

# Observing your position on the Earth



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*TA for assignments 2 & 3*

- Undergrad in molecular biology
- MSc in Earth and Ocean Science
- Currently a PhD student in the Integrated Remote Sensing Studio
- Research interests: microalgae, estuaries, shorebirds, drones, satellites



# Learning Objectives

- In this lecture you will learn...
  - How to define your position on the Earth.
  - What is the shape of the Earth and how is it defined ?











- This map is historically very significant
- Drawn in 1482 by Ptolemy it is not important in terms of the detail, but it was the first time a coordinate system was used to map locations
- It is the first map with latitude and longitude

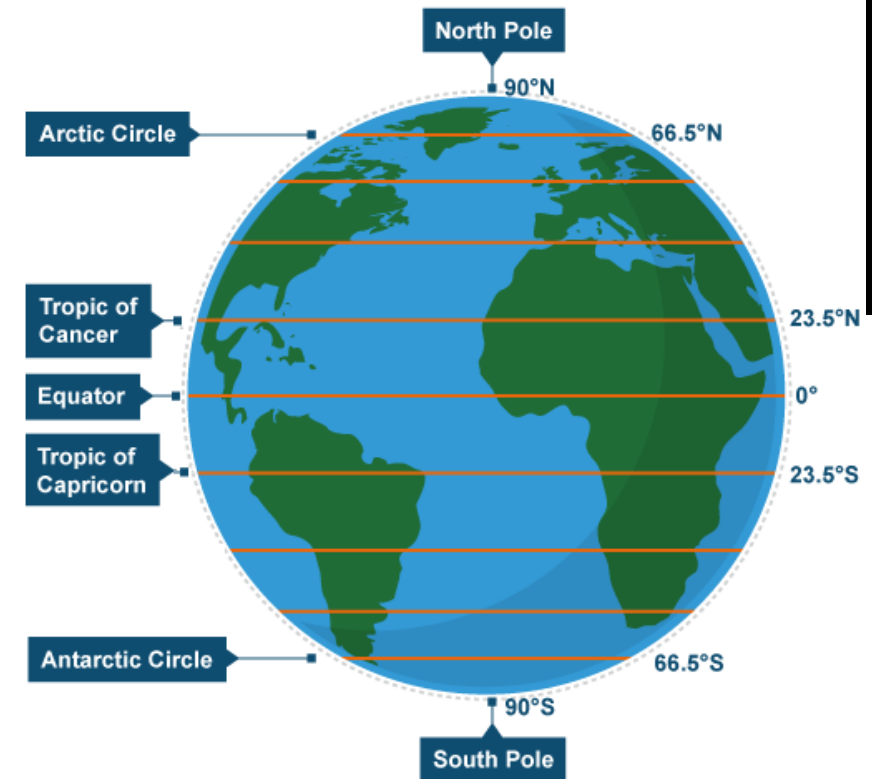
# Elements of Latitude

**Latitude:** angle that describes the north-south position.

**Parallel:** circle connecting all locations with a given latitude.

**Pole:** points where the Earth's axis of rotation meets its surface.

**Equator:** intersection of the Earth's surface with the plane perpendicular to the axis of rotation and midway between the poles. The equator is the biggest parallel.



