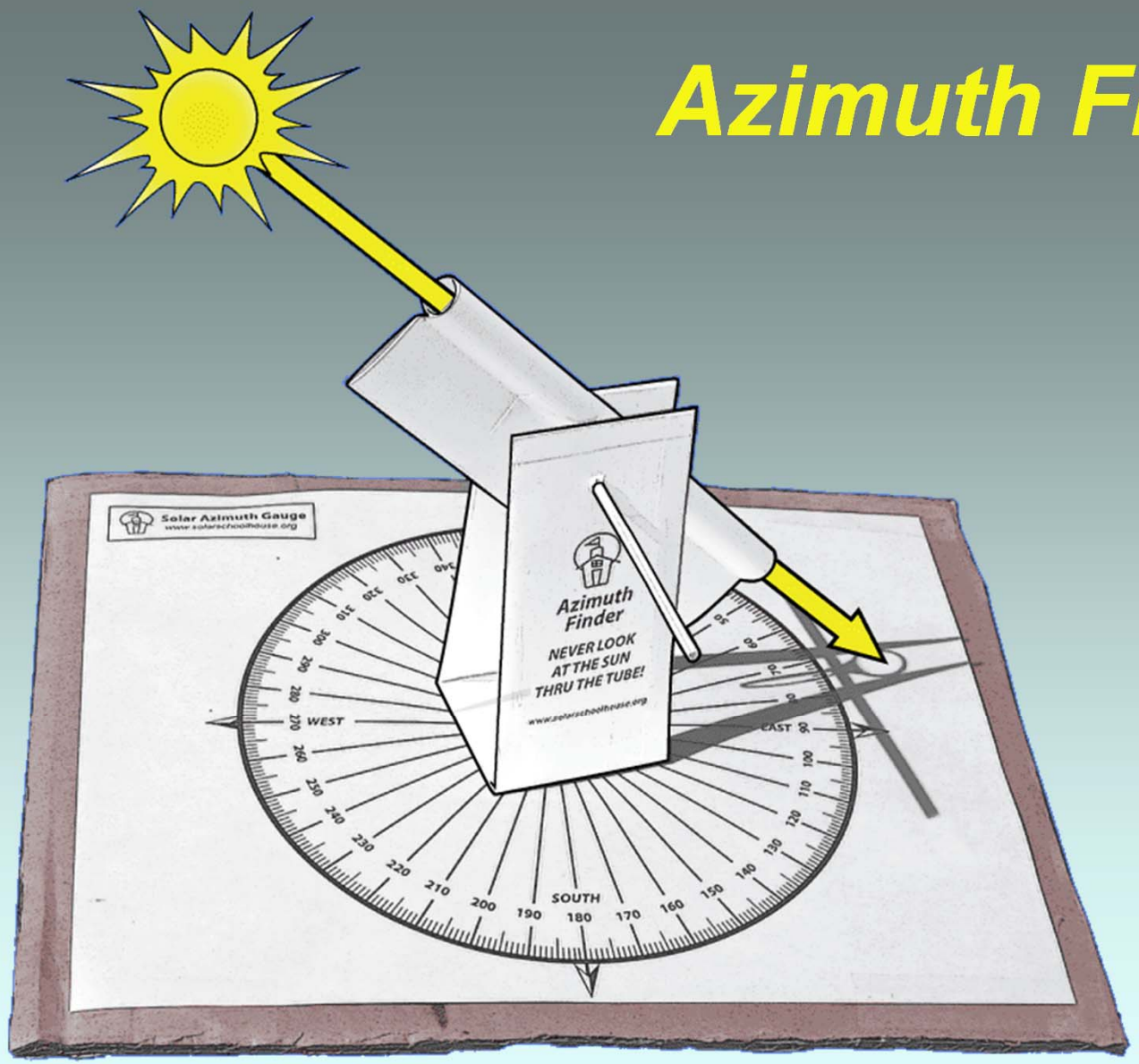
Azimuth Finder



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Charting the Sun's Path

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Solar Window

