2.1 Patterns in the Night Sky

• Our goals for learning:
  – What does the universe look like from Earth?
  – Why do stars rise and set?
  – Why do the constellations we see depend on latitude and time of year?
What does the universe look like from Earth?

With the naked eye, we can see more than 2,000 stars as well as the Milky Way.
A constellation is a *region* of the sky.

Eighty-eight constellations fill the entire sky.
Orion
The Celestial Sphere

Stars at different distances all appear to lie on the celestial sphere.

The 88 official constellations cover the celestial sphere.
The Celestial Sphere

- The north celestial pole is directly above Earth's North Pole.
- The south celestial pole is directly above Earth's South Pole.
- The ecliptic is the Sun's apparent annual path around the celestial sphere.
- The celestial equator is a projection of Earth's equator into space.
The Milky Way

A band of light making a circle around the celestial sphere.

What is it?

Our view into the plane of our galaxy.
The Milky Way
The Local Sky

- Zenith: altitude = 90°
- Altitude: altitude = 60°
- Direction: direction = SE
- Horizon: altitude = 0°
The Local Sky

**Zenith**: The point directly overhead.
The Local Sky

**Horizon**: Where the sky touches the ground.
The Local Sky

**Meridian**: A north-south line running through the zenith.
The Local Sky

An object’s **altitude** (above horizon) and **direction** (along horizon) specify its location in your local sky.
We measure the sky using *angles*. 
We measure the sky using angles.
We measure the sky using angles.

Stretch out your arm as shown here.
Angular Measurements

- Full circle = 360°
- $1° = 60'$ (arcminutes)
- $1' = 60''$ (arcseconds)
Why do stars rise and set?

Earth rotates from west to east, so stars appear to circle from east to west.
Why do stars rise and set?
Our view from Earth:

This star is circumpolar. Its daily circle is entirely above your horizon.

This star is never seen.

Other stars rise in the east and set in the west.
Thought Question

What is the arrow pointing to in the photo below?
A. the zenith
B. the north celestial pole
C. the celestial equator
Thought Question

What is the arrow pointing to in the photo below?
A. the zenith
B. the north celestial pole
C. the celestial equator
Why do the constellations we see depend on latitude and time of year?

• They depend on latitude because your position on Earth determines which constellations remain below the horizon.

• They depend on time of year because Earth's orbit changes the apparent location of the Sun among the stars.
Review: Coordinates on the Earth

- **Latitude**: position north or south of equator
- **Longitude**: position east or west of prime meridian (runs through Greenwich, England)

a. We can locate any place on Earth’s surface by its latitude and longitude.

b. The entrance to the Old Royal Greenwich Observatory, near London. The line emerging from the door marks the prime meridian.
The sky varies with latitude but not with longitude.

a The local sky at the North Pole (latitude 90°N).

b The local sky at latitude 34°S.
Altitude of the celestial pole = your latitude

a The pointer stars of the Big Dipper point to the North Star, Polaris, which lies within 1° of the north celestial pole. The sky appears to turn counterclockwise around the north celestial pole.

b The Southern Cross points to the south celestial pole, which is not marked by any bright star. The sky appears to turn clockwise around the south celestial pole.
Thought Question

The North Star (Polaris) is 50° above your horizon, due north. Where are you?
A. You are on the equator.
B. You are at the North Pole.
C. You are at latitude 50°N.
D. You are at longitude 50°E.
E. You are at latitude 50°N and longitude 50°E.
Thought Question

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The sky varies as Earth orbits the Sun

- As the Earth orbits the Sun, the Sun appears to move eastward along the ecliptic.
- At midnight, the stars on our meridian are opposite the Sun in the sky.
What have we learned?

• What does the universe look like from Earth?
  – We can see over 2000 stars and the Milky Way with our naked eyes, and each position on the sky belongs to one of 88 constellations.
  – We can specify the position of an object in the local sky by its **altitude** above the horizon and its **direction** along the horizon.

• Why do stars rise and set?
  – Because of Earth's rotation.
What have we learned?

- Why do the constellations we see depend on latitude and time of year?
  - Your location determines which constellations are hidden by Earth.
  - The time of year determines the location of the Sun on the celestial sphere.