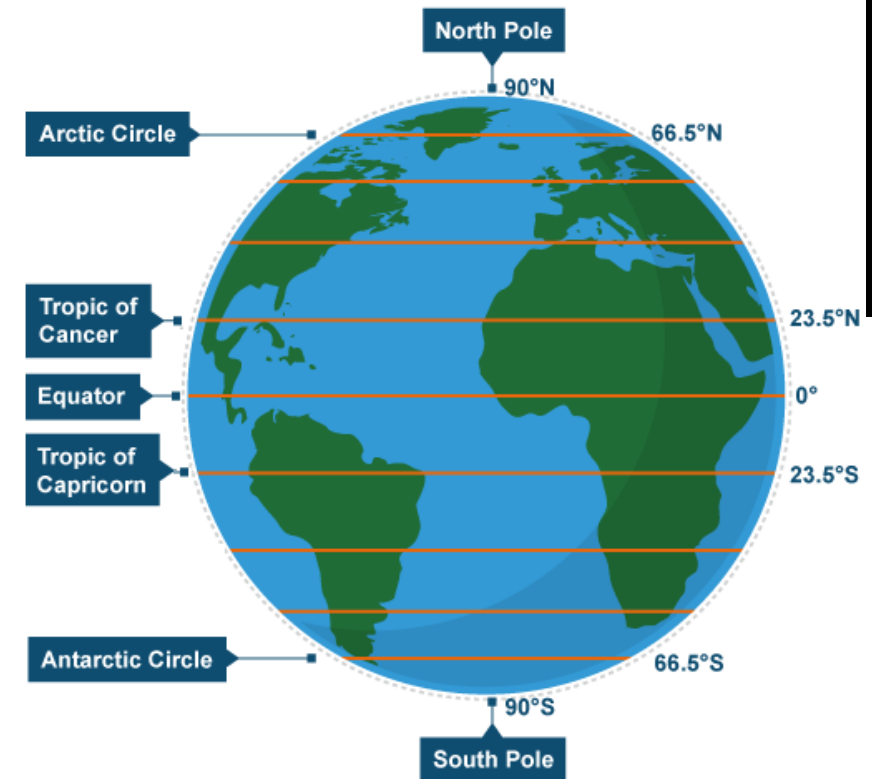
# Elements of Latitude

**Arctic Circle:** Southernmost latitude in the Northern Hemisphere where the Sun can remain continuously above or below the horizon for 24 h.

**Antarctic Circle:** Northernmost latitude in the Southern Hemisphere where the sun can remain continuously above or below the horizon for 24 h.

**Tropic of Cancer:** Northernmost circle of latitude where the Sun can be directly overhead .

**Tropic of Capricorn:** Southernmost circle of latitude where the Sun can be directly overhead.

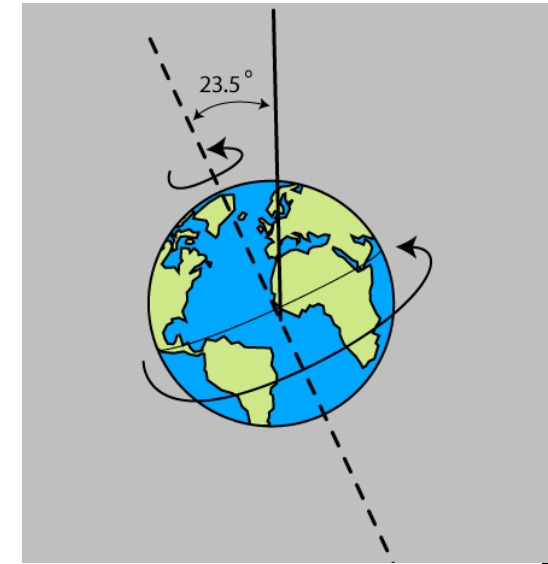


Elements of latitude. (source: BBC)

