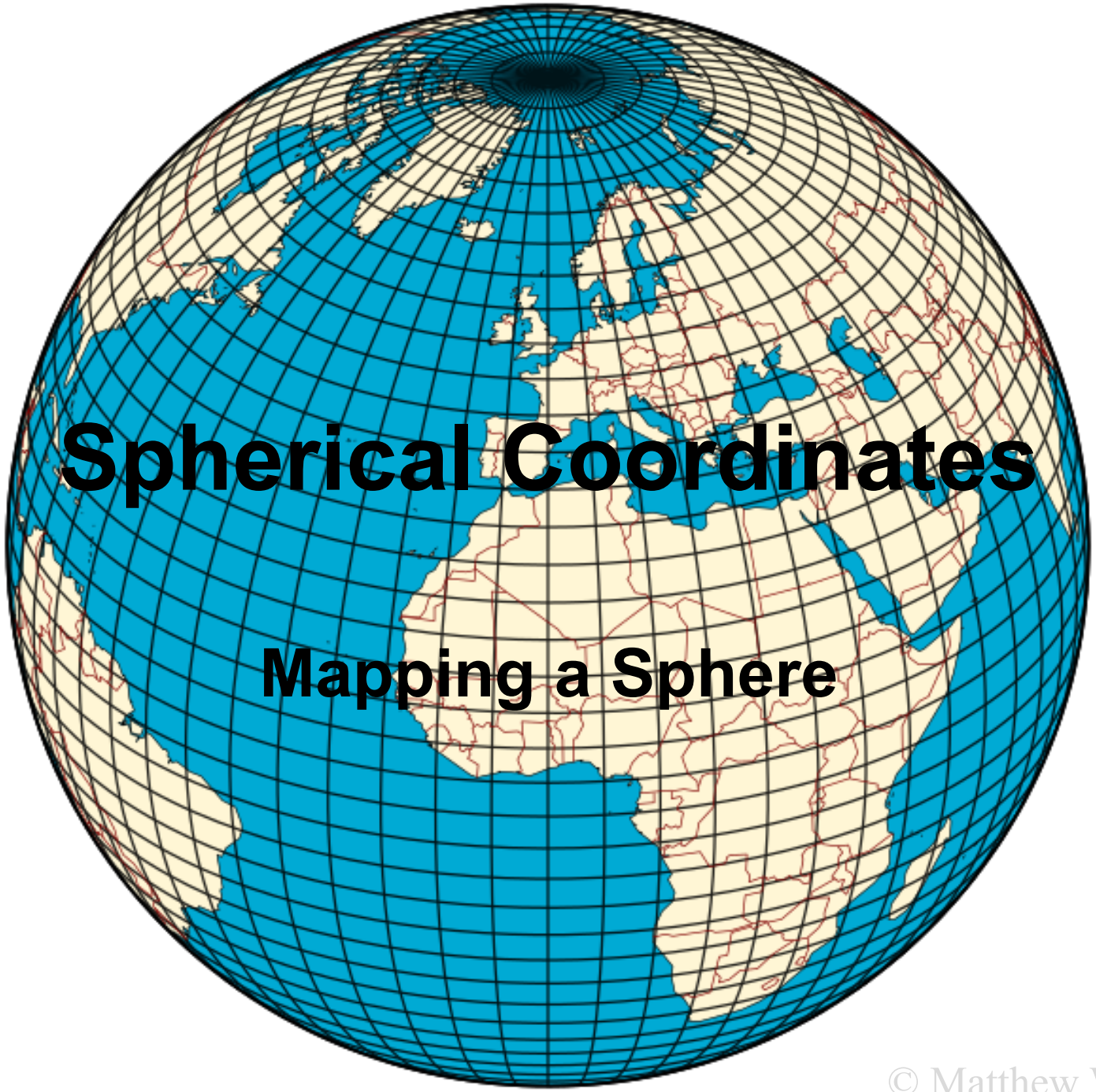
+ 35º 53' 16"

– 84º 09' 35"

35º 53' 16" N
84º 09' 35" W

(the precise location of
Farragut High School!)



	The student will be able to:	HW:
1	Utilize and convert SI units and other appropriate units in order to solve problems.	1
2	Utilize the concept of orders of magnitude to compare amounts or sizes.	2 – 3
3	Solve problems involving rate, amount, and time.	4 – 7
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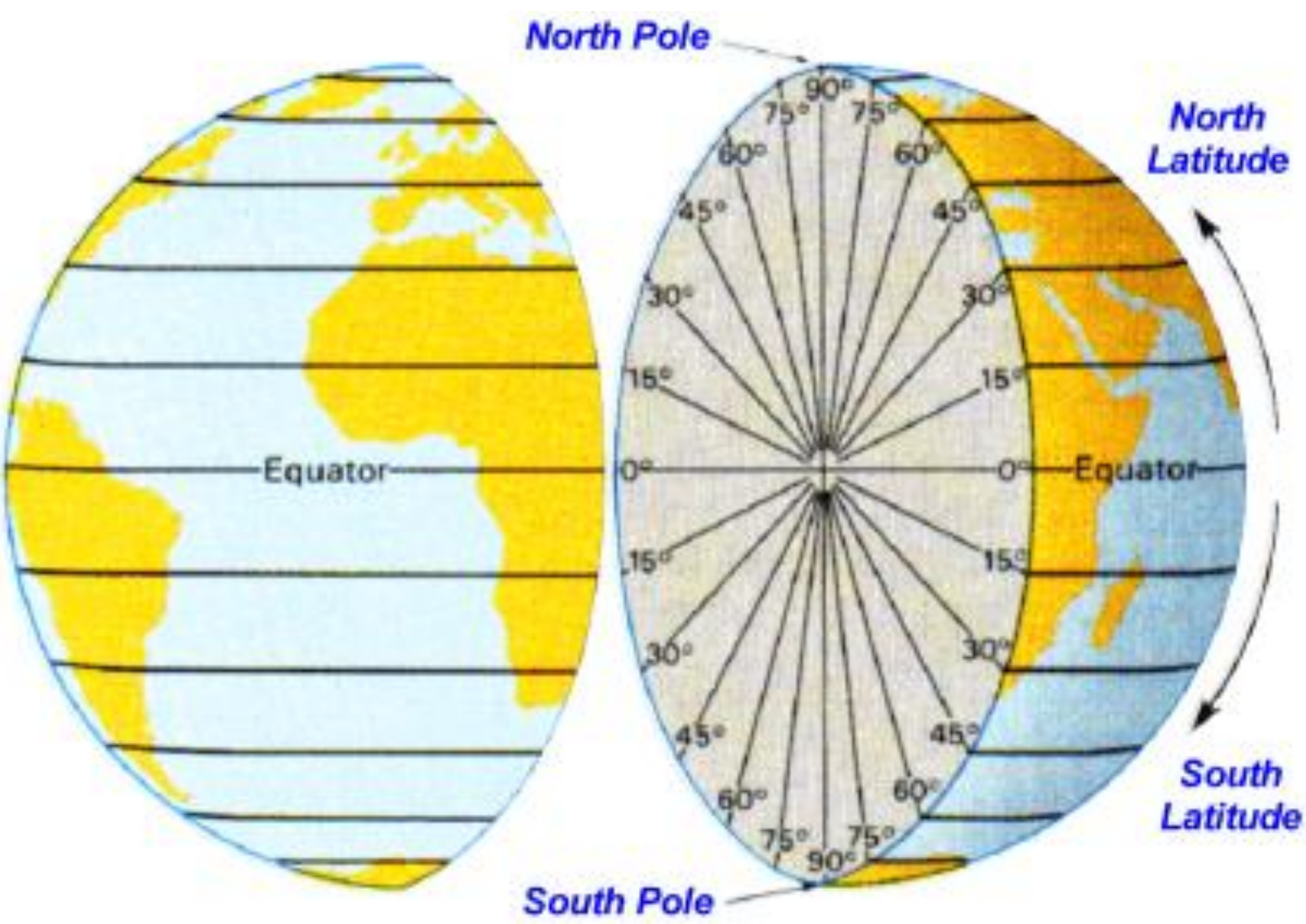
5	Solve problems relating the radius of a circle to diameter, circumference, arc length, and area.	14 – 15
6	Define and utilize the concepts of latitude, longitude, equator, North Pole and South Pole in order to solve related problems.	16 – 21
7	Define and utilize the concepts of altitude, azimuth, zenith, and nadir in order to solve related problems.	22 – 24

Spherical Coordinates

- Any location on Earth can be specified by coordinates of latitude and longitude.
- Likewise, a point on *any* spherical surface can be specified by two angles.
- Such systems are called spherical coordinates.
- In astronomy there are several different spherical coordinate systems of interest.

Latitude

- Latitude is the angular distance northward or southward from the equator.
- On a globe or map, latitude is represented by lines running east and west, parallel to the equator.
- Latitude, φ, is an angle in the range:
  $-90^\circ \leq \varphi \leq +90^\circ$



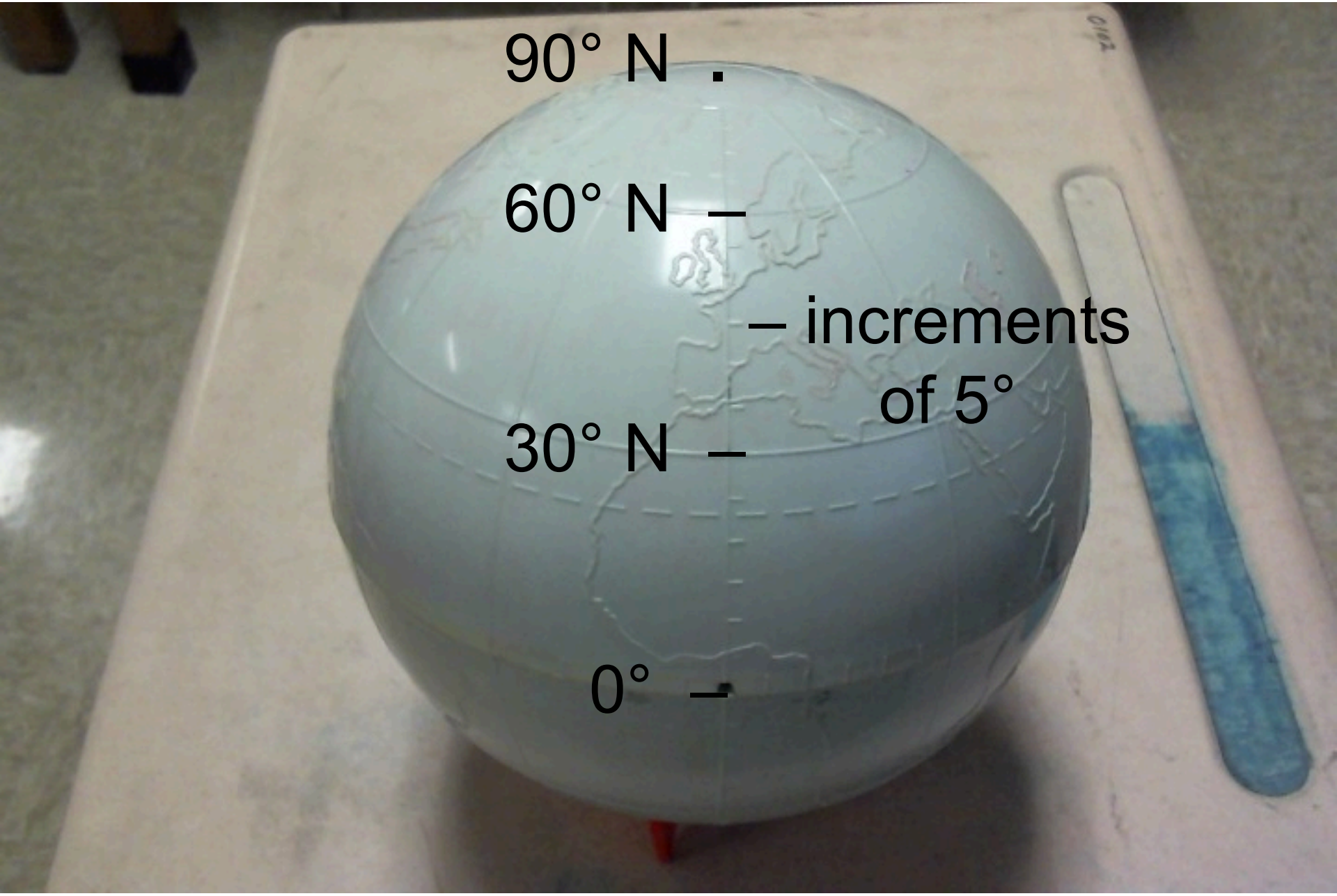
source: Geography World – www. geograpyworldonline.com

