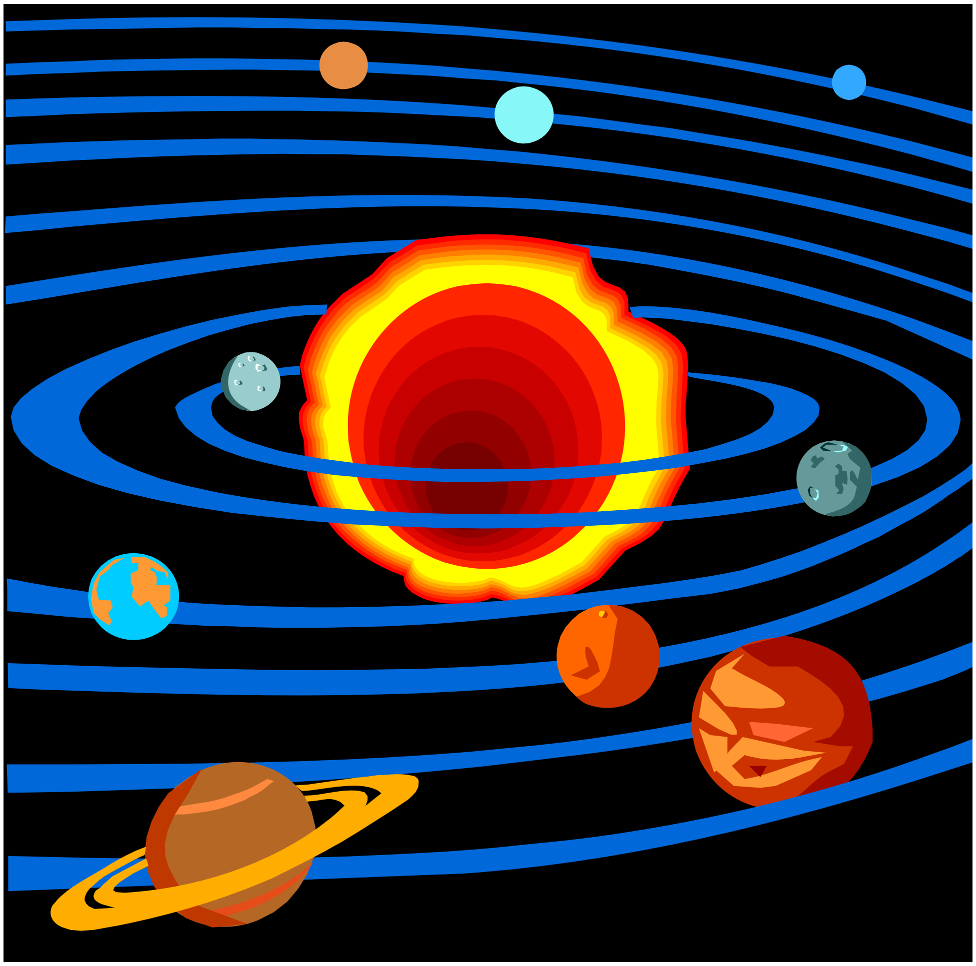

Outta this Atmosphere

Grade Levels 3-6

Unit Overview

Materials

- 3x5 cards
- A world globe
- Cardboard
- Cellophane tape
- Coffee creamer packages (small plastic containers that look like rocket engine nozzles)
- Computer with internet access
- Computer with Logger Lite software installed
- Copies of the National Geographic magazines listed in resources
- Crayons
- Egg-shaped hosiery packages (for nose cones)
- Electric air compressor or hand
- Fact sheet (see Appendix A)
- Fin and nosecone patterns (see Appendix B)
- Glue (Elmer's white school glue)
- Go! Link interface
- Hot-glue gun (to be used by teachers or adult volunteer)
- Internet connected computer with WWW browser program
- Launcher (see Appendix B)
- LCD projector
- Mailing tubes or tubes from paper rolls
- Maps of the community, state, country, and world
- Markers
- Marking pen
- Meter stick
- Metric rulers
- Mimio system
- Modeling clay
- "Orbits of the Inner Planets" transparency
- Paper (variety of weights-copy paper, construction paper, card stock)
- Pencils
- Pens
- Poster board, in various colors
- Reference books and pictures of the planets and our moon
- Rocket forms (short lengths of ½" PVC tubes)

- Rulers
- Scale model of the solar system depicting the planets
- Scissors
- Slides, posters, and pictures of the Jovian planets and Pluto
- Solar system model strung on a hanger, without respect to relative distances
- Spools
- String
- Student computers
- Styrofoam balls in nine different sizes
- Styrofoam cones, spheres, and cylinders
- Table or floor lamp with 60 watt bulb
- Tape
- Teacher computer
- Text or copy of movie
- Vernier Light Probe
- Web-Quest activity form
- White board
- Writing paper

Standards

Unit Content Standards	Unit Youth Development Standards
• LA.1.6.4.1: The student will use appropriate available technology resources (e.g., writing tools, digital cameras, drawing tools) to present thoughts, ideas, and stories. • LA.4.2.2.5: The student will select a balance of age and ability appropriate nonfiction materials to read (e.g., biographies and topical areas, such as animals, science, history), based on teacher recommendations, to continue building a core foundation of knowledge. • LA.4.3.3.2: Compare/contrast the features of the Jovian planets, including Pluto. • LA.4.6.4.1: Construct diagram representations of the four terrestrial planets in respect to one another. • LA.4.6.4.2: Use various media sources including the internet to research the four terrestrial planet of our solar system. • LA.4.6.4.2: Use various media sources, including the Internet, to research the Jovian planets and Pluto. • LA.5.1.6.1: The student will use new vocabulary that is introduced and taught directly. • LA.5.1.6.2: The student will listen to, read, and discuss familiar and conceptually challenging text. • LA.5.2.2.1: The student will locate, explain, and use information from text features (e.g., table of contents, glossary, index, transition words/phrases, headings, subheadings, charts, graphs, illustrations). • LA.6.1.6.1: The student will use new vocabulary that is introduced and taught directly. • LA.7.2.1.2: The student will locate and analyze elements of characterization, setting, and plot, including rising action, conflict, resolution, theme, and other literary elements. • MA.5.G.5.2: Demonstrate measurement skills. • MA.5.G.5.3: Solve problems requiring attention to approximation, selection of appropriate measuring tools, and precision of	• 3 – Child receives support from non-family adults • 5 – Relationships with teachers provide a caring & engaging environment • 10 – Child feels at home • 12 – School provides clear rules and consequences • 16 – Parent(s) and teacher expects the child to do their best work at school • 22 – Child is actively participating in activities outside of school • 24 – Child cares about teachers and other adults at school • 25 – Child enjoys reading for fun most days of the week • 34 – The student knows and is comfortable with cultural backgrounds and his/her own culture • 35 – Student can stay away from people likely to get him/her in trouble • 36 – Child seeks to resolve conflict nonviolently • 37 – Child feels that he/she has some influence over things that happen in his/her life • 38 – Child likes and is proud of the person that he/she is

measurement. • MA.5.S.7.2: Demonstrate the relative distances of the planets from the sun, along each planet's orbital path. • MA.7.G.4.4: Compare, contrast, and convert units of measure between different measurement systems (US customary or metric (SI)), dimensions, and derived units to solve problems. • MA.912.S.2.1: Compare the difference between surveys, experiments, and observational studies and what types of questions can and cannot be answered by a particular design. • SC.2.N.1.4: Explain how particular scientific investigations should yield similar conclusions when repeated. Draw conclusions about conditions on other planets. • SC.3.P.10.2: Recognize that energy has the ability to cause motion or create change. • SC.4.E.5.3: Discuss the causes of the seasons. • SC.4.E.5.4: Explain day and night and the Earth's movement. • SC.4.P.10.2: Investigate and describe that energy has the ability to cause motion or create change. • SC.5.E.5.1: Identify features and/or characteristics of the Jovian planets and Pluto. • SC.5.E.5.1: Observe and describe how the planets relate to each other in diameter. • SC.5.E.5.3: Distinguish among the following objects of the Solar System – Sun, planets, moons, asteroids, comets and identify Earth's position in it. Make a simulation of the planets of our solar system to scale. • SC.5.E.5.3: Describe the different bodies that make up our solar system. • SC.5.E.5.3: Explain the place of our solar system within the Milky Way Galaxy and the universe. • SC.5.N.1.5: Recognize and explain that authentic scientific investigation frequently does not parallel the steps of "the scientific method." • SC.5.P.10.2: Investigate and explain that energy has the ability to cause motion or create change.	

