Math
Explorer

MATH AND THE SPHERE

SKIES DOWN UNDER

Orion Is UPSIDE-DOWN!!!

Does the Census make Sense?

Math Explorer

Contents

Edna Lee Paisano

by Jean Davis

"Could I go back and say to the tribe 'I am a mathematician?'"

Edna Lee Paisano is a Nez Perce and Laguna Pueblo American Indian. She was born in 1948 and grew up on a Nez Perce reservation near Sweetwater, Oklahoma.

As a little girl she learned the things that were a part of her tribal culture: farming, fishing, gardening, raising cattle. Her grandmother taught her how to make moccasins and beaded purses. Edna was a good student. Learning came easy to her and she worked hard to make good grades. Math was her favorite subject in high school and she enjoyed competing with the boys. Edna also enjoyed sports such as softball and swimming.

Edna studied math at Boise Junior College. Though she did well and enjoyed it, she didn't see how majoring in math would enable her to help her tribe. So she majored in sociology and graduated from the University of Washington in Seattle. Two years later she received a masters degree in social work.

After college Edna held a series of jobs that each contributed to the benefit of her people. In 1976, she became the first American Indian to work full time for the Census Bureau. Here Edna was finally able to put her mathematics to use. In graduate school she had studied statistics. In situations where you do not have or cannot get all the facts to get an exact answer, statistics helps you get a pretty good answer from a sample of data.

The Census Bureau hired her to work on questions concerning American Indians and Alaskan natives. She used statistical techniques to meaningfully interpret information gathered by the government through questionnaires. The questions concerned such subjects as housing, income, education, employment, and health. Accurate interpretation of this data helps tribal governments make better plans for the future and also helps the United States government live up to its treaty obligations.

During the 1980 census, Edna traveled to several communities to make sure the American Indians were counted correctly. The efforts of Edna's department in the 1990 census to obtain more accurate data contributed to making this census the most accurate and complete picture of American Indians and Alaskan natives. For the future, she would like to learn more about estimating, applying formulas, and weighting data.

Edna has found a way to use mathematics to help her people. "In the end, I'd like to live back on the reservation – like coming full circle. Going out, then coming back, to share all I've learned."

References: Women and Numbers, Teri Perl, Wide World Publishing/Tetra, 1993
www.bu.edu/lernet/pathways/bios

*Jean Davis teaches mathematics at Southwest Texas State University*

1. When multiplied together two positive integers x and y give 360. What is the smallest possible value for $x + y$?

2. Dan has to make 3 phone calls, one to Alana, one to Betty, and one to Cliff. In how many different orders can Dan make the calls?

3. A ball is dropped from a height of 20 feet. Each time it hits the ground it bounces back to 1/2 of its previous height. How far has the ball travelled in total distance when it hits the ground for the third time?

4. The 3 small rectangles in the diagram at right are congruent, and together they tile the larger rectangle. The perimeter of the large rectangle is 30 inches. What is the area of the large rectangle?
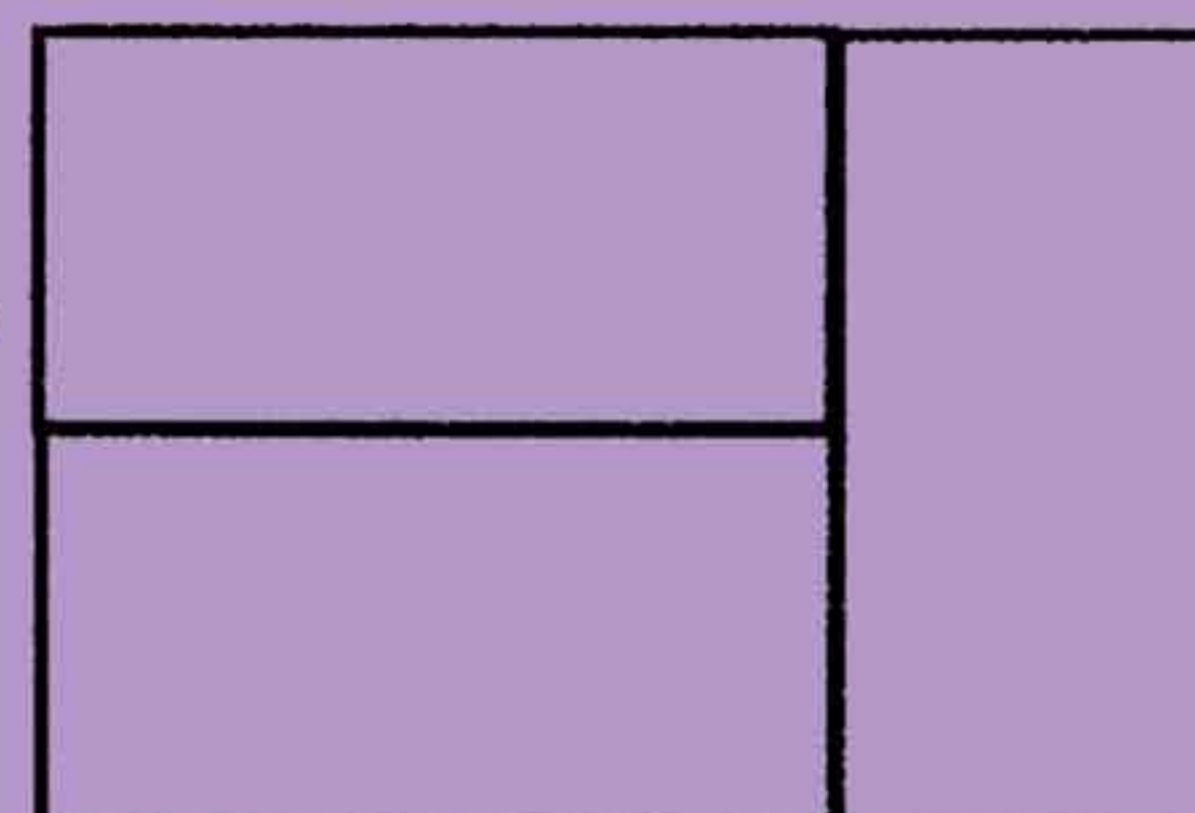
5. The first round of the World Cup had 32 teams divided into 8 groups of 4 teams each. Each team in a group played the other teams in the group exactly once. How many first round matches were in the World Cup?

6. The final stage of the World Cup had 16 teams. Once a team lost a game, it was eliminated from the tournament, except for the losing semi-finalists who played an extra match to determine 3rd and 4th places. How many matches were played in the final stage?

