OUR UNIVERSE: ALWAYS MOVING, ALWAYS CHANGING

Grade Level or Special Area: 3rd Grade
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Length of Unit: 11 lessons and a Culminating Activity (12 days, one day=80 minutes)

I. ABSTRACT

This unit is an interactive, experiential approach to learning astronomy as detailed in the *Core Knowledge Sequence*. It looks at astronomy, as it was understood in the past, how we study it today, and how it might look in the future. Students will participate in activities and experiments that are designed to help them understand the workings of our universe. This unit with all appendices included is available at www.ckcolorado.org.

II. OVERVIEW

A. Concept Objectives
   1. Students will analyze different objects in space and their interaction with each other.
   2. Students will understand that order exists in the relationship and interaction between objects in space.
   3. Students will recognize that our knowledge of space has changed over time and will continue to change in the future.

B. Content from the *Core Knowledge Sequence*
   1. The "Big Bang" (p. 83)
   2. The Universe: an extent almost beyond imagining (p. 83)
   3. Galaxies: Milky Way and Andromeda (p. 83)
   4. Our solar system (p. 83)
      a. Sun: source of energy (heat and light)
      b. The nine planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto
   5. Planetary motion: orbit and rotation (p. 83)
      a. How day and night on earth are caused by the earth's rotation
      b. Sunrise in the east and sunset in the west
      c. How the seasons are caused by the earth's orbit around the sun, tilt of the earth's axis
   6. Gravity, gravitational pull (p. 83)
      a. Gravitational pull of the moon (and to a lesser degree, the sun) causes the ocean tides on earth
      b. Gravitational pull of "black holes" prevents even light from escaping
   7. Asteroids, meteors ("shooting stars"), comets, Halley's Comet (p. 83)
   8. How an eclipse happens (p. 83)
   9. Stars and constellations (p. 83)
   10. Orienteering (finding your way) by using the North Star, Big Dipper (p. 83)
   11. Exploration of space (p. 83)
      a. Observation through telescopes
      b. Rockets and satellites: from unmanned to manned space flight
      c. Apollo 11, first landing on the moon: "One small step for man, one giant leap for mankind."
      d. Space shuttle
   12. Science biography: Copernicus (p. 83)

13. Science biography: Mae Jemison (p. 83)
14. "The Hunting of the Great Bear" (p. 67)
15. Produce a variety of types of writing- poetry (p. 65)

C. Skill Objectives

1. Students will understand that patterns of organization provide useful ways of interpreting the world. (Jefferson County Standards Science Strand 1.1)
2. Students will understand that most things are in the process of change and that there are patterns to those changes. (Jefferson County Standards Science Strand 1.2)
3. Students will seek answers by making careful observations and trying things out. (Jefferson County Standards Science Strand 2.1.B)
4. Students will make predictions based on their experiences. (Jefferson County Standards Science Strand 2.1.C)
5. Students will follow written directions. (Jefferson County Standards Science Strand 2.1.D)
6. Students will describe and compare things using such characteristics as shape, color, size, texture, weight, numbers and motion. (Jefferson County Standards Science Strand 2.1.E)
7. Students will use charts with appropriate labels to record and organize data. (Jefferson County Standards Science Strand 2.1.F)
8. Students will explain procedures or ideas in a variety of ways, such as sketching and labeling. (Jefferson County Standards Science Strand 2.2.A)
9. Students will be able to explain that tools are used to do things better. (Jefferson County Standards Science Strand 3.1.A)
10. Students will give examples of tools and technologies that are used in particular careers or occupations. (Jefferson County Standards Science Strand 3.2.E)
11. Students will recognize that the sun is a principal source of the Earth's energy. (Jefferson County Standards Science Strand 4.2.A and 5.2.A)
12. Students will describe what can be observed in the daytime and nighttime sky. (Jefferson County Standards Science Strand 4.4.A)
13. Students will explain the motion of the Earth in relation to the sun. (Jefferson County Standards Science Strand 4.4.B)
14. Students will recognize the basic components of the Solar System. (Jefferson County Standards Science Strand 4.4.C)
15. Students will describe and explain the significance of achievements of scientists. (Jefferson County Standards History Strand 4.1.B)

III. BACKGROUND KNOWLEDGE

A. For Teachers

1. Clark, Stuart. *Journey to the Stars*. New York: Barnes and Noble Books, 2000. 0-7606-1939-X.
2. Lippincott, Kristen. *Astronomy*. New York: DK Publishing, 1994. 1-56458-680-4.
3. Matloff, Gregory L. *Telescope Power*. New York: John Wiley and Sons, Inc., 1993. 0-471-58039-2.

B. For Students

1. Seasons (Kindergarten and 2nd Grade)
2. Sun: source of energy, light, heat (1st Grade)
3. The nine planets (1st Grade)
4. Stars (1st Grade)
5. Earth and its place in the solar system (1st Grade)

IV. RESOURCES

A. *The Universe: Think Big* by Jeanne Bendick (book for Lesson One)
B. *A True Book: Galaxies* by Paul P. Sipiera (book for Lesson Two)
C. *Galaxies* by Seymour Simon (book for Lesson Two)
D. *What Your Third Grader Needs to Know (Revised Edition)* (Varied Lessons)
E. *A True Book: Black Holes* by Paul P. Sipiera (book for Lesson Five)
F. *A True Book: Stars* by Paul P. Sipiera (book for Lesson Six)
G. *A True Book: Constellations* by Paul P. Sipiera (book for Lesson Six)
H. *Comets, Meteors, and Asteroids* by Seymour Simon (book for Lesson Eight)

V. LESSONS

Lesson One: The Universe: Let's Start off with a Bang (60-80 minutes)

A. *Daily Objectives*
   1. Concept Objectives
      a. Students will analyze different objects in space and their interaction with each other.
      b. Students will understand that order exists in the relationship and interaction between objects in space.
      c. Students will recognize that our knowledge of space has changed over time and will continue to change in the future.
   2. Lesson Content
      a. The universe: an extent almost beyond imagining
      b. The "Big Bang"
   3. Skill Objective
      a. Students will understand that most things are in the process of change and that there are patterns to those changes. (Jefferson County Standards Science Strand 1.2)

B. *Materials*
   1. *The Universe: Think Big* by Jeanne Bendick
   2. Appendix A: Leaping Light Years (one copy per student)
   3. Cut out stars (two stars for each student)
   4. Jar
   5. Small beads (enough to fill the jar)
   6. Newspapers
   7. Black construction paper
   8. White, yellow or glow in the dark paint

C. *Key Vocabulary*
   1. Universe - everything in space and the space in between those things
   2. "Big Bang" - a theory that states that all material in the universe was packed into a dense ball; something caused it to explode; this explosion sent chunks of matter into space; eventually, this matter became stars, planets and everything else in our universe
   3. Light year - the distance light travels in one year, about 6 trillion miles

D. *Procedures/Activities*
   1. Give each child two stars. Have them write one thing they already know about astronomy on one of the stars. On the other star, have them write one thing that they hope to learn. Collect the stars and display them in the classroom.
   2. Fill a jar with small beads the night before lesson one. Have the students estimate how many beads are in the jar. Give the child with the closest estimate a small prize.

3. Have a discussion with the students estimating how many miles from one end of the universe to another. Discuss how many stars might be in the universe.
4. Pass out Appendix A: Leaping Light Years.
5. Brainstorm answers together accepting all reasonable responses. Ask questions to get them thinking about why we don't measure distances between cities in inches and length of a paper clip in miles.
6. Introduce the idea of a light year being used to measure distances in space because miles are not big enough to cover the distances that occur in outer space. Light travels at about 186,000 miles per second. A light year is the distance light travels in one year, about six trillion miles. Write 6,000,000,000,000 on the board. Discuss the advantages of using light years over miles when measuring distances in space.
7. Tell the class that we do not know how large the universe is, or how many stars it contains, but scientists believe there is no beginning or end to the universe. Also, scientists believe that the universe is continuing to expand and grow larger. Even light years are not large enough to measure all distances in the universe; the universe is simply too big.
8. Read *The Universe: Think Big* or out loud to the class.
9. Demonstrate the "Big Bang" by opening the jar of beads and "bang" the bottom, sending beads in all directions. Have the students look for clusters of beads throughout the room. (We will identify these as galaxies tomorrow.)
10. Have the students go on a "galactic garbage" trip through the classroom picking up all the beads.
11. Make a splatter painting of a portion of the universe. Cover a large area of the room with newspaper. Have one or two students at a time fill a paintbrush with paint. Then they need to hold the brush over the paper and gently "bang" the handle of the brush. This works well with white, yellow and/or glow in the dark paint on black. Let paintings dry overnight and use them in Lesson Two.

E. *Assessment/Evaluation*
1. Ask comprehension questions to check understanding:
   a. What special unit of measurement is used to measure distances in space?
   b. Explain why we use light years instead of miles to measure distances in space.
   c. What theory explains that a big explosion created the universe?
   d. What is the universe?

