Orion, The Hunter

(Actual photograph)

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Many stars have Arabic names.

They are also classified using *Greek letters*:

\( \alpha \) - Alpha designates the brightest star in a constellation.
Ursa Major: The Great Bear
(a.k.a. The Big Dipper)
Also called the North Star, it and can be used to find which way is North!

Two stars in the Big Dipper point to an important star: Polaris.

It is visible every night because it is above the North Pole of Earth.

Also called the North Star, it and can be used to find which way is North!

It is not a very bright star.
Rising and Setting Stars

- The Earth’s eastward rotation causes stars to appear to move westward.
- Polaris, the North Star, doesn’t move.
- Stars near the Polaris move in small circles.
- Stars far from Polaris move in long arcs.

Julius Caesar: “I am constant as the North Star”
-W. Shakespeare
Motion of stars in the East

Looking east

Gemini
Orion

Motion of stars in the South

Looking south

Canis Major
The stars in a constellation are not close in space. In fact, the stars slowly move through space. Many years from now, the constellations will look different!
Distances to Stars

• Stars were once thought to be fixed in a dome above the Earth.
• We now know that the stars are scattered through space at great distances.
• The nearest stars are located about 10 trillion miles away. (10,000,000,000,000 miles)

• Astronomers measure huge distances using a special units.
Speed of Light

- Light can travel very fast: $3.0 \times 10^8$ meters per second (m/s)
- That’s 186,000 miles *per second*!
- Even at this speed, light takes years to travel between the stars.
- The distance light can travel *in one year* is called Light Year. (1.y.)

- One Light Year $= 1 \times 10^{16}$ meters
Light Years

- Light-Year is a unit of **distance**
- A light-second is the **distance** light travels in **one second**.

- The Sun is 8 light-**minutes** away
- The nearest star to the Sun is 4 light years away
- The nearest **galaxy** is 2 million light-years away
Looking Back in Time

• The star *Rigel*, in Orion, is 800 light years away.
• It takes light from Rigel 800 years to reach us.
• So we see Rigel as it was 800 years ago!

• We see the closest *galaxy* (Andromeda) as it was 2 million years ago.
Betelgeuse: 640 Light Years

Sirius: 8 light years

Photo (c): B. Tafreshi, apod.nasa.gov
Creating A Model

Whenever we try to understand a new concept, it’s useful to create a **model**. A model is a representation of the real world that is easier to visualize.

Models can be made with paper, with computers or our minds.

Our model for **space** is called the **Celestial Sphere**
The Celestial Sphere

... is an imaginary sphere around the Earth.

We can locate any star or planet on this sphere.

(In this model, we ignore the fact that stars are very far away)
The Celestial Sphere

In addition to North, South, East and West we have:

Zenith: The “Highest Point” directly above.

Horizon: Circle between sky and Earth

(Nadir: The “Lowest Point”, directly below.)
Three points on the Celestial Sphere:

**North Celestial Pole**: Point in space just above the North Pole of Earth

(The North Star is near the North Celestial Pole)

**Celestial Equator**: a circle in space above the Equator

**South Celestial Pole**: Point in space just “above” the South Pole of Earth
Viewing the Sky from Earth

- Our view of the sky depends on where we are on Earth.
- People in the Southern Hemisphere cannot see the North Star.
- People who live on Earth’s equator can see stars both North and South of the Celestial Equator.
- The *motions* of stars also depend on your location.
If we lived at the North Pole

Zenith

North celestial pole

Latitude 90°
If we lived in Alaska...
Latitude for San Francisco: 38°
If we lived at the Equator...
Cycles of the Sun

• In addition to rising and setting every day, the Sun undergoes yearly changes.
• It is in the sky more in Summer and less in Winter.
• The Sun rises and sets from different locations throughout the year.
• This fact was carefully observed by ancient people, and used to predict the Seasons.
An Ancient Observatory

Stonehenge
Built ~2500 BC in England
Mayan Observatory
Built ~600 AD at Chichen Itza, Mexico
The Annual “Motion” of the sun

- At night, we see different constellations at different times of the year.
- The constellations we see are always those away from the Sun.
- As Earth orbits around the Sun, we view the Sun from different perspectives.
- If we could see the stars behind the Sun, we would see it pass in front of 13 constellations.
- These are called the constellations of the Zodiac.
The Annual Motion of the Earth

Earth revolves around the Sun

The Sun appears “in front of” just 13 constellations.

(Note: You can’t see a constellation when the Sun is “in front of” it)
Throughout the year, the Sun moves from one constellation of the Zodiac to another. This path in the sky is called the **ecliptic**. But....the dates when this happens have slowly changed.
What’s Your (Real) Sign?

This is where the Sun is found at different times of the year

Capricorn - Jan 21 to Feb 17
Aquarius - Feb 17 to Mar 12
Pisces - Mar 12 to Apr 19
Aries - Apr 19 to May 14
Taurus - May 14 to Jun 21
Gemini - Jun 21 to Jul 21
Cancer - Jul 21 to Aug 11
Leo - Aug 11 to Sep 17
Virgo - Sep 17 to Oct 31
Libra - Oct 31 to Nov 21
Scorpius - Nov 21 to Nov 30
Ophiuchus - Nov 30 to Dec 18
Sagittarius - Dec 18 to Jan 21

Note: These dates are based on the true position of the Sun and don’t agree with most astrological dates!

...due to Precession of the Earth’s axis.