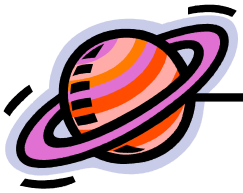

Astro-Chronology

Middle grades

Lesson Summary

Using the board game *Chronology* as a model, this lesson challenges students to correctly order the occurrence of important astronomical events and discoveries. From playing this game, students learn the history of discovery and exploration of the solar system, the history of scientific invention, and general history of astronomy, and see how progress in telescope, satellite, and spacecraft engineering has advanced scientific understanding.

Prior Knowledge & Skills

- General astronomy
- General knowledge of the history of science

AAAS Science Benchmarks

Historical Perspectives
Displacing the Earth from the Center of the Universe
The Nature of Technology
Technology and Science
The Physical Setting
The Universe

NSES Science Standards

- **History and Nature of Science**: Historical perspectives, Science as human endeavor
- **Science and Technology**: Understandings about science and technology

Teaching Time: One 45-minute period

Materials

Each group needs:

- Pencil or pen
- Set of playing cards
- (optional) drawing paper

If preparing your own cards, you will also need:

- Heavy paper
- Access to double sided photocopier
- Paper cutter

Advanced Planning
Preparation Time:

Allow 1 hour if you will be printing and cutting your own cards or 10 minutes if decks are already prepared.

1. Print and cut cards (optional)
2. Review the lesson plan
3. Gather materials
4. Form student groups

Astro-Chronology: A Board Game of Astronomical Proportions

Recommended Prior Knowledge:
- General astronomy
- General knowledge of the history of science

Learning Objectives
After this activity, students should be able to
- Identify milestones in the history of astronomy with emphasis on exploration of the solar system
- Identify milestones in the history of human space exploration
- Understand the extent and depth of the NASA space program
- Estimate the chronological order of historical events
- Use (deductive/inductive) reasoning skills to chronologically organize events in time

Lesson Summary
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Brief Explanation of the Game, Astron-Chronology
Players attempt to chronologically order a series of game cards.
Each card describes an event and provides the date of the event.
Each player begins with one card, face-up, and must decide in what order to place successive cards relative to the date on the cards they hold.

Estimated Preparation Time: 1 hour if preparing own cards, 10 minutes if using a pre-printed deck

Estimated Implementation Time: 1, 45-minute, period.

Materials for the Teacher
If printing and cutting own cards:
- Heavy paper
- Access to double sided photocopier
- Paper cutter

Materials for the Students
- Pencil or pen
- Set of playing cards
- (optional) drawing paper

Advanced Preparation
1. Read and review the lesson plan.
2. Copy the playing card reproducible masters to heavy paper.
3. Cut individual cards.
4. Repeat the copying process for as many sets of cards as needed.

Classroom Activity

Introducing the Activity

- Explain to students that they will play the game, *Astro-Chronology*, in order to gain knowledge about human exploration of the solar system, the history of astronomy, and other important historical events related to astronomy.
- Ask students if they have played the board game, *Chronology*, upon which this game is modeled. If students know the game, have one or more volunteer to describe the method of play.
- Distribute the rules of the game, the decks of cards, and divide students into small groups.
- Review the rules and model a single round of play for students.
- Explain or model to students the advantages of making a "best estimated guess". Point out that students need not know the exact date an event occurred but, only if it happened before or after a card that they hold.

Facilitating the Activity

- As students play, circulate among them to assess their progress.
- Remind students to estimate the date of an event if they do not know the exact date of occurrence.
- Help students as needed and help resolve any issues about the rules of play.

Summarizing the Activity

There are several ways to review this activity. Some suggestions include:

- Quickly have each student "share or pass" something that they learned from playing the game.
- Have students create a "Ticket to Lunch/next class" that states something that they learned from the game. Claim the passes at the end of class thus providing you with a quick assessment of lesson outcomes.
- Having teams create a timeline from the cards played. Timelines may be as elaborate or as simple as you and students have time and might include images of the individuals, events, or objects listed on the cards.
- As a class create a timeline from all the cards played

Resources

Windows to the Universe: Astronomy Timeline
http://www.windows.ucar.edu/tour/link=/the_universe/uts/timeline.html