Lesson Two: Glittering Galaxies (60-80 minutes)

A. *Daily Objectives*
1. Concept Objectives
   a. Students will analyze different objects in space and their interaction with each other.
   b. Students will understand that order exists in the relationship and interaction between objects in space.
   c. Students will recognize that our knowledge of space has changed over time and will continue to change in the future.
2. Lesson Content
   a. Galaxies: Milky Way and Andromeda
3. Skill Objectives
   a. Students will understand that patterns of organization provide useful ways of interpreting the world. (Jefferson County Standards Science Strand 1.1)

b. Students will describe and compare things using characteristics such as shape, size and motion. (Jefferson County Standards Science Strand 2.1.E)

B. *Materials*
1. *A True Book: Galaxies* by Paul P. Sipiera
2. *Galaxies* by Seymour Simon or other pictures of galaxies
3. *What Your Third Grader Needs to Know (Revised Edition)*
4. Splatter Paintings from Lesson One
5. Glass bowl
6. Water
7. Small metallic confetti (stars or circles)
8. Appendix B: Our Place in the Galaxy (made into an overhead)
9. Appendix C: Our Place in the Neighboring Galaxies (made into an overhead)
10. Black construction paper
11. White or yellow crayons

C. *Key Vocabulary*
1. Galaxy - a group of stars attracted to each other by gravity
2. Milky Way - the galaxy we live in
3. Andromeda - one of our neighboring galaxies
4. Spiral galaxy - a galaxy with a central bulge and arms of stars that curve outwards from the center

D. *Procedures/Activities*
1. Remind the class of yesterday's bead explosion. Ask if there were any groupings of beads. Take a few of yesterday's splatter paintings. Look for groupings of paint splatters. Tell the class that the universe is filled with large groups of stars and other space objects known as galaxies.
2. Fill a glass bowl with water. Sprinkle the star confetti into the bowl gently. Look for clumps of stars. Ask the class what we call the clumps of stars in the universe.
3. Read *A True Book: Galaxies* by Paul P. Sipiera or pp. 320-321 in *What Your Third Grader Needs to Know (Revised Edition).*
4. Discuss our galaxy, the Milky Way. If you look into the sky on a clear night, you might see a stripe of white running through the sky. Ancient people thought it was a road and named it the Milky Way, or milky road. It is part of the galaxy we live in within the universe.
5. Show Appendix B: Our place in the Milky Way on an overhead.
6. Tell the class that our galaxy is a spiral shaped galaxy and define spiral galaxy for them.
7. Show Appendix C: Our place with the Neighboring Galaxies on an overhead.
8. Discuss the Andromeda galaxy. It is one of our neighboring galaxies and can be seen with a telescope. It is 2 million light years away. Ask how long it would take us to get there. Two million light years would be 12 trillion miles away. If we traveled at 1,000 miles per hour the whole way, it would take 12 billion hours to get there. That would be 500 million days or about one and a half million years. Ask if it would be possible for one person to travel there in their lifetime.
9. Show pictures of various galaxies using *Galaxies* by Seymour Simon, other books, or the Internet
10. Have the students design a spiral galaxy using crayons on black paper. Tell them to make the center thicker and denser than the spiraling arms.
11. Optional: Have the students name their galaxy and create a myth or legend explaining how it got into the sky.

E. *Assessment/Evaluation*
   1. Review comprehension questions from Lesson One.
   2. Ask the following comprehension questions:
      a. What is a galaxy?
      b. What galaxy do we live in?
      c. Name on of our neighboring galaxies.
      d. How would you distinguish a spiral galaxy from an elliptical galaxy?

Lesson Three: Steppin' Through Our Solar System (60-80 minutes)

A. *Daily Objectives*
   1. Concept Objectives
      a. Students will analyze different objects in space and their interaction with each other.
      b. Students will understand that order exists in the relationship and interaction between objects in space.
   2. Lesson Content
      a. Our Solar System
      b. Sun: source of energy (heat and light)
      c. The nine planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Neptune, Pluto
   3. Skill Objectives
      a. Students will understand that patterns of organization provide useful ways of interpreting the world. (Jefferson County Standards Science Strand 1.1)
      b. Students will describe and compare things using such characteristics as shape, color, size, texture, weight, numbers and motion. (Jefferson County Science Standards Science Strand 2.1.E)
      c. Students will recognize that the sun is a principal source of the Earth's energy. (Jefferson County Standards Science Strand 4.2.A and 5.2.A)
      d. Students will recognize the basic components of the solar system. (Jefferson County Standards Science Strand 4.4.C)

B. *Materials*
   1. Appendix D: Solar System Walk (one copy for teacher)
   2. Appendix E: Solar System Quiz (one copy per student)
   3. Basketball
   4. Two grains of rice
   5. Two whole cloves
   6. One cherry
   7. One blueberry
   8. Two kernels of corn
   9. One grain/speck of coarsely ground black pepper

C. *Key Vocabulary*
   1. Solar System - the sun, its nine planets, their moons, the asteroids and comets
   2. Sun - our own star which the planets, asteroids and comets all orbit
   3. Planet - a round rocky or gaseous body which orbits a star
   4. Energy - waves of heat or light given out by an object

D. *Procedures/Activities*
   1. Ask the class to tell you how the Sun helps us. Be sure that the discussion covers the fact that the Sun gives us energy, the heat and light we need to live.
   2. Ask the class if they can define solar system. If they are not specific enough, give the definition.

3. Ask the class how many planets are in our solar system. Be sure they come to the conclusion that there are nine planets. Some astronomers are considering a tenth planet, but there has not been a conclusive decision about including it as a tenth planet.
4. Take a "Solar System Walk" using Appendix D. The walk will take 30-45 minutes. Give the class the facts for each planet as you mark the spot to represent their distance from the sun.
5. Ask comprehension questions such as the following:
    a. What would happen if we lived on Venus where the average temperature is over 800°F?
    b. Why can't we live on Jupiter?
    c. Why can't we live on Pluto?
    d. What other planets could support human life?
    e. Why is Earth the only planet that is able to support life?
6. Give the Solar System Quiz (Appendix E).

E. *Assessment/Evaluation*
1. Appendix E: Solar System Quiz

Lesson Four: Whirling and Twirling in the Solar System (60-80 minutes)

A. *Daily Objectives*
1. Concept Objectives
    a. Students will analyze different objects in space and their interaction with each other.
    b. Students will understand that order exists in the relationship and interaction between objects in space.
    c. Students will recognize that our knowledge of space has changed over time and will continue to change in the future.
2. Lesson Content
    a. Planetary motion: orbit and rotation
    b. How day and night on Earth are caused by the earth's rotation
    c. Sunrise in the east and sunset in the west
    d. How the seasons are caused by the earth's orbit around the sun, tilt of the Earth's axis
    e. Science biographies: Copernicus
3. Skill Objectives
    a. Students will understand that patterns of organization provide useful ways of interpreting the world. (Jefferson County Standards Science Strand 1.1)
    b. Students will make predictions based on their experience. (Jefferson County Standards Science Strand 2.1.C)
    c. Students will use charts with appropriate labels to record and organize data. (Jefferson County Standards Science Strand 2.1.F)
    d. Students will explain procedures or ideas in a variety of ways, such as sketching and labeling. (Jefferson County Standards Science Strand 2.2.A)
    e. Students will be able to explain that tools are used to do things better. (Jefferson County Standards Science Strand 3.1.A)
    f. Students will explain the motion of the Earth in relation to the sun. (Jefferson County Standards Science Strand 4.4.B)
    g. Students will describe and explain the significance of achievements of scientists. (Jefferson County Standards History Strand 4.1.B

B. *Materials*
   1. Appendix F: Rotations and Revolutions (one copy for teacher)
   2. Appendix G: Ptolemy's Universe (one overhead)
   3. Appendix H: Copernicus: A Radical Thinker (one copy per student)
   4. Appendix I: Copernicus' Universe (one overhead)
   5. Appendix J: An Updated Look (one overhead)
   6. Globe
   7. Lamp with the shade removed
   8. Ball smaller than the globe to represent the moon
   9. White construction paper (one 12" X 18" piece per student)

C. *Key Vocabulary*
   1. Orbit - a planet's path around the sun
   2. Rotation - the time it takes a planet or other object to spin on its axis once
   3. Revolution - the time it takes a planet or other object to orbit the sun
   4. Axis - a straight line around which a body orbits
   5. Elliptical - oval shaped

D. *Procedures/Activities*
   1. Ask the students to explain why we have day and night and seasons. Remind them of learning about the seasons in second grade.
   2. Use Appendix F: Rotations and Revolutions for a class demonstration.
   3. Ask the students if they remember the myth of Demeter and Persephone from second grade. Ask them to sum up how seasons occur according to this myth. Ask them if that is the real reason we have seasons.
   4. Introduce the idea that people's beliefs about the universe have changed over time. Show overhead of Appendix G: Ptolemy's Universe. Explain that for hundreds of years people believed Ptolemy's idea that the Earth was the center of the universe and everything revolved around it.
   5. Pass out Appendix H: Copernicus: A Radical Thinker.
   6. Read the paragraph together as a class. (If you use Step Up to Writing, this paragraph can be color coded to reinforce writing concepts).
   7. Show overhead of Appendix I: Copernicus' Universe.
   8. Discuss how modern science has proved that Copernicus' ideas were correct. However, with modern telescopes we have expanded on Copernicus' idea. We now know that the planets do not travel around the sun in perfect circles, but in elliptical orbits.
   9. Show Appendix J: An Updated Look.
   10. Ask the students if they think our understanding of how the solar system works will continue to change.
   11. Have the class sketch and label the three views of the universe on 12" X 18" paper that is divided into three sections.

