The Study of Outer Space
Astronomy

History of Astronomy
• Astronomy is the branch of science that deals with celestial objects (object located outside of the earth’s atmosphere), space, and the physical universe.
• Astronomy is considered the oldest of the natural sciences.
• Many civilizations looked to the sky to understand their world.
• When Stone age people turned to a more agricultural (farmer) way of life, their interest likely turned to the heavens.
• The seasons became important. People noticed that different star patterns appeared at different times of the year.
• How could this be helpful to them?
• We have learned about some societies that believed that the Sun God would need to be honored in order for the sun to rise every day.
• Imagine the fear that would exist during a solar or lunar eclipse.
• Predicting eclipses was possibly the earliest astronomical activity.
• Stonehenge is a particularly interesting astronomical site. It is estimated that it was constructed between 3100 BCE- 2000 BCE in Salisbury Plain, England.
• Many stories exist about this structure including the possibility that aliens built Stonehenge.
• A more realistic view of this structure is that it was built to keep track of the movement of the sun and moon as well as mark the changing of the seasons.
• Astronomers have noted that the “heelstone” is in direct alignment with the rising sun on July 21 (the summer solstice).
• Stonehenge is tied to the winter solstice also.
• Around December 20, the sun sets in the middle of 3 stones known as the Trilithon.
• There is little agreement on the significance of Stonehenge. In recent years, scientists have suggested that it is an ancient burial ground. Perhaps it is a combination of both.

Early Astronomers
• Ancient Chinese civilizations kept careful track of events in the skies....particularly what they called “guest stars.”
• A guest star would be a new or unusual light in the sky.
• As early as 1059 BCE, the Chinese kept track of a guest star that we now can trace to be Haley’s comet.
• **Pythagoras** (580- 500 BCE)- was a Greek mathematician well known for his theorem regarding triangles. \( a^2 + b^2 = c^2 \)
• He also is credited with recognizing that the “morning star” and “evening star” are both the planet Venus.
• **Aristotle** (384 – 322 BCE) came up with a theory that earth was the center of the solar system. He believed that the earth did not move and the universe moved around planet earth.
• His findings were present in the writings of St. Thomas Aquinas and became the foundation of Church beliefs for more than 14 centuries.
• Nikolas Kopernig (Copernicus 1473-1543 AD) developed an idea that put the sun at the center of the universe. He also established the proper order of the planets outward from the sun.
• Galileo Galilei (1564 -1642) designed his own telescopes and made many discoveries in astronomy....
  • Sunspots on the sun and craters/mountains on the moon.
  • Moons of Jupiter
  • Rings of Saturn
• Galileo also confirmed that Copernicus’ idea that the sun is the center of the solar system.
• This went against what the Catholic Church taught and he was put on trial in 1633.
• He was forced to “disavow” his work and was sentenced to house arrest for the remainder of his life...8 more years.
• Isaac Newton (1642 – 1727) is probably 2nd in importance of early astronomers to Galileo.
• Newton developed the Laws of Motion and used it to understand gravity.
• The Laws of Motion are as follows:
  • An object at rest tends to stay at rest, and an object in motion tends to remain in that state of motion, unless an external force is applied to it.
  • A force causes acceleration of an object.
  • For every action there is an equal and opposite reaction.
• How do the Laws of Motion relate to the Solar System?
• Newton concluded that without a “force” (gravity) pulling on planets, they would shoot off into outer space.
• This idea helped astronomers understand how and why planets orbit.

Tools of Space Exploration
• **Telescopes** are the first instruments, other than the naked eye, to study the solar system.
  • Probably the first telescope was invented by a Dutch eyeglass maker named Hans Lippershey. He applied for a patent in 1608.
  • We have learned that Galileo improved on this idea and used his improvements to further the development of space exploration.
  • Telescopes have advanced so much that there are now huge buildings that house observatories....which are giant telescopes that can look at the solar system.
  • Most of these telescopes use mirrors to enlarge objects.
  • The largest radio telescope was just finished in July 2016 in China. This type of telescope measures radio waves.
  • The dish of this telescope measures 1,650 feet that is being used to search for signs of life and other discoveries. This is a little more than 5 football fields.
  • Radio telescopes measure radio or magnetic waves.
  • Plans to build the world’s largest visual telescope to date was intended for Hawaii. This telescope will have a mirror that measures 127 feet.
  • Controversy around this telescope has occurred so the most recent plans are to move the building of this telescope to Chile.
  • One of the most important telescopes in our history is the launch of the Hubble telescope in 1990. It is considered the most important advance in astronomy since Galileo’s telescope.
• The Hubble telescope is named for Edwin Hubble who helped to prove that other galaxies existed outside of the Milky Way.
• He is considered to be one of the founders of the Andromeda galaxy.
• By showing that other galaxies existed, Edwin Hubble helped astronomers begin to grasp the sheer size of the universe.
• The Hubble telescope floats in the thermosphere layer of the atmosphere. It takes digital pictures as it orbits the earth.
• The Hubble telescope travels at a speed of 17,000 mph.
• It is powered by solar rays.
• The Hubble telescope is about the length of a school bus.
• The Hubble telescope is an example of a space satellite.
• Satellites are machines that are launched into space and orbit the earth, moon, or other planet.
• There are more than 4500 satellites in outer space. Some of them are taking pictures but some of them are providing cell phone signals and television signals that we use every day.
• The first satellite launched into space was the Russian Sputnik I in 1957. This was the first human made object launched into space. We will talk more about this when we discuss space exploration. It was the start of the “race to space” between the U.S. and Russia.
• Robots are another tool that astronomers use to gather information about outer space and other planets.
• We will talk more about this when we get into space exploration.
• 1976 is when the first space robot, Viking I landed on Mars and collected soil samples. Since then, many other robots have explored our planets.
• Robots have been the preferred type of space exploration because it is extremely dangerous for humans to travel that far into outer space and return to earth. Many times, scientists expect that their robots or satellites will disintegrate on the return trip to earth.
• Robotic arms have been used for many years to launch satellites and assist astronauts with their missions.
• Other more recent space robots have been used to explore the surface of Mars.