7. The Lakers won the final best-of-seven NBA series. What sequence of results could have lead to a Laker victory?

8. Find 5 consecutive numbers that add up to 125.

9. In the Figure, ABCDEF is a regular hexagon. Find the ratio of the area of the shaded part to the area of the hexagon ABCDEF. (From the 6th PMWC test)
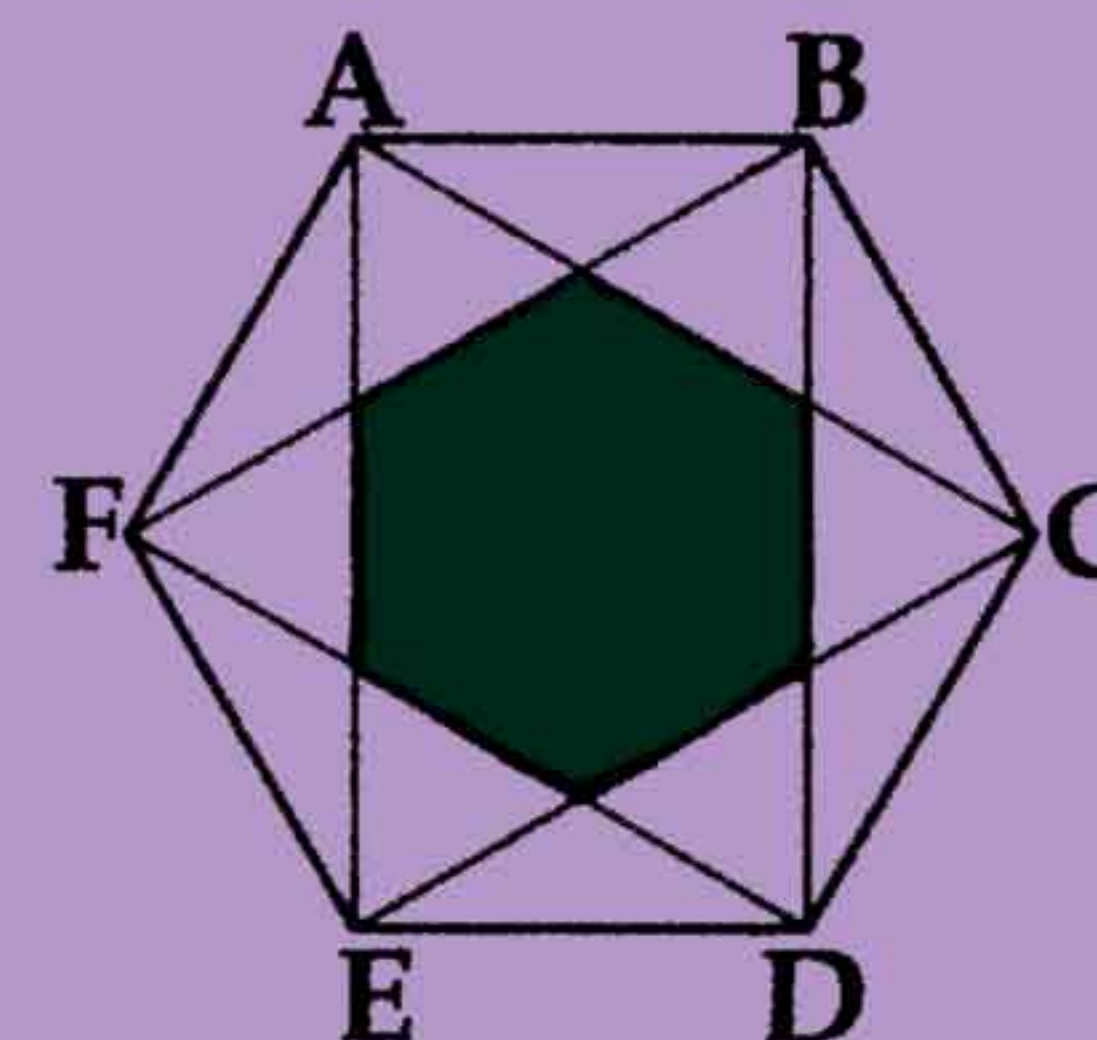
10. All the integers are colored white, except 1, which is colored red. Any integer that exceeds a red number by 20 or by 21 will be repainted red. What is the largest number that will remain white?(From the 6th PMWC test.)

11. Jun likes to take a walk through his neighborhood (shown in the diagram) visiting each street intersection exactly once. How many routes are there for Jun to choose from? The diagram shows one route, and it does not matter in which direction Jun walks along the route.
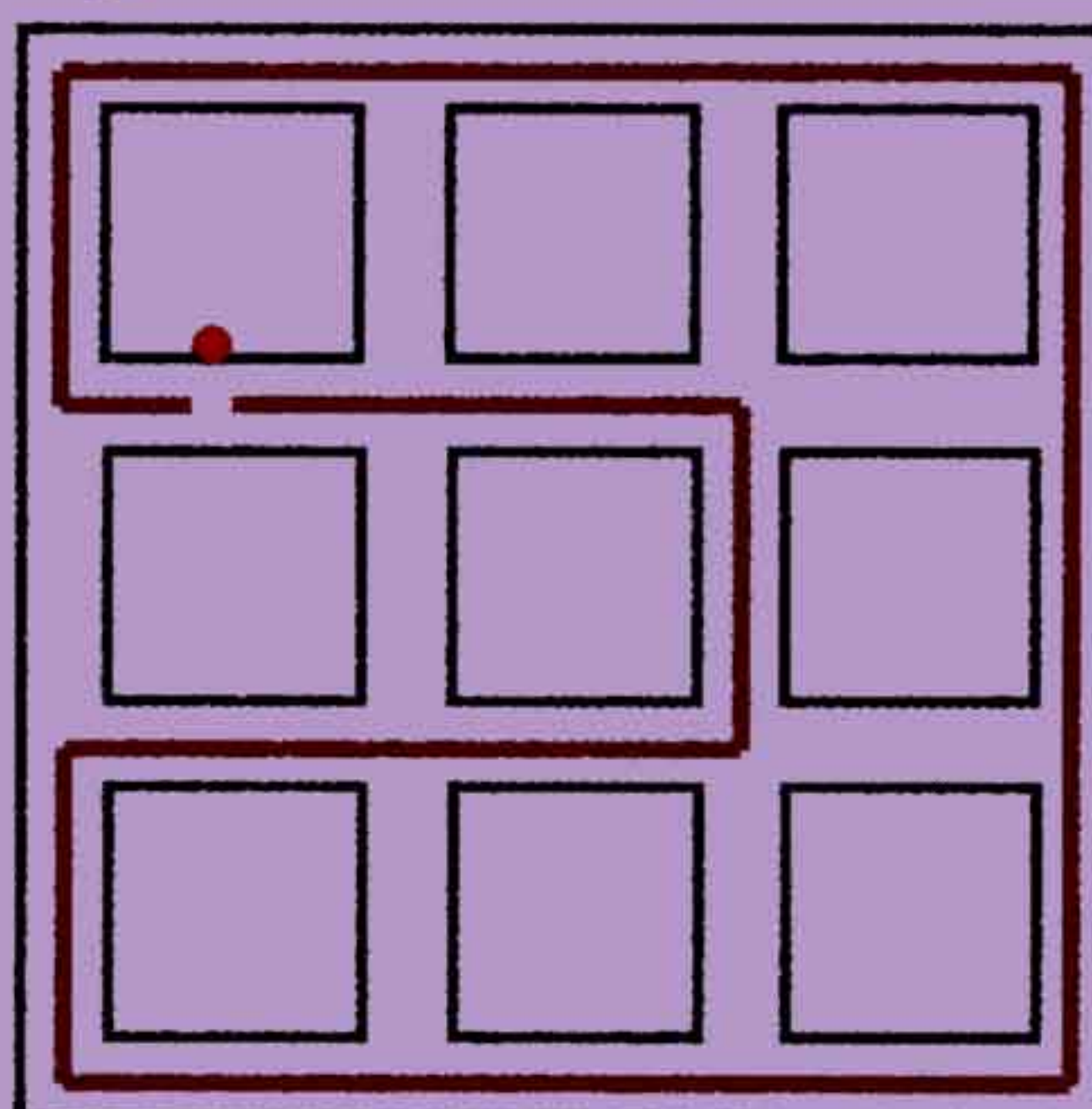
The Skies Down Under

by

Hisako Shiraishi

It was my very first day in Sydney, Australia. After checking in at a youth hostel in the city, I thought I would go for a walk. Of course I was a stranger there, and the only things I knew were:

> * The youth hostel was on King Street.
> * King Street runs east-west.
> * At the east end of the street is the University, and at the west end of the street is a station.

I decided to walk towards the University, but I didn't know which way was east! "Hmm, what should I do?"

It was a sunny day in July, about noon. I realized that my back was facing the sun, leaving a shadow in front of me. "I see, so I'm standing facing north." (Or so I thought.) I started to walk to the right – and guess what I saw at the end of the street – the station! And the reason why I walked in the completely opposite direction was – yes, the sun is in the NORTH in the sky in Australia, and in fact in all of the southern hemisphere. Do you know why?