E. *Assessment/Evaluation*
   1. Review with a few questions from Lessons One and Two.
   2. Ask comprehension questions orally:
      a. What is the Solar System?
      b. How many planets are in our Solar System?
      c. What is an orbit?
      d. What is a rotation?
      e. What is a revolution?
      f. How did Ptolemy see the universe?
      g. How did Copernicus see the universe differently?
      h. How do we see the universe differently today?

i. How do day and night occur?
j. How do the seasons occur?
k. Where does the sun rise?
l. Where does the sun set?

Lesson Five: Gravity: It's What Keeps Us Together (60-80 minutes)

A. *Daily Objectives*
   1. Concept Objectives
      a. Students will analyze different objects in space and their interactions with each other.
      b. Students will understand that order exists in the relationship and interactions between objects in space.
   2. Lesson Content
      a. Gravity, gravitational pull
      b. Gravitational pull of the moon (and to a lesser degree, the sun) causes ocean tides on Earth
      c. Gravitational pull of "black holes" prevents even light from escaping
   3. Skill Objectives
      a. Students will understand that most things are in the process of change and that there are patterns to those changes. (Jefferson County Standards Science Strand 1.2)
      b. Students will seek answers by making careful observations and trying things out. (Jefferson County Standards Science Strand 2.1.B)
      c. Students will make predictions based on their experiences. (Jefferson County Standards Science Strand 2.1.C)
      d. Students will follow written directions. (Jefferson County Standards Science Strand 2.1.D)

B. *Materials*
   1. Appendix K: Falling, Falling, Falling (one copy per student)
   2. Appendix L: Pulling, Pulling, Pulling (one copy for teacher)
   3. Appendix M: Groovy Gravity Game (one copy for teacher)
   4. Apples, oranges, grapes, raisins, peanuts (one of each for every group of 4 students)
   5. Tarp or plastic tablecloth
   6. Globe
   7. Stairs
   8. *A True Book: Black Holes* by Paul P. Sipiera
   9. *What Your Third Grader Needs to Know (Revised Edition)*
   10. Vacuum with hose attachment
   11. Thin, black cloth
   12. Confetti from Lesson Two

C. *Key Vocabulary*
   1. Gravity - the pull one object has on another
   2. Black holes - an invisible object with enough gravity to pull in and destroy anything near to it
   3. Tides - the rise and fall of the surface of the ocean

D. *Procedures/Activities*
   1. Hold up a globe. Ask the class if the people in Australia will fall off the globe. Ask them to explain why or why not. If no one volunteers gravity as the answer, ask if they know what gravity is. Give the definition.

2. Go to a place in your school with stairs. Have each student jump onto the first stair and off of the first stair. Discuss which was more difficult. Explain that gravity makes jumping down easier and jumping up more difficult.
3. Use Appendix K: Falling, Falling, Falling to conduct an experiment about gravity.
4. Read pp. 5-29 in *A New Book: Black Holes* by Paul P. Sipiera.
5. Read pp. 328-329 in *What Your Third Grader Needs to Know (Revised Edition).*
6. Use Appendix L: Pulling, Pulling, Pulling to demonstrate how scientists believe a black hole works.

E. *Assessment/Evaluation*
1. Appendix M: Groovy Gravity Game

Lesson Six: Stars and Constellations (60-80 minutes)

A. *Daily Objectives*
1. Concept Objectives
   a. Students will analyze different objects in space and their interaction with each other.
   b. Students will understand that order exists in the relationship and interaction between objects in space.
   c. Students will recognize that our knowledge of space has changed over time and will continue to change in the future.
2. Lesson Content
   a. Stars and constellations
   b. "The Hunting of the Great Bear" (an Iroquois legend)
3. Skill Objectives
   a. Students will understand that patterns of organization provide useful ways of interpreting the world. (Jefferson County Standards Science Strand 1.1)
   b. Students will describe and compare things using characteristics such as shape, size and numbers. (Jefferson County Standards Science Strand 2.1.E)
   c. Students will describe what can be observed in the daytime and nighttime sky. (Jefferson County Standards Science Strand 4.4.A)

B. *Materials*
1. *What Your Third Grader Needs to Know (Revised Edition)*
2. *A True Book: Stars* by Paul P. Sipiera
3. *A True Book: Constellations* by Paul P. Sipiera
4. Appendix N: A Star is Born (one copy per pair of students with sentences cut apart and scrambled ahead of time)
5. Appendix O: We Go Together (one copy made into an overhead)
6. Cereal boxes (one per student)

C. *Key Vocabulary*
1. Star - a hot, glowing ball of gases
2. Constellation - a grouping of stars that forms a picture

D. *Procedures/Activities*
1. Be sure you have enough cereal boxes for all students to use for their constellations.
2. Read "The Hunting of the Great Bear" (an Iroquois legend) to the class. It is on pp. 29-31 in *What Your Third Grader Needs to Know Revised Edition.*
3. Discuss how myths were used to explain nature.
4. Pass out sentence strips to pairs of students from Appendix N: A Star is Born.

5. Have students put the strips in the order they think is best. Let them know they will have a chance to change the order after you read the book.
6. Read pp. 5-8 and 16-36 in *A True Book: Stars* by Paul P. Sipiera.
7. Let students make corrections to their sentence strip order.
8. Check the correct order as a class.
9. Read pp. 5-16 in *A True Book: Constellations* by Paul P. Sipiera
10. Check to see if students can define "star" and "constellation."
11. Show overhead of Appendix O: We Go Together.
12. Students copy one of the constellations onto the bottom of a cereal box. Tell them to be sure to leave enough space between the dots. Students poke their pencil or pen through each dot.
13. Take flashlights and cereal box constellations to a dark room. Shine the flashlight into the box, projecting the constellation onto the ceiling and have the class "Name that constellation!"
14. Optional activity for language arts time: Create your own constellation and write a story explaining how it got into the sky.

E. *Assessment/Evaluation*
   1. Review with a few questions from previous lessons.
   2. Ask comprehension questions:
      a. What is a star?
      b. What is a constellation?
      c. What is gravity?
      d. What is a black hole?
      e. What do you think would happen if you were close to a black hole?
      f. What is the relationship between the ocean tides on Earth and the gravity on the moon?

Lesson Seven: Finding Your Way in the World (60-80 minutes)

A. *Daily Objectives*
   1. Concept Objectives
      a. Students will analyze different objects in space and their interaction with each other.
      b. Students will understand that order exists in the relationship and interaction between objects in space.
      c. Students will recognize that our knowledge of space has changed over time and will continue to change I the future.
   2. Lesson Content
      a. Orienteering by using the North Star and the Big Dipper
   3. Skill Objectives
      a. Students will understand that patterns of organization provide useful ways of interpreting the world. (Jefferson County Standards Science Strand 1.1)
      b. Students will follow written directions. (Jefferson County Standards Science Strand 2.1.D)
      c. Students will explain that tools are used to do things better, faster, or more easily. (Jefferson County Standards Science Strand 3.1.A)

B. *Materials*
   1. Appendix P: Long Ago (one copy per student)
   2. Piece of black butcher paper with the North Star drawn or painted in the center and the Big Dipper drawn or painted pointing towards it
   3. Parachute (if possible) with the black butcher paper attached

C. *Key Vocabulary*
   1. Orienteering - finding your way
   2. North Star - a fixed star that can be used to locate geographic north
   3. Big Dipper - a constellation shaped like a large spoon

D. *Procedures/Activities*
   1. Review with the class the idea of exploration. You can use Christopher Columbus or Lewis and Clark from previous grades or the explorers from the third grade content if you have already covered them. Discuss how they traveled and how they found their way. Mention that many of them lived before compasses.
   2. Read Appendix P: Long Ago and ask comprehension questions.
   3. Draw the diagram of the Big Dipper and the North Star on the board.
   4. Take the parachute, or black paper, to an area large enough for children to lay on their backs. Have some children lay on their backs looking up. Have other children walk slowly in a circle to "rotate" the Big Dipper. Explain that this is how the Big Dipper and the North Star seem to move throughout the year.
   5. Review lesson four's content about the sun rising in the east and setting in the west.
   6. Ask the students how this method could help somebody determine direction.