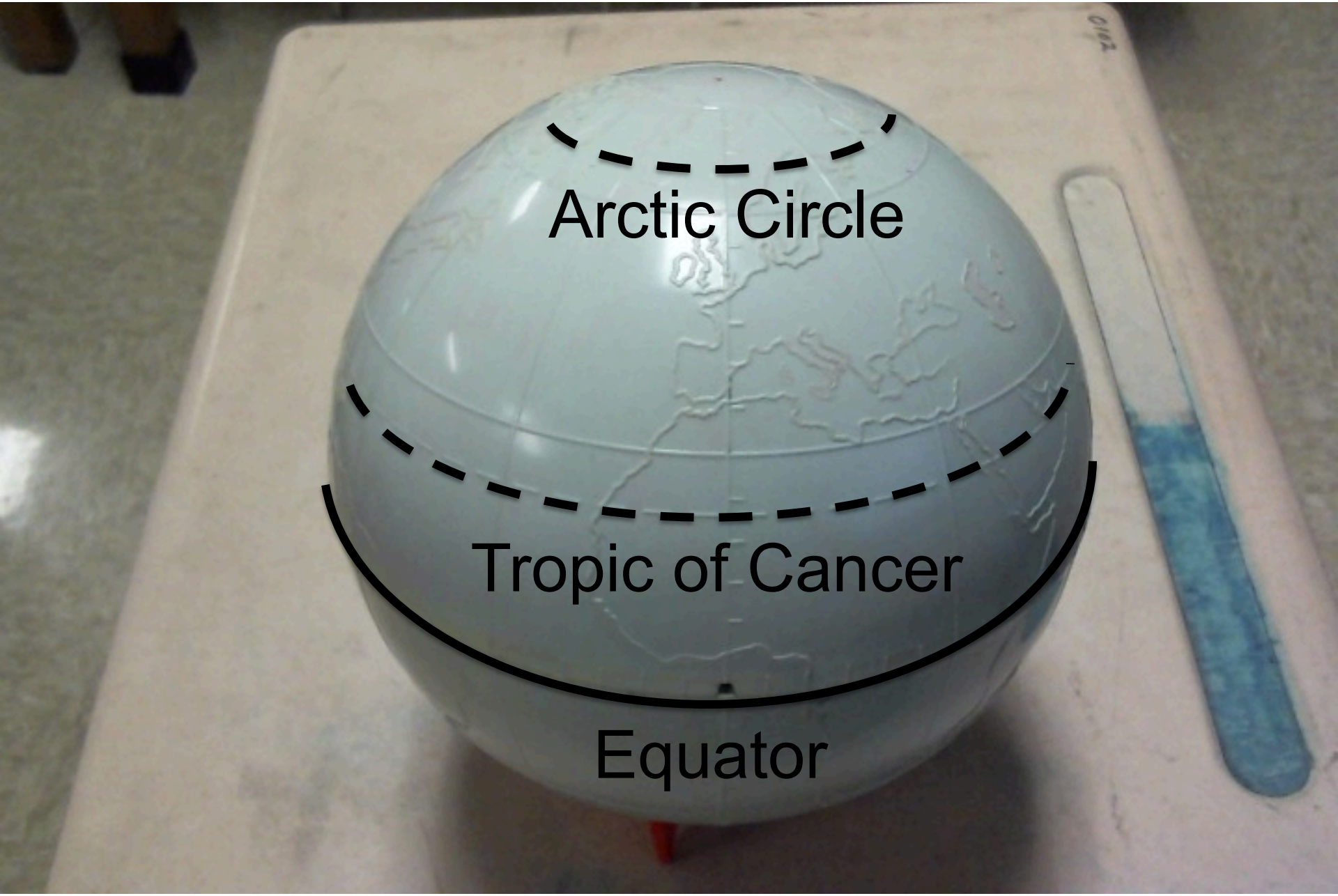
Parallels

- The east-west lines of latitude are sometimes referred to as parallels.
- The reference is the equator, which is defined to be zero degrees latitude.
- The equator is halfway between the north and south poles, which are defined by the axis of the Earth's rotation.

Fun With Globes

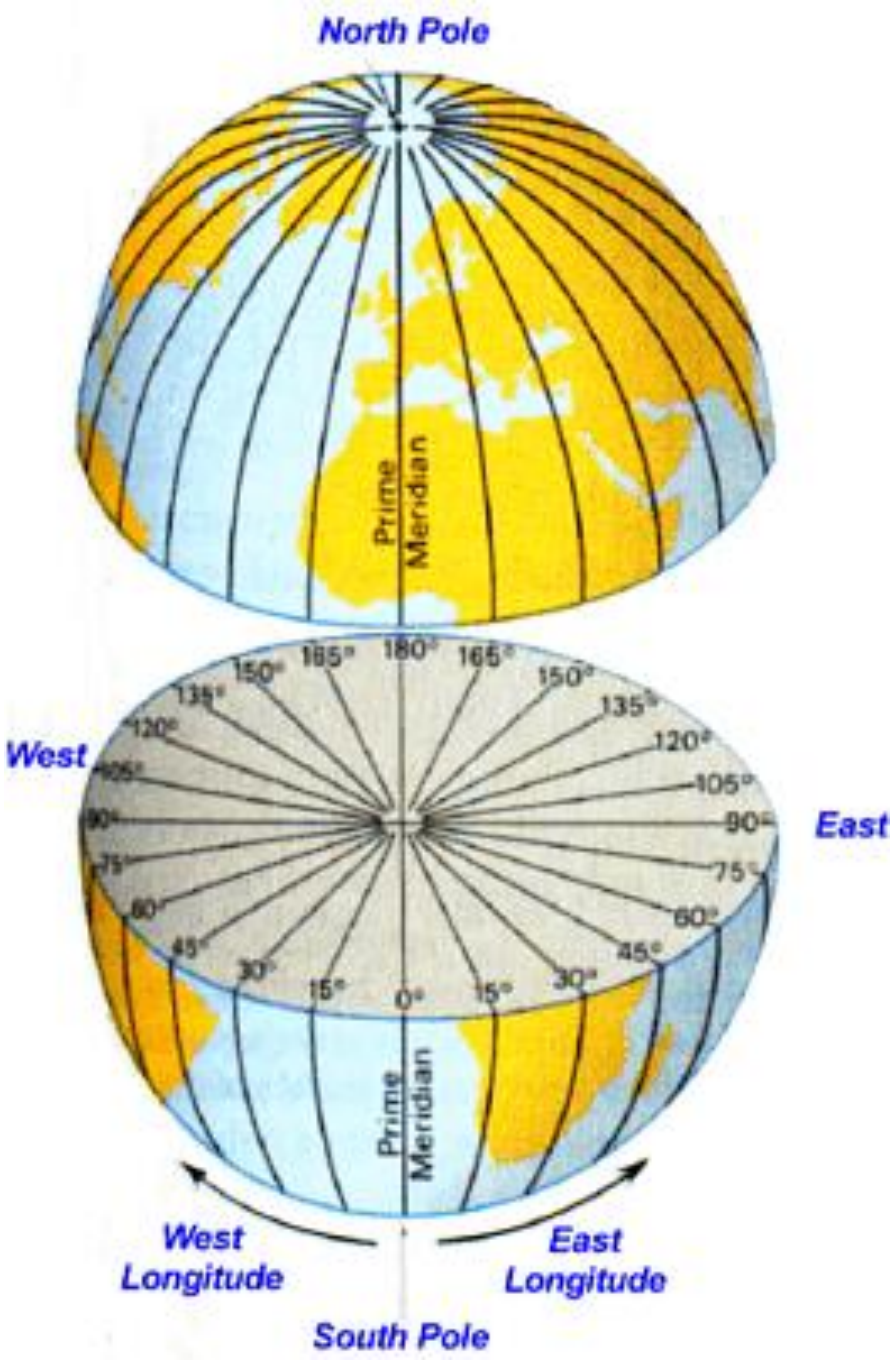
1. Determine the spacing of the lines of latitude (*i.e.* parallels) and label with the appropriate values in degrees.





Longitude

- Longitude is the angular distance east or west, measured in a plane parallel to the equator.
- On a globe or map longitude is represented by lines running north and south, perpendicular to the equator.
- Longitude, λ, is an angle in the range: $-180^{o} \leq \lambda \leq +180^{o}$



source: Geography World – www. geograpyworldonline.com

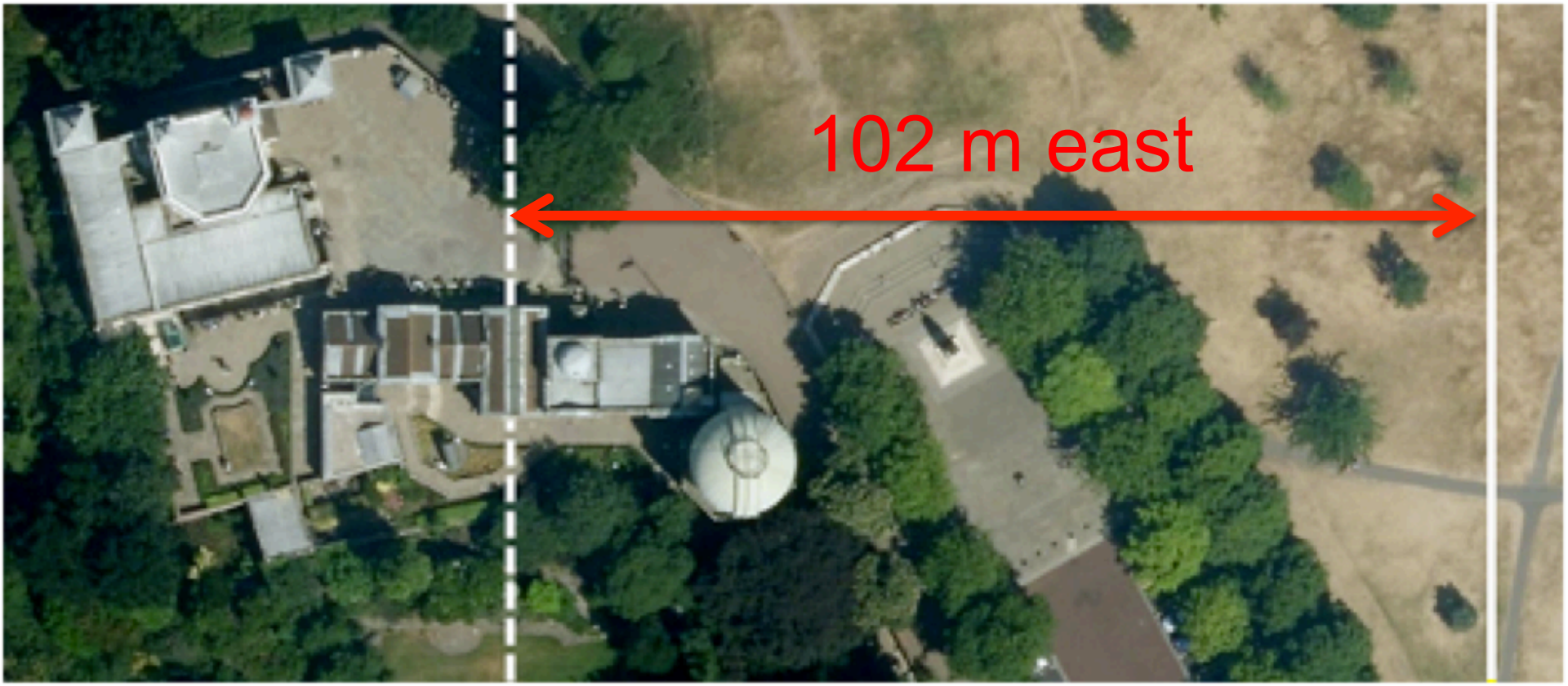
the Prime Meridian

- The north-south lines of longitude are sometimes referred to as meridians.
- The reference for measuring longitude is the **prime meridian**, which is an imaginary north and south line passing through Greenwich England.
- By definition (and international agreement), the prime meridian is zero degrees longitude.