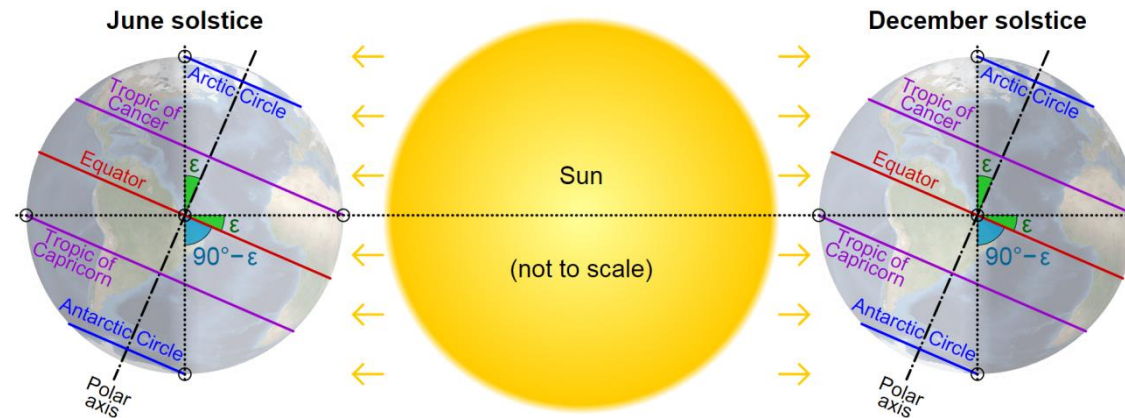
# Earth's axial tilt

The Earth spins at a  $23.44^\circ$  tilt

When the top of the Earth is tilted towards the sun, it is summer in the northern hemisphere. Since the southern hemisphere is tilted away from the sun, it's winter there.



Axial tilt . (source: education.com)



Relationship of Earth's axial tilt with the elements of latitude. (source: Wikimedia commons)

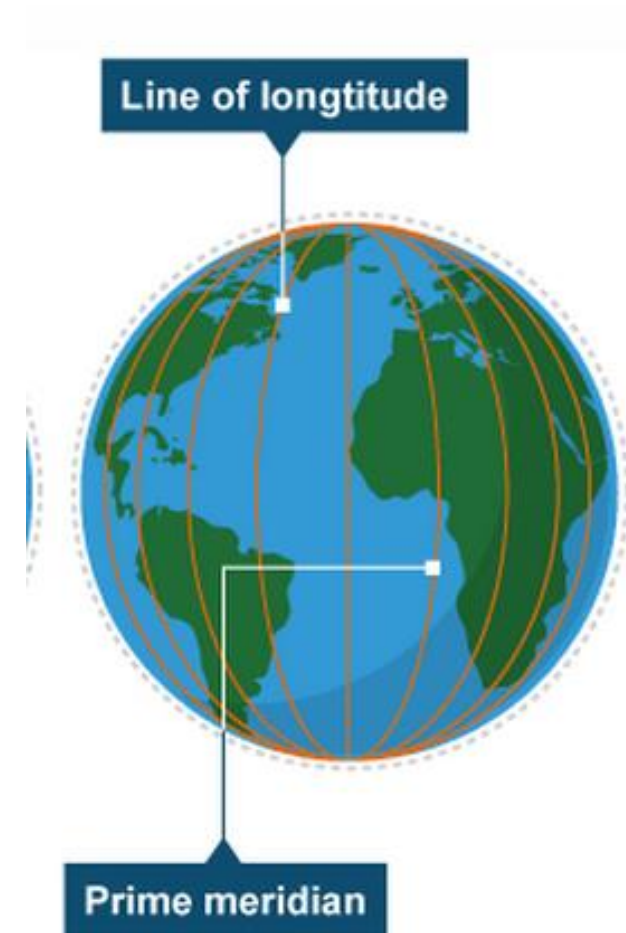


# Elements of Longitude

**Longitude:** angle that describes the east-west position.

**Meridian:** half of an imaginary great circle, terminating at the North Pole and the South Poles, connecting points of equal longitude.