E. *Assessment/Evaluation*
   1. Review with questions from previous lessons.
   2. Ask comprehension questions:
      a. What is orienteering?
      b. How did explorers find their way before compasses were invented?
      c. What constellation points to the North Star, helping travelers find out which way is north?

Lesson Eight: It's a Bird, It's a Plane, It's a Shooting Star (60-80 minutes)

A. *Daily Objectives*
   1. Concept Objectives
      a. Students will analyze different objects in space and their interaction with each other.
      b. Students will understand that order exists in the relationship between objects in space.
      c. Student will recognize that our knowledge of space has changed over time and will continue to change.
   2. Lesson Content
      a. Asteroids, meteors ("shooting stars"), and comets, Halley's Comet
      b. Produce a variety of types of writing- poetry
   3. Skill Objectives
      a. Students will recognize the basic components of the Solar System. (Jefferson County Standards Science Strand 4.4.C)
      b. Students will make predictions based on their experiences. (Jefferson County Standards Science Strand 2.1.C)
      c. Students will follow written directions. (Jefferson County Standards Science Strand 2.1.D)
      d. Students will describe and compare things using shape and size. (Jefferson County Standards Science Strand 2.1.E.)
      e. Students will use charts with appropriate labels to record information. (Jefferson County Standards Science Strand 2.1.F)

B. *Materials*
   1. *Comets, Meteors, and Asteroids* by Seymour Simon
   2. Construction paper (three 9" X 12" pieces per child)
   3. Tissue paper
   4. Appendix Q: Poetry Potpourri (one copy for teacher)
   5. Appendix R: Poetry Rubric (one rubric is needed for each student)
   6. Appendix S: Incoming! (one copy per student)
   7. Cake pan
   8. Flour
   9. Golf ball
   10. Ping pong ball
   11. Ruler

C. *Key Vocabulary*
   1. Asteroid - the largest space rocks
   2. Meteor - small bits of rock that enter the earth's atmosphere (sometimes called "shooting stars")
   3. Meteorite - a meteor that reaches the surface of the earth
   4. Comet - a chunk of ice, dust, and rock which orbits the sun and often has a tail behind it

D. *Procedures/Activities*
   1. Ask if anyone has ever seen a shooting star. Ask if anyone knows what a shooting star really is.
   2. Read *Comets, Meteors, and Asteroids* by Seymour Simon.
   3. Write the definition for the vocabulary words on the board.
   4. Have the class brainstorm facts about each space object based on the reading. Write them on the board.
   5. Have each student design an asteroid, a meteor and a comet using construction paper. Use the tissue paper for the comet's tail.
   6. Have each student write a different kind of poem on each object. The poem must include at least three facts about the object. Use Appendix Q: Poetry Potpourri for ideas on different kinds of poems.
   7. While students are working on their poems, use Appendix S: Incoming! to have small groups conduct an experiment about meteorites and the craters they create.

E. *Assessment/Evaluation*
   1. Use Appendix R: Poetry Rubric to evaluate poems.

Lesson Nine: Eclipses: Who Turned Out the Lights? (60-80 minutes)

A. *Daily Objectives*
   1. Concept Objectives
      a. Students will analyze different objects in space and their interactions with each other.
      b. Students will understand that order exists in the relationship and interaction between objects in space.
      c. Students will recognize that our knowledge of space has changed over time and will continue to change.
   2. Lesson Content
      a. How an eclipse happens
   3. Skill Objectives
      a. Students will understand that most things are in the process of change and that there are patterns to those changes. (Jefferson County Standards Science Strand 1.2)

b. Students will seek answers by making careful observations and trying things out. (Jefferson County Standards Science Strand 2.1.B)
c. Students will explain procedures in a variety of ways, such and sketching and labeling. (Jefferson County Standards Science Strand 2.2.A)

B. *Materials*
1. Appendix T: Darkness in Daytime (one copy per student)
2. Appendix U: Make Your Own Eclipse (one copy per student)
3. *What Your Third Grader Needs to Know (Revised Edition)*
4. One circle with a 12 inch diameter for each group of four students
5. One circle with a 4 inch diameter for each group of four students
6. One flashlights for each group of four students
7. 9" X 12" white construction paper for each student

C. *Key Vocabulary*
1. Eclipse- when one body in space totally or partially blocks another body in space

D. *Procedures/Activities*
1. Pass out Appendix T: Darkness in the Daytime.
2. Read the stories of how ancient people explained eclipses.
3. Ask the students if any of these stories seem scientific.
4. Read pp. 330-331 in *What Your Third Grader Needs to Know (Revised Edition)*.
5. Have students summarize the scientific explanation for an eclipse.
6. Use Appendix U: Make Your Own Eclipse to demonstrate how an eclipse occurs.
7. Have students work in groups to try to make their own eclipses.
8. Have students divide a 9" X 12" piece of white construction paper into four sections. Explain that the Sun should be the largest object and the moon should be the smallest object. Tell them they will have time to color their drawings at the end of the class period. Give the following directions with time to complete each sketch. In section one, draw the moon between the Sun and the Earth, but do not have it causing an eclipse. In section two, draw the moon between the Sun and the Earth causing a solar eclipse. In section three, draw the Earth between the Sun and the moon, but do not have it causing an eclipse. In section four, draw the Earth between the Sun and the moon causing a lunar eclipse.

E. *Assessment/Evaluation*
1. Section one should show the moon between the Earth and sun, but not lined up exactly. Section two should show a solar eclipse, when the moon is directly between the sun and the Earth. They should draw a small circular shadow to represent the area affected by the eclipse. Section three should show the Earth between the Sun and the moon, but not lined up directly. Section four should show a lunar eclipse where the Earth blocks all light from hitting the moon.

Lesson Ten: Space: The Final Frontier (60-80 minutes)

A. *Daily Objectives*
1. Concept Objective
   a. Students will recognize that our knowledge of space has changed over time and will continue to change in the future.
2. Lesson Content
   a. Exploration of space
   b. Observation through telescopes
   c. Rockets and satellites: from unmanned to manned space flights
   d. Apollo 11, first landing on the moon: "One small step for man, one giant leap for mankind."

3. Skill Objectives
    a. Students will see answers by making careful observations and trying things out. (Jefferson County Standards Science Strand 2.1.B)
    b. Students will explain that tools are used to do things better, faster, or more easily. (Jefferson County Standards Science Strand 3.1.A)
    c. Students will use tools to observe, measure, and make things. (Jefferson County Standards Science Strand 3.1.B)
    d. Students will give examples of tools and technologies that are used in particular careers or occupations. (Jefferson County Standards Science Strand 3.2.E)

B. *Materials*
1. Appendix V: Space Travel Begins (one copy per student)
2. Telescope (you can make a simple telescope by attaching magnifying glasses to both ends of a large cardboard tube)
3. Paper towel tubes, two for each student
4. Pictures of rockets from books or the internet

C. *Key Vocabulary*
1. Astronomer - a person who studies the universe
2. Mankind - the human race, or humans
3. Rocket - a craft with a strong enough engine to escape Earth's atmosphere and travel into space
4. Manned - carrying a person
5. Unmanned - not carrying a person
6. Satellite - an object that orbits another object

D. *Procedures/Activities*
1. Introduce the idea that space has always fascinated mankind. Ancient people created stories about the stars and other objects in space.
2. Discuss how technology has made it possible to study space more closely. Review how use of telescopes to study the movement of the stars and planets helped confirm Copernicus' theory about the sun being the center of the universe. A person whose job is an astronomer would use telescopes to do his work. He would learn more about the universe by using telescopes.
3. Use a telescope to look at objects in the area. You can look at objects in a park, instead of objects in the sky, because it will be daylight.
4. Go over the vocabulary from the lesson.
5. Pass out and read Appendix V: Space Travel Begins. If you teach Step Up to Writing, you can color code these paragraphs as well.
6. Have rocket races to test how design affects distance and speed of rockets. Give each student two paper towel tubes. Have them use one tube to design a rocket. They must attach pieces securely so their rocket doesn't fall apart. If possible, show them pictures of rockets. Take the tubes and the rockets outside and have them throw the tube as far as they can. Have them then throw their rocket in the same direction, as far as they can. Did their rockets travel farther than the simple tube? If time permits, have the students do 3-5 trials with their rockets.
7. Discuss what factors made some rockets fly farther than others. (strength of the thrower, how securely all parts were attached, what direction each student faced, etc.)
8. Explain that the features and shape of the rockets help them to travel as quickly and accurately as possible.

E. *Assessment/Evaluation*

1. Use a few review questions from each previous lesson to assess understanding of the unit.
2. Ask comprehension questions:
   a. Who was the first man to walk on the moon?
   b. What did he say when he took his first step?
   c. How did space travel change over time?
   d. What tool helps us see objects in space more clearly?
   e. What is a satellite?
   f. What is a rocket?