Greenwich Royal Observatory
established 1675

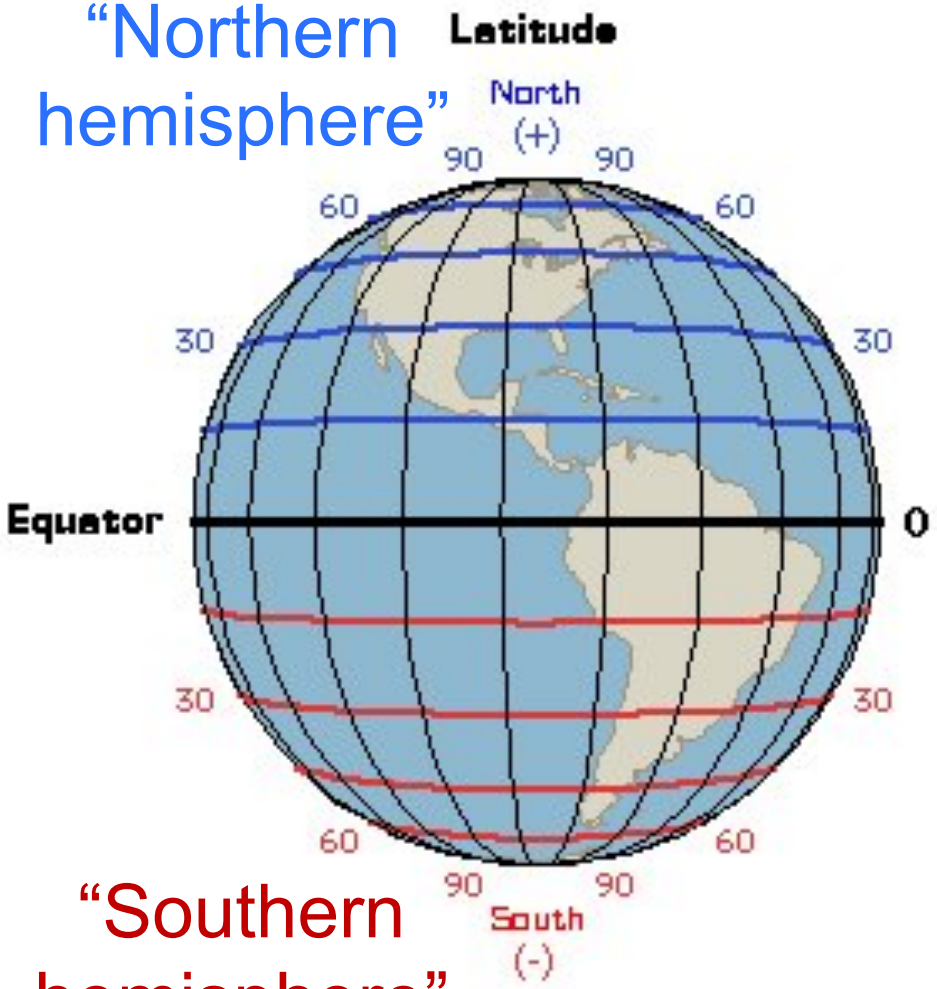
Original Prime Meridan

Prime Meridan determined by satellites 2015

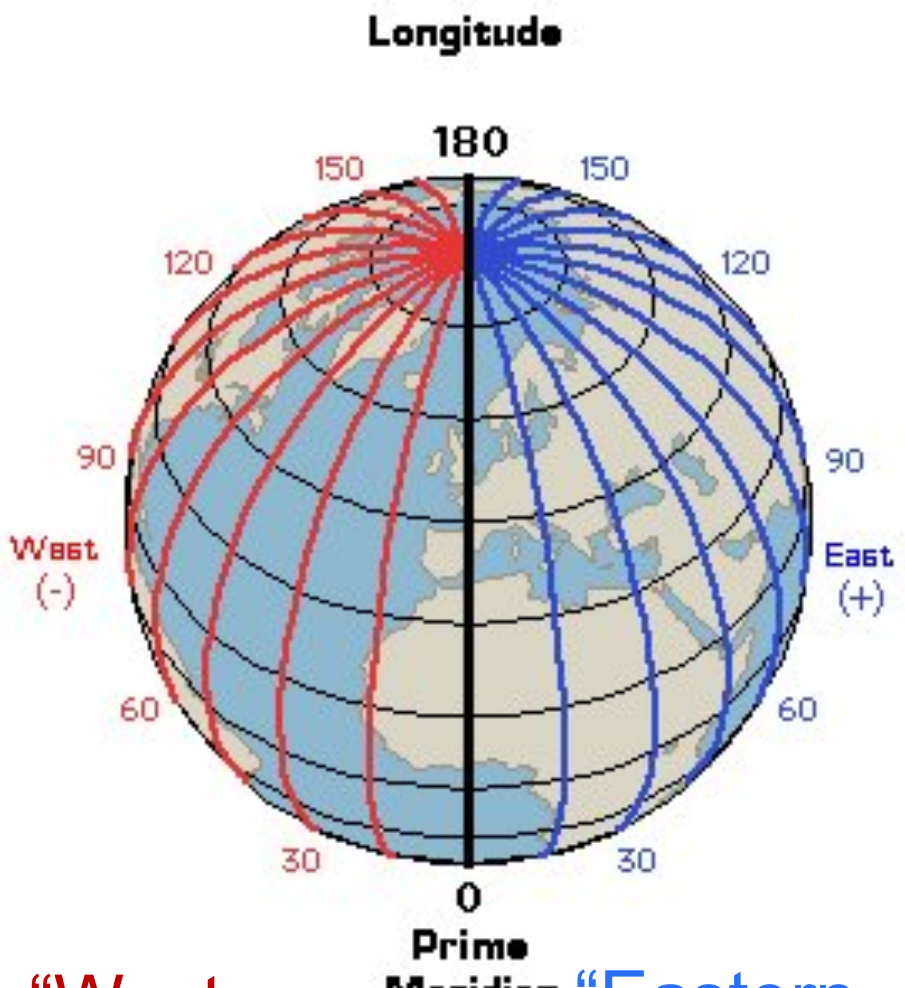


source: Google Maps, Infoterra Ltd, and Bluesky

“Northern hemisphere”



“Southern hemisphere”



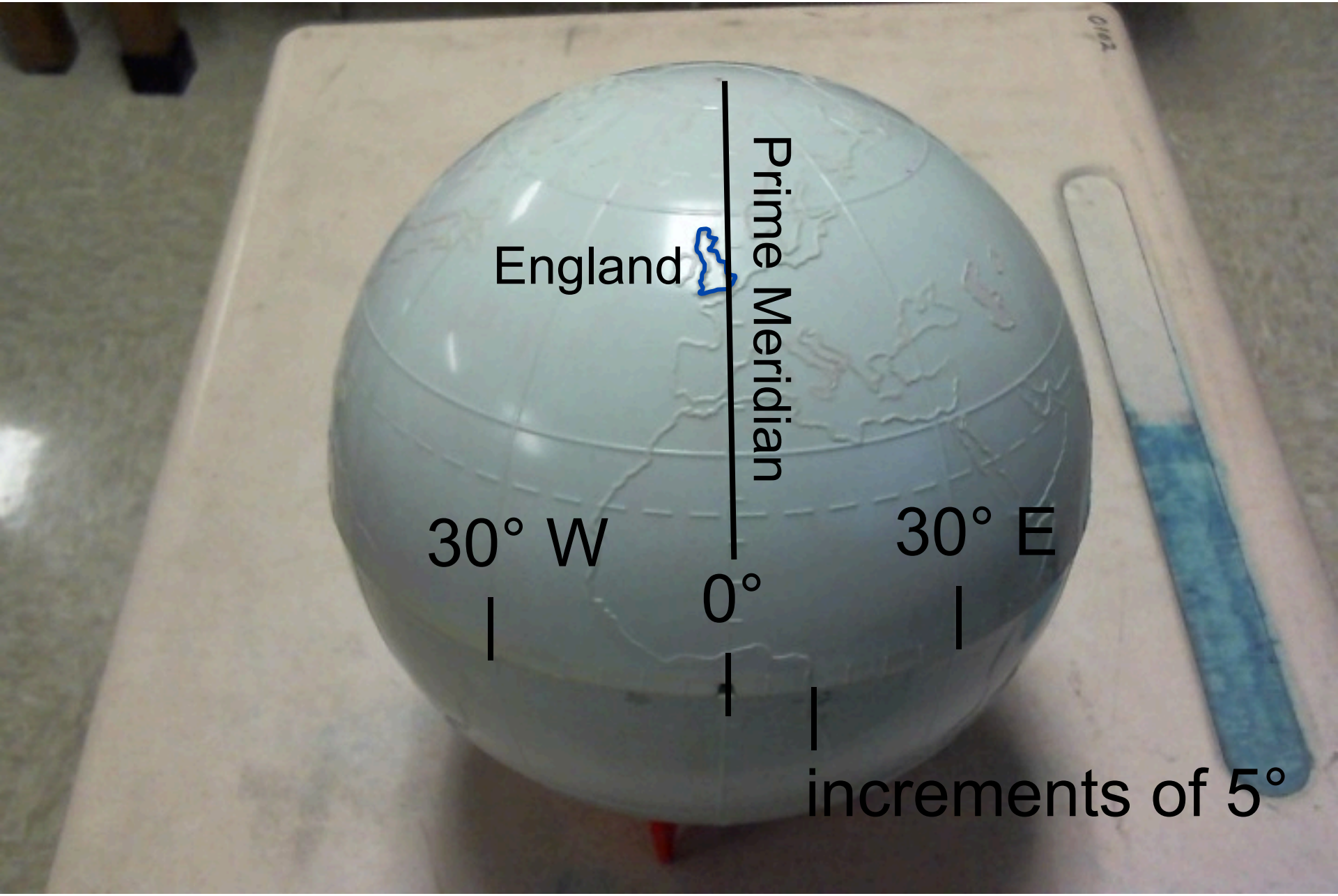
“Western hemisphere”