Let's think about the situation in terms of the relation between the sun and the earth in space. The earth is orbiting around the sun, and the axis of the earth is tilted by about 23.5°. In July, the orientation of the earth is such that the North Pole is closer to the sun than the South Pole.
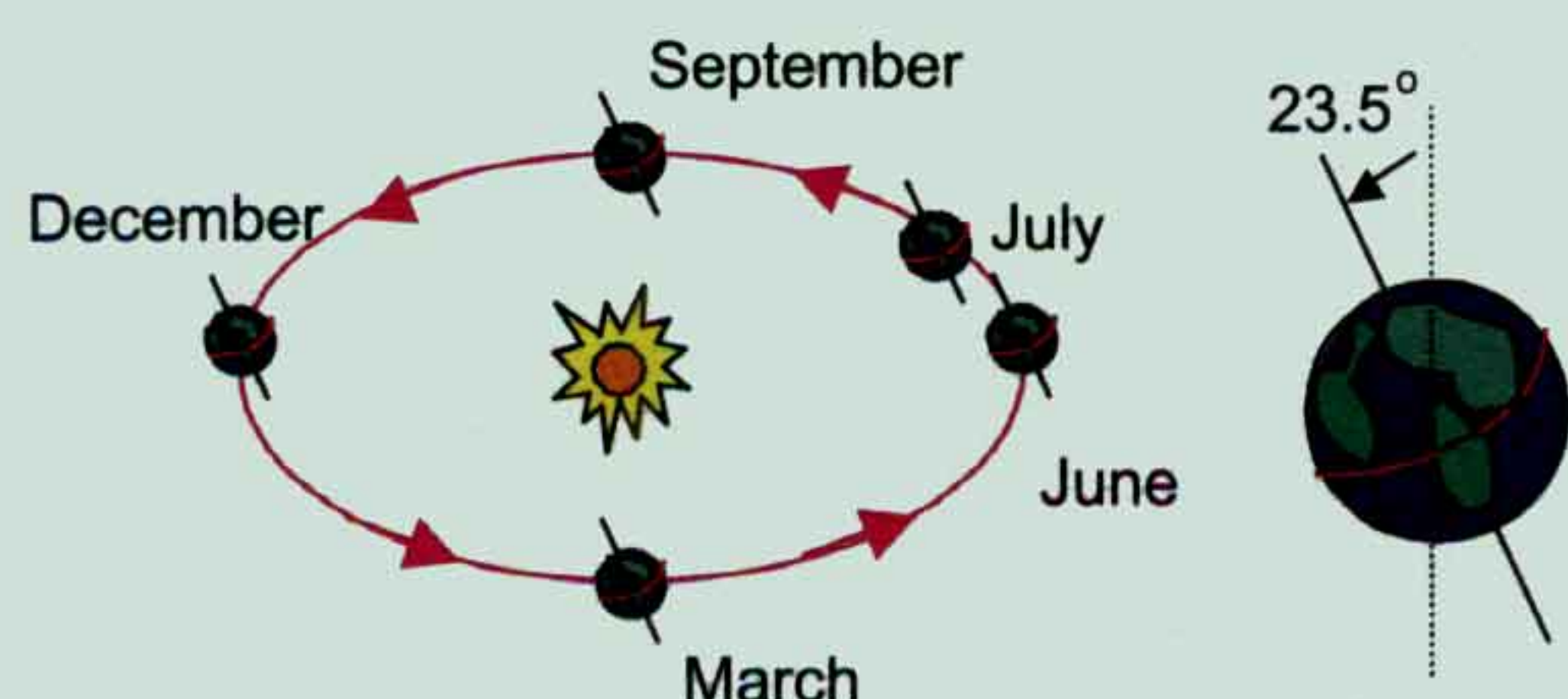