Nobel Prize Winners
http://nobelprize.org/physics/laureates/index.html

12 Billion years ago About the time that the “Big Bang” formed the Universe.
4.5 Billion years ago Scientists believe that the Sun formed about this time.
4.5 Billion years ago The Earth forms from materials thrown off by the Sun.
3000 B.C. The oldest known use of glass occurs about this time in Egyptian society.
3000 B.C Stonehenge is built in England.
2000 B.C. Egyptians develop the first calendars using the Sun and the Moon.
240 B.C. The Greek astronomer, Eratosthenes, measures the circumference of the Earth.
130 B.C. Hipparchus, a Greek astronomer, makes the first map of the stars.
140 A.D. Greek astronomer, Ptolemy, suggests that the Earth is at the center of the Universe.
813 A.D. Al Mamon founds the Baghdad school of astronomy in Iraq.
1054 AD Astronomers in China observe the explosion of a star, known as a supernova, in the constellation of Taurus.
1120 A.D. Construction of possibly the first observatory in Cairo, Egypt was begun.
1300 A.D. About this time Italians begin to grind glass and make lenses.
1350 A.D. The first artwork showing people wearing eyeglasses dates from this year.
1543 A. D. Nicholas Copernicus, a Polish astronomer, develops the theory that the Sun is at the center of the Solar system.
1572 A.D. Tycho Brahe, a Danish astronomer, made very accurate observations of the night sky, all without the aid of a telescope and built the world's first observatory.
1590 A.D. The father and son team, Zaccharias and Hans Janssen, make the first microscope in this year.
1608 A.D. In this year, Hans Lipperhey, of the Netherlands, files a patent for the first telescope.
1609 A.D. Johan Kepler shows that the paths of the planets for ellipses and develops laws for the motion of the planets.
1610 A.D. Galileo discovers moons circling the planet Jupiter, showing that the Earth is not the center of the Universe around which everything revolves, in this year.
1613 A.D. Around this time the Galileo turns his telescope toward the Sun and makes daily observations of the position and size of sunspots. Ever since this date, humans have kept records of sunspots and learned their 11 year cycle.
1656 A.D. Dutchman, Christian Huygens discovers the planet Saturn and its largest moon, Titan.
1666 A.D. Giovanni Cassini, an Italian-French astronomer, views ice on the planet Mars. Cassini also found divisions in Saturn’s rings.
1666 A.D. Sir Isaac Newton uses a prism to show that white light from the Sun disperses to form a series of colors – red, orange, yellow, green, blue, indigo, and violet – called the spectrum.
1705 A. D. The year when Edmond Halley, an English astronomer, predicts the return of a comet that now is named: Halley’s Comet.
1781 A. D. The year that the planet, Uranus, is discovered by William Herschel.
1800 A.D. In this year, Fredrick W. Herschel used a prism and thermometers to measure the temperature of each color of light. During this experiment he placed a thermometer to one side of the spectrum and discovered infrared light.
1801 A.D. The year that the first asteroid, Ceres, is discovered.
1801 A.D. Scientist, Johann W. Ritter discovers ultraviolet light by expanding of the work of Fredrick Herschel in this year.

1843 A.D. The year that the sunspot cycle, the 11 year change in sunspot number, is first described.
1846 A.D. Johann Galle discovers the planet Neptune
1859 A.D. In this year scientists send the light from burning a single element through a prism and learn that each element produces a unique sequence of dark and colored lines. Today, these "fingerprints" help us to learn the composition of distant objects.
1860 A.D. The first use of a spectroscope to study light from the stars.
1872 A.D. American, Henry Draper, photographs the light from the star, Vega.
1877 A.D. Asaph Hall, an American, identifies two moons of Mars, Phobos and Deimos.
1895 A.D. In this year, William Conrad Roentgen dropped a sheet of lead held in front of beams from a cathode ray tube. His hand, hit by the light from the tube, produced the first X-ray image.
1905 A.D. Albert Einstein introduces his *Special Theory of Relativity*.
1908 A.D. Gabrial Lippmann produces the first color photograph.
1912 A.D. Max von Laue, of Switzerland, demonstrates that X-rays are form of light when passing them through a crystal.
1918 A.D. Max Planck receives the Nobel Prize for describing matter – all stuff – in terms of "packets of energy" or quanta.
1914 A.D. American, Robert Goddard, begins to build and test the first modern rockets.
1923 A.D. Edwin Hubble, American astronomer, identifies galaxies that exist beyond our galaxy, the Milky Way.
1926 A.D. Liquid fuel is first used to launch a rocket
1929 A.D. Astronomer Edwin Hubble explains that the Universe is expanding in every direction and tries to figure out how fast expansion occurs.
1930 A.D. American Clyde Tombaugh discovers the planet Pluto...
1937 A.D. The year the first radio telescope is used to observe space.
1955 A.D. The year when the spectra – unique pattern of dark and colored lines – for the element hydrogen was first produced.
1955 A.D. The first LASERs – Light Amplification using Stimulated Emission of Radiation – are made. LASERs help scientists to study the structure of the atom and the nature of light.
1957 A.D. Sputnik, developed by Russia, is the first man-made object to circle the Earth.
1958 A.D. Explorer 1, the first American satellite, was launched and circled the Earth.
1961 A.D. Russian cosmonaut, Yuri Gagarin, becomes the first human to fly in space. It took Gagarin almost 2 hours to circle the Earth once.
1962 A.D. Astronaut, now senator from Ohio, John Glenn, becomes the first American to orbit the Earth.
1962 A.D. American astronaut Scott Carpenter makes the second manned flight, circling Earth three times in Mercury 7.
1962 A.D. Russian cosmonauts spend four days circling Earth in the Vostok spacecraft.
1963 A.D. The longest and final Mercury mission orbits Earth for 34 hours.
1963 A.D. cosmonaut Valentina Tereshkova becomes the first woman to fly in space.