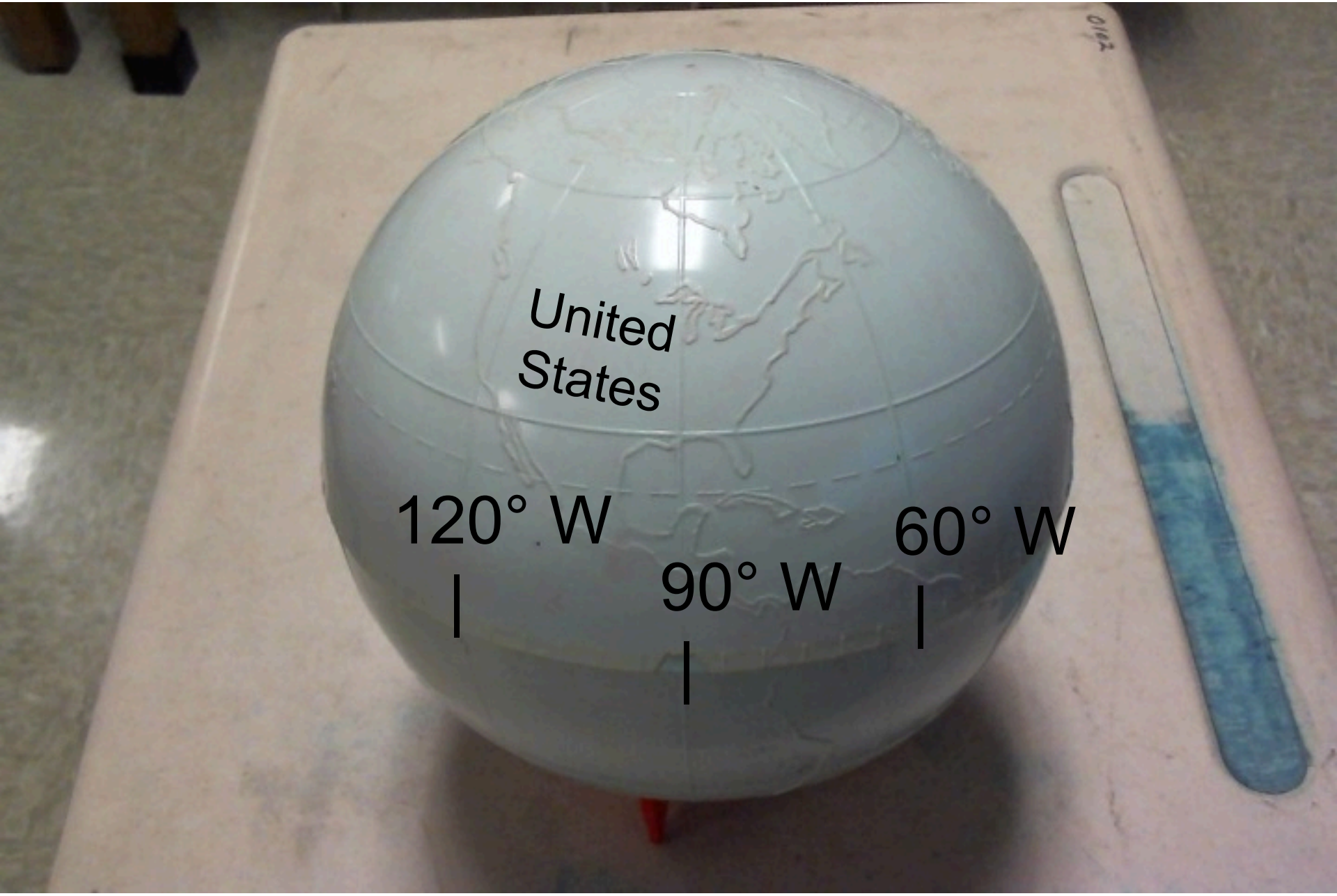
“Eastern hemisphere”

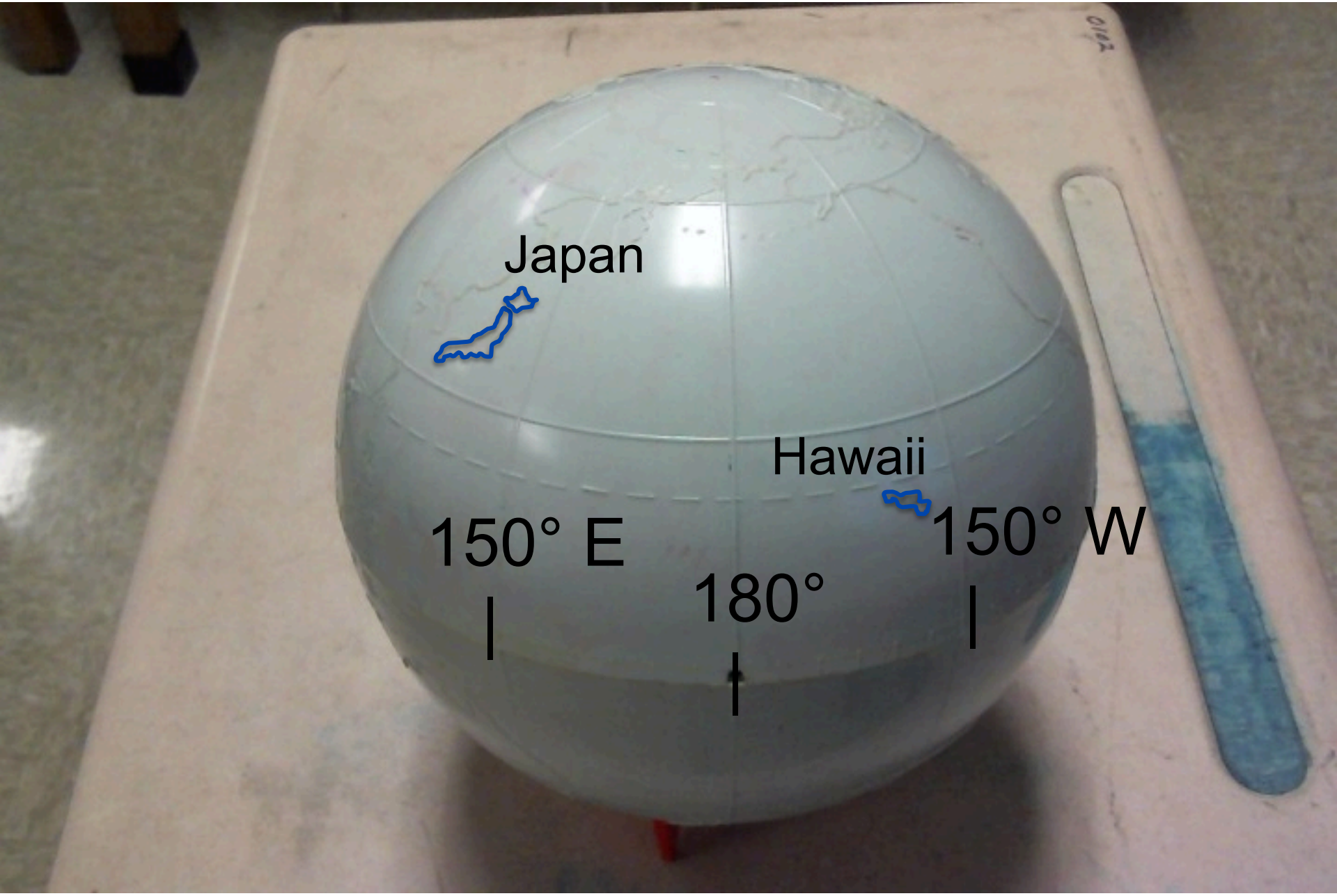

Greenland
(DENMARK)
Greenland Sea
Baffin Bay
Davis Strait
Denmark Strait
Norwegian Sea
Iceland
Jan Mayen (NORWAY)
Repulse Bay
Iqaluit (Frobisher Bay)
Nuuk (Godthåb)
Hudson Bay
CANADA
Edmonton
Winnipeg
Labrador Sea
Island of Newfoundland
St. Pierre and Miquelon (FRANCE)
Québec
Toronto
Chicago
New York
Denver
UNITED STATES
Los Angeles
Dallas
Bermuda (U.K.)
NORTH ATLANTIC OCEAN
Azores (PORT.)
Sweden
Norway
Finland
United Kingdom
Ireland
London
North Sea
Denmark
Germany
Poland
Paris
France
Italy
Portugal
Spain
Greece
Malta
Mediterranean Sea
Madeira Islands (PORT.)
Canary Islands (SPAIN)
Casablanca
Morocco
Tunisia
Algeria
Libya
Western Sahara
Cape Verde
Mauritania
Mali
Niger
Chad
Senegal
The Gambia
Guinea-Bissau
Guinea
Burkina Faso
Benin
Nigeria
Lagos
Sierra Leone
Côte d'Ivoire
Togo
Ghana
Liberia
Central African Republic
Cameroon
Equatorial Guinea
Gulf of Guinea
São Tomé and Príncipe
Gabon
Rep. of the Congo
Dem. Rep. of the Congo
Kinshasa
Gulf of Mexico
Mexico
The Bahamas
Cuba
Haiti
Dominican Republic
Jamaica
Belize
Guatemala
Honduras
El Salvador
Nicaragua
Costa Rica
Panama
Caribbean Sea
Trinidad and Tobago
Venezuela
Guyana
Suriname
French Guiana (FRANCE)
Colombia
Ecuador
Galapagos Islands (ECUADOR)
Manaus

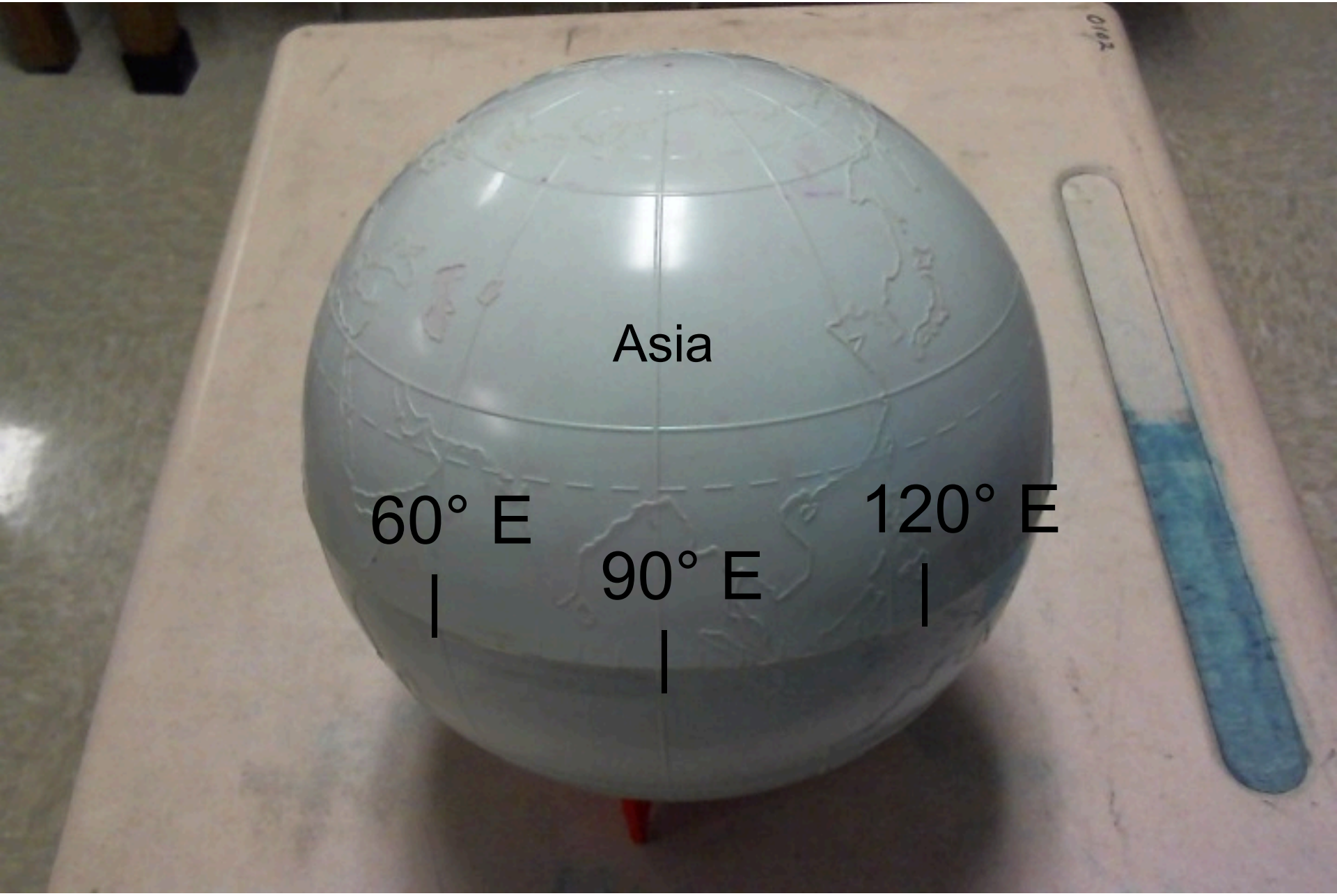
Fun With Globes

1. Determine the spacing of the lines of latitude (*i.e.* parallels) and label with the appropriate values in degrees.
2. Determine the spacing of the lines of longitude (*i.e.* meridians) and label with the appropriate values in degrees.