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Solar Schoolhouse
Jun 21st Sun Path
N
W
E
Dec 21 st Sun Path
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S
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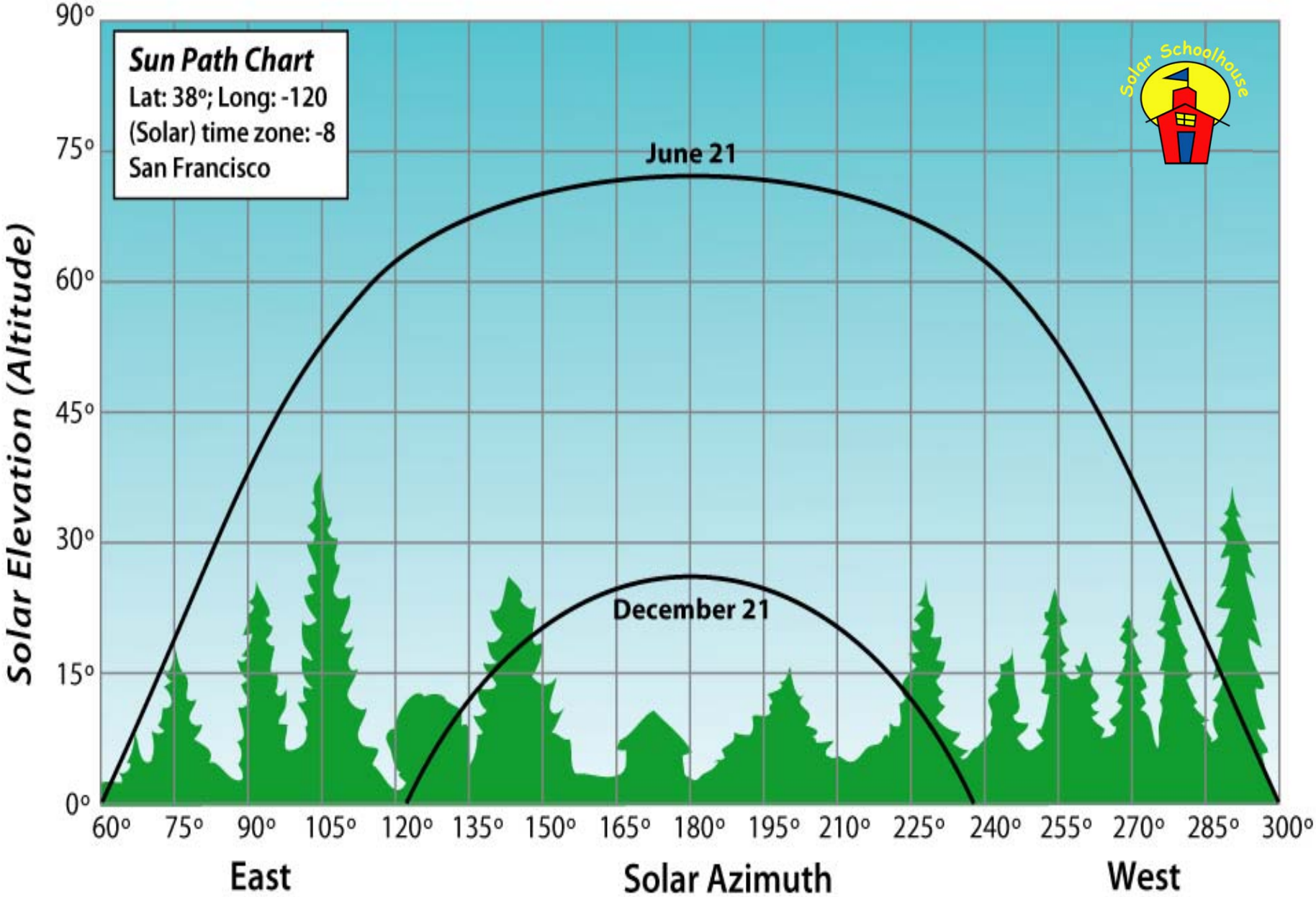
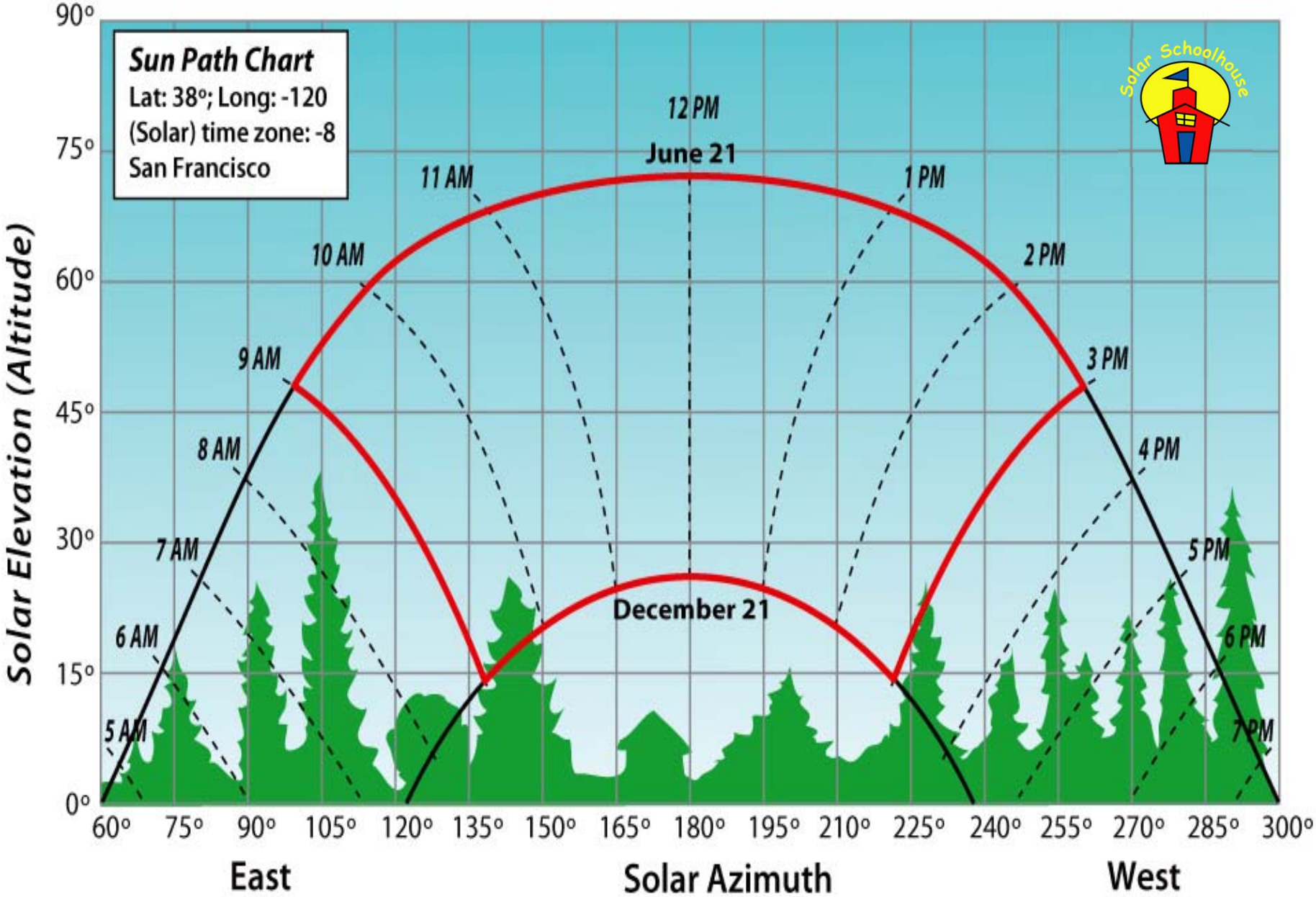
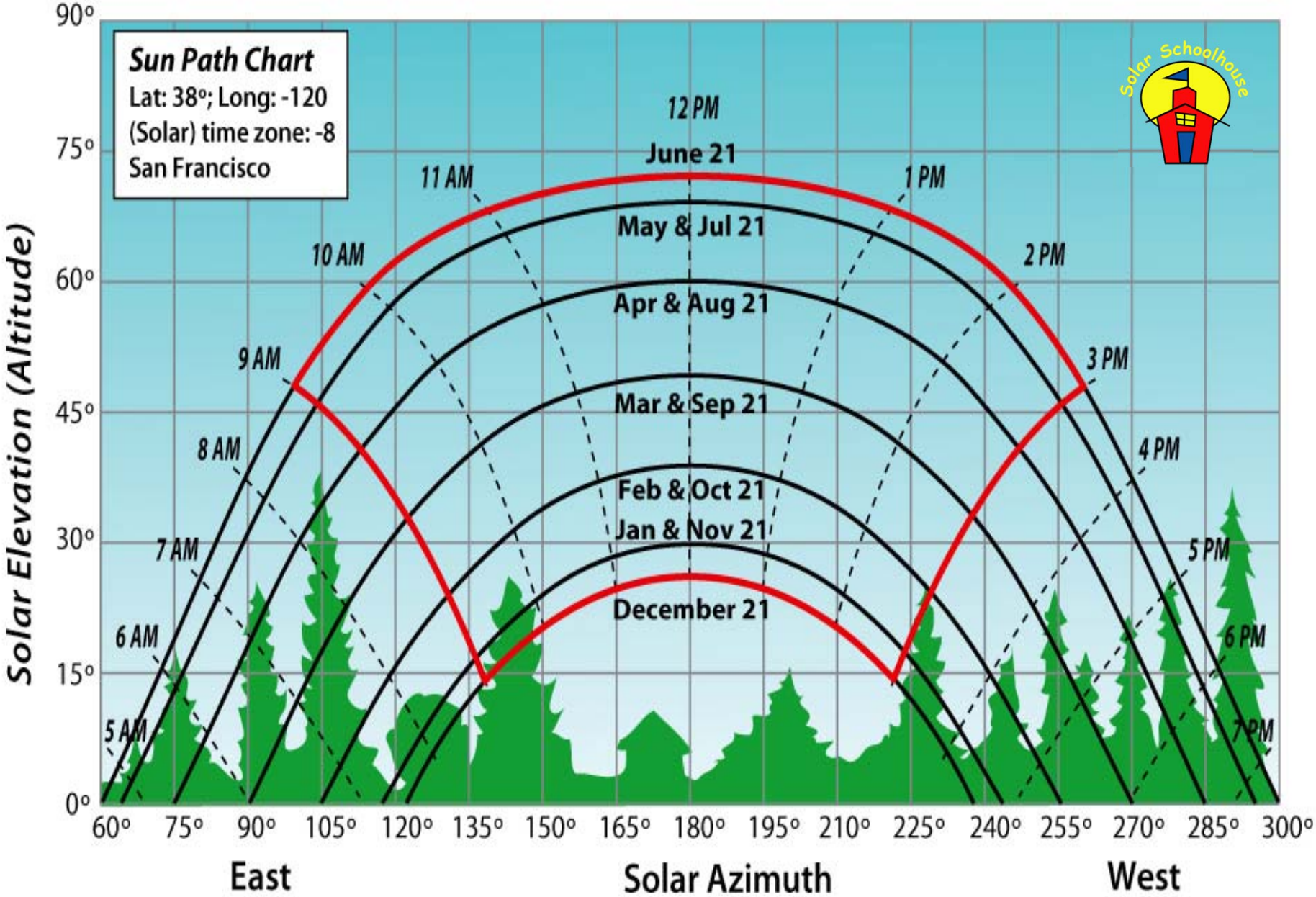
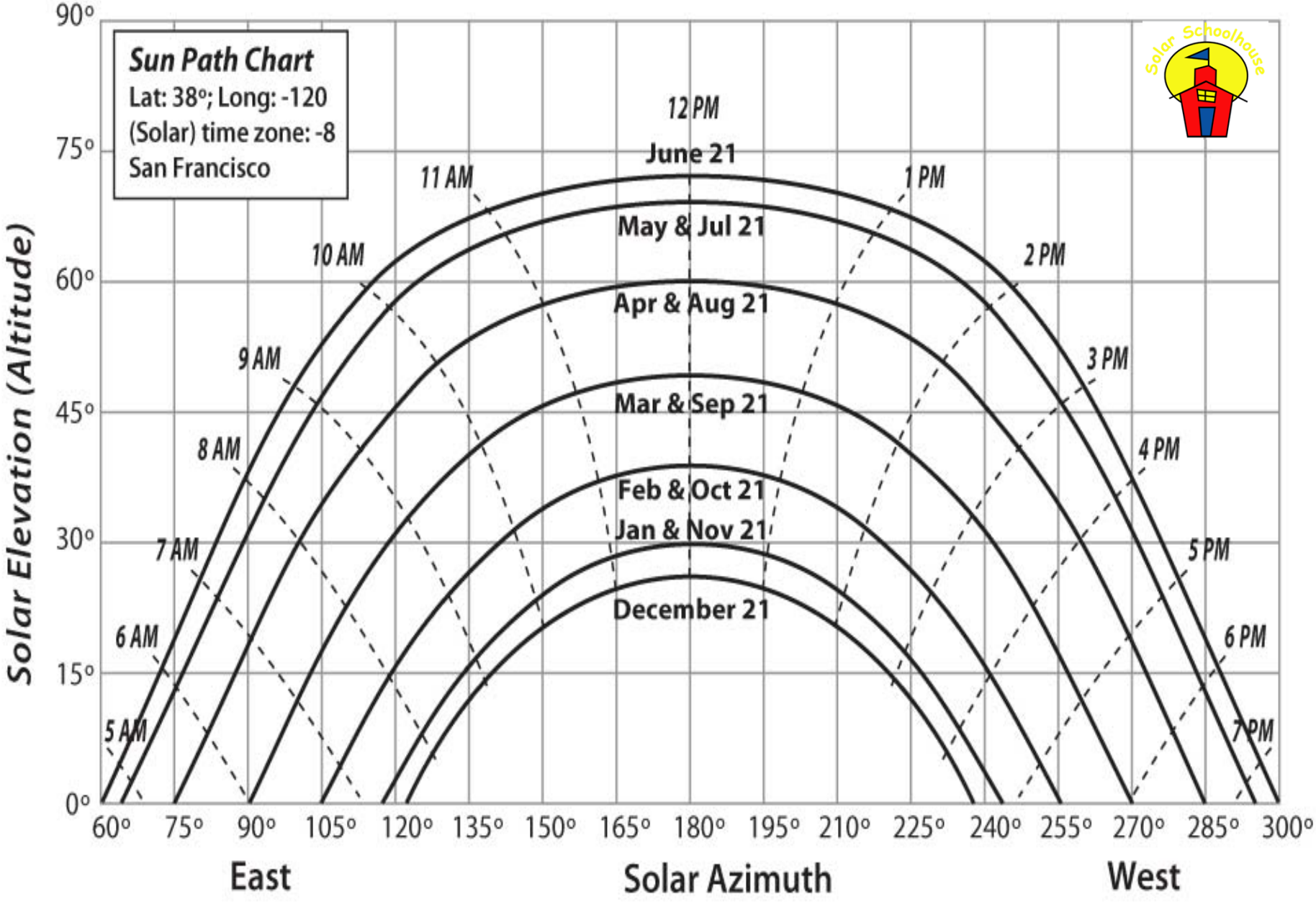