• SC.5.P.13.2: Investigate and describe that the greater the force applied to it, the greater the change in motion of a given object. • SC.5.P.13.3: Investigate and describe that the more mass an object has, the less effect a given force will have on the object's motion. • SC.6.E.6.1: Compare/contrast the features of the four inner planets. • SC.6.E.6.2: Identify features of the four terrestrial planets. • SC.7.N.2.1: Identify an instance from the history of science in which scientific knowledge has changed when new evidence or new interpretations are encountered. • SC.7.P.10.3: Recognize that light waves, sound waves, and other waves move at different speeds in different materials. Measure the amount of light from a light source at different distances. • SC.8.E.5.3: Create a diagram of the orbital paths of the Jovan planets and Pluto. • SC.8.E.5.9: Describe the relationship between an object and its gravitational attraction. • SC.8.E.5.9: Explain the impact of objects in space on each other including the Sun on the Earth including seasons and gravitational attraction. • SC.912.E.5.7: Relate the history of and explain the justification for future space exploration and continuing technology development. • SS.5.G.4.1: Use geographic knowledge and skills when discussing current events. • SS.912.W.4.6: Describe how scientific theories and methods of the Scientific Revolution challenged those of the early classical and medieval periods.	

Lesson Table of Contents

Lesson 1: Founders of Space Explorations: Who Developed the Interest in Exploring Space?

Essential Question:

What contributions to man would we not have if Copernicus, Aristrachus, Ptolemy, and Galileo Galilei had no interest in what lay beyond our skies?

Content Standards:

- LA.1.6.4.1: The student will use appropriate available technology resources (e.g., writing tools, digital cameras, drawing tools) to present thoughts, ideas, and stories.
- LA.4.2.2.5: The student will select a balance of age and ability appropriate nonfiction materials to read (e.g., biographies and topical areas, such as animals, science, history), based on teacher recommendations, to continue building a core foundation of knowledge.
- LA.5.2.2.1: The student will locate, explain, and use information from text features (e.g., table of contents, glossary, index, transition words/phrases, headings, subheadings, charts, graphs, illustrations).
- LA.6.1.6.1: The student will use new vocabulary that is introduced and taught directly.

Vocabulary

- Exploration
- Space
- Telescope
- Astronomy
- Star
- Meteor
- Planet

Youth Development Standards:

- 3 – Child receives support from non-family adults
- 5 – Relationships with teachers provide a caring & engaging environment
- 10 – Child feels at home
- 12 – School provides clear rules and consequences
- 16 – Parent(s) and teacher expects the child to do their best work at school
- 22 – Child is actively participating in activities outside of school
- 24 – Child cares about teachers and other adults at school
- 25 – Child enjoys reading for fun most days of the week
- 34 – The student knows and is comfortable with cultural backgrounds and his/her own culture
- 35 – Student can stay away from people likely to get him/her in trouble
- 36 – Child seeks to resolve conflict nonviolently
- 37 – Child feels that he/she has some influence over things that happen in his/her life
- 38 – Child likes and is proud of the person that he/she is

Teacher Background Knowledge:

- Teacher should have knowledge of the early astronomers and their contributions to the advancement of space exploration. Some good resources include:
  http://library.thinkquest.org/J0112188/history_of_astronomy.htm
  http://library.thinkquest.org/J0112188/timeline.htm
  http://library.thinkquest.org/J0112188/ptolemy.htm
  http://library.thinkquest.org/J0112188/nicolaus_copernicus.htm
  http://library.thinkquest.org/J0112188/galileo.htm
  http://library.thinkquest.org/J0112188/johannes_kepler.htm
  http://library.thinkquest.org/J0112188/sir_isaac_newton.htm

Materials:

- Teacher computer, LCD projector, white board, Mimio system, student computers

Procedure:

1. Teacher will have students complete a pre-assessment which consists of matching an early astronomer to their contribution to the exploration of space.
2. Teacher will introduce the subject by opening a discussion on early astronomers. Discussion should include the biographical information on the astronomers and what their general contributions were to the cause.
3. Discuss the history of astronomy as it relates to space exploration.
4. Lead the students on a web-quest/virtual field trip of early astronomers and related locations that had a strong impact on our desire to learn more about space.
5. Close lesson by giving the post-assessment, which is a copy of the pre-assessment.

Formative Assessment:

- Will come through each step of the lesson. As the students navigate the web quest/virtual field trip they will be asked to identify certain astronomers and their contributions.

Name: TEACHER GUIDE

Date:

Space Exploration Activity 1 Pre-Assessment

Describe the invention or contribution made by each of the following early astronomers

Galileo Galilei	Galileo began a revolution that helped make the works of Sir Isaac Newton successful. Using a telescope to help him, he observed sunspots on the Sun, mountains and valleys on the Moon, the four largest moons of Jupiter, and the phases of Venus.
Johannes Kepler	Johannes Kelper came up with the laws of planetary motion.
Sir Issac Newton	Sir Isaac Newton explained gravity and motion using his Three Laws of Motion. He helped explain things using mathematical terms, which made it seem more possible that science could be used to help explain things that are hard for humans to understand.
Ptolemy	Ptolemy proposed a theory to explain the motions and positions of the planets, the Sun, and the Moon. He said they moved in small circles in which the Earth was centered.
Nicolaus Copernicus	Copernicus was best known for his theory that the Sun is at the center of the universe, with the Earth and other space objects orbiting around it. His theory totally contradicted Ptolemy's theory that the Earth is at the center of the universe.
Hipparchus	Hipparchus was the most important Greek astronomer of his time. He could do so many fascinating things! He cataloged, charted, and calculated the brightness of perhaps as many as 1000 stars.
Tycho Brahe	Tycho Brahe measured the Sun, the Moon, stars, and planets and recorded their locations for over 20 years using only his naked eye. These records were very important to future astronomers.
John Glenn	John Glenn was the first human to make a nonstop supersonic (greater than the speed of sound) flight across the United States. He was also the first American to orbit the Earth while in space. On his last visit to space, he was 77 years old.
Yuri Gargarin	Yuri Gagarin was the first human in space.
Valentina Tereshkova	Valentina Tereshkova was the first woman to fly in space. She spent more time in orbit than all the U.S. Mercury astronauts combined.
Neil Armstrong	Neil Armstrong was the first man on the Moon. He was the commander of Apollo 11. He said the famous words " That's one small step for man, one giant leap for mankind."
Sally Ride	Sally Ride was the first U.S. woman to orbit the Earth. She was not the first woman in space though, Valentina Tereshkova was.

Name: TEACHER GUIDE
Date:

Space Exploration Activity 1 Pre-Assessment

Describe the invention or contribution made by each of the following early astronomers

Galileo Galilei	
Johannes Kepler	
Sir Issac Newton	
Ptolemy	
Nicolaus Copernicus	
Hipparchus	
Tycho Brahe	
John Glenn	
Yuri Gargarin	
Valentina Tereshkova	
Neil Armstrong	
Sally Ride	

Lesson 2: The Solar System

Essential Question:

What are the planets' places in our solar system and why are they aligned in such a manner?

Content Standards:

- SC.5.E.5.3: Describe the different bodies that make up our solar system.
- SC.5.E.5.3: Explain the place of our solar system within the Milky Way Galaxy and the universe.
- SC.4.E.5.4: Explain day and night and the Earth's movement.
- SC.4.E.5.3: Discuss the causes of the seasons.
- SC.8.E.5.9: Describe the relationship between an object and its gravitational attraction.

Vocabulary

- Solar system
- Milky Way Galaxy
- Orbit
- Revolution
- Rotation
- Gravitational attraction
- Universe
- Cause of seasons

Youth Development Standards:

- 3 – Child receives support from non-family adults
- 5 – Relationships with teachers provide a caring & engaging environment
- 10 – Child feels at home
- 12 – School provides clear rules and consequences
- 16 – Parent(s) and teacher expects the child to do their best work at school
- 22 – Child is actively participating in activities outside of school
- 24 – Child cares about teachers and other adults at school
- 34 – The student knows and is comfortable with cultural backgrounds and his/her own culture
- 35 – Student can stay away from people likely to get him/her in trouble
- 37 – Child feels that he/she has some influence over things that happen in his/her life
- 38 – Child likes and is proud of the person that he/she is

Teacher Background Knowledge:

- The sheer size and complexity of our solar system is often difficult for students to understand. Students will investigate and come to understand the forces of gravity and the effects of the Earth's movement, so they can better understand Earth's place in the solar system.
- Teacher resources:
  - http://solarsystem.nasa.gov/planets/index.cfm
  - http://en.wikipedia.org/wiki/Solar_System
  - http://www.solarviews.com/
  - http://www.solarviews.com/eng/solarsys.htm
  - http://www.kidsastronomy.com/solar_system.htm

Materials:

- Maps of the community, state, country, and world; globe; illustration or model of the solar system; Styrofoam balls in nine different sizes; string; pencils; paper; glue (Elmer's white school glue)

Procedure:

Students will be able to:

1. Describe the different bodies that make up our ***solar system***.
2. Explain the place of our solar system within the *Milky Way Galaxy* and the *universe*.
3. Explain day and night and the Earth's movement.
4. Discuss the *causes of the seasons*.
5. Describe the relationship between an object and its *gravitational attraction*.