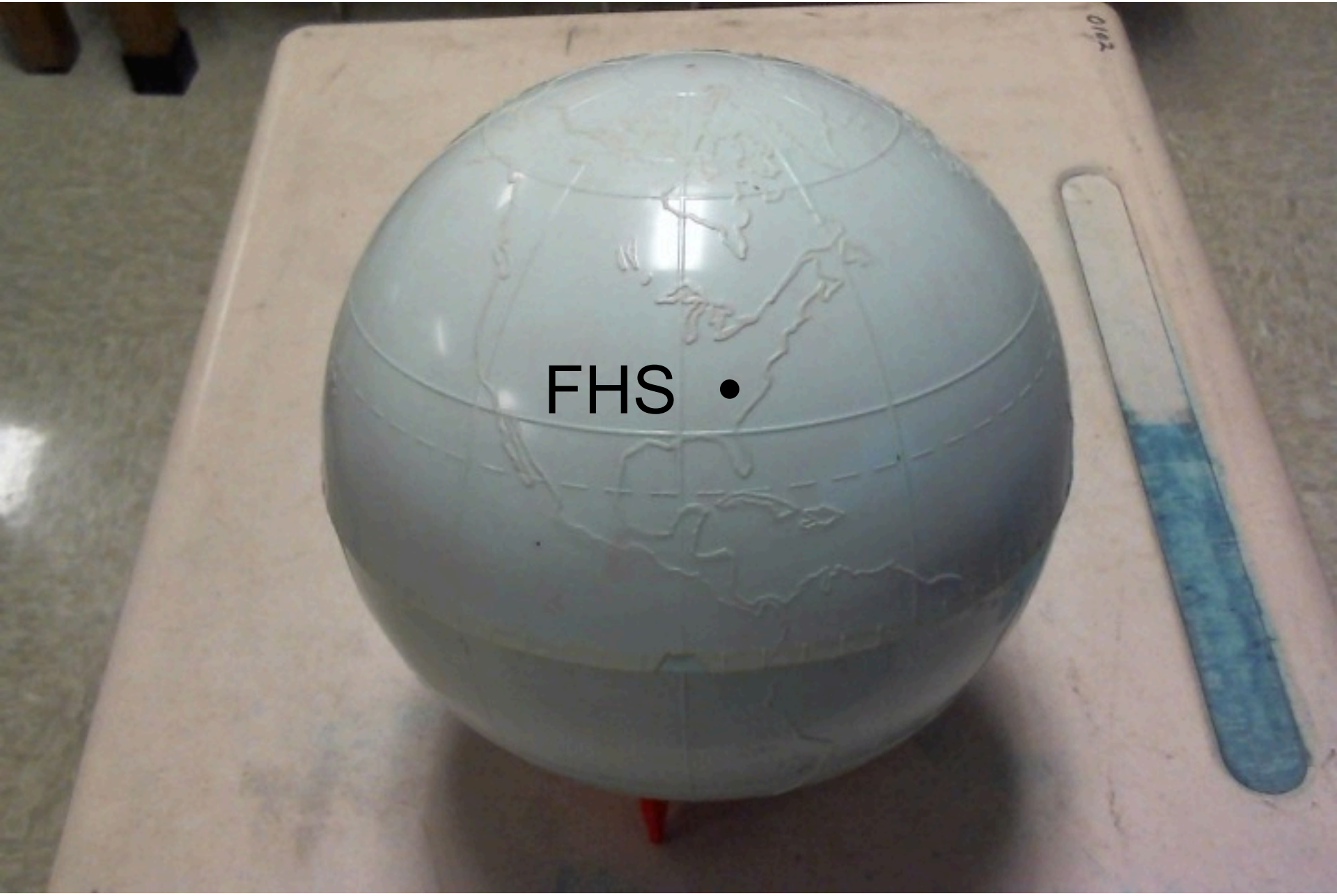


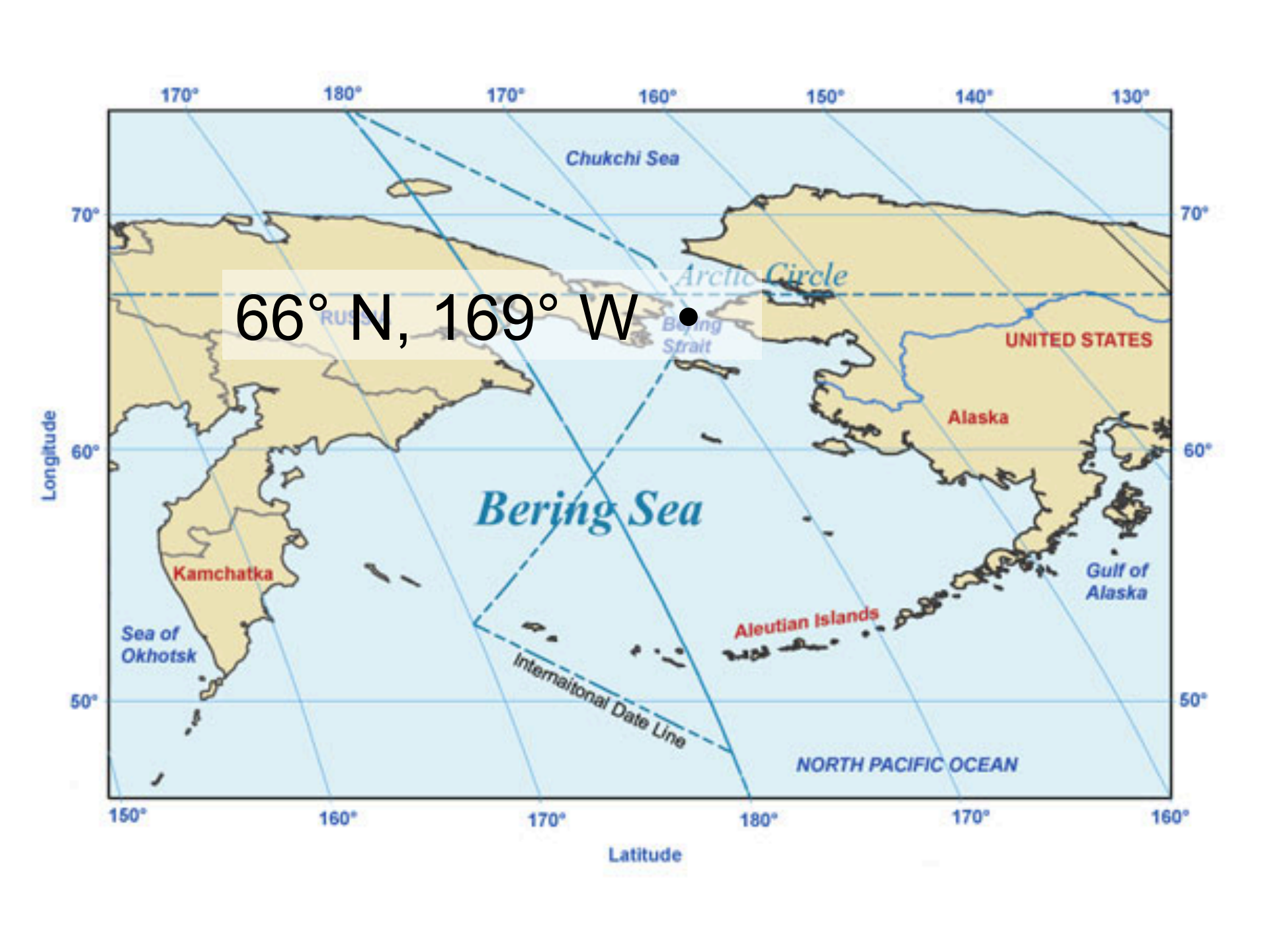




Fun With Globes

1. Determine the spacing of the lines of latitude (*i.e.* parallels) and label with the appropriate values in degrees.
2. Determine the spacing of the lines of longitude (*i.e.* meridians) and label with the appropriate values in degrees.
3. Mark the location of FHS based on its coordinates.
4. Determine the approximate coordinates of (a) the Bering Straight and (b) Madagascar.




66° N, 169° W
Chukchi Sea
Arctic Circle
Bering Strait
UNITED STATES
Alaska
Bering Sea
Kamchatka
Sea of Okhotsk
Gulf of Alaska
Aleutian Islands
International Date Line
NORTH PACIFIC OCEAN
170°
180°
170°
160°
150°
140°
130°
70°
60°
50°
150°
160°
170°
180°
170°
160°
Longitude
Latitude


Madagascar
COMOROS
MAYOTTE (France)
MOZAMBIQUE
Mozambique Channel
INDIAN OCEAN
MAURITIUS
RÉUNION (France)
Cap d'Ambre
Antsiranana
Nosy Be
Andoany
Ambanja
Iharaña
Maromokotro ▲ 9,436 ft. (2,876 m)
Antsohihy
Antalaha
Cap Est
Maroantsetra
Mahajanga
Sofia
Mandritsara
Baie d'Antongila
Nosy Sainte Marie
Besalampy
Maevatanana
Betsiboka
Ambatondrazaka
Maintirano
Toamasina
Tsiroanomandidy
Antananarivo
Ambatolampy
Antsirabe
Tsiafajavona 8,671 ft. (2,642 m)
Ambositra
Mananjary
Morombe
Fianarantsoa
Manakara
Massif de l'Isalo
Ihosy
Farafangana
Toliara
Betroka
Betioky
Ampanihy
Menarandra
Tôlañaro
Cap Sainte Marie
12° S
18° S
24° S
Tropic of Capricorn
36° E
42° E
48° E
0 150 Miles
0 150 Kilometers
© MAPQUEST.COM