Let's say you are standing on a street in San Marcos (30° N, 98° W) on a sunny day in July, at noon. The angle between the line connecting the sun and the center of the earth, and the plane that contains the equator should be about 21°.
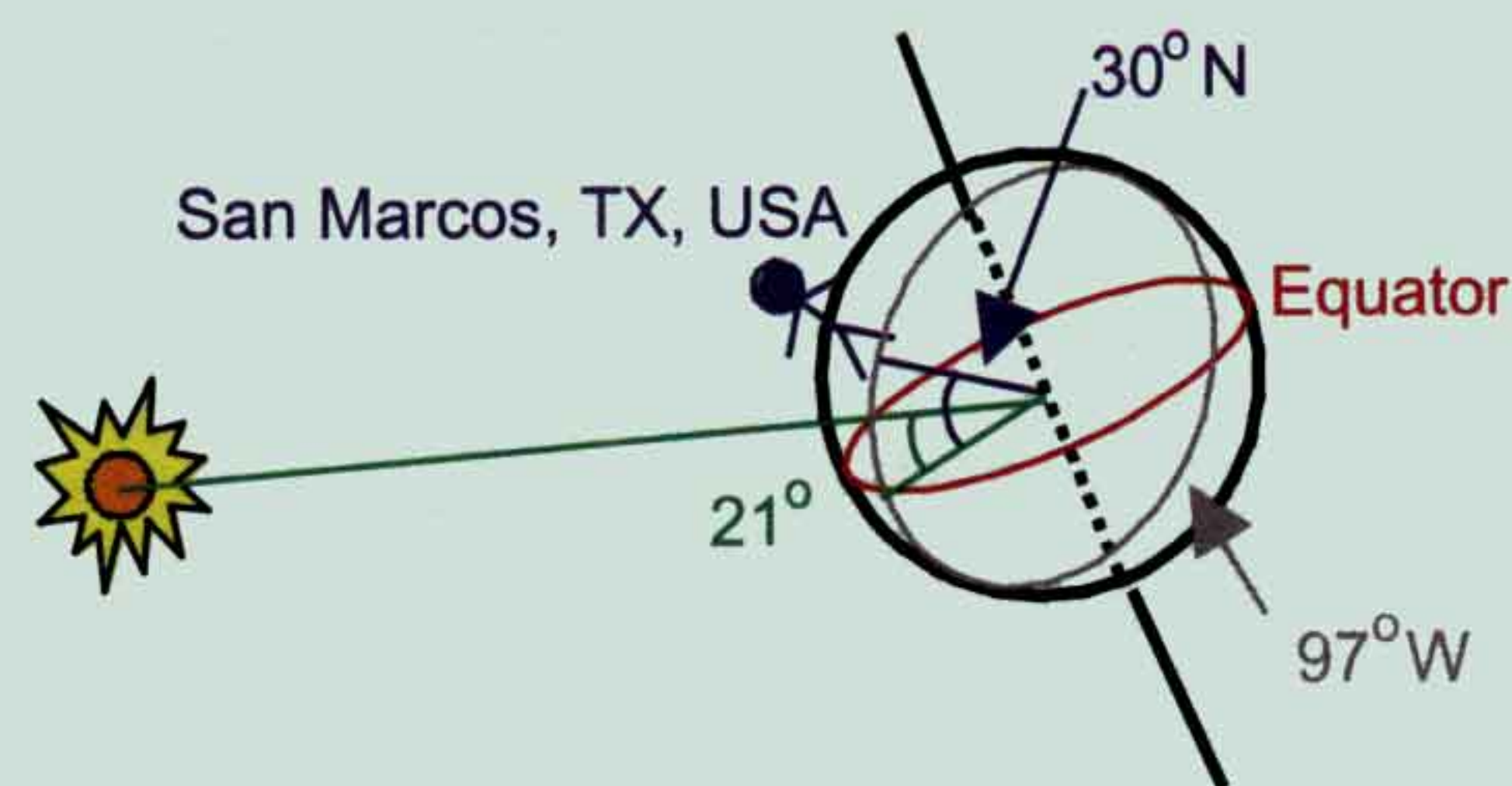
To see this situation in more detail, let's think on the plane that contains the sun and the axis of the earth. You should be exactly on