A pre-assessment will be given to see if the students can identify the location and name of the eight planets, and Pluto.

1. By using a series of maps, you can help the student visualize the enormity of the universe. Start with a map of the community and continue with a state map, then a map of the country, a globe of the world, and finally an illustration of the solar system.
2. To help the students learn the positions of the planets, make up a phrase using the first letter of each planet's name in the order of their distances from the sun. For example: "My Very Educated Mother Just Sat Upon Pink Nests" (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Pluto, Neptune). Note that until 1999, the orbit of Pluto will be closer to the sun than that of Neptune.
3. Let the students act out the parts of the sun and the Earth. Have them demonstrate the rotation of the Earth and its revolution around the sun.

Tying It all together:

4. Students can use colored Styrofoam balls to construct a model of the solar system. Have the students choose a planet, research the planet, and then present this information to the other students. At this time, the students can make a living model of the solar system.
5. Students can use a spring scale to measure the gravitational pull or weight of several objects. They can compare the gravitational pull and construct a chart of their results.

Formative Assessment:

- While the activities are taking place the teacher should circulate the classroom to make certain all students are labeling planets for their solar system model correctly, in the order from closest to the Sun to furthest away. The final assessment will be the completed solar system model.

Name: ______________________

Date: _______________________

Activity #2 Pre-Assessment

Starting from the Sun and moving outward; list the names of the planets in order.

1	
2	
3	
4	
5	
6	
7	
8	

Lesson 3: The Terrestrial Planets

Essential Question:

How does Earth compare to the other planets in terms of supporting life?

Content Standards:

- LA.4.6.4.1: Construct diagram representations of the four terrestrial planets in respect to one another.
- LA.4.6.4.2: Use various media sources including the internet to research the four terrestrial planet of our solar system.
- SC.6.E.6.2: Identify features of the four terrestrial planets
- SC.6.E.6.1: Compare/contrast the features of the four inner planets.

Vocabulary

- Planet
- Fusion
- Orbit
- Orbital period
- Terrestrial planets
- Terrestrial

Youth Development Standards:

- 3 – Child receives support from non-family adults
- 5 – Relationships with teachers provide a caring & engaging environment
- 10 – Child feels at home
- 12 – School provides clear rules and consequences
- 16 – Parent(s) and teacher expects the child to do their best work at school
- 22 – Child is actively participating in activities outside of school
- 24 – Child cares about teachers and other adults at school
- 25 – Child enjoys reading for fun most days of the week
- 34 – The student knows and is comfortable with cultural backgrounds and his/her own culture
- 35 – Student can stay away from people likely to get him/her in trouble
- 36 – Child seeks to resolve conflict nonviolently
- 37 – Child feels that he/she has some influence over things that happen in his/her life
- 38 – Child likes and is proud of the person that he/she is

Teacher Background Knowledge:

- The terrestrial planets are Mercury, Venus, Earth, and Mars. The links below list some of the major differences between the planets. Have transparency of “Orbits of the Inner Planets” on overhead when the students walk in, have students working in groups of three or four, discuss what the design represents without giving them any clues. Each group will write a brief, one paragraph explanation of what they think the design represents. Then have the groups share out their guesses. After the guesses have been shared continue with the following;

  http://education.nasa.gov/students1.html
  http://dustbunny.com/afk

http://freeware.intrastar.net/solarsystem/solarsy1.htm
http://starchild.gsfc.nasa.gov/docs/StarChild/StarChild.html
http://kids.msfc.nasa.gov/

and if available:

"Celebration of the Earth and Beyond". National Geographic. January 2000, special issue.

"Galileo Mission". National Geographic. September 1999, volume 196, number 3.

"The Age of Comets". National Geographic. December 1997, volume 192, number 6.

"The Universe". National Geographic. October 1999, volume 196, number 4.

"Return to Mars". National Geographic. August 1998, volume 194, number 2.

"The Hubble Telescope". National Geographic. April 1997, volume 191, number 4.

Other Worlds: Images of the Cosmos from Earth and Space. A National Geographic publication. James Trefil.

"Interactive Astronomy: The Hubble Space Telescope brings the Universe to the Classroom". The Science Teacher. March 1997, volume 64, number 3.

Materials:

- "Orbits of the Inner Planets" transparency
- Copies of the National Geographic magazines listed in resources
- Scale model of the solar system depicting the planets
- Fact sheet (see Appendix A)

Procedure:

1. From the motivator, explain that the design was a graphic representation of the orbits of the inner planets.
2. Discuss the four inner, terrestrial planets: Mercury, Venus, Earth, and Mars.
3. Briefly discuss some of the features of these planets. (i.e., terrestrial)
4. Have the students use the Internet and other resources researching information about the inner planets. (some excellent web sources are listed in resources, as well as magazine articles with pictures)
5. Students will need to fill out a fact sheet for each of the four, inner, terrestrial planets (see Appendix A).
6. Students will need to draw a representation of the inner planets orbital path in relation to the sun on the back of one of the fact sheets.

Formative Assessment:

- The students will complete a summary comparing and contrasting the features of the terrestrial planets. (This may be a graphical compare and contrast, i.e., Venn diagram) They will need to include a diagram of each planet on the opposite side of the paper depicting some of the surface features.

Lesson 4: The Gas Giants/Jovian Planets

Essential Question:

Why are the planets past Mars made up mainly of gases?

Content Standards:

- LA.4.3.3.2: Compare/contrast the features of the Jovian planets, including Pluto.
- LA.4.6.4.2: Use various media sources, including the Internet, to research the Jovian planets and Pluto.
- SC.5.E.5.1: Identify features and/or characteristics of the Jovian planets and Pluto.
- SC.8.E.5.3: Create a diagram of the orbital paths of the Jovian planets and Pluto.

Vocabulary

- Planet
- Fusion
- Orbit
- Orbital period
- Jovian
- Gas giants

Youth Development Standards:

- 3 – Child receives support from non-family adults
- 5 – Relationships with teachers provide a caring & engaging environment
- 10 – Child feels at home
- 12 – School provides clear rules and consequences
- 16 – Parent(s) and teacher expects the child to do their best work at school
- 22 – Child is actively participating in activities outside of school
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- 25 – Child enjoys reading for fun most days of the week
- 34 – The student knows and is comfortable with cultural backgrounds and his/her own culture
- 35 – Student can stay away from people likely to get him/her in trouble
- 36 – Child seeks to resolve conflict nonviolently
- 37 – Child feels that he/she has some influence over things that happen in his/her life
- 38 – Child likes and is proud of the person that he/she is

Teacher Background Knowledge:

- **Teacher background knowledge:** Have posters, pictures, and slides of the Jovian planets and Pluto for the class to see. Allow the students a few minutes to look at the pictures, etc., and discuss what they see with their classmates. Have each student do a five minute write about why they think the planets are the color and size that they are as a pre-assessment to this activity.

- **Resources**:
  http://education.nasa.gov/students1.html
  http://dustbunny.com/afk

http://freeware.intrastar.net/solarsystem/solarsy1.htm
http://starchild.gsfc.nasa.gov/docs/StarChild/StarChild.html
http://kids.msfc.nasa.gov/
"Celebration of the Earth and Beyond". National Geographic. January 2000, special issue.
"Galileo Mission". National Geographic. September 1999, volume 196, number 3.
"The Age of Comets". National Geographic. December 1997, volume 192, number 6.
"The Universe". National Geographic. October 1999, volume 196, number 4.
"Return to Mars". National Geographic. August 1998, volume 194, number 2.
"The Hubble Telescope". National Geographic. April 1997, volume 191, number 4.
Other Worlds: Images of the Cosmos from Earth and Space. A National Geographic publication. James Trefil.
"Interactive Astronomy: The Hubble Space Telescope brings the Universe to the Classroom". The Science Teacher. March 1997, volume 64, number 3.

Materials:

- Slides, posters, and pictures of the Jovian planets and Pluto
- Scale model of the solar system depicting the planets
- fact sheet (see Appendix A)

Procedure:

1. From the motivator, discuss some of the features of the Jovian planets and Pluto. (i.e. gas giants, coloring, rings)
2. Briefly explain Pluto's inclusion in this set of planets.
3. Discuss the Jovian planets: Jupiter, Saturn, Uranus, and Neptune.
4. Have the students use the Internet and other media sources to research facts and characteristic of these remaining planets.
5. The students will be given a fact sheet for each of the planets that they must fill out.
6. Students will need to draw each of the remaining planets orbital paths with relation to the sun on the back of one of the fact sheets.

Formative Assessment:

- The students will write a one-page summary comparing and contrasting the features of the Jovian planets and Pluto. They will need to include a diagram of each planet on the back of the paper depicting some of the surface features.

Name: ___________________________

Date: ___________________________

Activity #4 Pre-Assessment

Why do you think the planets are they way they appear in terms of color and size?

Lesson 5: What is our Place in the Universe?