Lesson Eleven: Traveling to Space Again and Again (60-80 minutes)

A. *Daily Objectives*

1. Concept Objective
   b. Students will recognize that our knowledge of space has changed over time and will continue to change.
2. Lesson Content
   a. Exploration of space
   c. Space shuttle
   d. Science biography: Mae Jemison
3. Skill Objective
   a. Students will give examples of tools and technologies that are used in particular careers or occupations. (Jefferson County Standards Science Strand 3.2.E)

B. *Materials*

1. Appendix W: Meet Mae Jemison (make copies for each reader and highlight the parts they will read)
2. *What Your Third Grader Needs to Know (Revised Edition)*
3. Pictures of the space shuttle from books or the Internet

C. *Key Vocabulary*

1. Space shuttle - a vehicle used for traveling to space, it can be used many times

D. *Procedures/Activities*

1. Review yesterday's information about space travel. Explain that a rocket that could only be used once got very expensive. NASA (National Aeronautics and Space Administration) needed to find a vehicle that could travel to space over and over again. Ask if anyone knows what that vehicle is.
2. Show pictures of the space shuttle.
3. Discuss the similarities and differences between space shuttles and rockets.
4. Read about space shuttles on pp. 338 in *What Your Third Grader Needs to Know (Revised Edition)*.
5. Pass out Appendix W: Meet Mae Jemison.
6. Read Appendix W together.

E. *Assessment/Evaluation*

1. Have the students write a sequence of events in Mae Jemison's life.
2. Oral review for the test. Use all previous questions and add the following:
   a. What is Mae Jemison known for?
   b. How is a space shuttle different than a rocket?

VI. CULMINATING ACTIVITY

A. Appendix X: Astronomy Assessment

B. Create a newscast. Some students create commercials for space travel, joining NASA, space food etc. Some students prepare weather reports for the planets. Some students compose an interview with someone we studied during the astronomy unit. Some students debate about the necessity of space travel. Some students report on various bodies found in space. Practice and perform for parents or another class.

VII. HANDOUTS/WORKSHEETS (available at www.ckcolorado.org)

A. Appendix A: Leaping Light Years
B. Appendix B: Our Place in the Galaxy
C. Appendix C: Our Place in the Neighboring Galaxies
D. Appendix D: Solar System Walk
E. Appendix E: Solar System Quiz
F. Appendix F: Rotations and Revolutions
G. Appendix G: Ptolemy's Universe
H. Appendix H: Copernicus: A Radical Thinker
I. Appendix I: Copernicus' Universe
J. Appendix J: An Updated Look
K. Appendix K: Falling, Falling, Falling
L. Appendix L: Pulling, Pulling, Pulling
M. Appendix M: Groovy Gravity Game
N. Appendix N: A Star is Born
O. Appendix O: We Go Together
P. Appendix P: Long Ago
Q. Appendix Q: Poetry Potpourri
R. Appendix R: Poetry Rubric
S. Appendix S: Incoming!
T. Appendix T: Darkness in the Daytime
U. Appendix U: Make Your Own Eclipse
V. Appendix V: Space Travel Begins
W. Appendix W: Meet Mae Jemison
X. Appendix X: Astronomy Assessment
Y. Appendix Y: Quiz and Assessment Grading Key

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Appendix A

Leaping Light Years

Answer in complete sentences. What unit of measure would you use to measure the following?

1. The length of a paper clip

2. The length of a pencil

3. Your height

4. The width of the classroom

5. The distance to your house from school

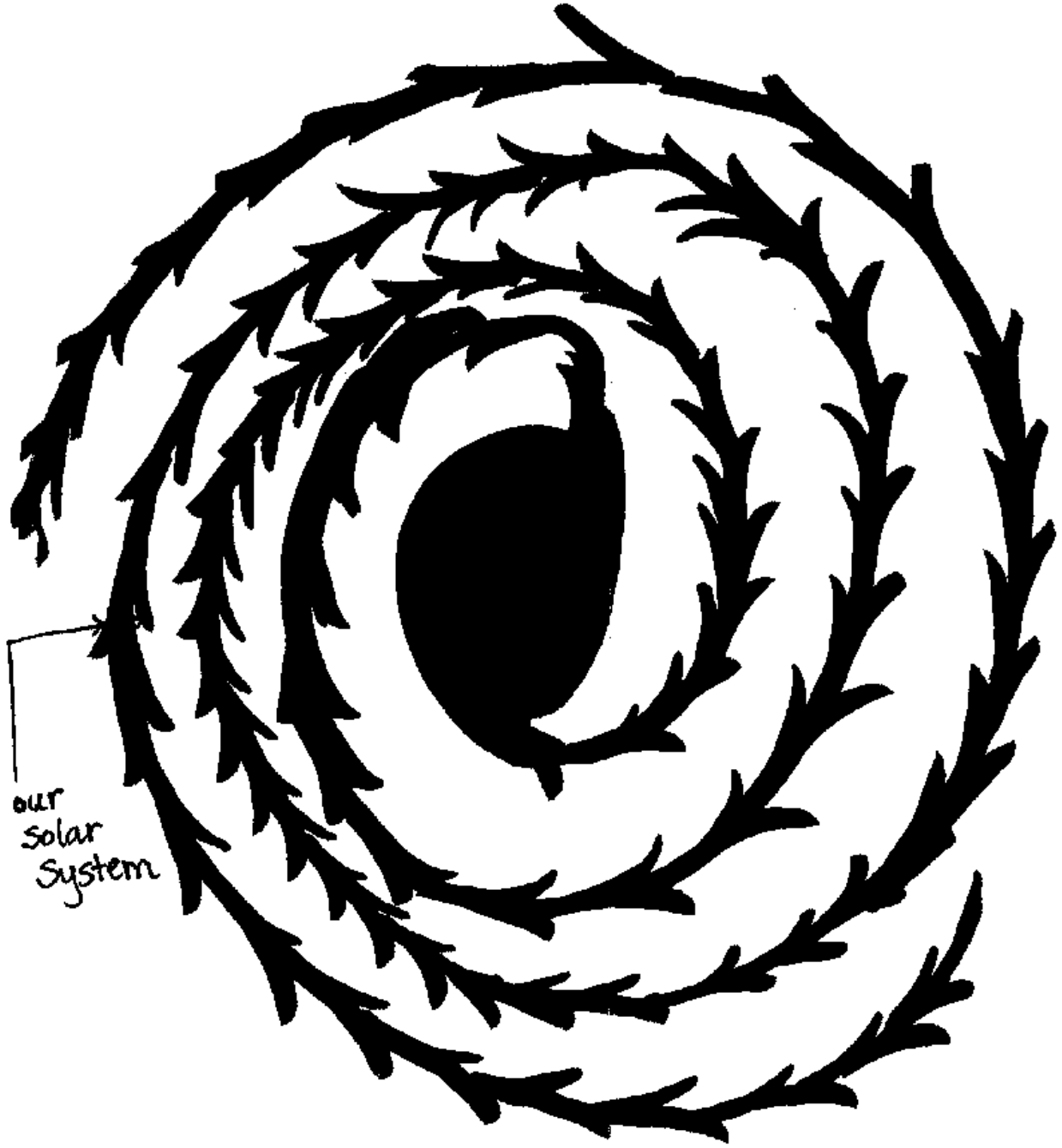
6. The distance from California to New York