20° S, 46° E •

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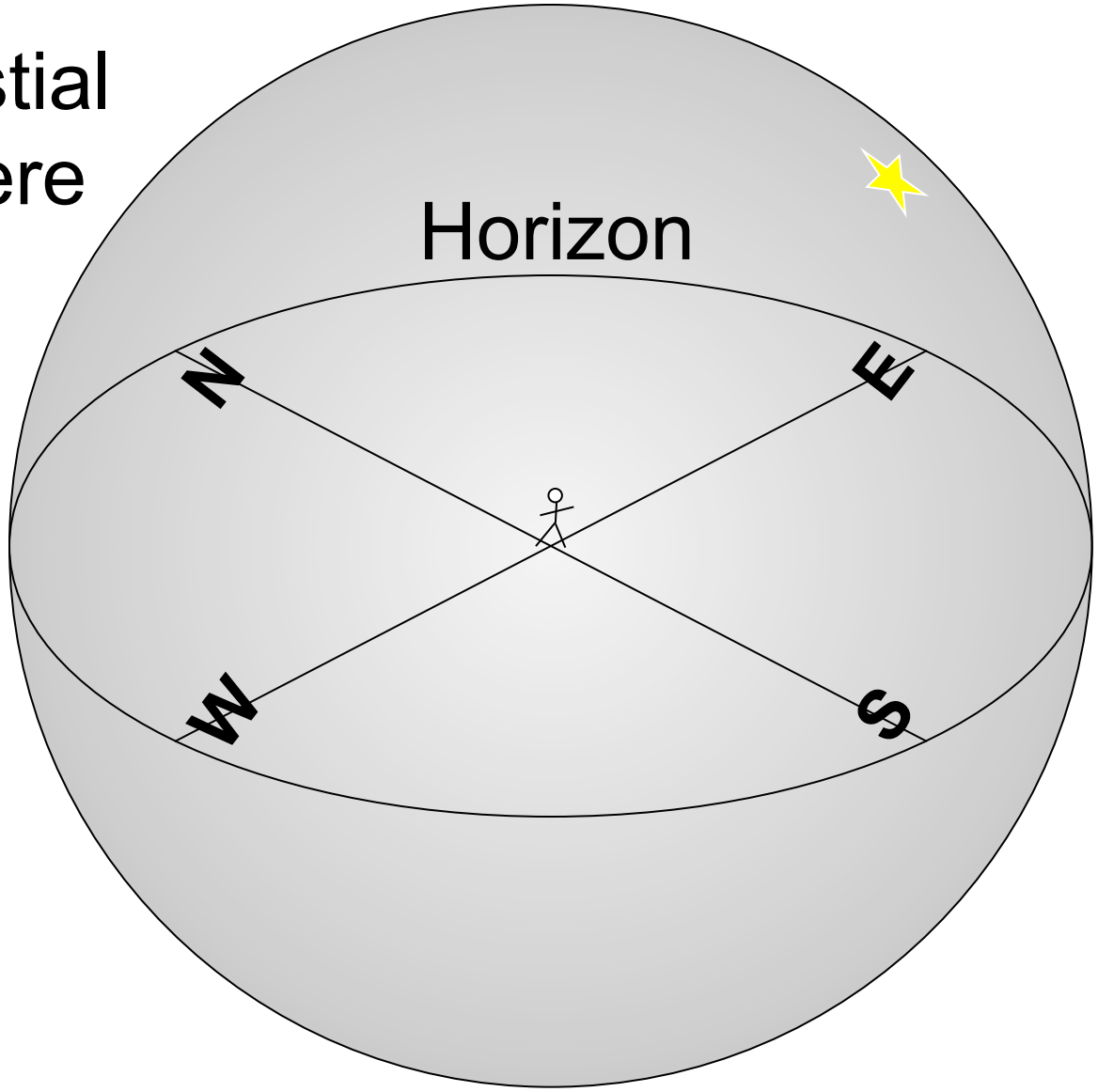
Altazimuth Coordinates

- The purpose is to specify the apparent position of an object from the perspective of the observer.
- Values of altitude and azimuth give the position on the observer's celestial sphere.
- The celestial sphere is an imaginary globe surrounding the observer that is located at its center.

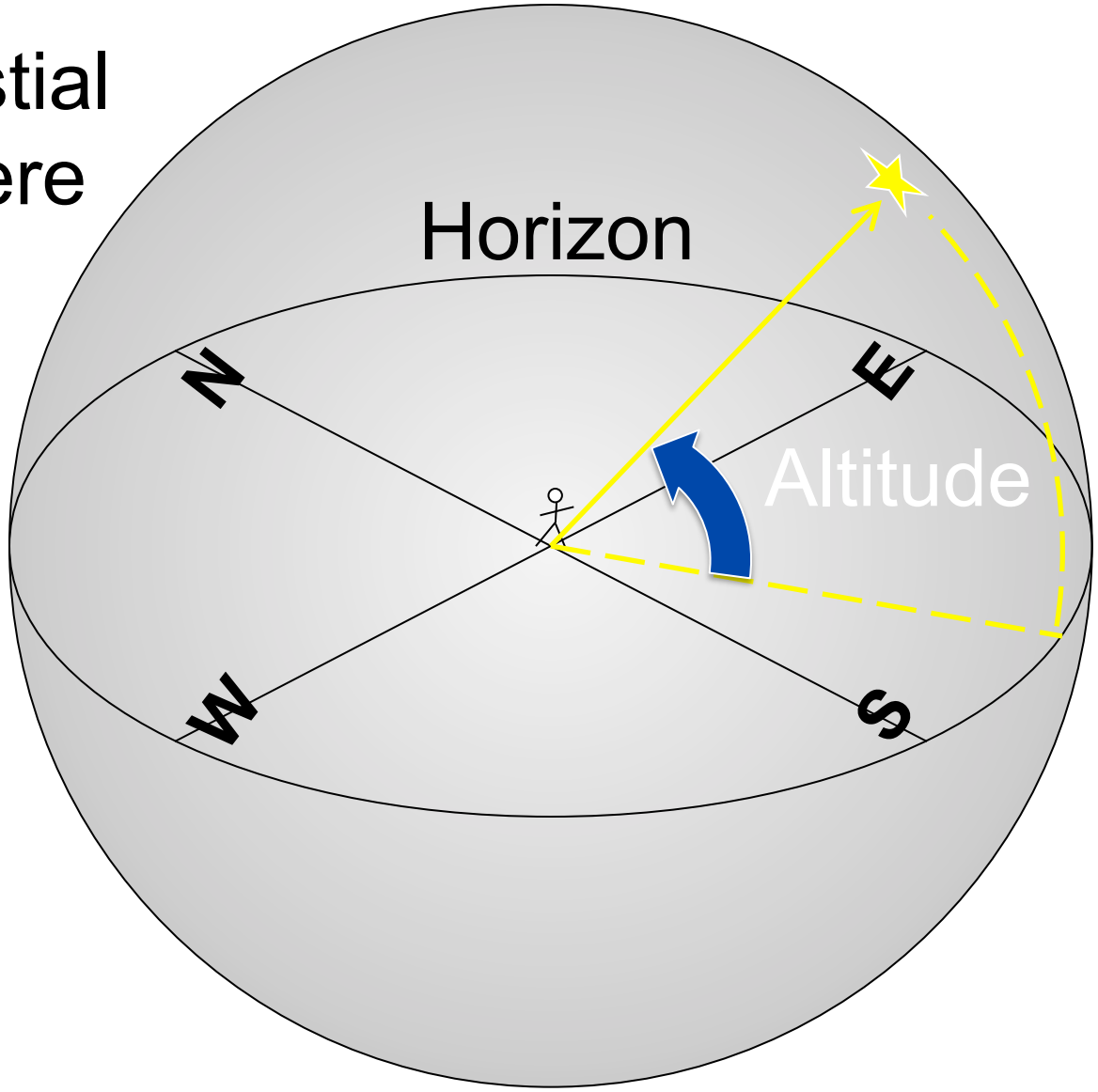
Celestial Sphere



Altitude

- Altitude is the angular distance measured vertically from the observer's horizon.
- Altitude, φ, is an angle in the range:
  $-90^\circ \leq \varphi \leq +90^\circ$
- 0° = on the horizon (level with the eye)
- $+90^\circ$ = at the zenith (directly above)
- -90° = at the nadir (directly below)