Essential Question:

How do we know that we live on a small planet in a small galaxy orbiting a rather ordinary star?

Content Standards:

- MA.5.G.5.2: Demonstrate measure skills.
- MA.5.S.7.2: Demonstrate the relative distances of the planets from the sun, along each planets orbital path.
- SC.5.E.5.1: Observe and describe how the planets relate to each other in diameter.

Vocabulary

- Diameter
- Pace

Youth Development Standards:

- 3 – Child receives support from non-family adults
- 5 – Relationships with teachers provide a caring & engaging environment
- 10 – Child feels at home
- 12 – School provides clear rules and consequences
- 16 – Parent(s) and teacher expects the child to do their best work at school
- 22 – Child is actively participating in activities outside of school
- 24 – Child cares about teachers and other adults at school
- 25 – Child enjoys reading for fun most days of the week
- 34 – The student knows and is comfortable with cultural backgrounds and his/her own culture
- 35 – Student can stay away from people likely to get him/her in trouble
- 36 – Child seeks to resolve conflict nonviolently
- 37 – Child feels that he/she has some influence over things that happen in his/her life
- 38 – Child likes and is proud of the person that he/she is

Teacher Background Knowledge:

- Have a model of the solar system with the planets strung on a coat hanger. Show this model to the class, allowing it to pass among the students. Group the students in three or four. Have each group try to determine what is wrong with the model, and write a brief one-paragraph summary detailing their reason(s). Have the students share out their responses with the class.

Materials:

- Solar system model strung on a hanger, without respect to relative distances
- Poster board, in various colors
- Scissors, pencils, crayons, markers, etc.

- Metric rulers
- 3 x 5 cards
- Reference books and pictures of the planets and our moon (their fact sheets from the previous days will make a great references)

Procedure:

1. Have the students work in teams of two.
2. The students will need to review their fact sheets from the previous days, making sure to note relative diameter and distance of each planet with relation to the sun.
3. Tell the students that for this activity the relative diameter of the sun will be 50 centimeters. (see attached sheets for chart)
4. Have the students determine what the relative diameter of each planet would be if the sun's relative diameter is 50 centimeters.
5. After the students have checked their measurements with the teacher for accuracy, have the students draw a scale diagram of the planets on index cards. (one planet to a card)
6. Using the relative distances in the attached charts, give each student a copy of the distances.
7. Allow the students to go outside (or in the gym), taking their planet cards, have the students mark off the distance in paces that corresponds to each planet. Start with the inner planets in order. The students will probably not get past Earth or Mars before they run out of space.
8. After returning to the classroom, have the students discuss the use of tiny paces to mark off the relative distances of the planets in relation to the sun.

Formative Assessment:

- Have the students in their groups of two investigate how they could downsize the distances provided.
- Have the students briefly write about their process. Then have the students create a new model with their smaller distances taken into account.

Name: ___________________________

Date: ___________________________

Activity #5 Pre-Assessment

What is wrong with the model displayed at the front of the room?

Lesson 6: Distance to the Sun

Essential Question:

Have you ever thought about what it would be like if you were on another planet looking back at the sun?

Content Standards:

Vocabulary

- Speed of light
- Light year
- Astronomical unit

- SC.5.E.5.3: Distinguish among the following objects of the Solar System – Sun, planets, moons, asteroids, comets and identify Earth's position in it. Make a simulation of the planets of our solar system to scale.
- SC.7.P.10.3: Recognize that light waves, sound waves, and other waves move at different speeds in different materials. Measure the amount of light from a light source at different distances.
- SC.2.N.1.4: Explain how particular scientific investigations should yield similar conclusions when repeated. Draw conclusions about conditions on other planets.
- SC.5.N.1.5: Recognize and explain that authentic scientific investigation frequently does not parallel the steps of "the scientific method."

Youth Development Standards:

- 3 – Child receives support from non-family adults
- 5 – Relationships with teachers provide a caring & engaging environment
- 10 – Child feels at home
- 12 – School provides clear rules and consequences
- 16 – Parent(s) and teacher expects the child to do their best work at school
- 22 – Child is actively participating in activities outside of school
- 24 – Child cares about teachers and other adults at school
- 25 – Child enjoys reading for fun most days of the week
- 34 – The student knows and is comfortable with cultural backgrounds and his/her own culture
- 35 – Student can stay away from people likely to get him/her in trouble
- 36 – Child seeks to resolve conflict nonviolently
- 37 – Child feels that he/she has some influence over things that happen in his/her life
- 38 – Child likes and is proud of the person that he/she is

Teacher Background Knowledge:

- Teacher should be familiar with the use of Vernier CBL equipment. The lab is self explanatory, set-up procedures are outlined for the students in the procedure.

Materials:

- Computer with Logger Lite software installed
- Go! Link interface
- Vernier Light Probe
- Meter stick
- Table or floor lamp with 60 watt bulb
- Tape and marking pen

Procedure:

Part I: Marking the Distances of the Planets

1. Make sure the Light Probe is connected to the Go! Link and that the Go! Link is connected to the computer.
2. Start Logger Lite on your computer.
3. Open the file for this activity by doing the following:
   a. Click the Open button, .
   b. Open the file called “Elementary Science.”
   c. Open the file called “23 Distance from Sun.”
4. Now you will use the meter stick and tape to make a scale model that shows the relative distances of the planets from the sun by following the steps below:
   a. Put 0 cm end of the meter stick at the light.
   b. Measure 10 cm from the light and mark the place with a piece of tape labeled “Mercury”. In this model, 25 cm is one Astronomical Unit, or AU. One AU is the distance from the Sun to the Earth. All of the other planet distances are compared to this distance between Earth and the Sun.
   c. Measure 20 cm from the light. Mark this place with a piece of tape labeled “Venus.”
   d. Continue marking the distances from the sun to the planets, using the Table of Distances, below.

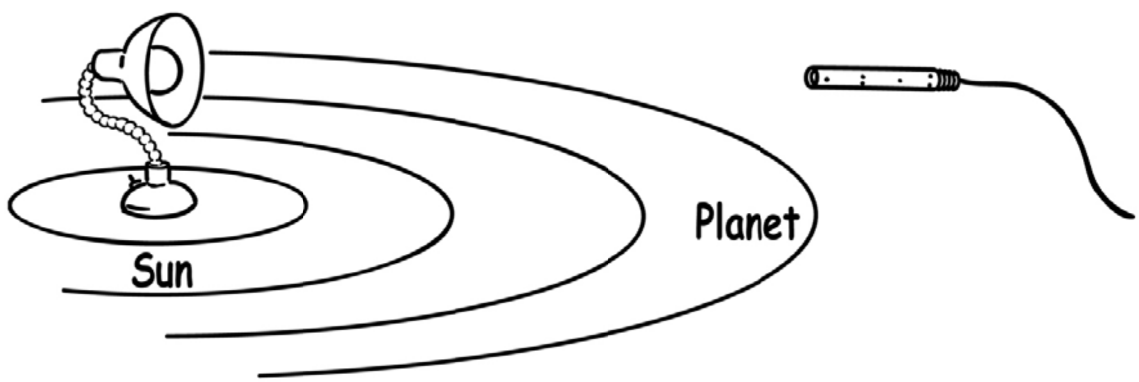
Table of Distances		
Planet	**Distance in meters**	**Distance in AU**
Mercury	10 cm	0.4 AU
Venus	18 cm	0.7 AU
Earth	25 cm	1 AU
Mars	38 cm	1.5 AU
Jupiter	125 cm	5 AU
Saturn	237 cm	9.5 AU
Uranus	475 cm	19 AU
Neptune	750 cm	30 AU

Part II: How Much Light Would Each Planet Get From the Sun?

Key Question
How does the light level change when you get farther away from the sun?

Prediction
Click on the Prediction button, [pencil icon], and draw how you think the light level will change as you increase the distance between the Light Probe and the light bulb.

5. Turn the lamp on, and then darken the room as much as possible.
6. Collect data by following the steps below:
   a. Decide who will hold the Light Probe and who will enter the data into the computer.
   b. Click [▶ Collect] to begin data collection.
   c. Put the probe at the position where Mercury is located in the model so the probe is pointing towards the lamp.
   d. Look at the live meter on the computer screen, showing what light level is reaching the probe. Move the tip around a bit to get the highest reading you can.
   Careful: Make sure you are still pointing towards the lamp!
   e. Click [Keep] to save this data point.
   f. In the box that appears on the screen, enter in the value for the planet location in AU based on the table above (for Mercury this value is 0.4) and then click [OK].



7. Repeat Step 6 for each of the planets in the model.
8. When you have collected all your data, click [■ Stop] to end data collection.
9. Write your observations on the Observations Sheet.

Formative Assessment:

- The completion of the Distance to the Sun – Analyze your Data will be used as the assessment tool.