7. The distance from Earth to the moon

8. The distance from Earth to the Sun

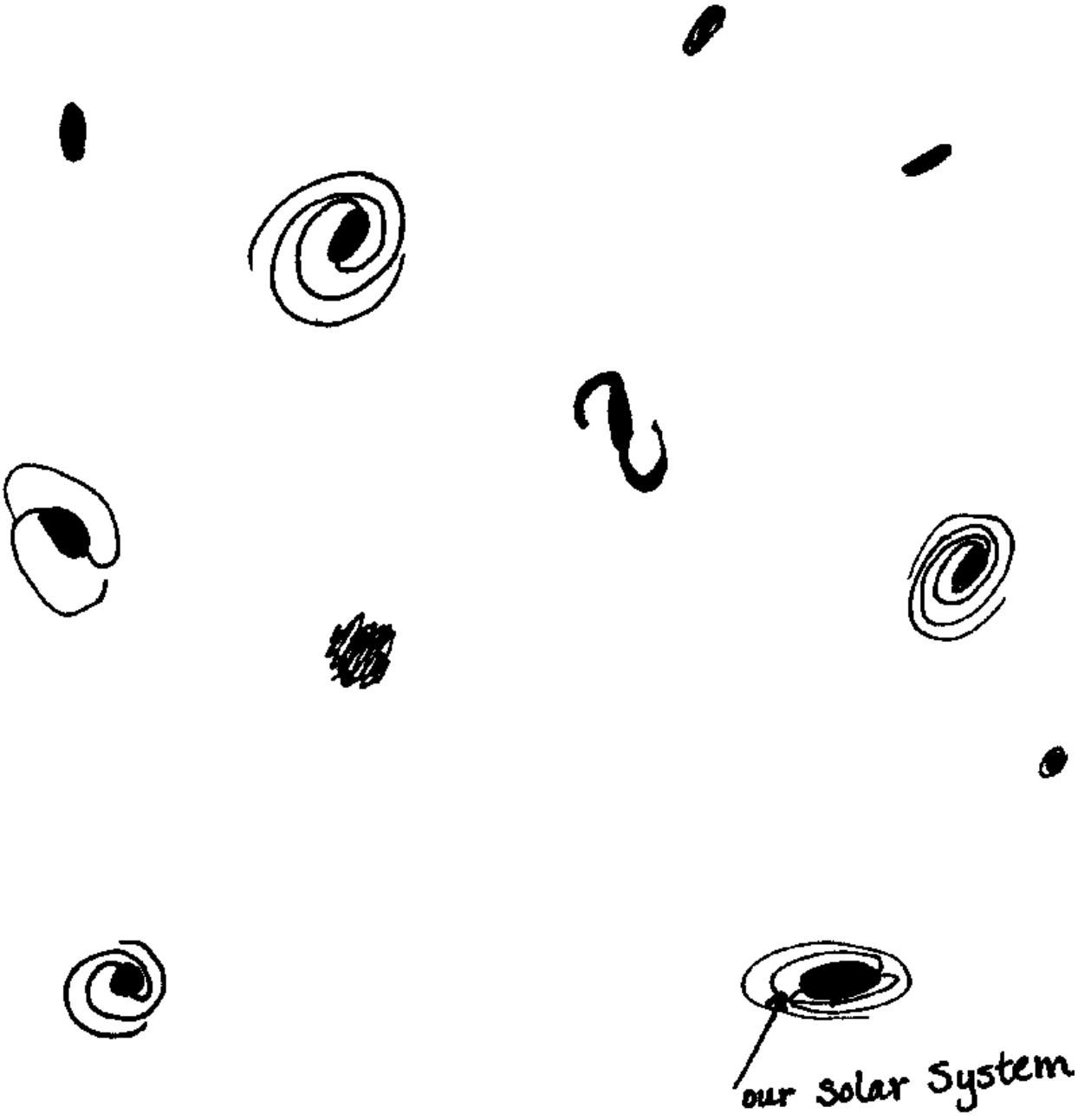
9. The distance from one star to another star

Appendix B
Our Place in the Galaxy



Adapted from Seymour Simon's book Galaxies.

Appendix C
Our Place in the Neighboring Galaxies



Adapted from A New Book: Galaxies by Paul P. Sipiera

Appendix D
Solar System Walk

Mark the spot for the **sun**. (About basketball size)
Share fun facts: The core of the sun is about 27 million degrees Fahrenheit. The surface is about 10,000°F. The sun provides the light and heat we need to survive.

Walk 3 paces and mark a spot for **Mercury**. (Smaller than a grain of rice)
Fun facts: Mercury's daytime temperature is about 800°F. However, the nighttime temperature is -270°F. There is no water, no life, no air, no blue skies, only rock with scorching days and freezing nights.

Walk 3 more paces for **Venus**. (About the size of a whole clove)
Fun facts: Venus is often called Earth's twin because they are similar in size. But Venus is too hot to support life. It is even hotter than Mercury, with temperatures averaging about 867°F. Most of the land is made from the lava that flows from Venus' many volcanoes.

Walk 2 paces for **Earth**. (Also, about the size of a whole clove)
Fun facts: Earth is the only planet whose crust, or land is broken into pieces that are constantly changing and moving. These are our continents. Although they are constantly moving, they are moving so slowly, we cannot feel the movement at all.

Walk 5 paces for **Mars**. (About the size of a grain of rice)
Fun facts: Mars is called the red planet because the surface is covered with red dust. The largest mountain in the Solar System is found on Mars. It is called Olympus Mons. This volcano is nearly three times larger than the largest mountain on Earth, Mount Everest.

Walk 32 paces for **Jupiter**. (About the size of a cherry)
Fun facts: Jupiter is the largest of the planets. 1,300 Earth's could fit into Jupiter. Three Earths could fit into the Great Red Spot. The Great Red Spot is really the top of a very strong tornado.

Walk 37 paces for **Saturn**. (About the size of a blueberry)
Fun facts: Saturn is the second largest planet, known for the beautiful rings that circle around it. There are seven rings around Saturn. Each ring is made of thousands of smaller ringlets. The rings are made of chunks of ice.

Walk 83 paces for **Uranus**. (About the size of a kernel of corn)
Fun facts: Compared to other planets, Uranus spins on its side. It takes Uranus 84 years to revolve around the sun. This means that one pole has sunlight for 42 years, then it has darkness for 42 years. Uranus is also surrounded by rings, but not nearly as many rings as Saturn has.

Walk 93 paces for **Neptune**. (About the size of a kernel of corn)
Fun facts: Neptune is often called Uranus' twin. Both of them are large watery planets. Neptune has two dark spots near its Southern Hemisphere that are similar to Jupiter's Great Red Spot. Sometimes Neptune is farther from the sun than Pluto.

Walk 81 paces for **Pluto**. (About the size of a speck of ground pepper)
Fun facts: Pluto is the smallest planet in our Solar System. Pluto is smaller than many moons in the Solar System, including our own moon. Pluto may be made of rock and it may be made of ice, scientists are not sure.

(Adapted from "Invite the Solar System onto Your Street" Earthsearch by John Cassidy)

Appendix E: Solar System Quiz

Name: _____ Date: _____

Answer each of the following questions with the name of one of the planets. You may use the same planet for more than one answer.

1. _____ is the closest planet to the sun.

2. Earth's twin is _____.

3. The Great Red Spot is found on _____.

4. _____ has two spots similar to the Great Red Spot.

5. The hottest planet is _____.

6. We live on _____.

7. _____ is called the Red Planet because of the rust that covers the surface.

8. The largest mountain in the Solar System is on _____.

9. _____ spins on its side.

10. The smallest planet in the Solar System is _____.

11._____ has thousands of ringlets surrounding it.

12.Uranus' twin is _____.

Appendix F
Rotations and Revolutions

Have a lamp with the shade removed in the center of the room.

Hold the globe so the lamp shines on North America. Slowly turn the globe on its axis. When a planet spins on its axis, it is called rotation, which causes day and night. Write "1 rotation=24 hours or one day" on the board. Have the class say whether it is day or night in America as you rotate the globe again. Be sure to rotate the globe in a counter-clockwise direction. Talk about how the sun rises in the east and sets in the west.

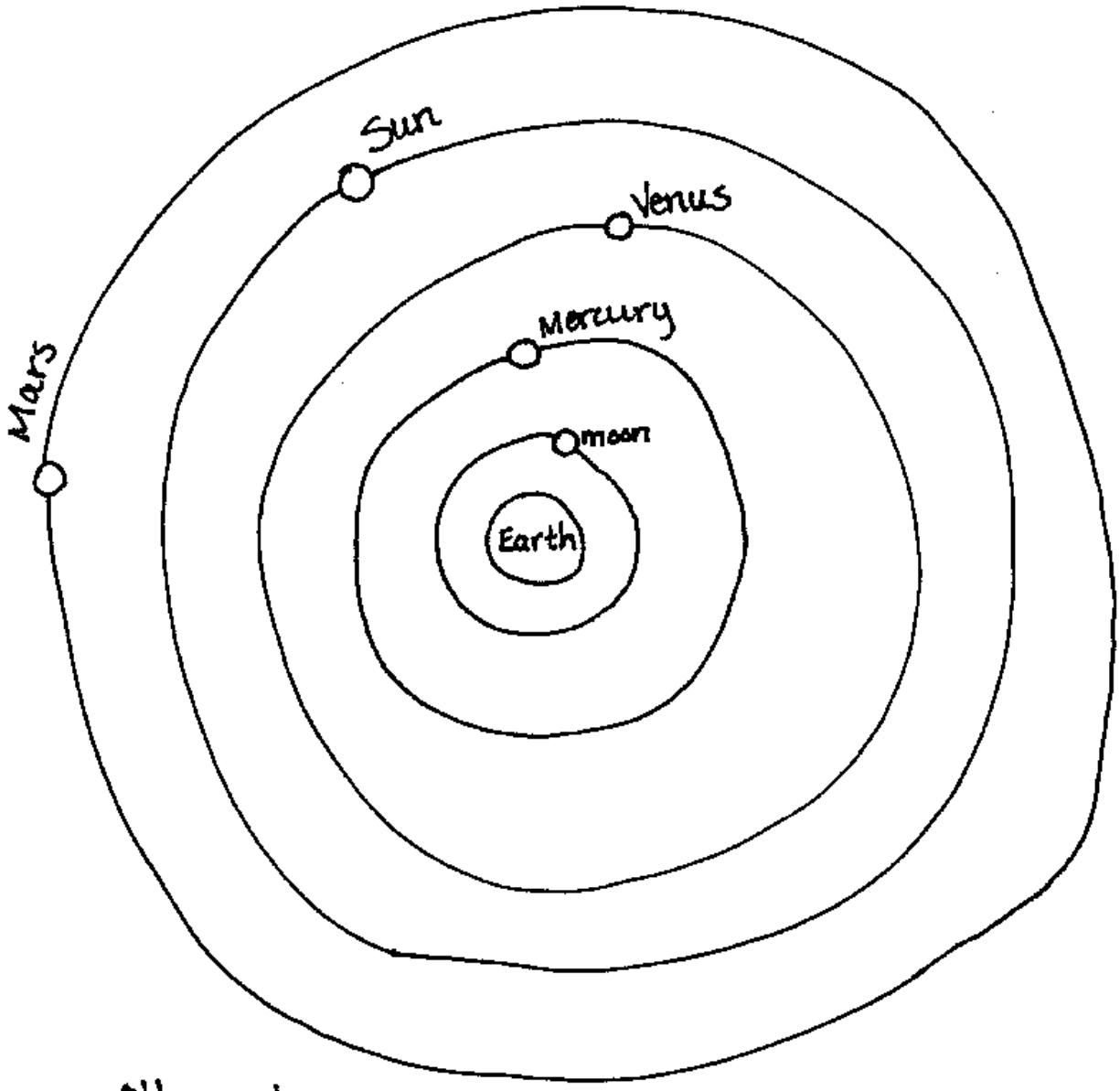
Walk the globe around the lamp. Explain that this is revolution, or the orbit of the earth around the sun. Write "1 revolution or orbit=365 days or one year" on the board.