**Prime Meridian** Origin of the measures of Longitude (zero degrees of longitude).



Elements of longitude. (source: BBC)

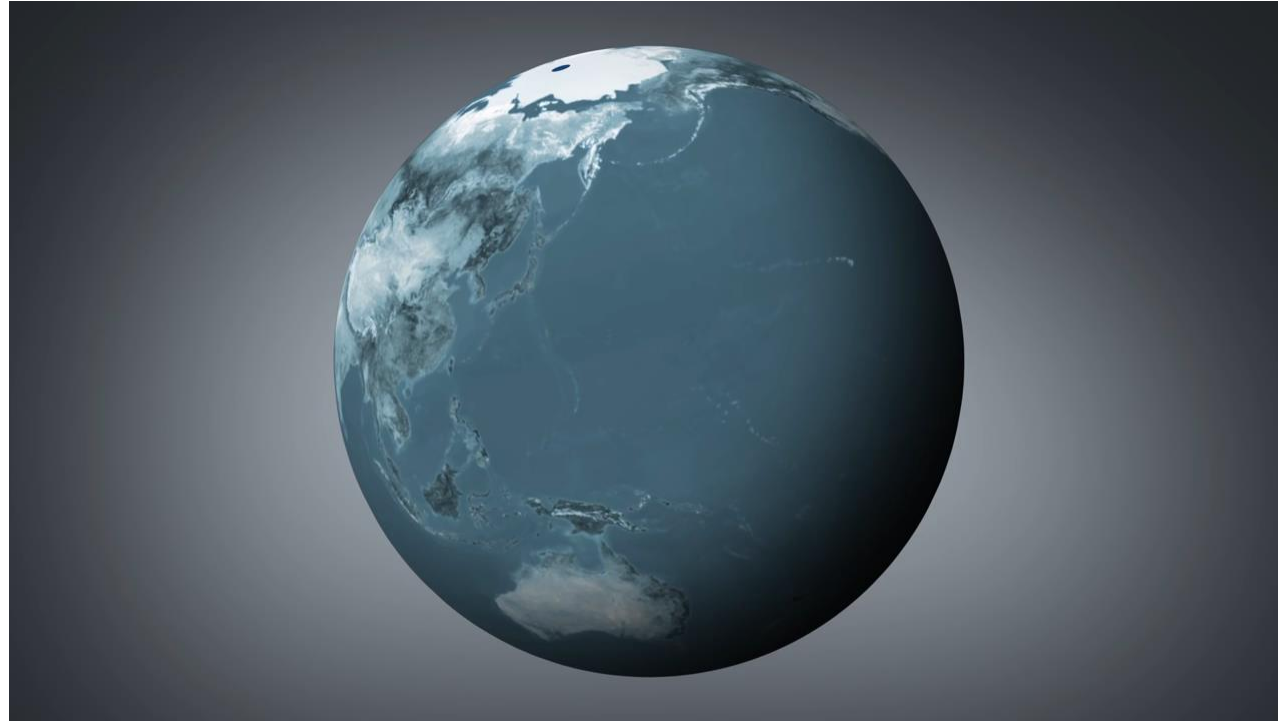




<http://www.excel.md/higher-school-in-britain/Greenwich-School-of-Management/>



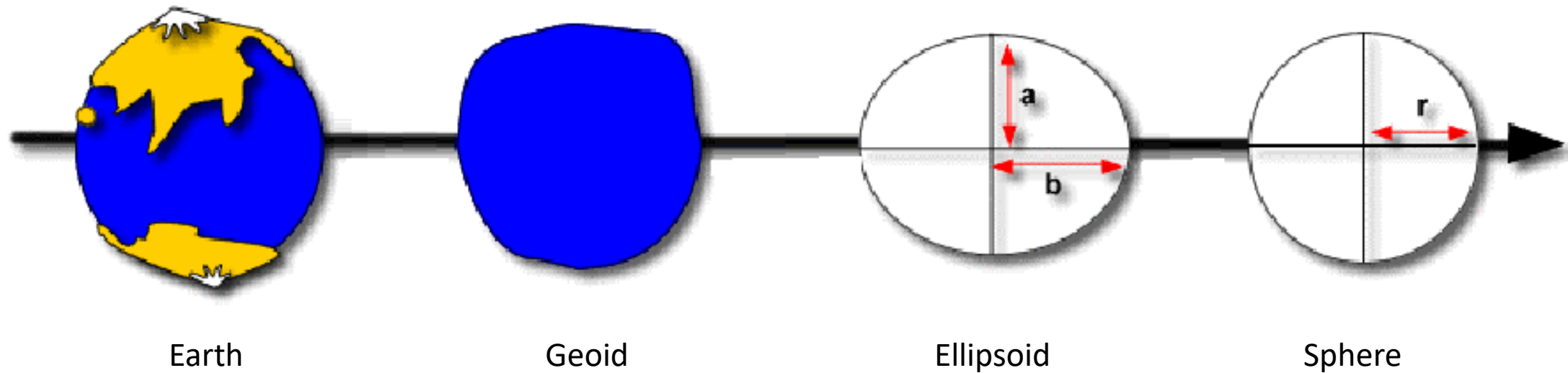
# Defining Position with Latitude and Longitude