Distance from the Sun Observation Sheet

Name:	
Date:	
Write observations about how the light level changes as you move away from the Sun.	
1	
2	
3	
4	
5	
6	
7	
8	

Name: ______________________

Date: ______________________

Distance to the Sun – Analyze your Data

1. Use the data from your graph to describe the light levels of the first five planets.

____

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2. Write about two ways that we on Earth depend on the sun.

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3. Imagine you have traveled to one of the outermost planets. Write a sentence that describes what the sunlight on the planet might be like and how the sun would look from that planet.

____

____

____

4. Imagine that we are going to try to begin a colony on another planet. Using what you know about how we on Earth depend on the Sun, and your data from this activity, describe what you would need to make the colony a place where humans could survive.

____

____

____

Lesson 7: Aurora's: Natures Light Show

Essential Question:

Where can you see auroras and what do they look like?
What makes them happen, and why do they have different colors?

Content Standards:

- SC.8.E.5.9: Explain the impact of objects in space on each other including the Sun on the Earth including seasons and gravitational attraction.
- SC.912.E.5.7: Relate the history of and explain the justification for future space exploration and continuing technology development.

Vocabulary

- Aurora
- Electromagnetism
- Pole
- Magnetic field
- Charged particles
- Magnetotail

Youth Development Standards:

- 3 – Child receives support from non-family adults
- 5 – Relationships with teachers provide a caring & engaging environment
- 10 – Child feels at home
- 12 – School provides clear rules and consequences
- 16 – Parent(s) and teacher expects the child to do their best work at school
- 22 – Child is actively participating in activities outside of school
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- 35 – Student can stay away from people likely to get him/her in trouble
- 36 – Child seeks to resolve conflict nonviolently
- 37 – Child feels that he/she has some influence over things that happen in his/her life
- 38 – Child likes and is proud of the person that he/she is

Teacher Background Knowledge:

- Students go a tour of auroral phenomena through research images and taped interviews with scientists. Diagrams and text provide background on qualitative magneto-dynamics, and explanations of locations of auroral zones on the Earth. Variations in color are used to introduce ideas about spectroscopy.

Student Activities
A self-guided tour of auroras in five sections, illustrated with pictures of aurora, images from spacecraft, and diagrams. Students navigate through pages sequentially.

Student Prerequisites
Browser skills, basic geography; an understanding of the basic concepts of electric charge and magnetic fields.

Learning Objectives
Students will be familiar with auroral phenomena and where they appear on the Earth's surface.

Students will connect auroras on Earth to activity on the Sun, and understand the mechanism that produces auroras.

Students will be familiar with the study of auroras from the Earth and from space.

Materials:

- Internet connected computer with WWW browser program.
- A world globe is useful.

Procedure:

Adapted from http://cse.ssl.berkeley.edu/SegwayEd/abtauror.html

Picture yourself outside on a clear dark night. Low on the horizon you notice a faint glow of greenish light which forms an arch, stretching lazily across the sky. As time passes, additional bands of light form and drift overhead, slowly brightening to form giant curtains in the sky that slowly wave as if a gentle breeze were blowing. Suddenly, the bottom of the curtain brightens with a reddish tint and ripple faster. Blues and purples appear. As the curtains pass directly overhead, you see bright points of light that swirl like a pinwheel. The entire sky seems to be full of color and motion. Then, after several minutes, everything fades into a warm green glow.

Before we can understand auroras, we need a few facts about the space around our Earth. There are many things in this space that we can't see.

One thing is the air we breathe, our atmosphere. It is really a mixture of several gases, mostly nitrogen and oxygen, with traces of hydrogen, helium and various compounds.

A Field of Earth

Another thing we can't see is a magnetic field that surrounds the Earth. If you've ever played with a bar magnet and iron filings you've seen the curved patterns the filings form in the magnetic field. The next picture shows how the magnetic field around the earth's core is like the field of a bar magnet.

The Earth's "magnet" is deep in the core. Since we can't see the magnetic field, we draw lines to represent it. The field lines go into and out of the Earth around the Earth's magnetic poles. Where the lines are closest together the field is strongest. Where they are furthest apart it is weakest. Can you tell where the magnetic field is the strongest? Where is it weakest?

Charged Particles

A third invisible thing in the space around the Earth is plasma, made of lots of charged particles. There are always electrons and positive ions in the surrounding magnetic field. Charged particles in a magnetic field move in a special way: they are guided by the field. The particles travel along magnetic field lines as if they were wires, circling around the lines in a long spiral as they go. Charged particles are the "ammunition" of an aurora.

Solar Powered Display

The short answer to how the aurora happens is that energetic electrically charged particles (mostly electrons) accelerate along the magnetic field lines into the upper atmosphere, where they collide with gas atoms, causing the atoms to give off light. But why does that happen? To find the answer, we must look further away, to the Sun. The spectacular, "great" auroras in "What do they look like?" are powered by what is called the solar wind.

This wind is always pushing on the Earth's magnetic field, changing its shape. You change the shape of a soap bubble in a similar way when you blow on its surface. We call this compressed field around the earth the magnetosphere. The Earth's field is compressed on the day side, where the solar wind flows over it. It is also stretched into a long tail like the wake of a ship, which is called the magnetotail, and points away from the Sun.

Squeezing the Earth's magnetic field takes energy, just the way it takes energy to compress a balloon with air in it. The whole process is still not fully understood, but energy from the solar wind is constantly building up in the magnetosphere, and this energy is what powers auroras.

The Big Push

So we have the Earth's magnetosphere, with the solar wind squeezing the magnetosphere and charged particles everywhere in the field. Solar particles are always entering the tail of the magnetosphere from the solar wind and moving toward the Sun. Now and then, when conditions are right, the build-up of pressure from the solar wind creates an electric voltage between the magnetotail and the poles, like the voltage between the two terminals of a battery. It can reach about 10,000 volts!

The voltage pushes electrons (which are very light) toward the magnetic poles, accelerating them to high speeds, much like the electrons in a TV picture tube that accelerate to hit the screen. They zoom along the field lines towards the ground to the north and south, until huge numbers of electrons are pushed down into the upper layer of the atmosphere, called the ionosphere.

In the ionosphere, the speeding electrons collide violently with gas atoms. This gives the gas atoms energy, which causes them to release both light and more electrons. In this way, the gases of the ionosphere glow and conduct flowing electric currents into and out of the polar region. The electrons flowing back out don't have as much energy as the speedy incoming ones had - that energy went into creating the aurora!

The way the aurora works is a lot like a neon sign, except that in the aurora, the conducting gas is in the ionosphere, instead of a glass tube, and the current travels along magnetic field lines instead of copper wires.

The Sun also has an atmosphere and a magnetic field that extend into space. The Sun's atmosphere is made of hydrogen, which is itself made of subatomic particles: protons and electrons. These particles are constantly boiling off the Sun and streaming outward at very high speeds. Together, the Sun's magnetic field and particles are called the "solar wind."

What is the solar connection?

We know that the solar wind is the power source for auroras. It has also been known for a long time that there is a connection between activity on the Sun and auroral activity on the earth. The following graph shows how historically, measurements have suggested sunspots and auroras might be related.

Bigger and Brighter

The Sun and its wind are constantly changing. The flow of particles and the intensity of the solar wind's magnetic field increase when the Sun is more active. Scientists now know that certain kinds of high-energy solar events can result in very large and unusual auroras.

These types of solar activity include coronal mass ejections (CME's) like the one pictured here, and sudden solar flares. In these events, parts of the Sun's outer atmosphere practically explode, producing huge bursts of solar wind packed with as many sub-atomic particles as a mountain!

It's a Blast

It takes 2 to 4 days for solar wind and particles to reach Earth. When these events arrive, they strike the magnetosphere like a shock wave and inject huge amounts of energy into the magnetic field, often causing enormous and unusual auroras. We will also see that such intense "gusts" of solar wind can affect where auroras can be seen.

Where can you see them?

Shuttle's Eye View

Auroras seem to spread and sway across the sky above us. But to astronauts in the space shuttle above the earth, auroras seem to cling to the surface below. In fact, auroras begin at about 60 miles above the Earth's surface, above most of the atmosphere. Imagine: if you could "drive" from the surface to the bottom of an aurora, it would take you an hour at 60 m.p.h.!

The space shuttle, in its "low earth" orbit 250 kilometers above Earth's surface, is a great spot for observing auroras from above the polar regions. This photo, taken from the shuttle, shows red-tipped arcs near the south pole. In the next section, we'll look into where the different colors in auroras come from.

What We See

Auroras form in rings centered over the Earth's magnetic poles. During an aurora, rings form around the North and South poles at the same time. Even near the poles, someone on Earth can only see a tiny section of the auroral oval.

Why are they different colors?

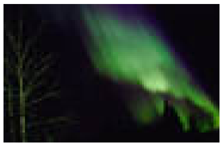
Have you ever noticed the different colors in streetlights? Some are a dark yellow color while others have a blue or purplish light. How about neon signs? They have many different colors.