1963 A.D. Scientists J. Hans D. Jensen and Maria G. Mayer describe the structure of the atom in terms of shells. Their work helps predict the behavior of and properties of elements.
1964 Russians send the first team of cosmonauts into space.
1965 A.D. Russian, Alexei Leonov, becomes the first person to walk in space.
1965 A.D. Americans, Gus Grissom and John Young, use the first computer in space to maneuver the Gemini spacecraft
1965 A.D. Edward White is the first American to walk in space. He floated for 22 minutes attached to the Gemini 4 spacecraft.
1966 A.D. In this year both American and Russian spacecraft make the first successful landing on the Moon.
1966 A.D. In this year the first two spacecraft, Gemini 8 and Agena rocket, dock in space. The mission astronauts were Neil Armstrong and David Scott.
1967 A.D. Apollo 1 bursts into flames during training and three astronauts die
1967 A.D. Soyuz 1 crashes and cosmonaut, Vladimir Komarov, dies...
1968 A.D. Apollo 7 sends the first television pictures to Earth from space...
1968 A.D. Apollo 8, commanded by Frank Borman, makes the first orbit of the Moon.
1968 A.D. In this year, Humans, astronauts, first see the dark side of the Moon.
1969 A.D. Russians use Soyuz 4 and 5 to exchange passengers in space.
1969 A.D. In this year the first lunar module carrying humans lands of the surface of the Moon.
1969 A.D. At 10:56 AM on July 20 of this year, Neil Armstrong became the first human to walk on the moon. He was by Buzz Aldrin. Armstrong and Aldrin remained on the surface for 20 hours and took a two-hour moonwalk.
1970 A.D. The movie, Apollo 13, tells the story of how astronauts overcame disaster through skill, training, and teamwork. What was the year of this mission?
1970 A.D. The first spacecraft, the Russian-built Venera 7, lands on the planet Venus.
1972 A.D. Pioneer 10 is launched by the US on a year-long flight to the planet Jupiter.
1974 A.D. NASA spacecraft, Mariner 10 sends the first pictures of Mercury to Earth in this year.
1977 A.D. NASA launches two Voyager spacecraft to explore planets furthest from the Sun in late summer of this year. .
1980 A.D. The Voyager 1 spacecraft reaches Saturn and sends back the first pictures of the ringed planet in this year
1981 A.D. The first space shuttle, Columbia, was launched into orbit in April of this year.
1986 A.D. This year Voyager 2 reaches the neighborhood of the planet Uranus after traveling more than 1.5 billion miles...
1986 A.D. The space shuttle, Challenger, explodes shortly after take-off in January of this year. On board, was the first teacher to fly into space, Christa McAulliffe.
1990 A.D. Named for Edwin Hubble, the Hubble Space Telescope was placed in orbit around Earth in this year to produce images of space without the distortion caused by Earth's atmosphere.
1992 A.D. Pope John Paul II announces that the Catholic Church erred when it sentenced Italian astronomer Galileo to house arrest for life for stating that the Earth was not the center of the Universe.
1993 A.D. Comet Shoemaker-Levy 9 is discovered in this year

1994 A.D. Shortly after being discovered, Comet Shoemaker-Levy 9 crashes into the planet Jupiter. Photographs if the impact are captured by the Hubble Space Telescope.
1995 A.D. While in orbit around Earth the space shuttle Atlantis is used to launch the Galileo space probe on its journey to Jupiter in the middle of this year.
1996 A.D. Yuji Hyakutake of Japan uses binoculars to discover a new comet. The comet flew very close to Earth — about 9 million miles — and on clear nights could be seen with the naked eye.
1998 A.D. In this year sixteen countries join together to begin construction of the International Space Station.
1999 A.D. The first woman, Eileen Collins, commands the flight of a space shuttle. On this mission the Chandra X-ray Observatory is placed in orbit.
1999 A.D. In this year scientists measure the rate at which the Universe is expanding with information form the Hubble Space Telescope. The "Hubble Constant" (55 kilometers/second or 34 miles/second) explains why distant galaxies appear to move away from Earth in every direction.
2003 A.D. After over 100 successful missions, a second shuttle – Columbia – explodes upon reentering the Earth's atmosphere in this year.