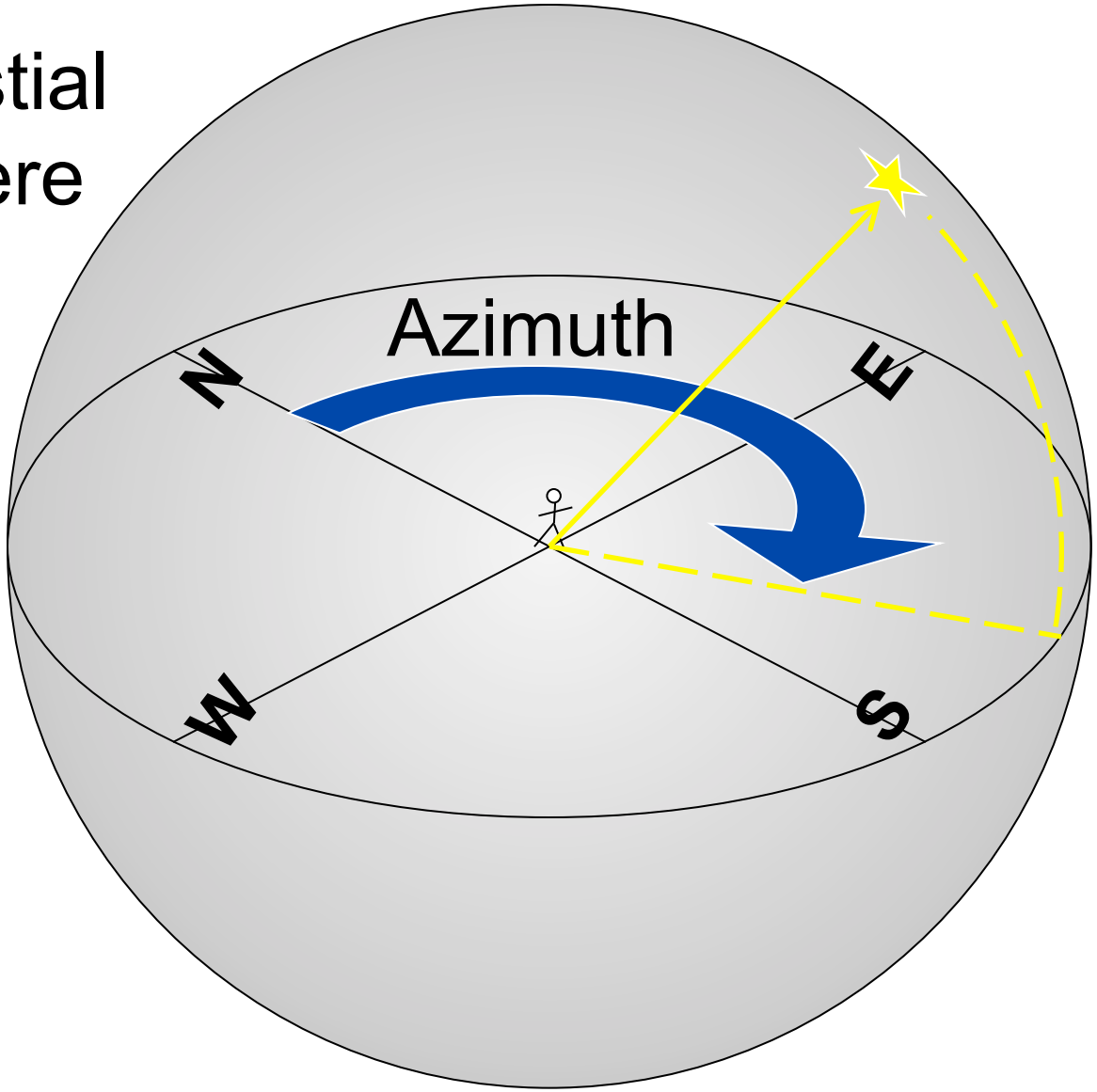
Celestial Sphere

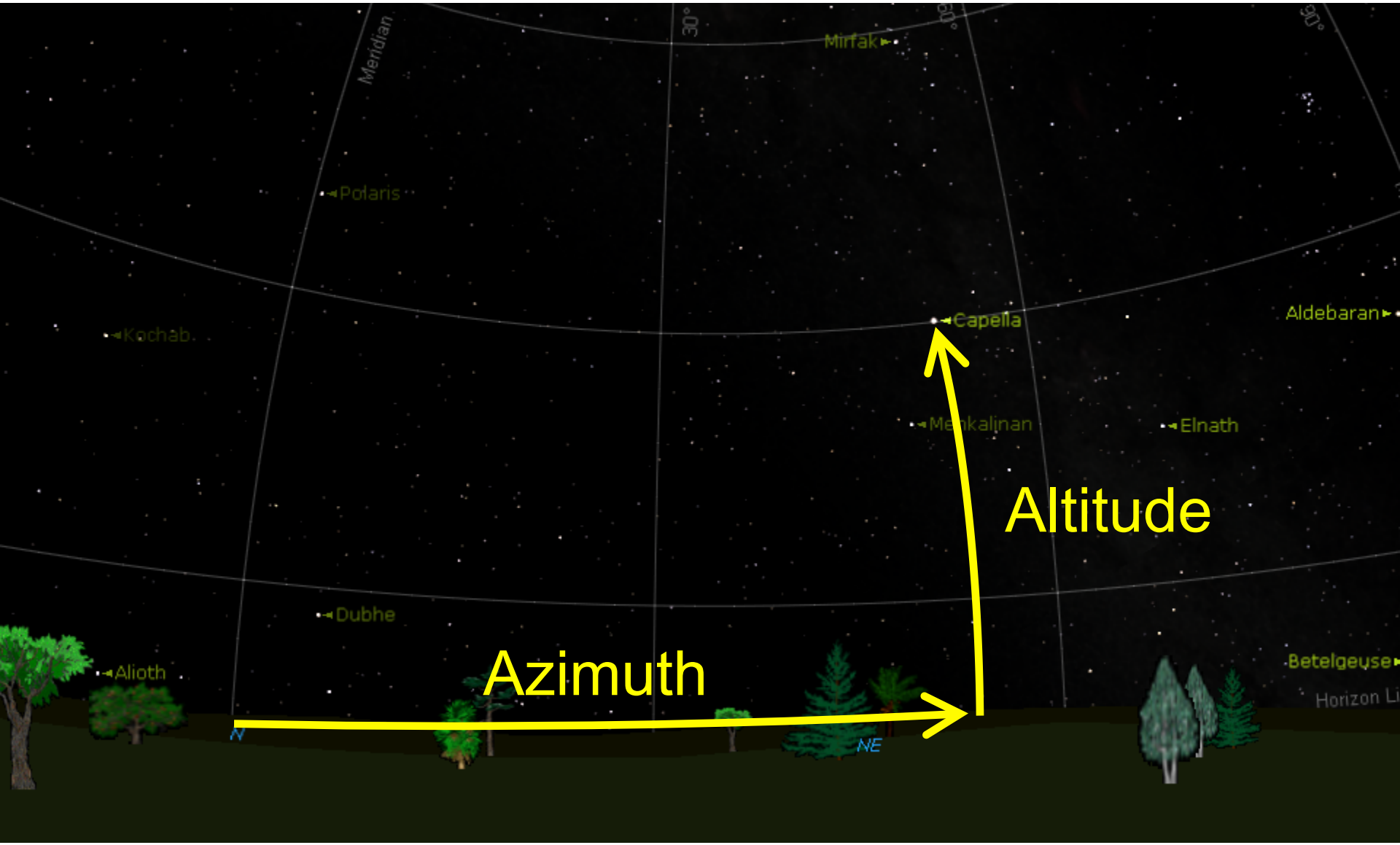


Azimuth

- Azimuth is the angular distance measured clockwise from north in the plane of the horizon.
- Azimuth, θ, is an angle in the range: $0^\circ \leq \theta < 360^\circ$
- 0° = North
- 90° = East
- 180° = South
- 270° = West

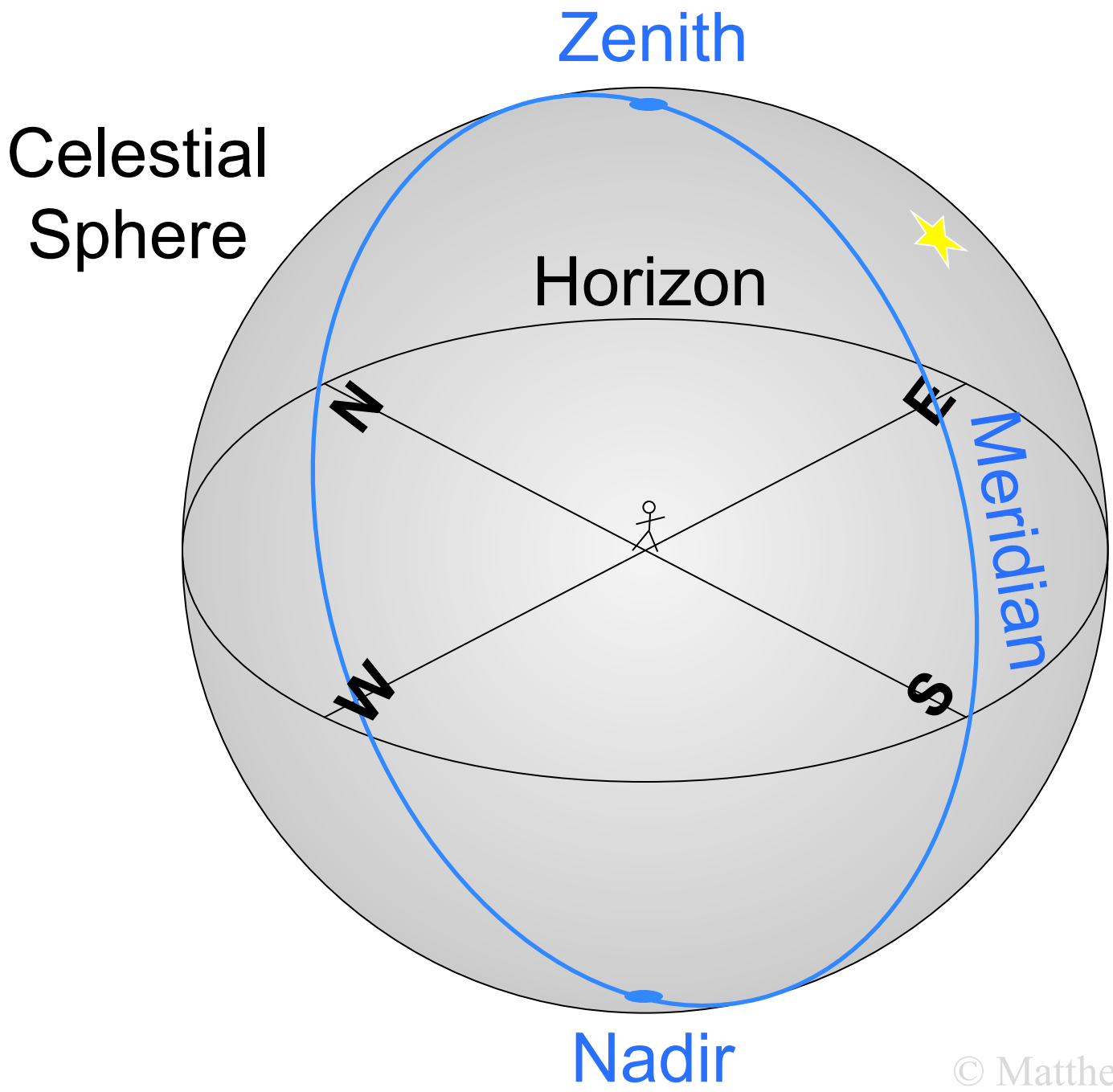
Celestial Sphere




Meridian
30°
Mirfak
Polaris
Kochab
Capella
Aldebaran
Menkalinan
Elnath
Altitude
Dubhe
Alioth
Azimuth
Betelgeuse
Horizon
N
NE

Meridian

- When using altazimuth coordinates, the term meridian refers to an imaginary line passing through the zenith and running north and south around the celestial sphere.
- It is also sometimes referred to as the local meridian or observer's meridian.
- It can be thought of as a projection (into the sky) of the observer's geographical meridian (*i.e.* line of longitude).



Fun With Hemispheres

1. Create an observer and horizon on a blank piece of paper by tracing around the bottom of the hemisphere. Label the four cardinal points on your paper: N, S, E, and W.
2. Use wet erase marker to label the altitude and azimuth lines on the hemisphere. Label the four cardinal directions around the bottom of the hemisphere.

Fun With Hemispheres

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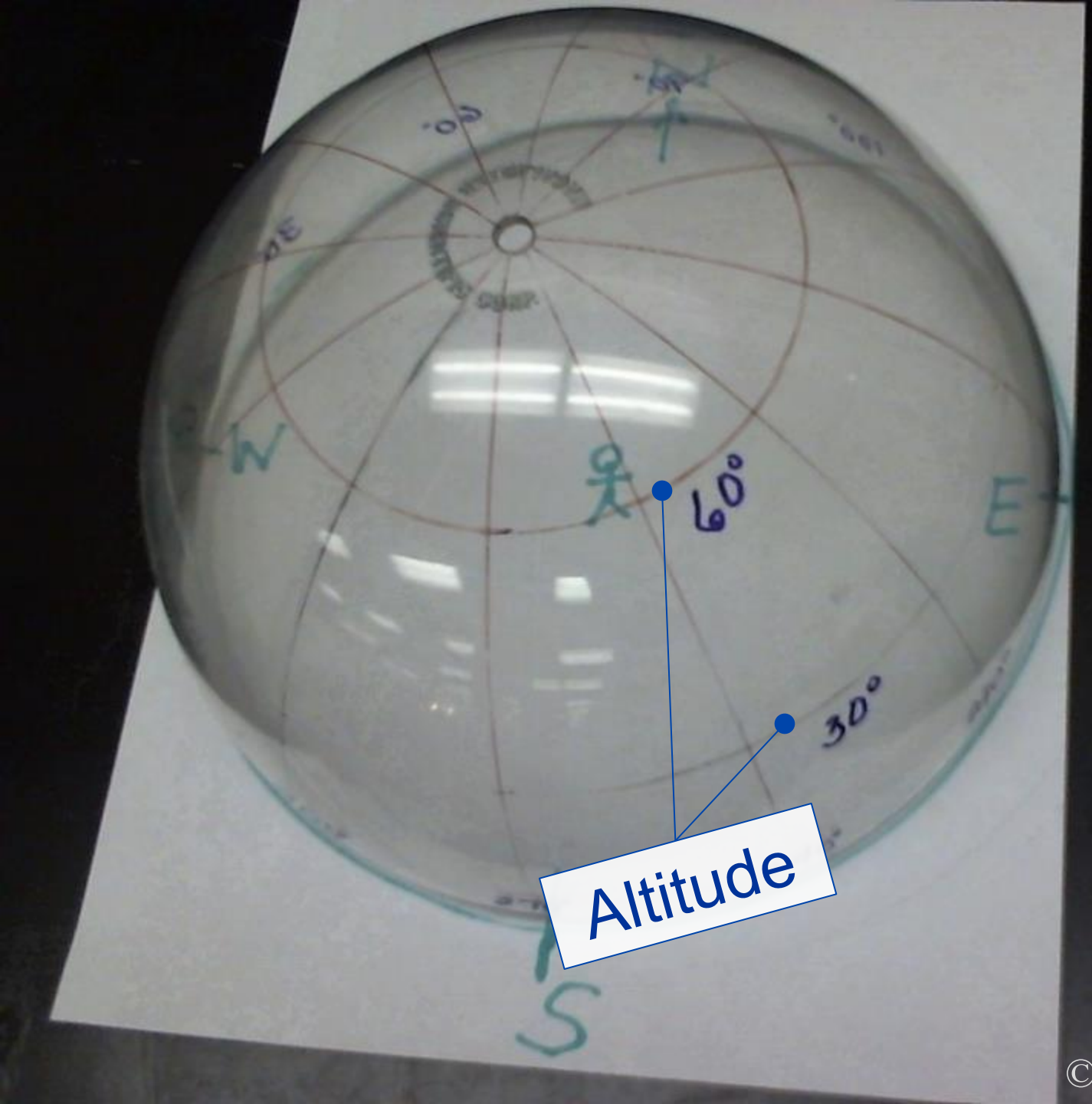