Latitude and longitude @ National Air and Space Museum, Smithsonian Institution

The Attributes of Position

# The Shape of the Earth



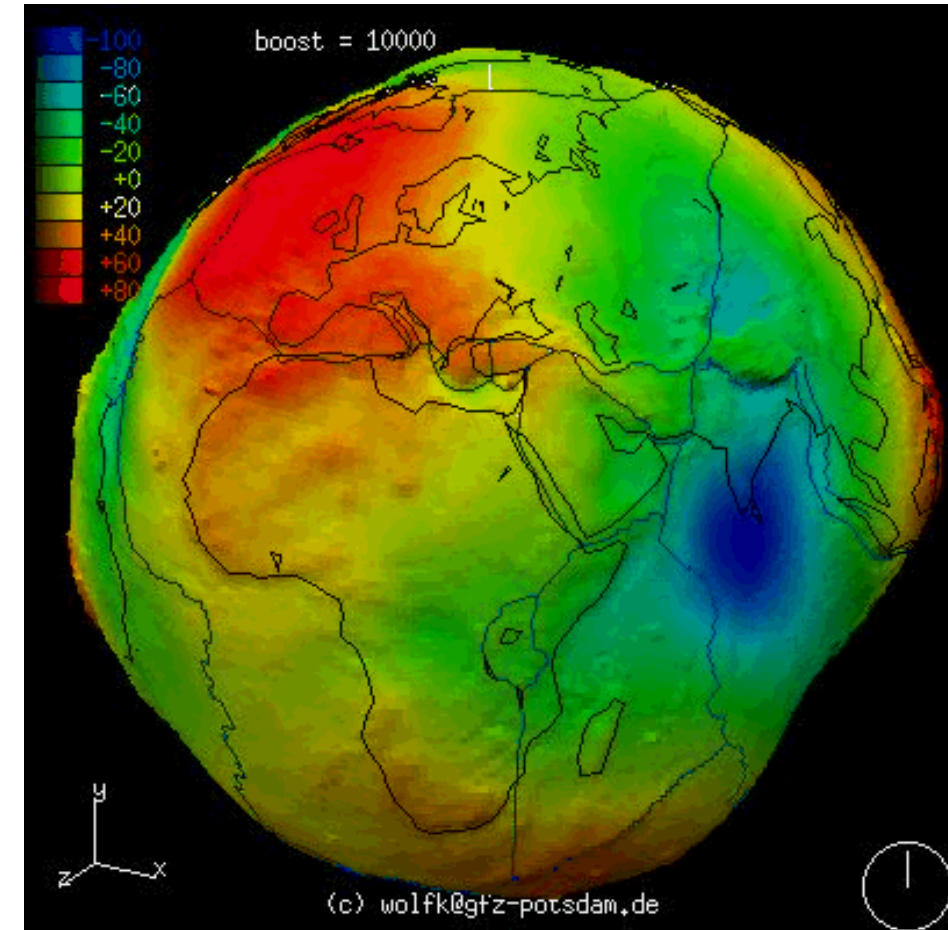
Levels of approximation to the figure of the Earth: from more complex to simplest. (source: University of Alaska System)



# The Shape of the Earth

## Geoid

- Physical approximation of the figure of the Earth.
- Shape of the surface of calmed oceans, in the absence of other influences such as winds and tides.
- Computed using complex physical models and gravity readings of Earth's surface.
- Used to measure surface elevations with a high degree of accuracy.

