Chapter 18: Studying Space

18.1 – Astronomy: The Original Science
**What is Astronomy?**

- **Astronomy** is the study of the universe.

- People in ancient cultures used the seasonal cycles of the stars, planets, and the moons to mark the passage of time.

- Early farmers learned the best times of year to plant and harvest crops.
Our Modern Calendar

- The calendar is based on observations of bodies in our solar system.
- A **year** is the time required for the Earth to orbit once around the sun.
- A **month** is roughly the amount of time required for the moon to orbit the Earth.
- A **day** is the time required for the Earth to rotate once on its axis.
Early Astronomers

- **Ptolemy** (140 CE) – Greek astronomer who thought that the Earth was at the center of the universe and all other planets and the sun revolved around Earth

- **Ptolemaic Theory** was believed to be true for over 1,500 years in Europe
Early Astronomers cont.

- **Copernicus (1543)**– A Polish astronomer who had a new theory; that the sun is at the center of the universe, and all the planets orbit the sun

- This theory was slow to catch on because of opposition by religious groups
Early Astronomers cont.

- **Johannes Kepler** (1609) – Developed the Laws of Planetary Motion
  - One of which says that planets revolve around the sun in elliptical orbits
  - Therefore the sun is not the exact center of the orbits
Early Astronomers cont.

- **Galileo Galilei** (1609) – Was one of the first people to use a telescope to observe objects in space
  - He discovered:
    - Craters and mountains on the moon
    - Four of Jupiter’s moons
    - Sunspots
    - The phases of Venus
Early Astronomers cont.

- **Isaac Newton** (1687)– Shows that all objects in the universe attract each other through gravitational force
  - The force of gravity is related to an object's mass, which explains why all the planets orbit the Sun
Modern Astronomy

- Until 1920 it was thought that our galaxy, The Milky Way, was all that there was.
- **Edwin Hubble** (1924) – Proved that other galaxies existed beyond the edge of the Milky Way.
The Andromeda Galaxy
Chapter 18: Studying Space

18.2 – Telescopes
# Types of Telescopes

<table>
<thead>
<tr>
<th>Type</th>
<th>How is it made?</th>
<th>We use it to see…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refracting (Optical)</td>
<td>2 sets of convex lenses</td>
<td>Items in our solar system, and stars</td>
</tr>
</tbody>
</table>
## Types of Telescopes

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<tbody>
<tr>
<td>Reflecting (Optical)</td>
<td>A curved mirror(s)</td>
<td>Items in our solar system, and stars</td>
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</tbody>
</table>

![Diagram of a reflecting telescope]

![Image of a reflecting telescope]
### Types of Telescopes

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<th>Type</th>
<th>How is it made?</th>
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</thead>
<tbody>
<tr>
<td>VERY LARGE Reflecting</td>
<td>Many, many large mirrors</td>
<td>Distant objects in space or our solar system</td>
</tr>
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</table>
# Types of Telescopes

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<th>Type</th>
<th>How is it made?</th>
<th>We use it to see…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Telescope in Space</td>
<td>Can be refracting or reflecting</td>
<td>Distant galaxies and stars</td>
</tr>
</tbody>
</table>
Types of Telescopes

- Visible light in the Electromagnetic Spectrum is VERY small
  - It is like 1 key on a piano
- Atmosphere can affect the quality of a telescope’s pictures
## Types of Telescopes

<table>
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<tr>
<th>Type</th>
<th>How does it work?</th>
<th>We use it to see…</th>
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</thead>
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<tr>
<td>Radio</td>
<td>Detects radio waves</td>
<td>Other galaxies and distant stars</td>
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</table>

- **Jupiter: visible**
- **Jupiter: radio (21 cm)**
Types of Telescopes

- Telescopes in space:
  - Hubble
  - Chandra X-Ray Observatory
1.) Is the NGST a tool for optical or nonoptical astronomy? Explain.

The NGST is a nonoptical telescope. It detects infrared rays, which we cannot see – we only feel them as heat.
2.) List two differences between the NGST and the HST.

1.) NGST is nonoptical, HST is optical
2.) NGST will be in an orbit farther out than HST
3.) HST can only detect near-infrared rays, NGST detects all infrared rays
3.) What components would you expect NGT to include?

- Transmitter to send pictures back to Earth
- Large polished mirror
- IR detecting device
- Computer equipment to transmit data
4.) List two difficulties that astronomers might face by having telescopes remain in orbit long term.

- Difficult to repair (costly and dangerous)
- Trajectory problems (Staying in orbit)
- Long delay between commands from Earth and when the telescope receives command
5.) What do you think images from the NGST might teach us about our own galaxy?

- Clues to the age of the galaxy
- Heat/radiation from planets and stars
- Clues about possible life in the galaxy
James Webb
Space Telescope
Chapter 18: Studying Space

18.3 – Mapping the Stars
Mapping the Stars

- Today, we see the same star patterns that ancient cultures saw

- **Constellations** – Sections of the sky that contain recognizable star patterns

- Understanding the location and movement of constellations helped people navigate and track time
Mapping the Stars

- Every star or galaxy is located within 1 of the 88 constellations
- (think of constellations as states)
Mapping the Stars

- Sky maps show the location of constellations in a particular hemisphere at a given time of year
- Seasonal changes
  - Constellations are not in the same locations all year
  - As the Earth revolves around the sun the apparent locations of the constellations change from season to season
Mapping the Stars

- **Astrolabe** is an instrument used to describe the location of a star or planet
Mapping the Stars

- **Zenith** is the point in the sky directly above you
- **Altitude** is the angle between an object in the sky and the horizon
- **Horizon** the line where the sky and the Earth appear to meet