Sun Path Chart
Lat: 38°; Long: -120
(Solar) time zone: -8
San Francisco
June 21
December 21
Solar Schoolhouse
Solar Elevation (Altitude)
90°
75°
60°
45°
30°
15°
0°
60° 75° 90° 105° 120° 135° 150° 165° 180° 195° 210° 225° 240° 255° 270° 285° 300°
East
Solar Azimuth
West


Sun Path Chart
Lat: 38°; Long: -120
(Solar) time zone: -8
San Francisco
Solar Schoolhouse
12 PM
June 21
11 AM
1 PM
10 AM
2 PM
9 AM
3 PM
8 AM
4 PM
7 AM
5 PM
December 21
6 AM
6 PM
5 AM
7 PM
90°
75°
60°
45°
30°
15°
0°
Solar Elevation (Altitude)
60° 75° 90° 105° 120° 135° 150° 165° 180° 195° 210° 225° 240° 255° 270° 285° 300°
East
Solar Azimuth
West


Sun Path Chart
Lat: 38°; Long: -120
(Solar) time zone: -8
San Francisco
Solar Schoolhouse
12 PM
June 21
11 AM
1 PM
May & Jul 21
10 AM
2 PM
Apr & Aug 21
9 AM
3 PM
Mar & Sep 21
8 AM
4 PM
Feb & Oct 21
Jan & Nov 21
7 AM
5 PM
December 21
6 AM
6 PM
5 AM
7 PM
Solar Elevation (Altitude)
90°
75°
60°
45°
30°
15°
0°
60° 75° 90° 105° 120° 135° 150° 165° 180° 195° 210° 225° 240° 255° 270° 285° 300°
East
Solar Azimuth
West


Sun Path Chart
Lat: 38°; Long: -120
(Solar) time zone: -8
San Francisco
Solar Schoolhouse
12 PM
June 21
May & Jul 21
Apr & Aug 21
Mar & Sep 21
Feb & Oct 21
Jan & Nov 21
December 21
5 AM
6 AM
7 AM
8 AM
9 AM
10 AM
11 AM
1 PM
2 PM
3 PM
4 PM
5 PM
6 PM
7 PM
Solar Elevation (Altitude)
0°
15°
30°
45°
60°
75°
90°
60° 75° 90° 105° 120° 135° 150° 165° 180° 195° 210° 225° 240° 255° 270° 285° 300°
East
Solar Azimuth
West

http://solardat.uoregon.edu/SunChartProgram.html

DAYLIGHT SAVINGS TIME

Subtract an Hour

At 10am:

The sun's position will be on the 9am LINE!