the circle, which represents the earth, and the equator should look like a straight line.
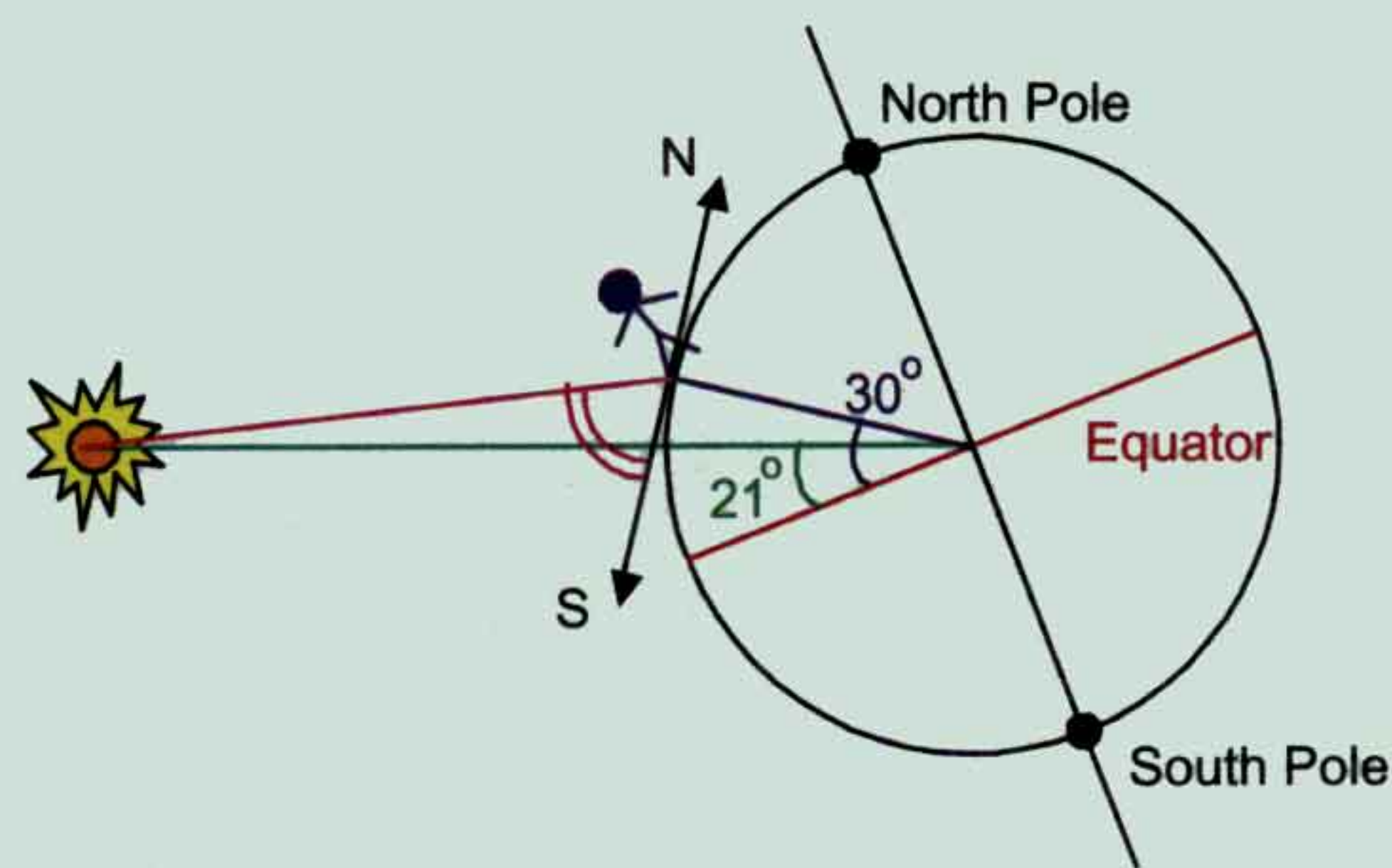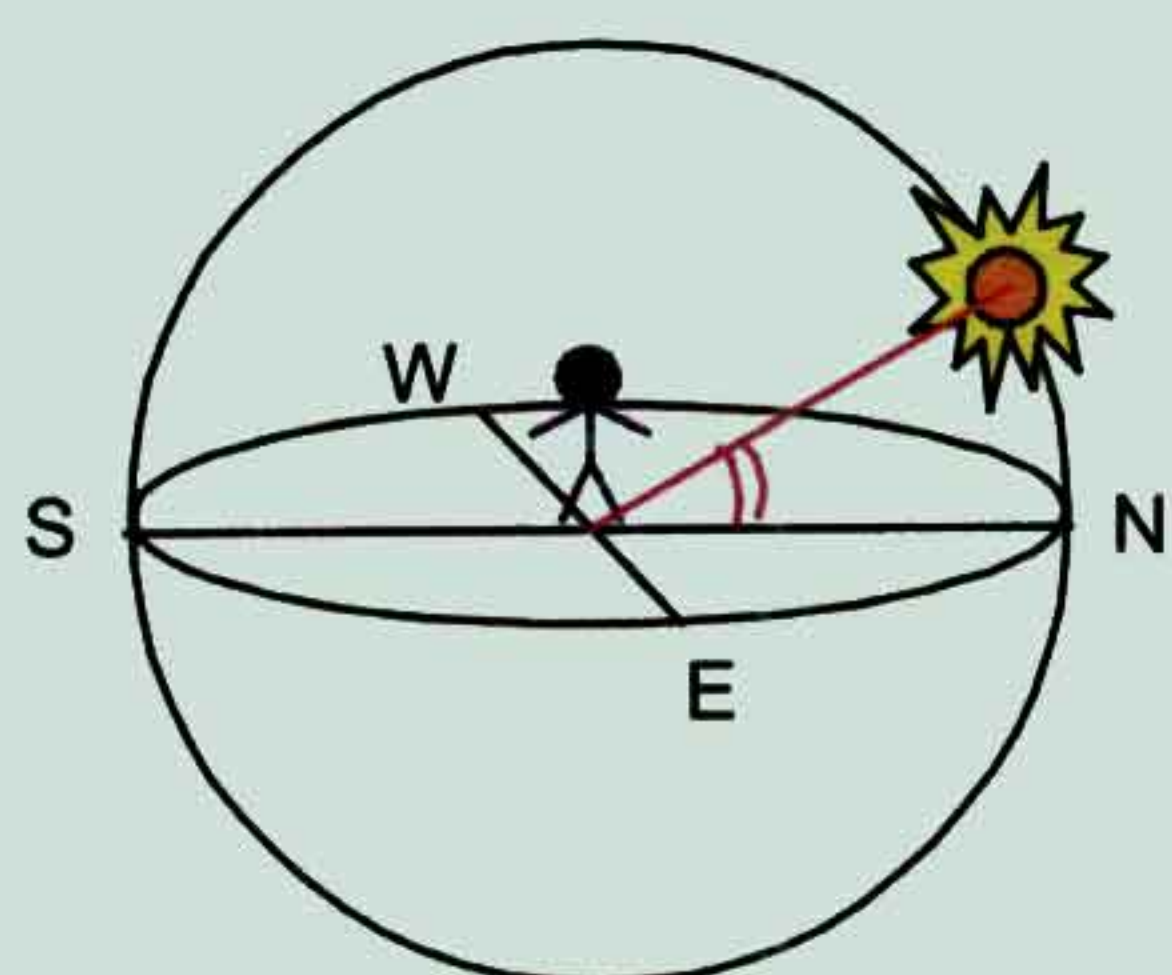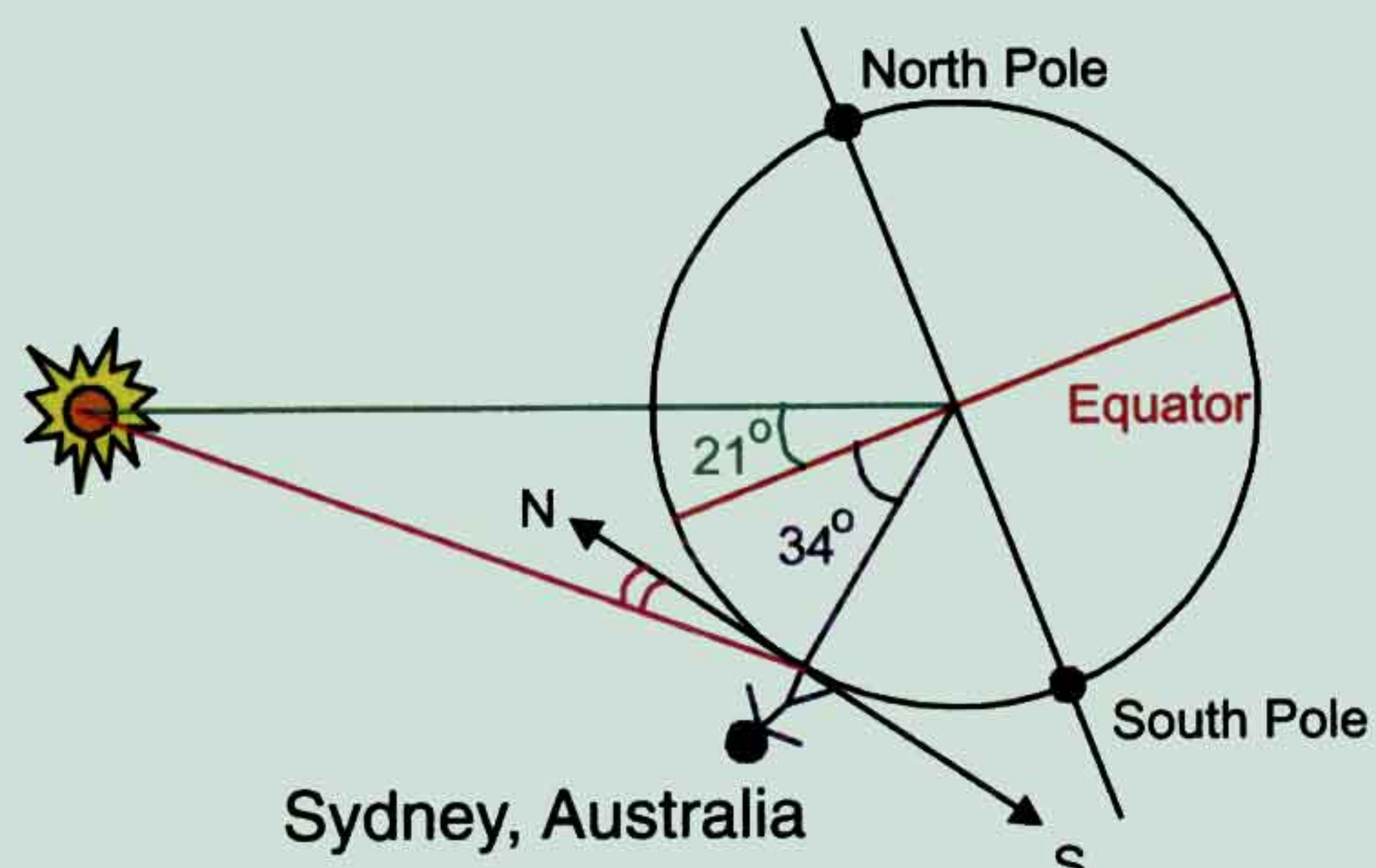
The line tangent to the circle at the point where you are standing is running exactly north-south, the north being the direction towards the North Pole and the south being towards the South Pole.
