The Moon

What effects does the Moon have on Earth and how does its motions create the phases of the moon?
The Moon

- **Moon** - a body that orbits a planet or asteroid as they orbit the Sun
- There are 173 moons in our solar system

Europa, Jupiter
The Moon

- Theory of Earth’s Moon Formation
  - Co-formation Theory
  - Capture Theory
  - Fission Theory
  - Giant Impact Theory
The Moon

- Giant Impact Theory - a planetesimal [size of Mars] struck the earth, ejecting large volumes of matter that condensed to form the Moon in orbit around the Earth
Giant Impact Theory
The Moon

- The Moon - large round object that orbits the Earth and that shines at night by reflecting light from the sun.
The Moon

- The Moon orbits is elliptical
- The plane of the moon’s orbit is inclined to Earth’s at about 5 degrees
The Moon's Incline

5° ANGLE

The Moon's Incline
The Moon

• One orbit is 27.3 days
• The Moon rotates once every 27.3 days
## The Moon

<table>
<thead>
<tr>
<th>Celestial Object</th>
<th>Mean Distance from Sun (million km)</th>
<th>Period of Revolution (d=days) (y=years)</th>
<th>Period of Rotation at Equator</th>
<th>Eccentricity of Orbit</th>
<th>Equatorial Diameter (km)</th>
<th>Mass (Earth = 1)</th>
<th>Density (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUN</td>
<td>—</td>
<td>—</td>
<td>27 d</td>
<td>—</td>
<td>1,392,000</td>
<td>333,000.00</td>
<td>1.4</td>
</tr>
<tr>
<td>MERCURY</td>
<td>57.9</td>
<td>88 d</td>
<td>59 d</td>
<td>0.206</td>
<td>4,879</td>
<td>0.06</td>
<td>5.4</td>
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<tr>
<td>VENUS</td>
<td>108.2</td>
<td>224.7 d</td>
<td>243 d</td>
<td>0.007</td>
<td>12,104</td>
<td>0.82</td>
<td>5.2</td>
</tr>
<tr>
<td>EARTH</td>
<td>149.6</td>
<td>365.26 d</td>
<td>23 h 56 min 4 s</td>
<td>0.017</td>
<td>12,756</td>
<td>1.00</td>
<td>5.5</td>
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<tr>
<td>MARS</td>
<td>227.9</td>
<td>687 d</td>
<td>24 h 37 min 23 s</td>
<td>0.093</td>
<td>6,794</td>
<td>0.11</td>
<td>3.9</td>
</tr>
<tr>
<td>JUPITER</td>
<td>778.4</td>
<td>11.9 y</td>
<td>9 h 50 min 30 s</td>
<td>0.048</td>
<td>142,984</td>
<td>317.83</td>
<td>1.3</td>
</tr>
<tr>
<td>SATURN</td>
<td>1,426.7</td>
<td>29.5 y</td>
<td>10 h 14 min</td>
<td>0.054</td>
<td>120,536</td>
<td>95.16</td>
<td>0.7</td>
</tr>
<tr>
<td>URANUS</td>
<td>2,871.0</td>
<td>84.0 y</td>
<td>17 h 14 min</td>
<td>0.047</td>
<td>51,118</td>
<td>14.54</td>
<td>1.3</td>
</tr>
<tr>
<td>NEPTUNE</td>
<td>4,498.3</td>
<td>164.8 y</td>
<td>16 h</td>
<td>0.009</td>
<td>49,528</td>
<td>17.15</td>
<td>1.8</td>
</tr>
<tr>
<td>EARTH’S MOON</td>
<td>149.6 (0.386 from Earth)</td>
<td>27.3 d</td>
<td>27.3 d</td>
<td>0.055</td>
<td>3,476</td>
<td>0.01</td>
<td>3.3</td>
</tr>
</tbody>
</table>
Same Side of the Moon
The Moon

- Half of the moon is always in sunlight
- As the moon revolves around Earth the illuminated portion changes due to our viewing angle
- As a result, the moon appears to change shape during the month creating the phases
The Moon

- **Crescent Moon** - phase that is less than half way full
- **Full Moon** - phase that appears as an entire circle in the sky
The Moon

• **Gibbous Moon** - phase when the moon is more than half way full

• **New Moon** - phase where no part is visible from the Earth
The Moon

- **Waxing Moon** - to increase in size [lit portion] gradually
- **Waning Moon** - to decrease in size [lit portion] gradually
- “Light on right… moon grows bright!” - A. Camera
Phases of the Moon
Earth has phases too?
The Moon

- The lunar phase cycle is 29.5 days
- The Moon spends the extra 2.2 days "catching up" due to Earth traveling an additional 45 million miles in its revolution around the Sun
The Moon

- Umbra - the fully shaded inner region of a shadow
- Penumbra - the partially shaded region of a shadow
The Moon

• Solar Eclipse - when the Sun is obscured by the moon
  • Occurs only during a new moon
  • The moon’s umbra has a width of about 269 km
  • Duration is up to 7 minutes as it passes over
Solar eclipse
The Moon

• Lunar Eclipse - when the moon appears darkened as it passes into the earth's shadow
  • Occurs during a full moon phase
  • The moon remains visible as a red-orange color due to some sunlight being refracted through Earth’s atmosphere into the umbra
  • Duration may last for up to 1.8 hours
Lunar eclipse

Lunar Eclipse
Lunar Eclipse
The Moon

• Tides - the cyclic rise and fall of sea levels caused by the Moon’s gravity, Sun’s gravity and Earth’s rotation

• Tides are caused by the Moon’s gravity, Sun’s gravity and the rotation of the Earth

• One tidal cycle is 12 hrs and 25 mins
The Moon

Cyclic Pattern
The Moon

- **Spring Tide** - occur when the Sun and Moon are aligned [full and new moon] causing higher high tides
- **Neap Tide** - occur when the Sun and Moon are acting on the earth in opposing direction
Neap Tides
Bay of Fundy, Canada
Bay of Fundy, Canada