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Field Work

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Field Work

1. Chart Shading Obstacles

2. Measure Sun Position

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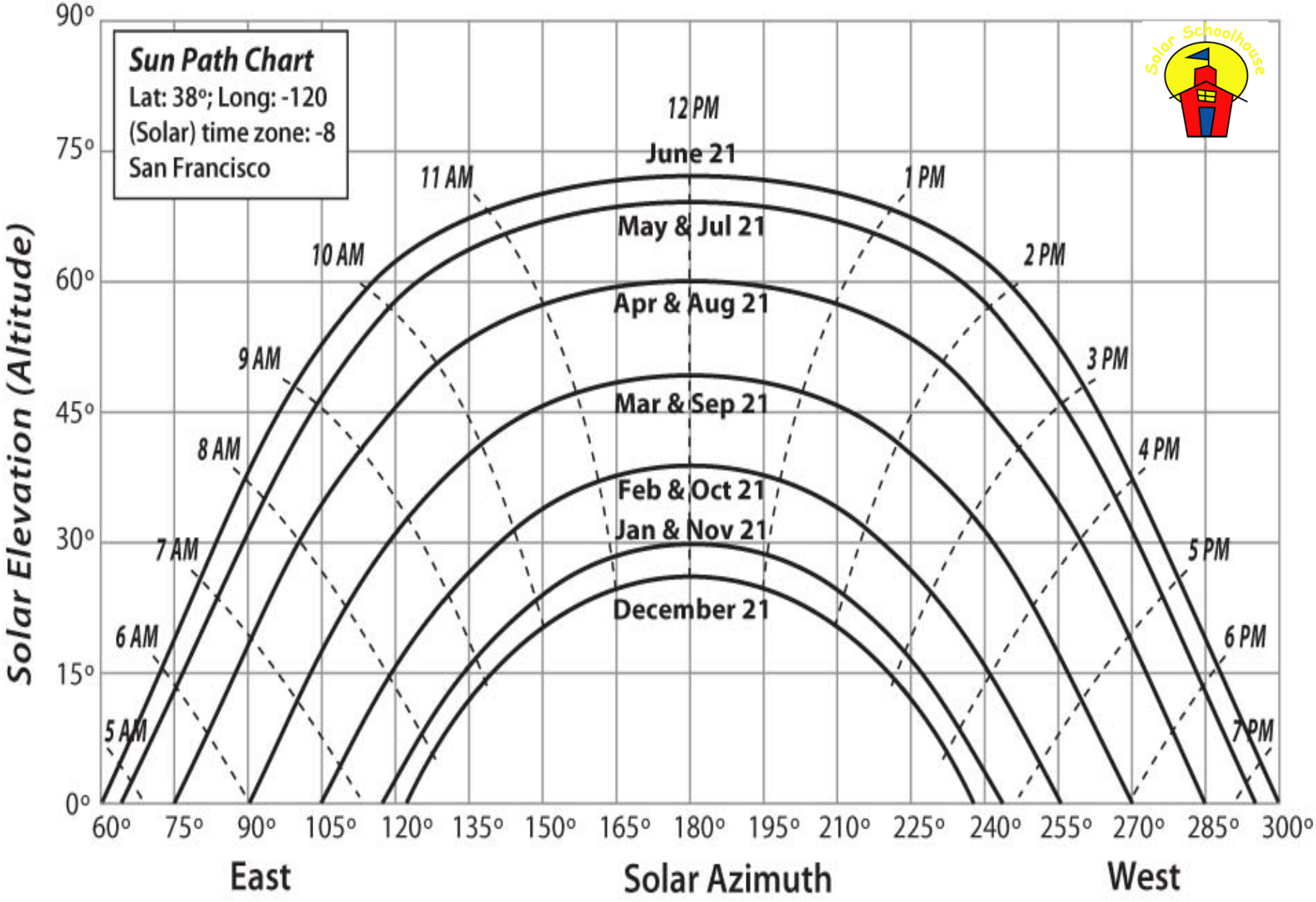
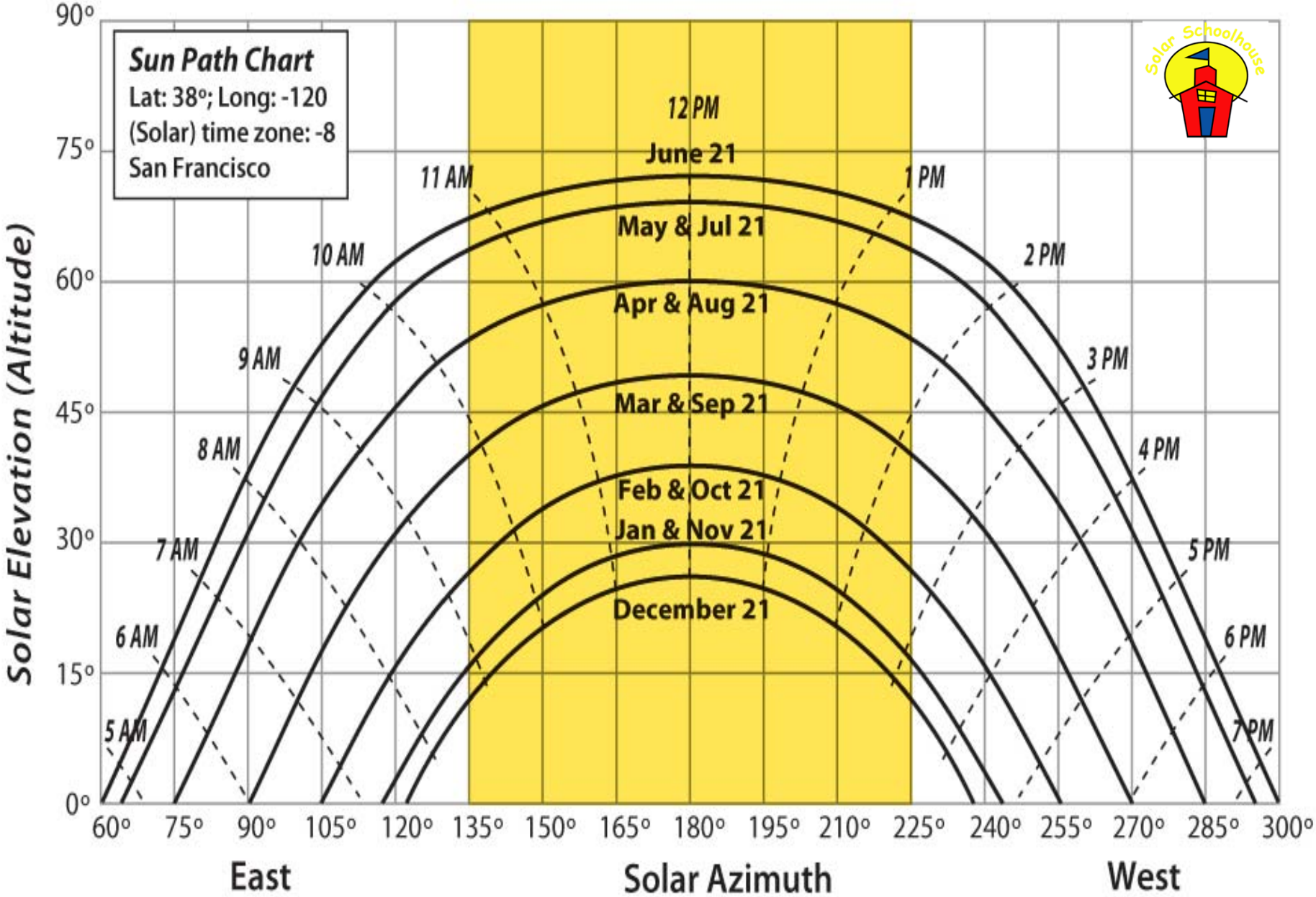
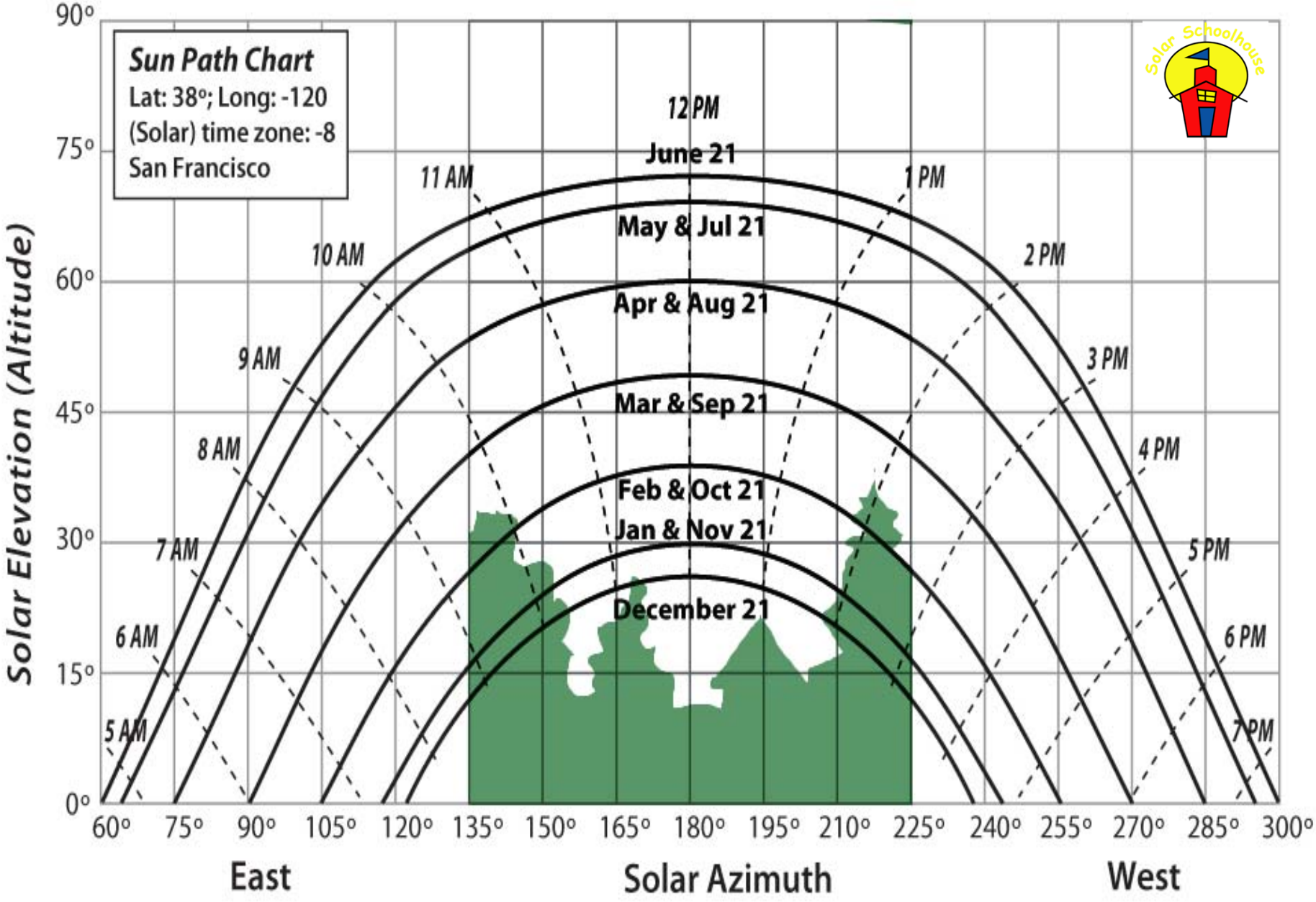