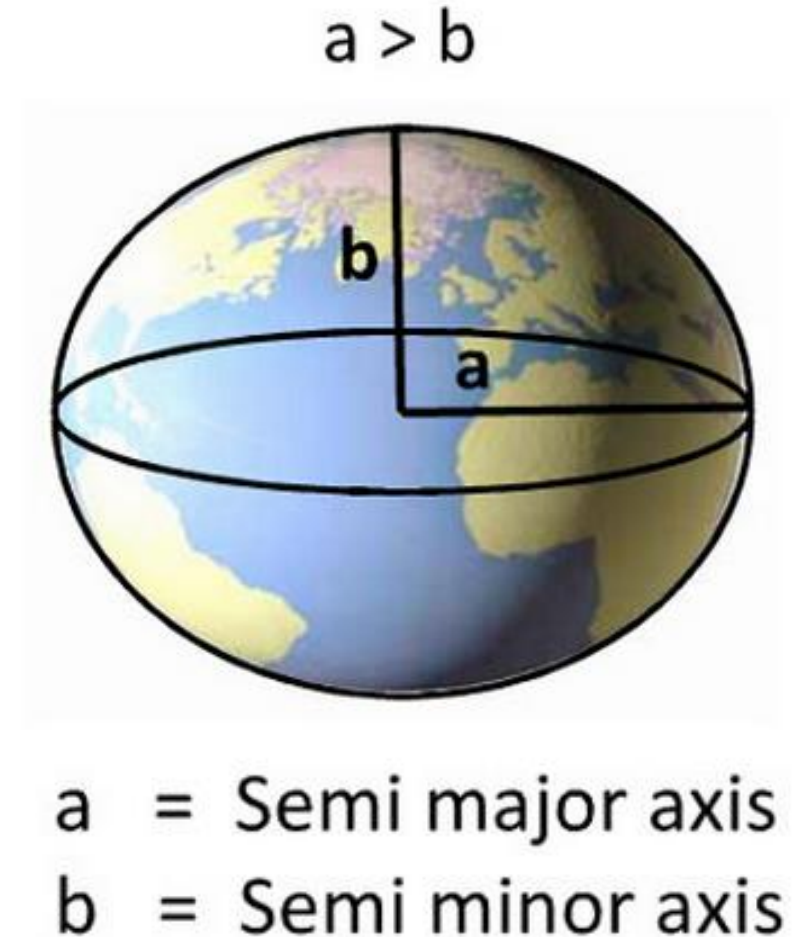


Geoid. (source: Universität Stuttgart)