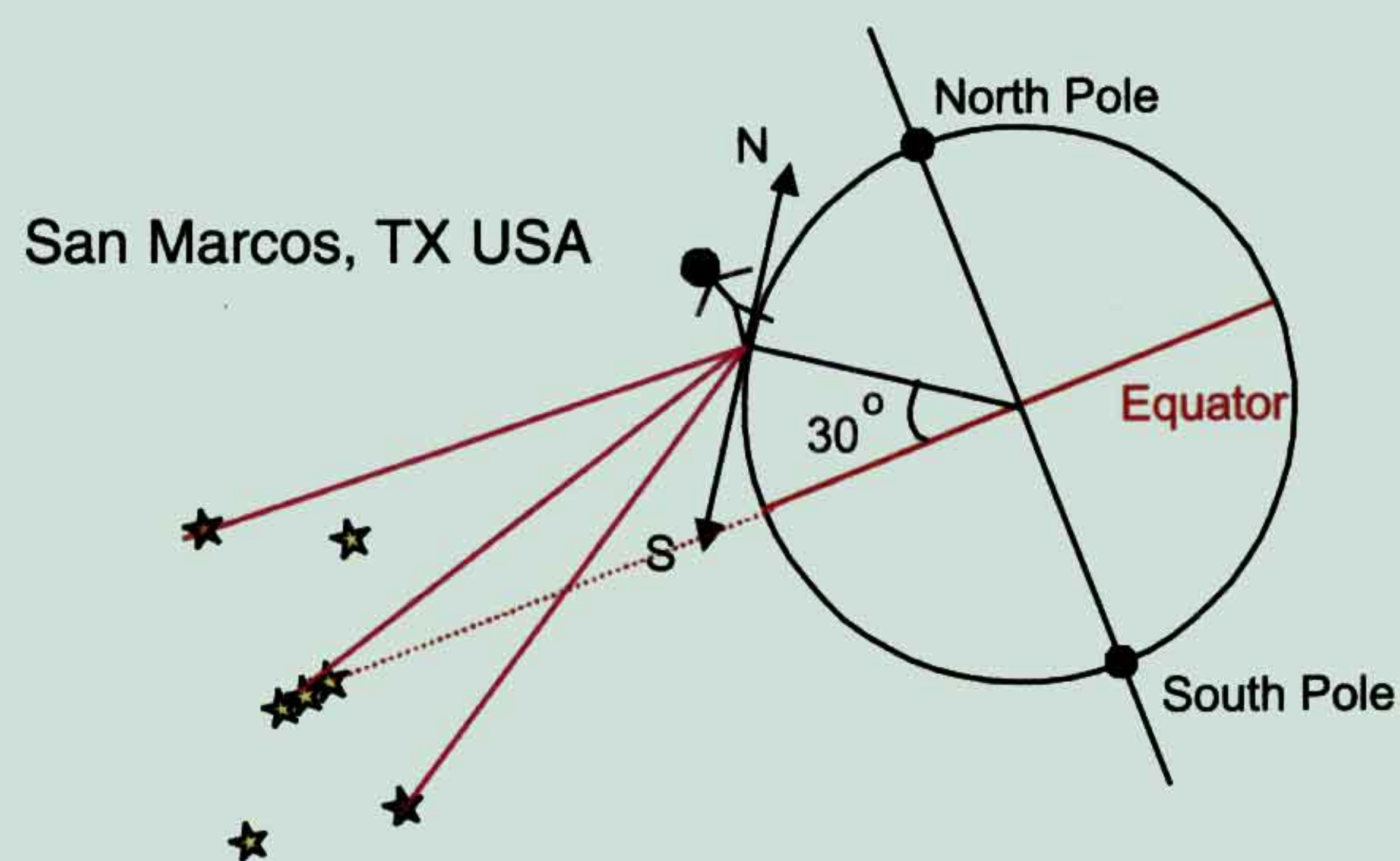
You can then translate this relative position with the sun into a more familiar figure, representing the whole sky with a hemisphere. This is where you see the sun in San Marcos.
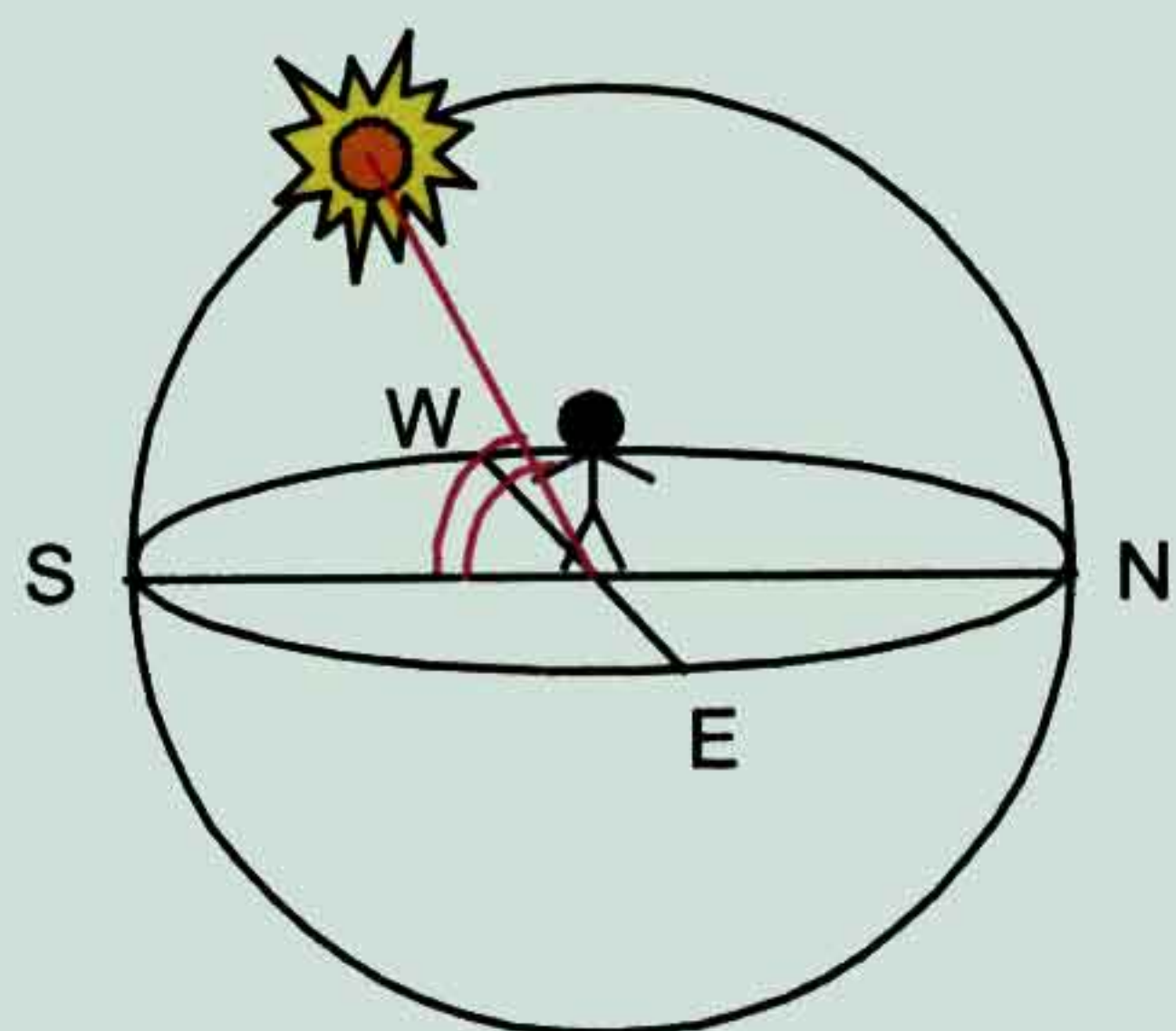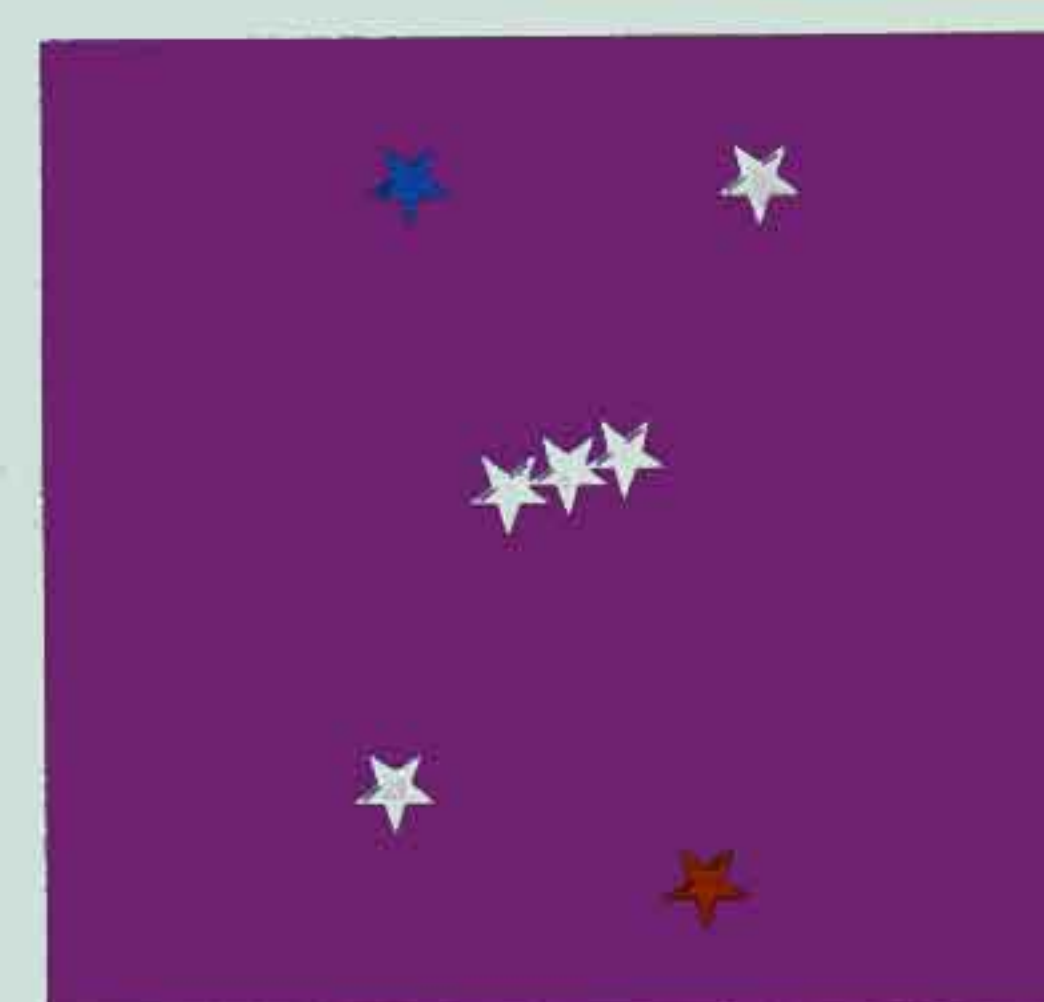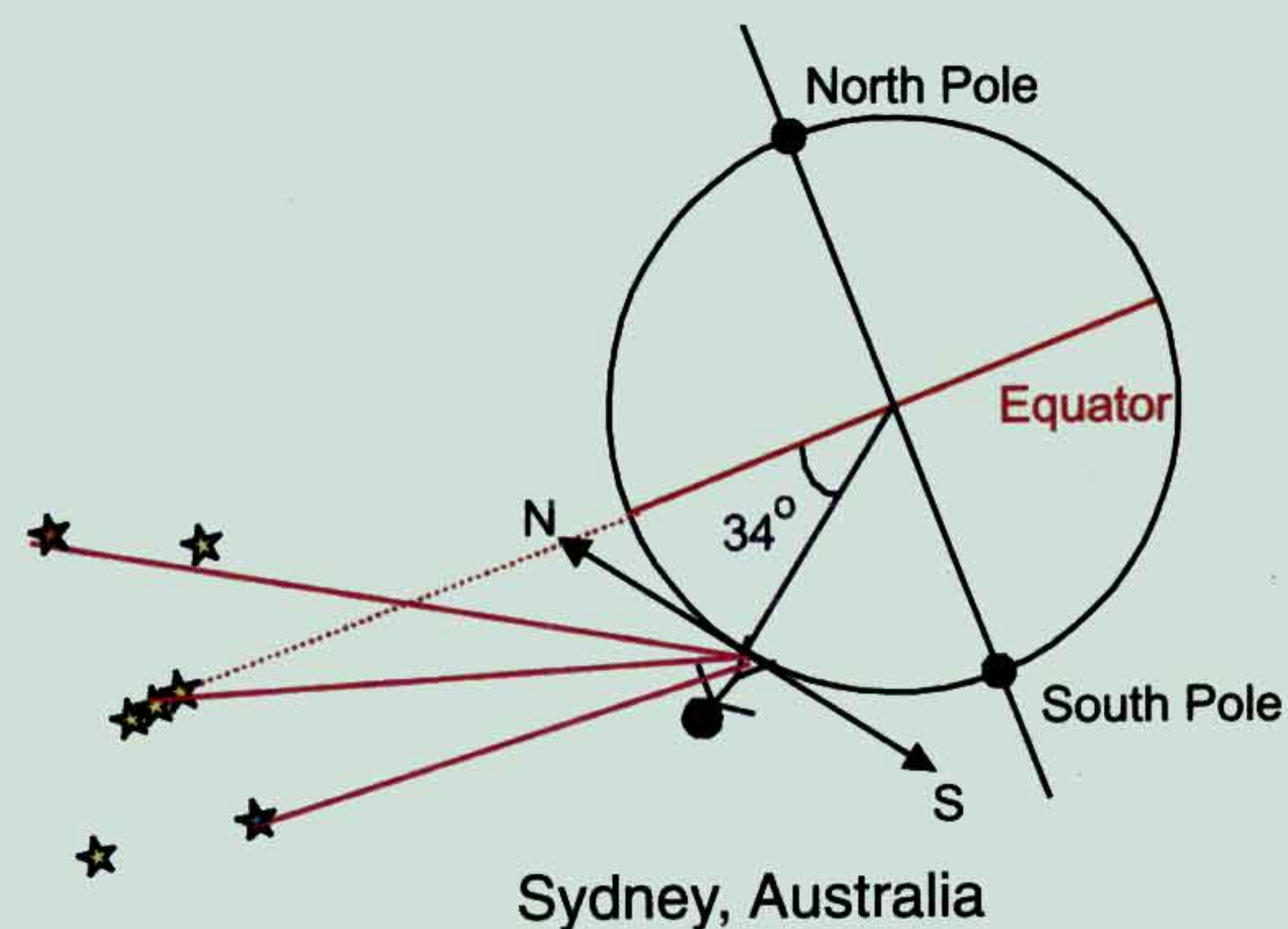