Streetlights and neon signs are filled with gas. When they are turned on, an applied voltage energizes electrons in the gas. These electrons strike the gas molecules, which excites them to emit light. The color of the light you see depends on the type of gas. Every gas shines with its own special colors of light. These colors are like a fingerprint because no two gases give off exactly the same colors. Streetlights filled with sodium gas give off a dark yellow light. Only sodium atoms give off that particular shade of yellow. Orange neon signs are filled with pure neon gas. Other colors of neon signs are actually neon mixed with other types of gases, like helium or argon. The unique colors of light produced by a gas are called its "spectrum". The auroral lights' colors are determined by the spectra of gases in the Earth's atmosphere, and the height at which the most collisions take place. Incoming particles tend to collide with different gases at different heights.

Very high in the ionosphere (above 300 km or 180 miles), oxygen is the most common atom, and collisions there can create a rare red aurora. The strong yellow-to-green light that is most common is produced by collisions with oxygen at lower altitudes, between 100 and 300 km. Around 100 km, nitrogen molecules produce a red light that often seems to form the lower fringes on aural curtains. If our atmosphere were neon instead of oxygen and nitrogen, what color would auroral lights be? You guessed it, orange!

Lighter gases high in the ionosphere, like hydrogen and helium, make colors like blue and purple, but our eyes cannot always see them in the night sky. Good photographic film can be more sensitive to some colors than our eyes. Eyes see best in the green-yellow-orange part of the spectrum, where the Sun emits most of its light.

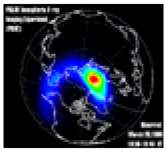
Additional resources:



The Aurora Page at Michigan Technical University, features photographs by Jan Curtis. Beautiful aurora photographs.http://www.geo.mtu.edu/weather/aurora/images/aurora/jan.curtis/index.html

Space Weather at NASA. Get the latest on solar events and their effects on Earth. Subscribe for email updates.
http://www.spaceweather.com/

Ultraviolet Images of the Earth's Aurora

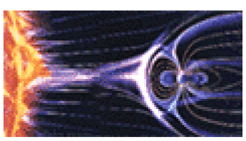


A First from NASA's Polar Satellite!http://www.exploratorium.edu/learning_studio/news/june96.html

Jan Curtis's Aurora's Northern Lights
A huge gallery of great photos and a good starting point.

http://climate.gi.alaska.edu/Curtis/curtis.html

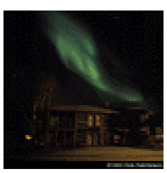
FAST: The Fast Auroral SnapshoT mission education and public outreach site has more lessons.
http://cse.ssl.berkeley.edu/Fast_epo/index.html



Exploration of the Earth's Magnetosphere

A complete primer: includes a variety of images and thorough explanations.

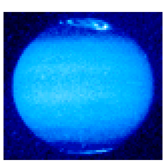
http://www-spof.gsfc.nasa.gov/Education/Intro.html



Shooting the Aurora Borealis

See fantastic pictures of auroras and get expert tips on how to photograph them.

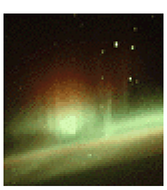
http://www.ptialaska.net/~hutch/aurora.html



Hubble Images of Jupiter's aurora

See the photos, read the press release.

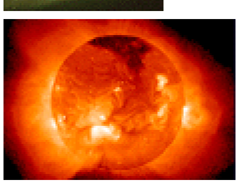
http://hubblesite.org/newscenter/archive/releases/1996/32



"Astronomy Picture of the Day" on November 14, 1995.

This site has an interesting variety of images with explanations by scientists.

http://antwrp.gsfc.nasa.gov/apod/ap951114.html



Yohkoh Solar X-ray Telescope

See great x-ray solar images. Also provides links to other solar sites.

http://www.lmsal.com/SXT/homepage.html

All About Auroras

Space.com’s aurora page with a gallery of images and real-time cameras of aurora.

http://www.space.com/auroras/

Formative Assessment:

- See attached form for student assessment.

Student: ___________________________
Date: ___________________________

Auroras: Paintings in the Sky Student Questionnaire

http://cse.ssl.berkeley.edu/SegwayEd/abtauror.html

1. What does an aurora look like from the ground?
   a) Millions of sparkling lights
   b) A rainbow
   c) A slowly waving curtain of light
   d) You can only see them from high in the air
2. What do auroras look like from space?
   a) Slowly waving curtains of light
   b) Rings of light near the equator
   c) Rings of light near the north and south poles
   d) Millions of sparkling lights
3. What causes an aurora?
   a) Charged particles from the Earth hit atmospheric gases
   b) Charged particles from the Sun hit atmospheric gases
   c) The atmosphere reflects the moonlight
   d) An exploding star such as a supernova
4. Where can you see auroras on the Earth?
   a) Around the geographic poles of the Earth
   b) Around the magnetic poles during high solar activity
   c) In high latitudes near electric storms
   d) Near the equator during high solar activity
5. Why are auroras different colors?
   a) It depends on where the Earth is in its orbit around the Sun
   b) The Sun strikes different parts of the aurora at different angles
   c) They aren't - it's just different shades of the same color
   d) The colors are determined by the different gases in the Earth's atmosphere

6. What is the magnetosphere? Explain how it comes about.

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____

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____

7. Would you like to learn more about Auroras?

____

____

____

8. What was one thing you learned that you didn't know before?

____

____

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9. Would you like to learn more about Earth and Space Science?

____

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____

10. Did you tell anyone outside the class about the internet lesson? Who? What did you say?

____

____

____

Lesson 8: A Brief Lesson on the History of Rockets

Essential Question:

Do you think we would have rockets today if it weren't for people like Archytas, or Hero of Alexandra? Who are they and why are they important to the history of rocketry?

Content Standards:

- LA.5.1.6.1: The student will use new vocabulary that is introduced and taught directly.
- LA.5.1.6.2: The student will listen to, read, and discuss familiar and conceptually challenging text.
- SC.7.N.2.1: Identify an instance from the history of science in which scientific knowledge has changed when new evidence or new interpretations are encountered.
- SS.912.W.4.6: Describe how scientific theories and methods of the Scientific Revolution challenged those of the early classical and medieval periods.

Vocabulary

- Aerodynamics
- Force
- Propulsion
- Center of Mass
- Center of Propulsion
- Combustion Chamber
- Mass
- Oxidizer
- Propellant
- Stages

Youth Development Standards:

- 3 – Child receives support from non-family adults
- 5 – Relationships with teachers provide a caring & engaging environment
- 10 – Child feels at home
- 12 – School provides clear rules and consequences
- 16 – Parent(s) and teacher expects the child to do their best work at school
- 22 – Child is actively participating in activities outside of school
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- 36 – Child seeks to resolve conflict nonviolently
- 37 – Child feels that he/she has some influence over things that happen in his/her life
- 38 – Child likes and is proud of the person that he/she is

Teacher Background Knowledge:

- Teacher should preview the websites associated with this lesson prior to assigning the web-quest activity to the students.
  Source: http://exploration.grc.nasa.gov/education/rocket/TRCRocket/history_of_rockets.html

Materials:

- Pen/pencil

- Computer with internet access
- Web-quest activity form
- Mailing tubes or tubes from paper rolls
- Spools
- Coffee creamer packages (small plastic containers that look like rocket engine nozzles)
- Cardboard
- Egg-shaped hosiery packages (for nose cones)
- Styrofoam cones, spheres, and cylinders
- Glue
- Tape

Procedure:

1. Teacher will open discussion by asking to the two essential questions: Do you think we would have rockets today if it weren't for people like Archytas, or Hero of Alexandria? Who are they and why are they important to the history of rocketry?

2. Teacher will then navigate the classroom computer to the start page of the activity: http://exploration.grc.nasa.gov/education/rocket/TRCRocket/history_of_rockets.html

3. Students will open the laptop computer, log-in and navigate to the same web site. Once all students have successfully opened the site, the reading activity will start. This will be completed in a jigsaw fashion.

4. Split the class into groups of three students each. Each group should have three positions, reader, recorder and reporter. These jobs should rotate with each reading assignment. The job descriptions:

   Reader: This student reads aloud the text as presented on the web site to his/her teammates.

   Recorder: Takes notes that all team members feel are appropriate.

   Reporter: Reports the summary for the team of the text they have read.

5. Divide the reading assignments as equally a possible between 6 or 7 groups. The assignments should be comprised of one subheading and subsequent text per group. If there are more subheadings than groups, simply re-start the rotation at group one.

6. Once each group has read their portion of the first assignment, each group will give a short summary of what they have read. Once every group has presented their summary, the next round of reading may begin.

7. At the completion of the web site reading, the teams will complete the attached web-quest form.

Formative Assessment:

- The teacher will circulate the room during the reading activities to ensure students are staying on point. Student teams will build representations of famous rockets, or their team's interpretation of what an early rocket may have looked like. All teams will complete the Web-Quest activity.