Tilt the earth at a 23° angle. Slowly orbit the lamp again. Have the class observe which hemisphere is getting the most light. Have them name the season America is experiencing by the amount of light it receives. During America's summer, the Northern Hemisphere will be tilted toward the sun. During America's winter, the Northern Hemisphere will be tilted away from the sun. During spring and fall, both hemispheres receive about the same amount of light. (This will take some practice to keep the globe at a 23° angle. I choose an object in the room, like the exit sign, and keep the North Pole pointed toward that object at all times).

Look at a chart showing the rotation and revolution of different planets. If you have time, you might want to demonstrate Uranus' orbit with its horizontal axis.

Demonstrate the moon's orbit. It takes about 24 hours to orbit the earth and it takes about 24 hours to rotate on its axis. Put the globe in the center of the room. Take the small ball and carry it around the globe to show one trip around the Earth. Rotate slowly enough so that the moon makes one complete rotation in the same amount of time it takes to make one revolution. This is why we only see one side of the moon from Earth.

Appendix G
Ptolemy's Universe



Adapted from Galileo and the Universe by Steve Parker.

Appendix H
Copernicus: A Radical Thinker

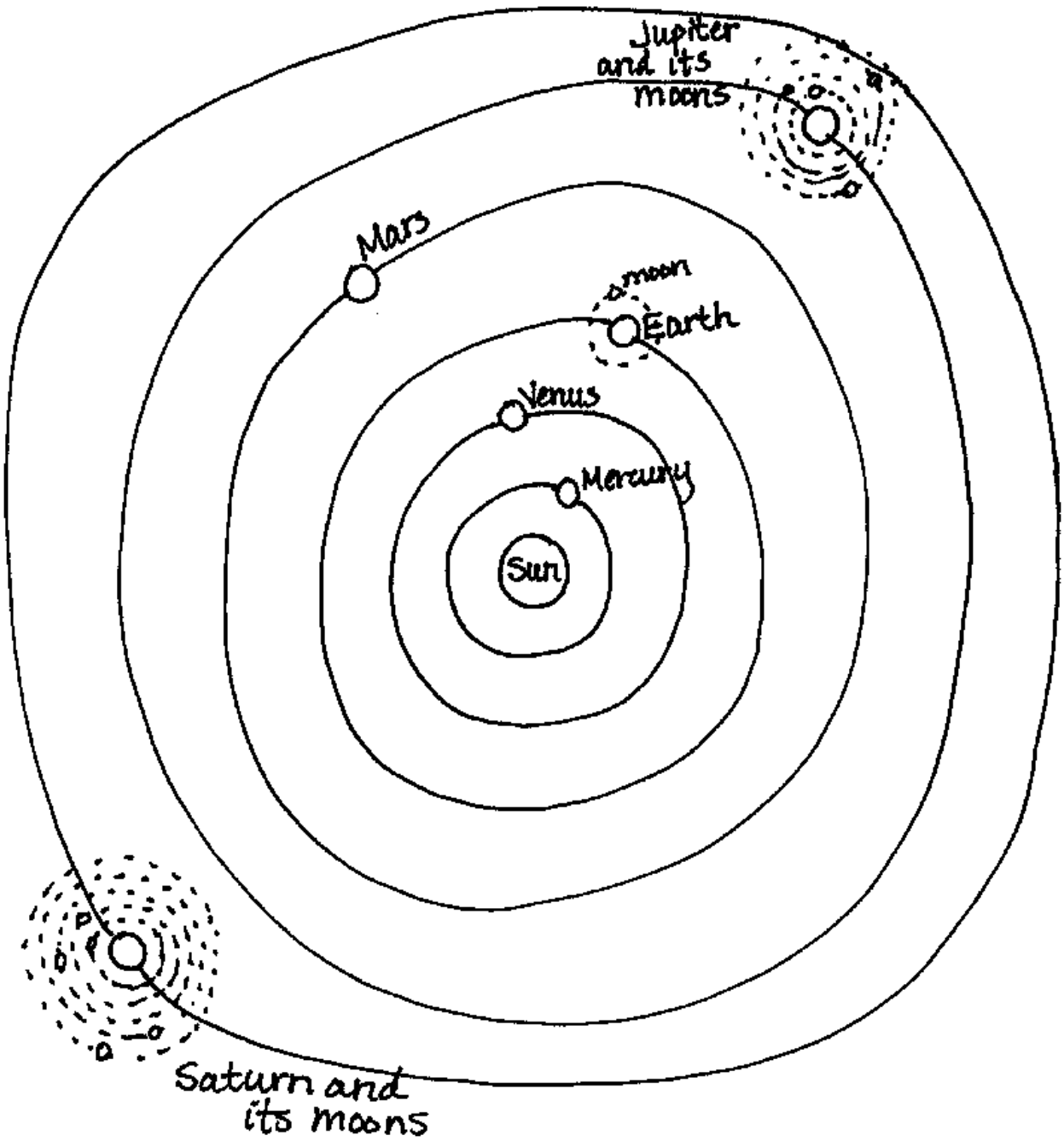
When Copernicus was young, scientists believed that the Earth was the center of the universe. Copernicus, who lived from 1473-1543, changed how we see the universe. First, he studied liberal arts and later he studied medicine and law. After time had passed, Copernicus became interested in geography and astronomy. As Copernicus studied astronomy he began to believe that the Earth was not the center of the universe as many believed in his time. Later, Copernicus wrote a book explaining his theory that the sun was the center and not the earth. Copernicus wrote that the planets including Earth, traveled around the sun in circles. He also wrote that the stars traveled in a fixed disc around the edge of all the planets. Finally, his book was published, right before he died. Copernicus has helped us to understand the universe better.

Thanks to modern technology, there are a few modern adjustments to Copernicus' theory. First, we know now that the stars are not held in a fixed circle. They are spread throughout the universe. Also, the planets do not travel around the sun in perfect circles. The paths of the planets are elliptical, or oval shaped. Modern tools help us to continue to learn about our universe.

Adapted from "Nicolaus Copernicus" from the on-line encyclopedia Encarta.