# The Shape of the Earth

## Ellipsoid

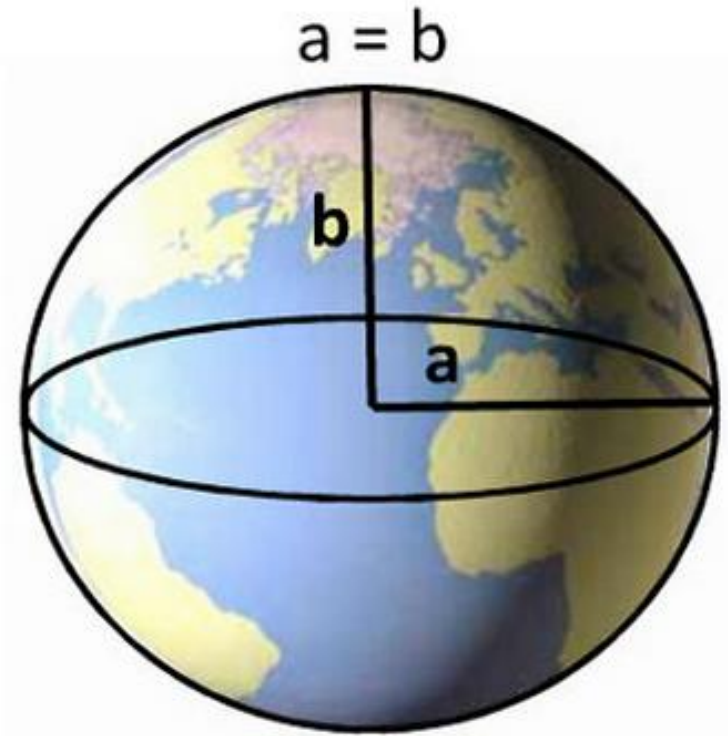
- Mathematical approximation of the shape of the Earth.
- The Earth is flattened at the poles and bulges at the equator due to its revolution, ellipsoid geodesy accounts for this. It is suitable for direct mathematical computations.
- Ellipsoid geodesy is uniquely defined by two numbers: semi-major and semi-minor axis.
- $a \neq b$



# The Shape of the Earth

## Sphere

- Simplest (and least accurate) approximation of the shape of the Earth.
- The Earth's radius is constant.
- $a=b$

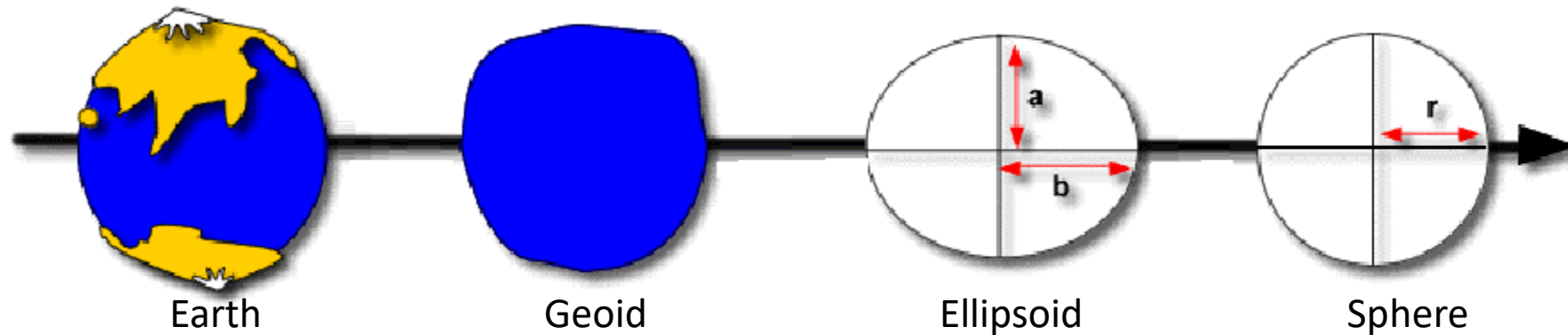


$a$  = Semi major axis  
 $b$  = Semi minor axis

Sphere. (source: GeoCue Group Newst)

# The Shape of the Earth

- The Earth is not quite a perfect sphere.
- Geodesy is the science that studies and determines the shape and dimensions of the Earth.
- Different models have been defined to represent the Earth's shape, varying in their complexity and in the accuracy which they represent the size and shape of the Earth.



Levels of approximation to the figure of the Earth: from more complex to simplest. (source: University of Alaska System)



# Position Example Questions

- Defining latitude and longitude
  - What is the Tropic of Cancer?
  - What is the Tropic of Capricorn?
- Approximations of the shape of the earth
  - What is the most accurate?
  - What is the least accurate?