Team Names: ___________________________________

____

____

Date: ___________________________________

Activity 8: Web-Quest

The History of Rockets

Who is Aulus Gellius?

What is the town of Tarentum known for?

Who invented the aeolipile?

Who is credited with making the first true rocket?

Around what year was this done?

What did Joanes de Fontana of Italy invent?

When is it believed that rocketry became a science?

What purpose were rockets serving at the time?

In what year did modern rocketry come into being?

How is a rocket defined in its simplest form?

What are Newton's Three Laws of Motion?

How does gravity affect a rocket?

What type of propellants do rockets use?

Why do people think rockets are dangerous?

Lesson 9: The Rocket Boys/October Sky

Essential Question:

Who was Homer Hickum and why was Sputnik so important to him?

Content Standards:

- LA.7.2.1.2: The student will locate and analyze elements of characterization, setting, and plot, including rising action, conflict, resolution, theme, and other literary elements.
- MA.7.G.4.4: Compare, contrast, and convert units of measure between different measurement systems (US customary or metric (SI)), dimensions and derived units to solve problems.
- SC.4.P.10.2: Investigate and describe that energy has the ability to cause motion or create change.
- SS.5.G.4.1: Use geographic knowledge and skills when discussing current events.

Vocabulary

- Abolish
- Acceleration
- Affliction
- Arc
- Astronaut
- Bastion
- Chagrined
- Confounded
- Defiance
- Infatuation
- Launch
- Perpetrator
- Pessimist
- Recession
- Retaliation
- Satellite
- Shaft
- Shuttle
- Sputnik
- Strategy

Youth Development Standards:

- 3 – Child receives support from non-family adults
- 5 – Relationships with teachers provide a caring & engaging environment
- 10 – Child feels at home
- 12 – School provides clear rules and consequences
- 16 – Parent(s) and teacher expects the child to do their best work at school
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- 36 – Child seeks to resolve conflict nonviolently
- 37 – Child feels that he/she has some influence over things that happen in his/her life
- 38 – Child likes and is proud of the person that he/she is

Teacher Background Knowledge:

- Read the book ”Rocket Boys” by Homer Hickam, Jr. The movie “October Sky” can be used in lieu of the text due to the varied reading levels among the students.

Materials:

- Text or copy of movie
- Pencils/pens
- Writing paper

Procedure:

(*Taken from :* http://teachwithmovies.org/samples/october-sky.html#before)

1. **Before watching the movie:**

   The following will greatly enhance a child's understanding and appreciation of this movie:
   From 1946 to 1991, the U.S. was locked in a Cold War with Russian Communism. The Soviets claimed that Communism was the wave of the future and that it would bury capitalism, democracy, and the United States. Russia and Communism were a serious threat to the U.S. and the Western democracies.

   In the 1950s, the United States believed that its technology was the best in the world. We had more cars than any country in the world. We had the best televisions, refrigerators, record players and a host of other consumer goods. At that time U.S. factories were building these products. Japan was still recovering from WW II and China was still undeveloped. We had been first with the atomic bomb and first with the hydrogen bomb. Our airplanes and jet fighters were the best in the world. We thought that our military equipment was better than the Russians'. Americans took comfort in the belief that we had the best scientists and engineers that ever lived.

   The belief in American technical superiority changed in 1958. Sputnik was the first man-made satellite to orbit the earth. It was sent up, not by the Americans, but by the Russians. Americans looked up to see a Communist star traversing the heavens and realized that in the important arena of space, our technology was inferior to that of the Russians. People worried about what would happen if the Russians put an atomic bomb on one of their satellites. This insecurity deepened as the first several U.S. efforts to orbit a satellite failed miserably. Rockets exploded on the launch pads or they crashed soon after lift-off. All of this occurred live on world-wide television. It was more than embarrassing. It was frightening.

For years, the Soviets led the space race, hoisting larger payloads into space than the U.S., including the first animal in space and the first man in space. All of this occurred during one of the most distrustful and competitive periods of the Cold War. The launch of Sputnik shook the United States to its roots.

"October Sky" shows one boy's reaction to this event. The story told by this movie is pretty much true.

The movie takes place in a coal town in West Virginia. Coal towns existed for the sole purpose of mining coal. Everything in the town was owned by the coal company: the stores, the church, the schools and the houses in which the miners lived. If a miner was incapacitated and could no longer work, his family was forced to move out of their company owned house, which meant leaving town. Often, when the father was injured, the children had to work in the mines to pay the rent and remain eligible to live in company owned housing. If a miner died in the mines, his family had a very short time (usually two weeks) to move. The coal company didn't want the grim reminders of the dangers of the mine to be around too long. Coalwood, where Homer lived, was one of the better company towns, but it was still subject to harsh practices by the mine owners.

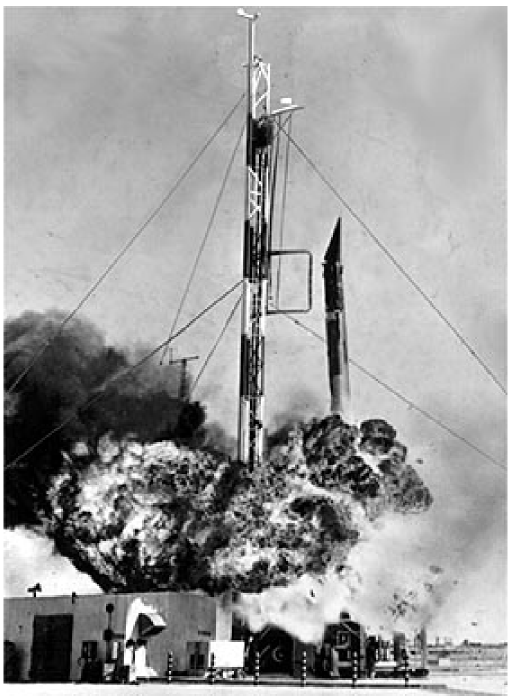
In a mine, coal dust pollutes the air and literally covers everything. A common ailment among miners is black lung disease (pneumoconiosis) caused by inhaling coal dust. Homer's father was suffering from this disease. The mine owners refused to compensate miners for this occupational hazard, so the Federal Government stepped in and set up a health and worker's compensation plan for the miners.

2. **Watch the movie.**
3. **After watching the movie:**
   It was very unusual for any boys from Homer's home town to go to college, other than on a sports scholarship. However, each of the Rocket Boys graduated from college and Homer Hickam fulfilled his dream by becoming an engineer for NASA.

   The U.S. eventually pulled equal to the Russians in the space race and was victorious in the Cold War. Russia abandoned Communism in 1991 and has adopted a capitalist model. It is no longer a super power that competes with the U.S. Space exploration is now a cooperative international effort. The Russians are making money by charging very rich people (often Americans) millions of dollars for a trip into space in a Russian space capsule.

   Homer Hickam's book, <u>The Rocket Boys</u>, is better than the movie and contains a number of wonderful vignettes that are not in the film. For example, as the boys built more complex rockets Homer realized that they needed to learn calculus to take the next steps in rocket design. Homer and the science teacher convinced the principal of the high school to offer a new course in calculus. The enrollment was limited to six people, the exact number of boys involved in the effort to make the rockets. No one expected anyone else at the school to sign up for the class.

   However, the girl that Homer had a crush on signed up too, and since Homer's grades in math were the worst of any of the applicants, he was excluded from the class. The principal at this point was not sure that the Rocket Boys were really up to any good and called them "bombers," a reference to their first effort which had blown up Homer's mother's fence. The principal would not increase the enrollment in the class by one person to allow Homer to take it. Initially, Homer felt that his dreams of a career in rocketry were over, but in the depths of his depression, he found a calculus text on the bookshelf at home. There were notes in the book in his father's handwriting showing that his father, who had never gone to college but who was called upon to supervise engineers, had taught himself calculus. Homer began to study the text and the other members of the club helped him. Homer learned calculus without the class, to his own amazement and that of his teachers and the principal.



December 6, 1957: Two seconds after launch Vanguard was four feet off the pad. Thrust ceased, it crumpled and then exploded.

The film does not present a sympathetic view of the United Mine Workers of America (UMW) local in Coalwood. This is a departure from the book. While Homer's father was the manager of the mine and a company man through and through, and while he believed that the reasons for the strike were trivial, it is not clear that he was right. Moreover, the Union men supported the Rocket Boys long before Homer's father did and they were instrumental in facing down the company when it wanted to shut down the boys' test firing range (it was on a massive expanse of tailings from the mine). Overall, the UMW has made an important positive contribution to U.S. history, forcing the coal operators to make the mines safer and to pay a living wage. For a film that shows some of the difficulties the miners had in organizing their union and gaining recognition from the mine owners, see Matewan.