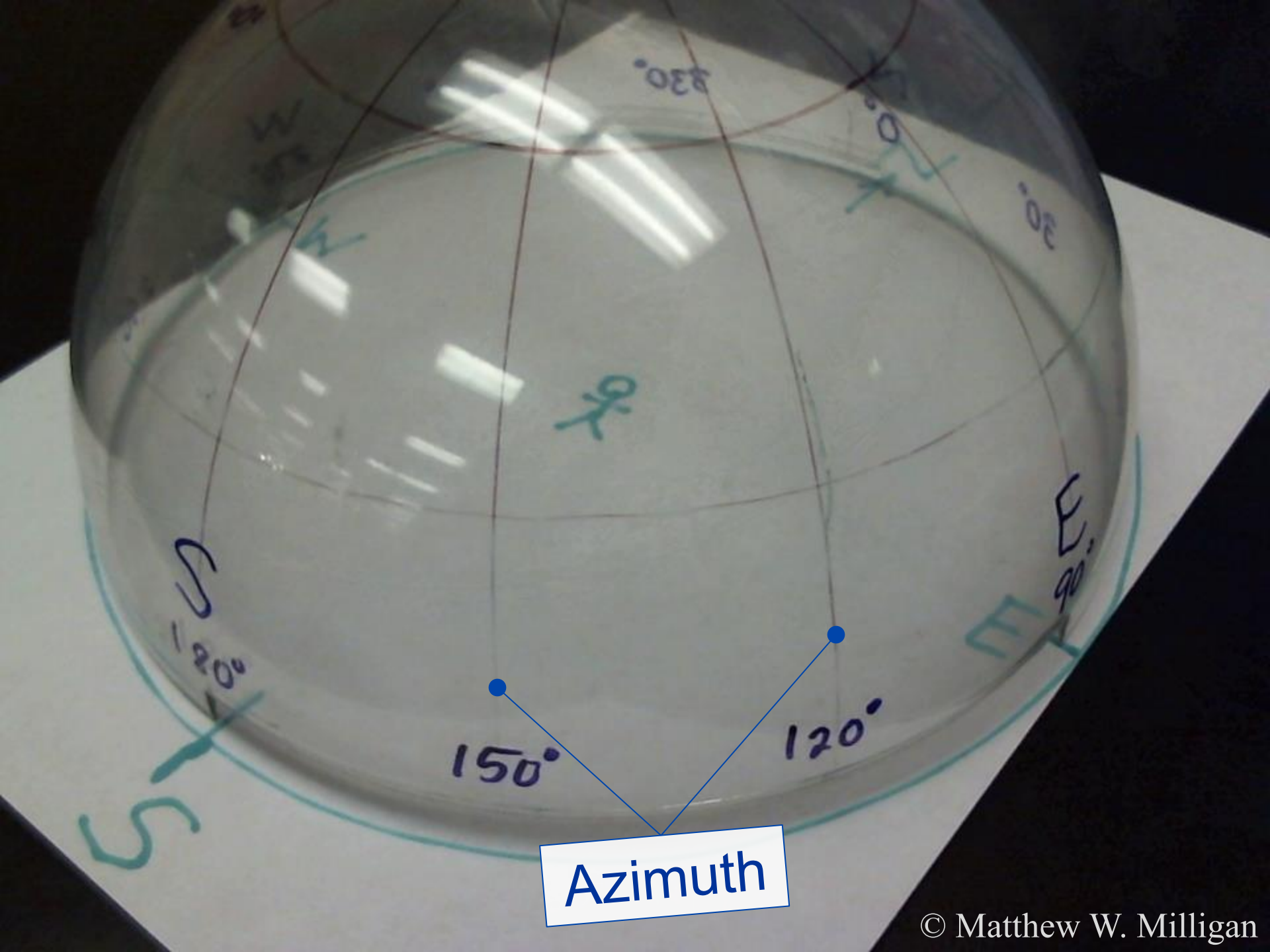

Fun With Hemispheres

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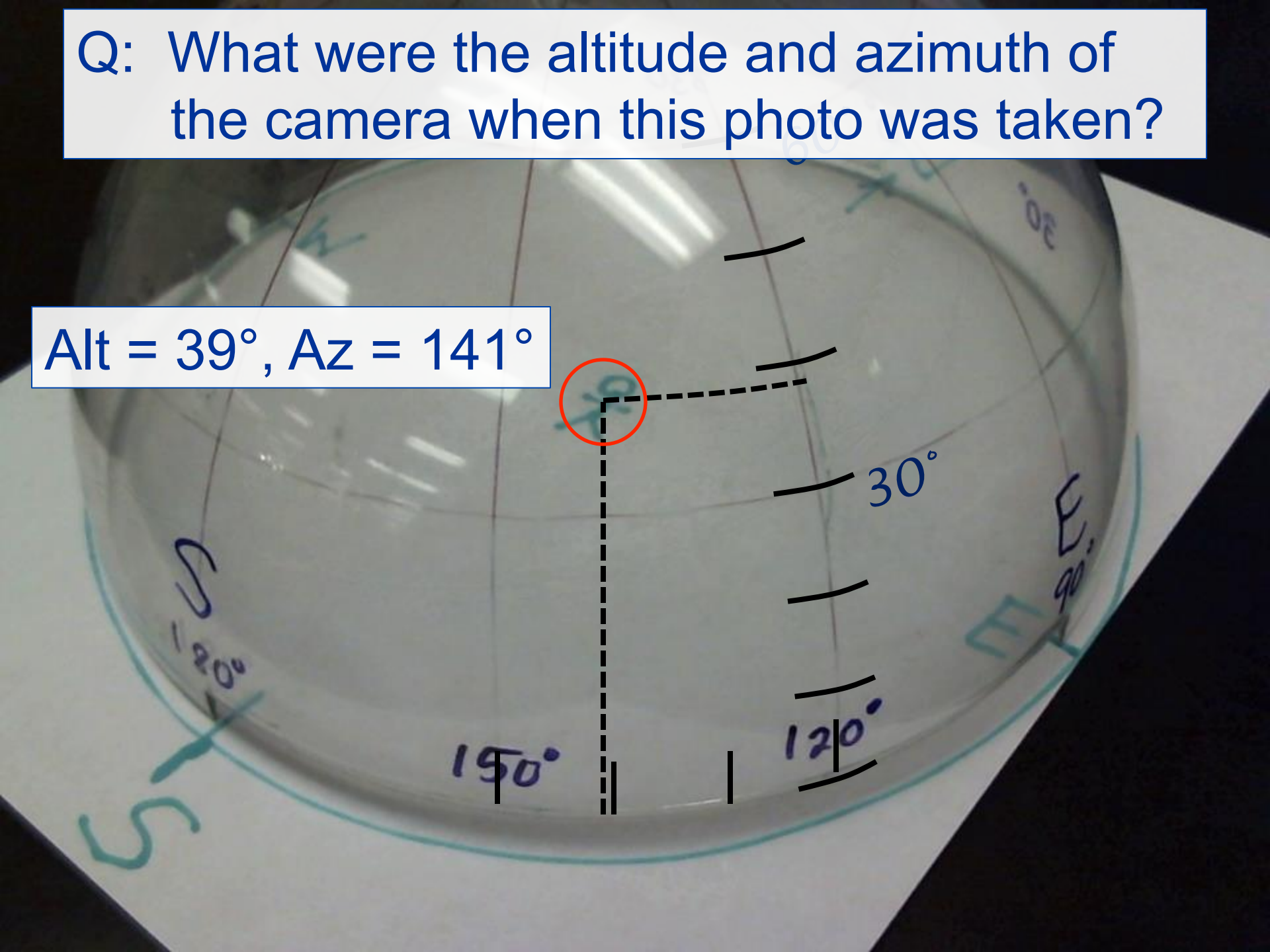
2. Use wet erase marker to label the altitude and azimuth lines on the hemisphere. Label the four cardinal directions around the bottom of the hemisphere.
3. Use wet erase marker to plot the locations of the Sun, Moon, etc. as determined by computer program.

Q: What were the altitude and azimuth of the camera when this photo was taken?



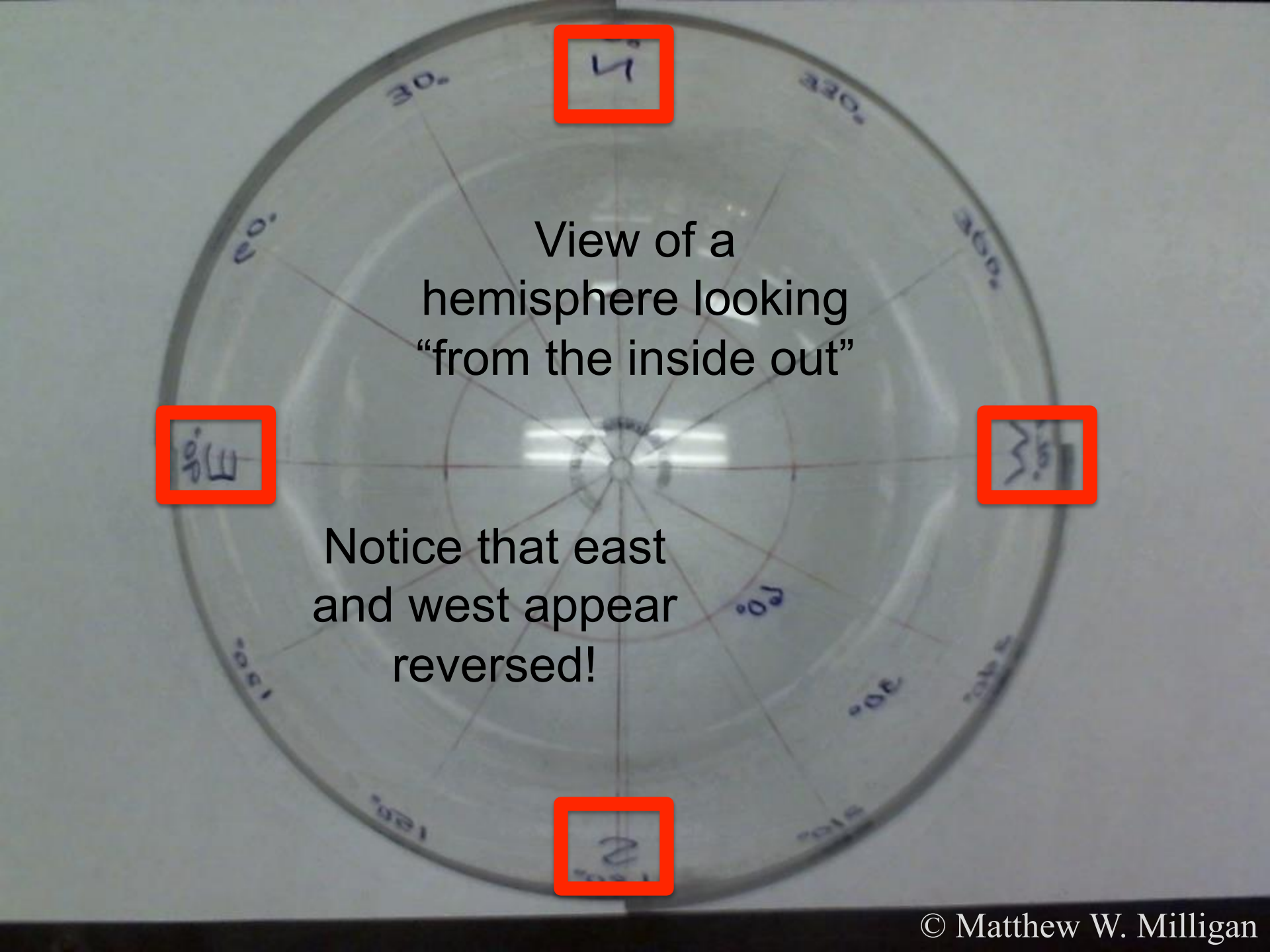
“I Spy” – Altaz Game!

- Secretly locate an object in the room and use your hemisphere to estimate its altitude and azimuth.
  (Partner closes eyes.)
- Give the coordinates to your partner and challenge them to determine the object you spied. Hemisphere must not move!
- Then reverse roles and have your partner spy an object and give you the coordinates for you to guess.

Maps of the Sky

Fun With Hemispheres

4. Turn your hemisphere over and look at the markings “from the inside out”. What do you notice about east and west? What about the azimuth values?



Maps of the Sky