Sun Path Chart
Lat: 38°; Long: -120
(Solar) time zone: -8
San Francisco
Solar Schoolhouse
12 PM
June 21
May & Jul 21
Apr & Aug 21
Mar & Sep 21
Feb & Oct 21
Jan & Nov 21
December 21
5 AM
6 AM
7 AM
8 AM
9 AM
10 AM
11 AM
1 PM
2 PM
3 PM
4 PM
5 PM
6 PM
7 PM
Solar Elevation (Altitude)
0°
15°
30°
45°
60°
75°
90°
60° 75° 90° 105° 120° 135° 150° 165° 180° 195° 210° 225° 240° 255° 270° 285° 300°
East
Solar Azimuth
West


Sun Path Chart
Lat: 38°; Long: -120
(Solar) time zone: -8
San Francisco
Solar Schoolhouse
12 PM
June 21
May & Jul 21
Apr & Aug 21
Mar & Sep 21
Feb & Oct 21
Jan & Nov 21
December 21
5 AM
6 AM
7 AM
8 AM
9 AM
10 AM
11 AM
1 PM
2 PM
3 PM
4 PM
5 PM
6 PM
7 PM
Solar Elevation (Altitude)
0°
15°
30°
45°
60°
75°
90°
60° 75° 90° 105° 120° 135° 150° 165° 180° 195° 210° 225° 240° 255° 270° 285° 300°
East
Solar Azimuth
West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4 PM
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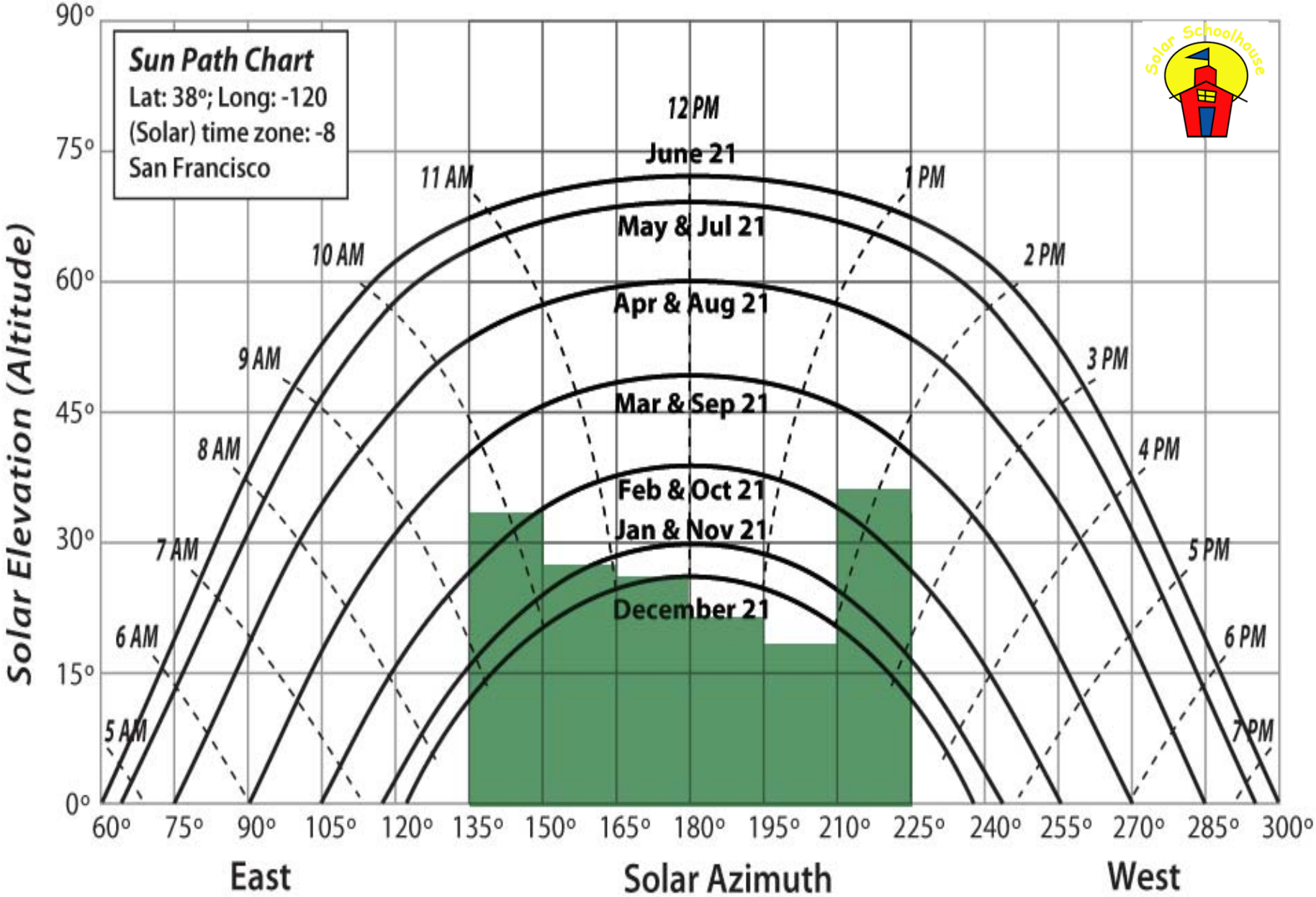
150°
165°
180°
195°
210°
225°
240°
255°
270°
285°
300°
East
Solar Azimuth
West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East
Solar Azimuth
West