Also in the book, and not in the film, is a clear explanation of how the Rocket Boys got the precision nozzles necessary to fly their rockets. After Homer's father had sent Mr. Bikovsky (the first machinist to help the Rocket Boys) into the mine as punishment, the town coalesced behind them. Homer then convinced the supervisor of another mine machine shop to make the nozzles and Homer's father permitted company time and company materials to be used. A fundamental truth illuminated by this story is that to perform amazing feats, not only do people need to be committed and work hard, they often need the support of their communities. Moreover, they need to seek out and get that help. This is especially true in today's complex environment.

The sequence in which Homer quits high school and goes to work in the mine is fictional but rings true from a former time when the mine owners provided no benefits for the miners or their families. (The real Homer Hickam did work in the mine during the summer after his first year of college, but he was not forced to take the job.) Homer Hickam had this to say about the movie and about this incident:

It was great fun to see Rocket Boys become the movie "October Sky." Of course, I thought they should have just filmed it exactly the way I wrote it down in my book but Hollywood has its ways, and they're not generally the same as book-writers. But only good things have come of it, I'd have to say, even though *I didn't like that the movie showed me quitting [high] school. I would have never quit school. My parents would have lived in a tree before they would have ever let that happen!* But so many people across the world have been inspired by the movie. A lot of astronauts even watch it the night before they climb aboard the shuttle. Now, that's pretty special! [Quoted from Bookwire Speaks with Homer Hickam.]

The black machinist tells Homer that he flew with the "Red Tails." This is a reference to the "Red Tailed Angels" of the all African-American 332nd Fighter Group. In the Second World War, the 332nd was the only Fighter Group which never lost a bomber to enemy planes, thereby destroying the prejudice that blacks could not fly modern fighters. See *Learning Guide* to "The Tuskegee Airmen".
Discussion Questions:

Should the people in the early U.S. space program have been deterred by their many failures to launch rockets? Suggested Response: Daniel S. Goldin, former administrator of NASA, said that one should never be deterred by failure but that if you learned from your failures they would be the building blocks for later success. Commencement address to the 2001 graduating class of the Engineering School, University of California, Berkeley.

According to the movie, what would have happened to Homer's family if no one had been working in the mine even though his father was still recuperating from injuries he had received saving miners' lives? Suggested Response: If no one in the family was working in the mine, the family would have been evicted from its home by the coal company. This was true even if the miner was still recuperating from injuries received in a mine accident. (We don't know if the mine owners applied the same standard to management employees like Homer's father. But it did apply to the miners, the vast majority of the company's employees.) If a miner died or was too injured to work, the mine owners would evict the family. This meant forcing them to move out of town, since the mine company owned everything in the town. The family would generally have to move within a few weeks of the injury or the death of the miner. The company didn't want any grim reminders to stay around and spook the other miners.

Formative Assessment:

- Pose these extension questions to small groups of students and have them come to a consensus on the answers, then have them submit a written copy of their group answer.
    1. What did the Rocket Boys prove by their success?
    2. How big is the coal industry today? To what extent does the United States still rely on coal for power and for coke for the steel mills? Are there still coal towns?

Lesson 10: Air Powered Rocketry Condensed from "How In The World Do They Do It?" By Gregory Vought/NASA JSC

Essential Question:

Can you make a rocket that will launch and travel with air power alone?

Content Standards:

- SC.5.P.13.2: Investigate and describe that the greater the force applied to it, the greater the change in motion of a given object.
- SC.3.P.10.2: Recognize that energy has the ability to cause motion or create change.
- MA.5.G.5.3: Solve problems requiring attention to approximation, selection of appropriate measuring tools, and precision of measurement.
- MA.912.S.2.1: Compare the difference between surveys, experiments, and observational studies and what types of questions can and cannot be answered by a particular design.
- SC.5.P.10.2: Investigate and explain that energy has the ability to cause motion or create change.
- SC.5.P.13.3: Investigate and describe that the more mass an object has, the less effect a given force will have on the object's motion.

Vocabulary

- Air pressure
- Fuselage
- Nose cone
- Fin
- Force
- Motion
- Orbit
- Satellite
- Sir Isaac Newton

Youth Development Standards:

- 3 – Child receives support from non-family adults
- 5 – Relationships with teachers provide a caring & engaging environment
- 10 – Child feels at home
- 12 – School provides clear rules and consequences
- 16 – Parent(s) and teacher expects the child to do their best work at school
- 22 – Child is actively participating in activities outside of school
- 24 – Child cares about teachers and other adults at school
- 25 – Child enjoys reading for fun most days of the week
- 34 – The student knows and is comfortable with cultural backgrounds and his/her own culture
- 35 – Student can stay away from people likely to get him/her in trouble
- 36 – Child seeks to resolve conflict nonviolently
- 37 – Child feels that he/she has some influence over things that happen in his/her life
- 38 – Child likes and is proud of the person that he/she is

Teacher Background Knowledge:

- Teacher should be familiar with Homer Hickam's "The Rocket Boys", or the movie "October Sky."

Materials:

- Paper (variety of weights-copy paper, construction paper, cardstock, etc.)
- Cellophane tape
- Scissors
- Rulers
- Pencils
- String
- Cardboard
- Modeling clay
- Rocket forms (short lengths of ½ " PVC tubes)
- Fin and Nosecone patterns (see Appendix B)
- Poster board
- Hot-Glue gun (to be used by teacher or adult volunteer)
- Launcher (see Appendix B)
- Electric Air Compressor or Hand
- ***Also see the attached "Constructing the air pressure launcher" for instruction and materials needed for the launching device.***

Procedure:

1. Choose a type of paper and roll it around the short lengths of ½" PVC pipe. The tube serves as a form for constructing the body of the rocket. The paper should be snug on the form but able to slide easily.
2. Use cellophane tape or a glue stick to secure paper in the form of a rolled tube around the piece of PVC pipe.
3. Choose a fin shape, trace on poster-board, and attach to body of rocket with tape. (After stability tests, fins should be attached with hot glue.)
4. Trace nosecone, add modeling clay for weight if you wish, and attach to body of rocket with tape. (After the stability tests, the nosecone should be attached with hot glue.)
5. Perform Rocket Stability Tests:
    a) Find the center of mass. This line on the rocket represents an average of the mass of the entire rocket. Demonstrate how to find this point by tying a string around the model rocket. Adjust the string so that the rocket will be parallel to the floor. This is the center of mass; use the ruler to measure where this line is located.
    b) Conduct the swing test. Spin the sample rocket in a circle using the attached string. A well-designed rocket will spin with the nose cone facing forward without wobbling.
6. Find the center of pressure. This line represents an average of the pressure exerted on a rocket during its flight. A simple way to calculate this is to trace and cut out a cardboard silhouette of the rocket. Show students an example, and show them how, by balancing this on a ruler, they can estimate the location of the center of pressure. Students should record the center of mass and the center of pressure on their scale drawing. The center of mass should be close to the nosecone and the center of pressure should be close to the fins. After the three tests, the trainees may wish to

make modifications, so the groups should not permanently attach their nose cones/fins until the tests are complete.

Launch Procedures:

7. Select a clear field for the launch. Although the rockets are made of paper, they can still cause injury if someone is struck by them.
8. Set up the launcher and orient the base so that the launch tube can point straight upward. If the wind is blowing, you will want to aim the angle of the tube slightly into the wind.
9. Connect the air compressor or hand pump to the tire valve on the launcher. With the valve closed, pump the launcher up to 30 pounds of pressure. Test fire a rocket and observe how far the rocket goes and in which direction. Make adjustments to the aiming and pump the launcher up to 50 pounds of pressure. Again, test fire a rocket and make any final aiming adjustments.
10. Allow each student to load the rocket on the launch pad. (Student launching must wear safety goggles.) Clear the landing site from bystanders, perform countdown, and launch rocket.

Safety Rules

- ✓ Do not pump the launcher up to a pressure grater than half the rated pressure of the weakest part. The PVC pipes and the valve come with pressure ratings. If the lowest rating is 150 PSI, do not pressurize the launcher to greater than 75 PSI. This provides a significant safety margin.
- ✓ Be careful in handling the launcher. PVC can crack if dropped or struck with sufficient force. Inspect the launcher before use. Discard a launcher that shows signs of cracking.
- ✓ Do not lean over the launch rod at any time.
- ✓ Do not place anything inside the launch rod.
- ✓ Wear eye protection for launches.

Formative Assessment:

- Students will assess their own rocket project. They will make a prediction on flight time and distance prior to launch, then see how close they come to their prediction when the rocket is actually launched.

Appendices

Appendix A	Planetary Fact Sheet
Appendix B	Rocket Launcher Instructions
Appendix C	Rockets
Appendix D	Theme Map
Appendix E	Vocabulary – Activity 1
Appendix F	Vocabulary – Activity 2
Appendix G	Vocabulary – Activity 3
Appendix H	Vocabulary – Activity 4
Appendix I	Vocabulary – Activity 5
Appendix J	Vocabulary – Activity 6
Appendix K	Vocabulary – Activity 7
Appendix L	Vocabulary – Activity 8
Appendix M	Vocabulary – Activity 9
Appendix N	Vocabulary – Activity 10