Exploring the Seasons

June Solstice
- Noon sun vertical at 23.5° N
- Sun’s rays

March Equinox
- Noon sun vertical at equator
- Sun’s rays

September Equinox
- Noon sun vertical at 23.5° S
- Sun’s rays

December Solstice
- Noon sun vertical at 23.5° S
- Sun’s rays

Equator

Noon sun vertical at 23.5° N

Noon sun vertical at equator
Exploring Phases of the Moon

- Waxing Gibbous
- First Quarter
- Waxing Crescent
- New Moon
- Full Moon
- Waning Gibbous
- Third Quarter
- Waning Crescent
Solar Eclipse

- Sunlight
- Sun
- Earth
- Moon
- Umbra
- Penumbra
- Solar Eclipse
Lunar Eclipse

- Penumbra
- Umbra
- Earth

Sunlight

Sun
High and Low Tides

High tide
Low tide

Earth

High tide
Low tide

Moon
98 Collision Theory of the Moon’s Origin

1. A large object strikes Earth.

2. Material from Earth’s outer layer is broken off by the collision.

3. Material from the object and Earth is thrown into orbit.

4. Material in orbit forms the moon.
Corona

Chromosphere

Photosphere

Core

Sunspots

Prominence
### The Inner Planets

<table>
<thead>
<tr>
<th>Planet</th>
<th>Number of Moons</th>
<th>Period of Revolution (Earth years)</th>
<th>Period of Rotation (Earth days)</th>
<th>Average Distance From the Sun (kilometers)</th>
<th>Diameter (kilometers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>0</td>
<td>0.24</td>
<td>59</td>
<td>58,000,000</td>
<td>4,878</td>
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<tr>
<td>Venus</td>
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<td>0.62</td>
<td>243</td>
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<td>12,104</td>
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<tr>
<td>Earth</td>
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<td>1</td>
<td>1</td>
<td>150,000,000</td>
<td>12,756</td>
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<tr>
<td>Mars</td>
<td>2</td>
<td>1.9</td>
<td>1.03</td>
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<td>6,794</td>
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</table>
## The Outer Planets

<table>
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<tr>
<th>Planet</th>
<th>Diameter (kilometers)</th>
<th>Period of Rotation (Earth days)</th>
<th>Average Distance From the Sun (kilometers)</th>
<th>Period of Revolution (Earth years)</th>
<th>Number of Moons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jupiter</td>
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<tr>
<td>Pluto</td>
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<td>6.4</td>
<td>5,913,000,000</td>
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</tbody>
</table>
102 Refracting and Reflecting Telescopes

Refracting Telescope

- Objective lens
- Eyepiece lens
- Focal length of objective lens

Reflecting Telescope

- Eyepiece lens
- Flat mirror
- Curved mirror
Parallax

Sky as seen from Earth in January

Sky as seen from Earth in July

Earth in January

Earth in July

Sun
104 Hertzsprung-Russell Diagram

Hertzsprung-Russell Diagram

Blue or blue-white
White
Yellow
Red-orange
Red

Supergiants
Betelgeuse
Polaris
Aldebaran
Alpha Centauri A

Giants
Alpha Centauri B

White Dwarfs
Sirius B

Main Sequence
Rigel
Algol
Sirius A

Brightness
Increasing

Surface Temperature (°C)
50,000
20,000
10,000
6,000
5,000
3,000
A star’s life begins when gas and dust in a nebula contract to form a protostar. When a star begins to run out of fuel, it expands to become a giant or supergiant.

Giant and supergiant stars can blow up into supernovas. Small and medium stars become red giants and then white dwarfs. When a white dwarf runs out of energy, it turns into a black dwarf.

The remains of the most massive stars collapse into black holes. Not even light can escape from a black hole. The remains of the supernova become a neutron star.
The Milky Way Galaxy
Formation of the Solar System

1. A cloud of gas and dust formed a spinning disk.
2. Gas in the center of the disk collapsed to form the sun.
3. The remaining gas and dust formed the planets.
4. The solar system includes the sun, planets, and belts of rock, ice, and dust.