How about if you were standing on a street in Sydney (34° S, 151° E)? Let's draw the same figure as before. The positions of the sun and the earth are the same as above, but you are now standing further south. Now where is the sun in the sky?

How about in December? What if you were standing on the equator? You can draw similar figures to determine where you'll see the sun at any time of the year from any point on the earth.

Another fascinating thing about the sky in the southern hemisphere is its constellations. Have you ever seen Orion in the southern sky in the winter?

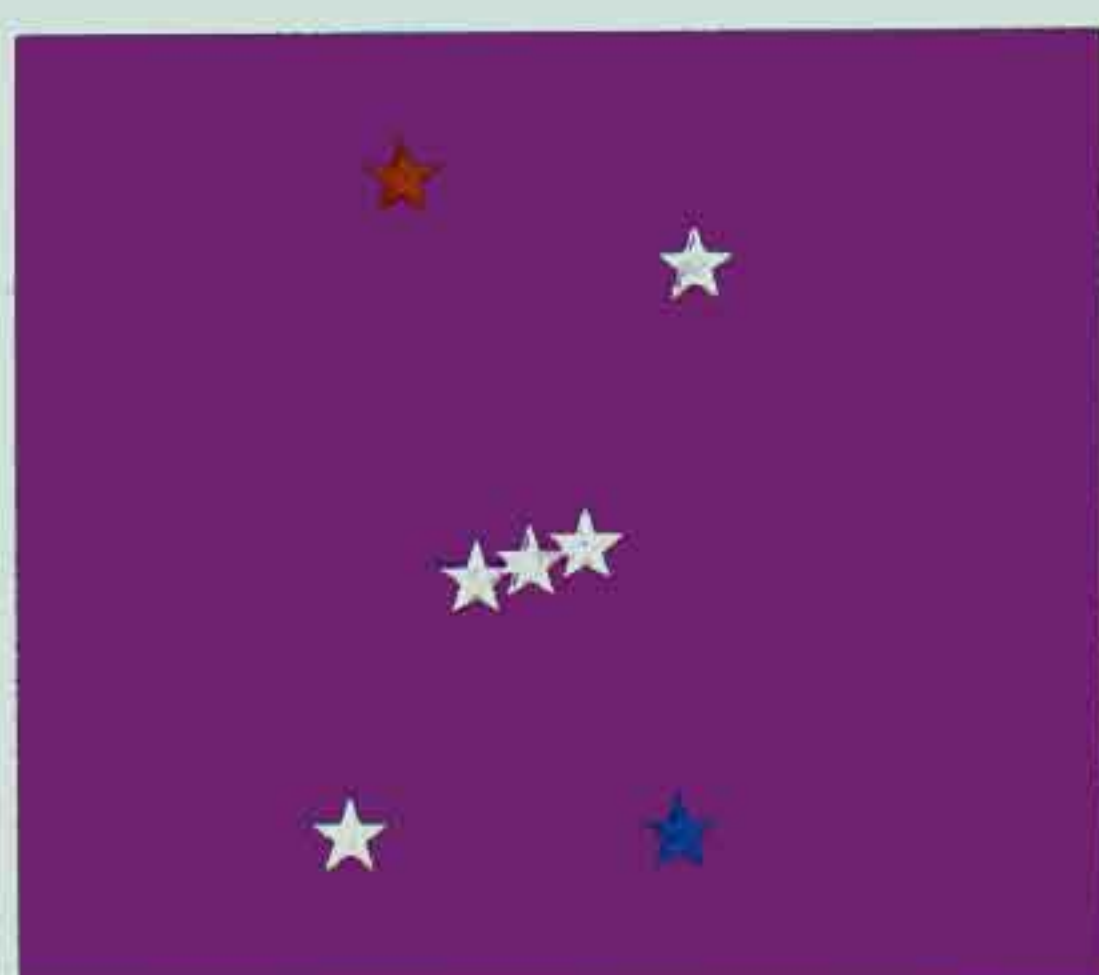Orion is located almost directly above the equator.

Let's see where you'll see it and what it looks like in Sydney. Let's draw the same picture as before. By applying the procedure to each star, you should be able to figure out where they are positioned in the sky. What does it looks like?

In Sydney, Orion is visible in the northern night sky, and is "upside-down"!

In fact, the constellations in the southern hemisphere are very different. What do you think Scorpius looks like? Where is the Big Dipper? Well, I'll let you answer these questions!

If you ever get the chance to travel to the southern hemisphere, look up in the night sky: that's when you'll know the earth is really a sphere!

Hisako Shiraishi is working on a Masters of Engineering in Electrical Engineering at the University of Sydney. She received her undergraduate degree from the University of Tokyo. In her spare time, Hisako enjoys bushwalking.

Puzzle Page

Word Search

Forwards or backwards, up, slanted, or down.
Where can the words in this puzzle be found?

Point
Line
Circle
Plane
Pole
Latitude
Longitude
Hemisphere
Tangent
Equator

```
N O I S H R M I S H P E R E
O M H T E S E Q U E N Q E A
N R I G E T E W U I O U E F
F O L A T I T U D E I A R U
T S E Q U E A C R A S T Y N
A T F E T Y E E E E C O T E
N I D B C A H B I T I R I D
G N E A N P T A A O R E R U
E F E X S P O I N T C G A T
N I T I R B L E D N L M L I
T N M E O Q P L A N E A I G
Q E P N T T O R N S I A M N
H T V I T U L S O A H C I O
J E E L O O E I E R O C S L
```

15,951 is a palindrome (the same forward and backwards). What are the three next palindrome numbers?

A man wants to know how many different routes there are from point A to point B. He can only travel on the lines either due N, due E, or NE. How many routes are there?

IF

AND

THEN

?