Charting Shading Obstacles

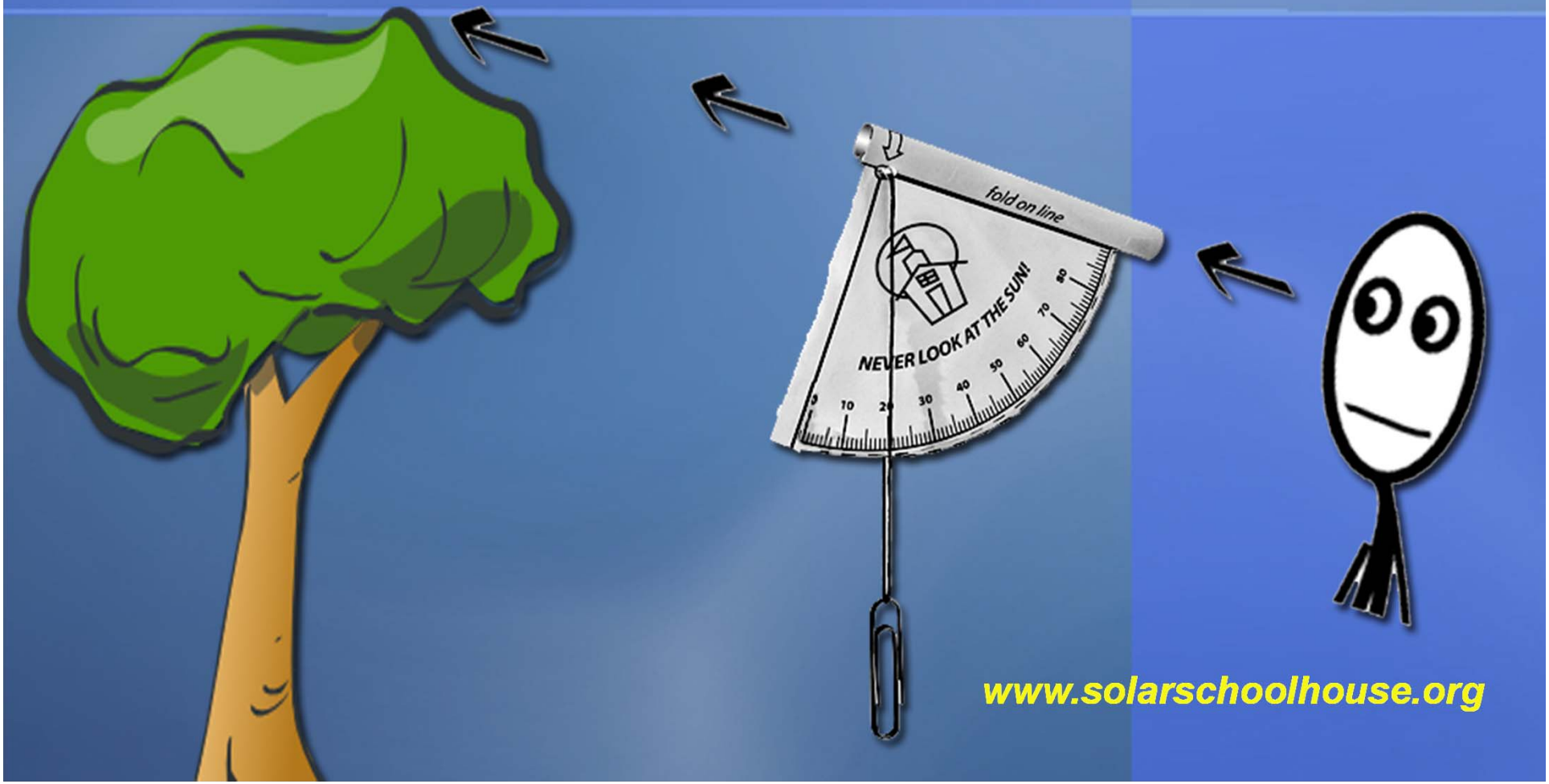

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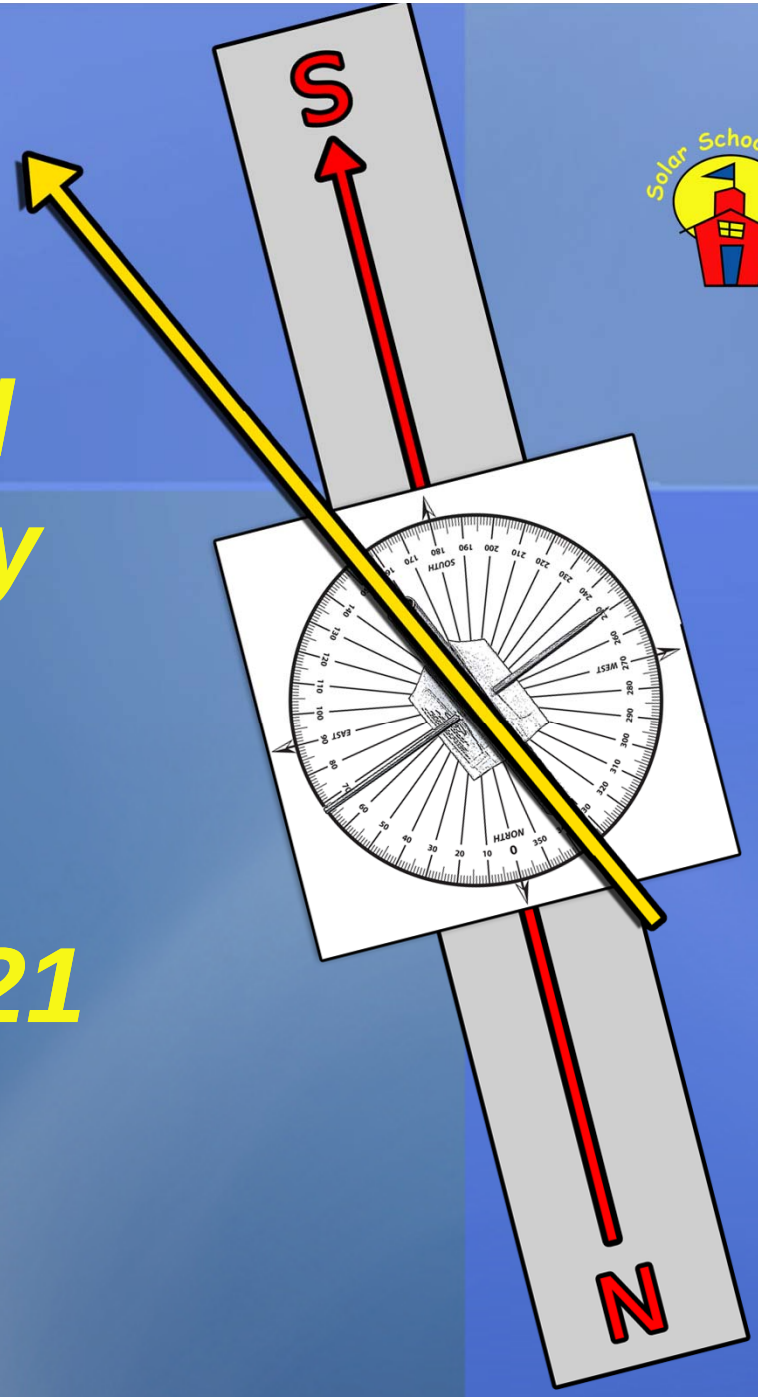
Chart a Small Section of Sky

9AM to 3PM On December 21



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Measure Sun Position

Match with Sun Chart

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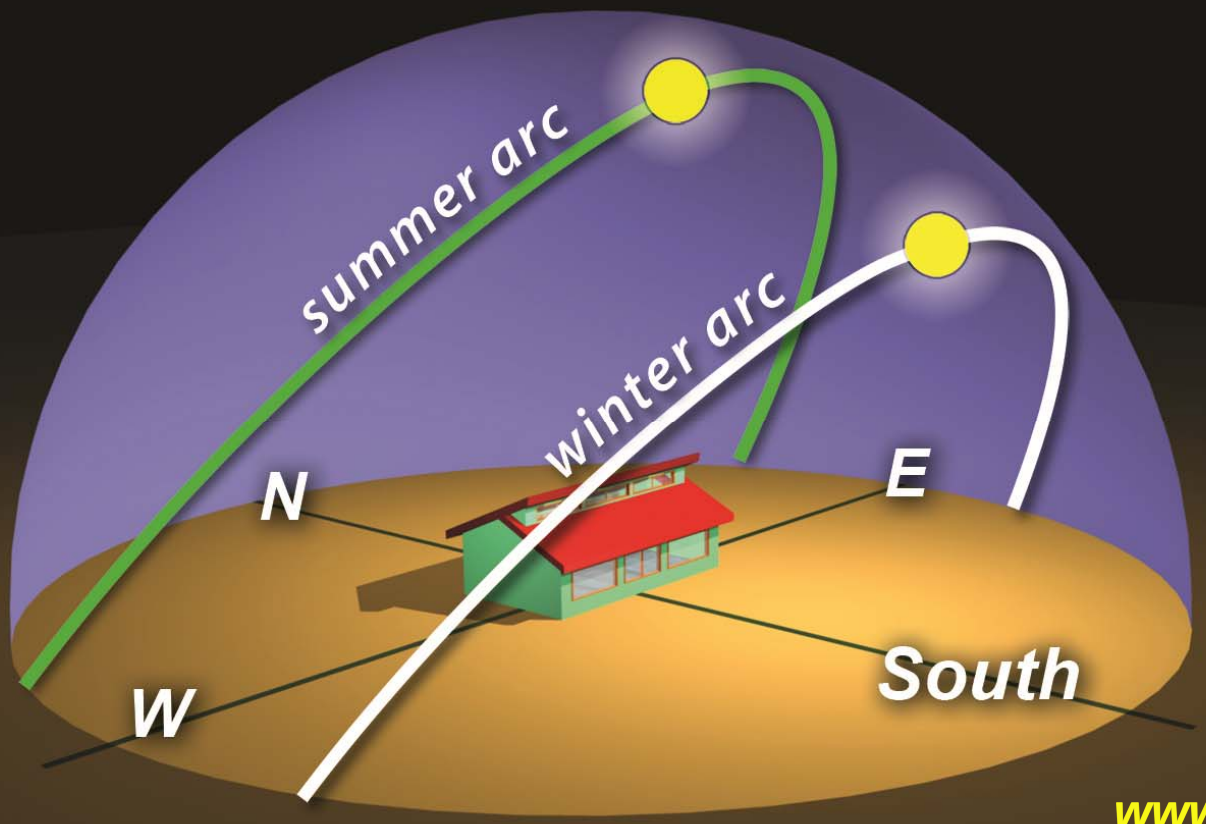
Solar Orientation:

Using Solar Energy in Any Season



Clay Atchison
Media Director
Rahus Institute

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