N
W — E
S

B

A

6
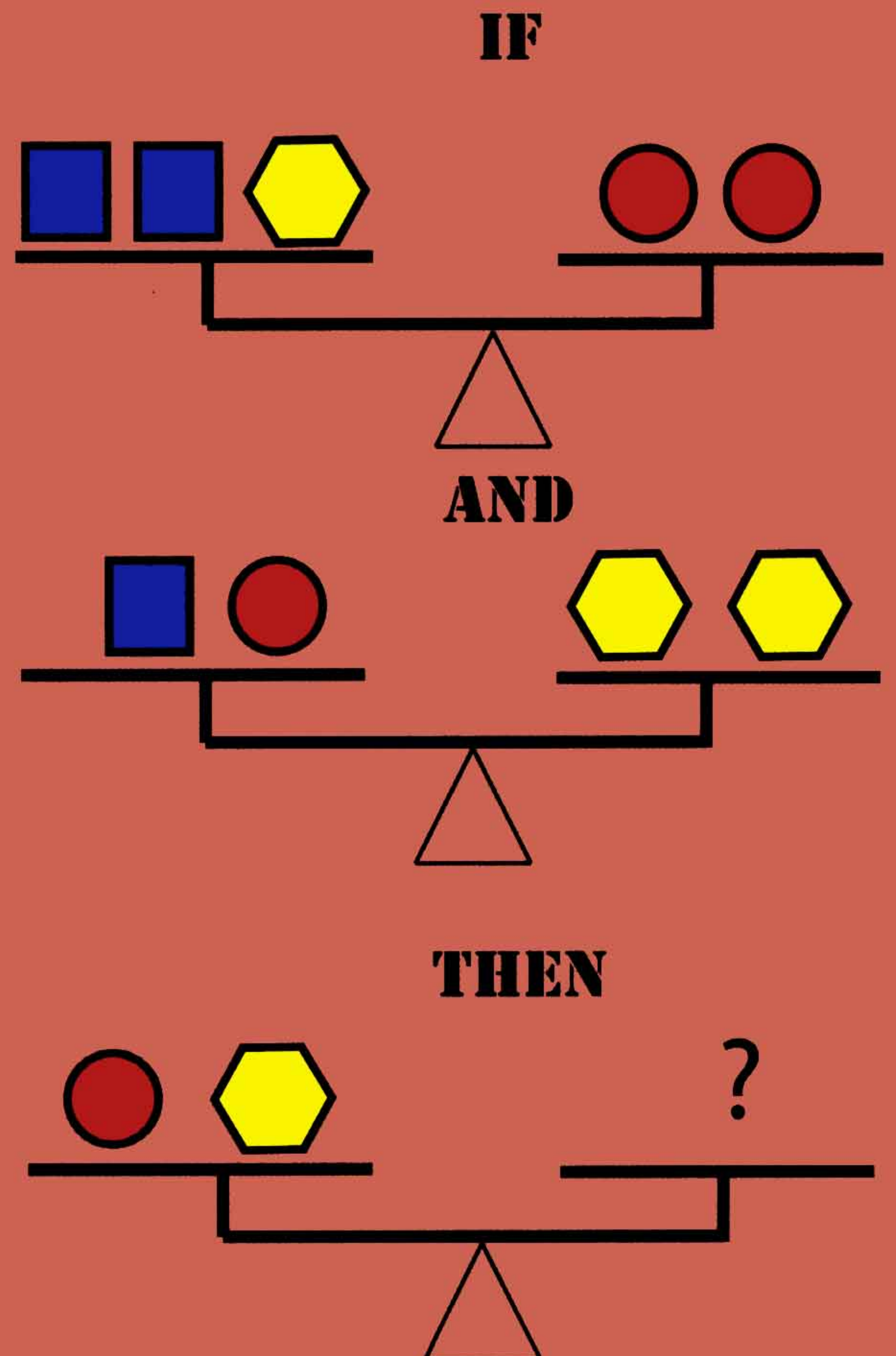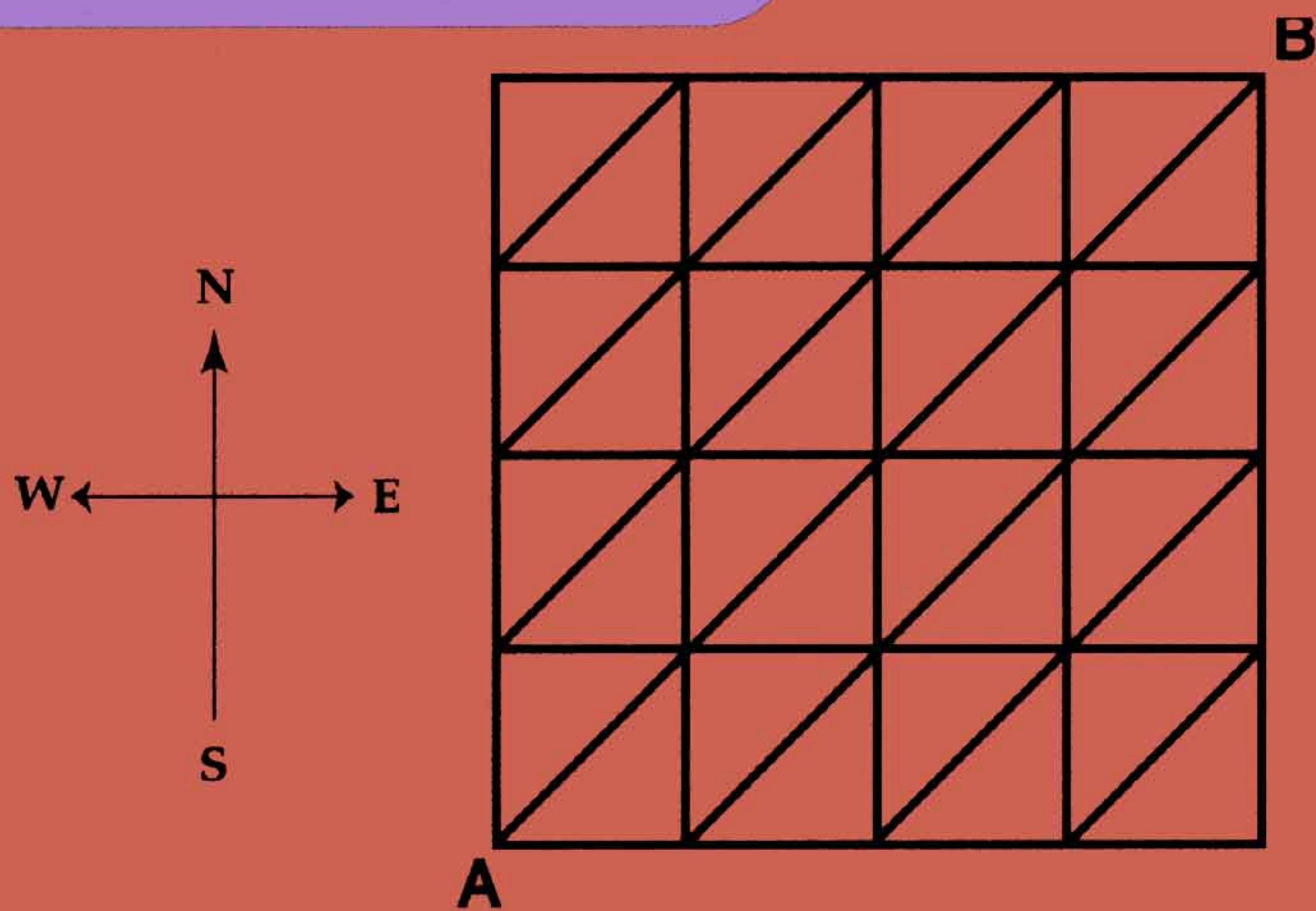
Bulletin Board

Did you know?

The year 2002 is the 800th anniversary of the completion of one of the most famous books in the history of mathematics: the *Liber Abbaci*, by Leonardo of Pisa, also known as Fibonacci. The sequence that is named after this mathematician, the Fibonacci numbers, begins 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ….any idea what number follows 55? Do you see a pattern?

American Mathematics Competitions

AMC seeks to increase interest in mathematics and to develop problem solving ability through a series of friendly math contests for junior and senior high schools students. Check out www.unl.edu/amc

Mathematics and Art

Helaman Ferguson received his Ph. D in mathematics and now creates "…sculptures embodying mathematical ideas…" says the citation which he and his wife received from the Society for Industrial and Applied Mathematics. To view some of his sculptures, go to his website: http://www.helasculpt.com/

A Notable Quote

It is not enough to have a good mind. The main thing is to use it well.

Rene Descartes

MATHCOUNTS

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Circles, Spheres, and the Globe

Have you ever seen an inflatable globe or a beach ball? Notice that before you blow any air into it, it resembles a very flat pancake or a tortilla. Blow it up and we now see that the surface of the earth forms a sphere. The sphere is defined to be all the points in space (our three-dimensional world) that are a fixed distance from a certain point, also called the center. The fixed distance is called the radius.

In geometry we often talk about points and lines. If we take a line and a sphere, notice that the line can completely miss the sphere. Another possibility is that the line touches the sphere in just one point. In this case, we say the line is tangent to the sphere. The last possibility is that the line skewers the globe (better not do this with our inflatable globe), and so the line touches the sphere in two places.
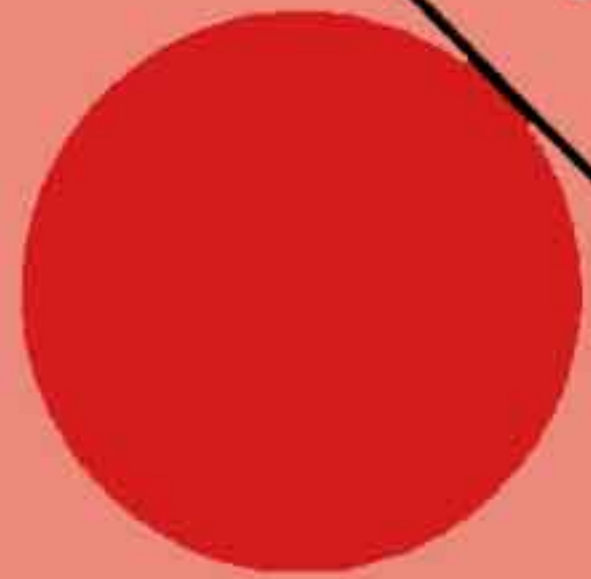
If we now take a plane and a sphere, we still have the case where the plane misses the sphere entirely. Another case is when the sphere sits on top of the flat surface and there is just one point of contact. The plane is said to be tangent to the sphere. The last case is when the plane cuts through the sphere, in which case the intersection is a circle. See if you can visualize it with a beach ball. Can you see different size circles being formed? Latitudes on the globe are examples of such circles. Notice that the planes containing the center of the sphere form the largest circles, called great circles. One example of a great circle on the globe is the equator.

The shortest distance between two points on a sphere is along a portion of a great circle containing these two points. Try drawing this on your beach ball. For example, if you are flying between Chicago and Tokyo, can you determine the shortest path? This could help save jet fuel!

Other examples of great circles are those containing both the south and north poles. The longitudes are half of the great circles from one pole to the other. Geographers locate points on earth using latitudes and longitudes, using degree measurements. For example, San Marcos, Texas, is located at 30°N 98°W. The latitude angle is the measurement of the angle formed by the plane containing the equator and the line containing the location and the center. The longitude is the angle formed by the great circle through Greenwich England and the poles with the great circle through San Marcos, Texas, and the poles.

As you can see, geometry is an important part of our world.
To learn more visit: http://geography.about.com, http://math.rice.edu/~pcmi/sphere/sphere.html

Dear Math Explorers:

We at Math Explorer want to wish you a wonderful new year, 2003! The year number 2003 may be a fun project to explore. For example, it is a prime number. Write us with some of your observations and we will share them with our readers.

Though it is winter in Texas and the northern hemisphere, in Australia and the southern hemisphere it is summer. In our main article, you will discover some interesting celestial differences depending on which half of the sphere you're in! Best of all, mathematics helps us to understand and explain the phenomena. We hope you'll take time out to view the constellations in the night sky and imagine how they might look from the other hemisphere.

Happy New Year!

Sincerely,

Hiroko K. Warshauer

Hiroko K. Warshauer, editor