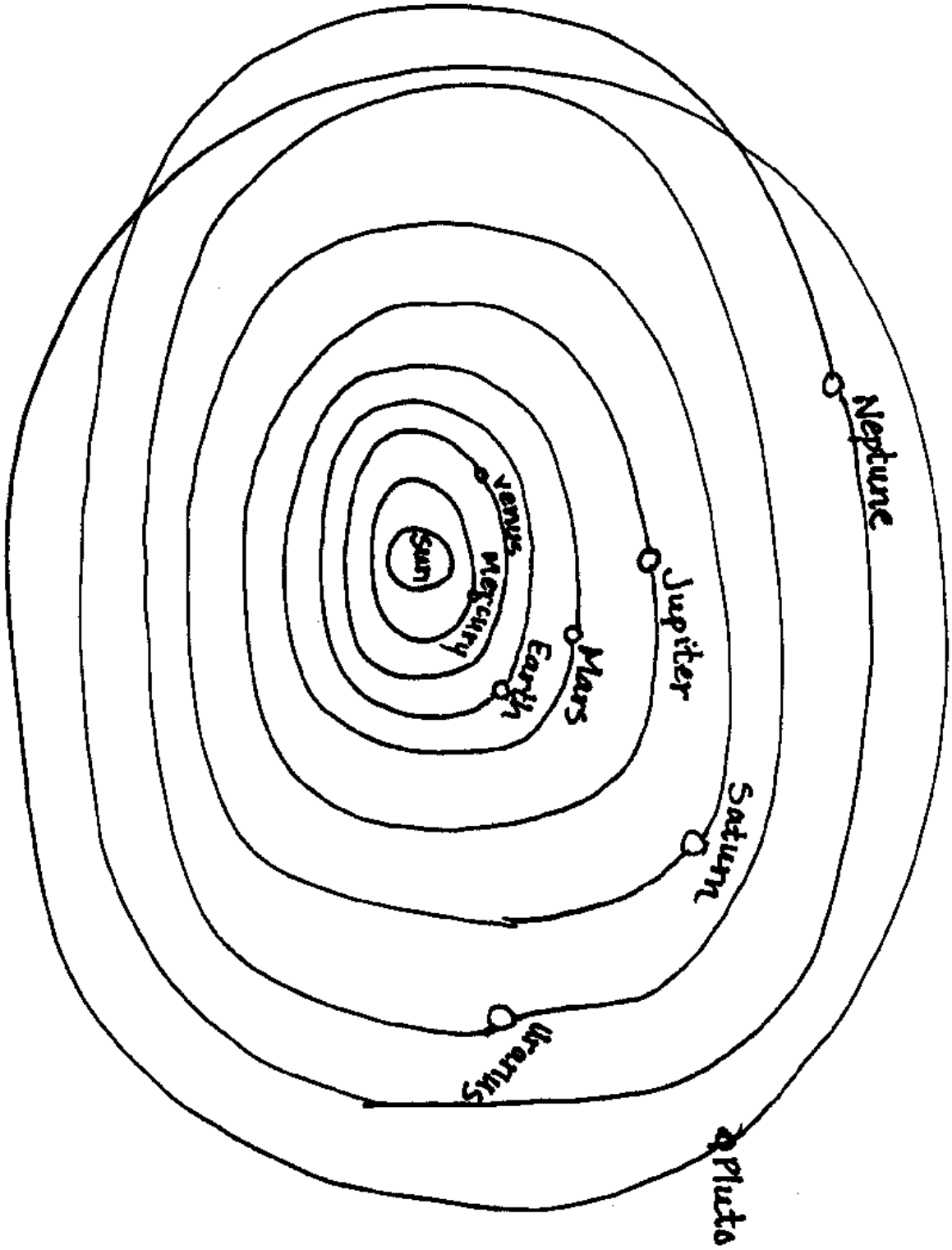
Appendix I

Copernicus' Universe



Adapted from Galileo and the Universe by Steve Parker.

Appendix J
An Updated Look



Appendix K
Falling, Falling, Falling

Step 1: Hold up an apple and an orange.

Step 2: Ask the students which piece of fruit they think will hit the ground first if both are dropped at the same time. Have each student write a prediction on a piece of paper.

Step 3: Have the class gather around you lying on the floor. Drop both pieces of fruit at the same time onto a tarp or plastic tablecloth. Do this three times.

Step 4: Have the students write down their observations about what happened on their piece of paper.

Step 5: Hold up an apple and a grape.

Step 6: Ask the students which piece of fruit they think will hit the ground first if both are dropped at the same time. Have each student write a prediction on a piece of paper.

Step 7: Have the class gather around you lying on the floor. Drop both pieces of fruit at the same time. Do this three times.

Step 8: Have the students write down their observations about what happened on their piece of paper.

Step 9: Point out that gravity pulls objects toward the ground at the same speed, regardless of the size or weight of the object.

Step 10: Have students write a conclusion about how gravity affects different sized objects.

Step 11: Allow groups of children to conduct the experiment on their own with other fruits.

Hint: If it is a nice day, you can conduct the experiment in a grassy area.

Appendix L
Pulling, Pulling, Pulling

Use a vacuum with a hose attachment and a large black cloth to demonstrate how a black hole works:

- Have one student lay on the floor and hold the hose of a vacuum.
- Have the remainder of the class hold a large (2 yards) piece of black cloth over the hose. Instruct them to hold it tightly, so that the cloth does not get sucked into the vacuum.
- Turn on the vacuum. If the cloth begins to get sucked in, turn off the vacuum.
- Sprinkle some confetti near the hose.
- Ask the class to describe what is happening.
- Sprinkle some confetti around the cloth.
- Ask the class why only some of the confetti is being pulled by the vacuum.
- Turn off the vacuum and discuss that scientists believe a black hole is like the vacuum, it pulls things that are near to it inside of itself.

Adapted from Exploring Space by Barbara Bourne and Wendy Saul.

Appendix M
Groovy Gravity Game

- Have each student make a tic-tac-toe grid on a piece of paper.
- Have each student write nine of the following words, one in each space of their tic-tac-toe grid: gravity, tides, moon, black holes, Jupiter, Pluto, oceans, jumping up, jumping down, orbit.
- Tell the students that they need to try to cover two sets of three words in a row.
- Randomly choose one of the questions or clues below and read it out loud to the class.
- Students should cover or mark off the word that answers the question or completes the clue.
- Continue choosing questions and clues until a student wins.

Questions and Clues

- What do we call the force that pulls objects together?
- What do we call the rise and fall of the surface of the ocean?
- What object pulls on the ocean causing high tide and low tide?
- What invisible object in space has enough gravity to keep light from escaping?
- Which planet has a stronger gravitational pull than Earth?
- Which planet has a weaker gravitational pull than Earth?
- What geographic term describes the feature on Earth that is most affected by the moon's gravity?
- Which way of jumping is made easier by the pull of gravity?
- Which way of jumping is made more difficult by the pull of gravity?
- What do you call the path each planet makes around the sun as it is pulled by the sun's gravity?

Appendix N

A Star Is Born

Stars are born in giant clouds of gas and dust called a nebula.

Gravity pulls the atoms of gas and dust particles together.

As more and more matter comes together, a dark sphere forms.

The sphere gets hotter and hotter.

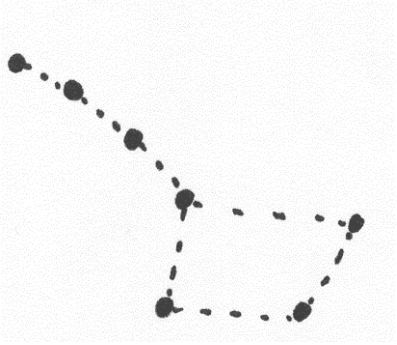
If there is enough mass, a nuclear reaction will occur and the star will shine.

For billions of years the star will shine steadily.

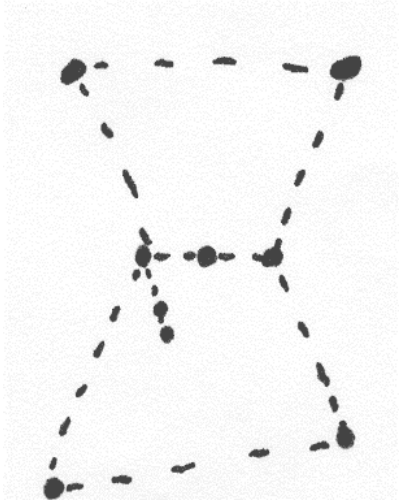
Then the star will become much larger and cooler. It will be called a red giant.

Finally, the star will become a white dwarf, which will eventually die, or a black hole.

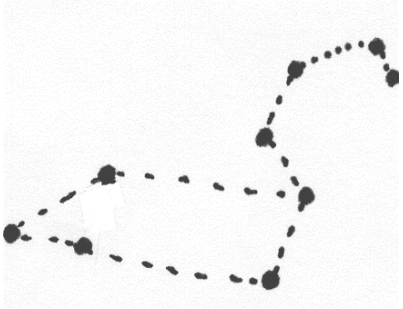
Appendix O
We Go Together



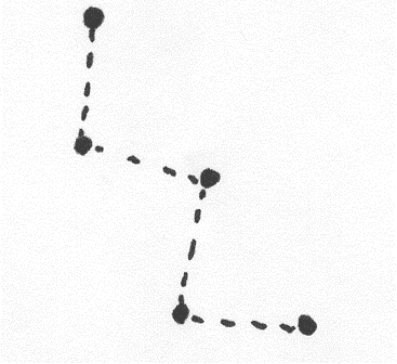
Big Dipper



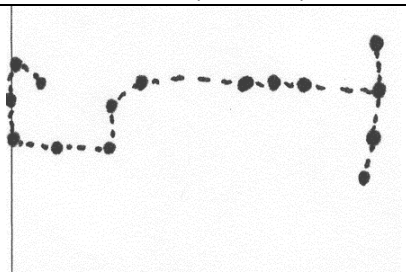
Orion (hunter)



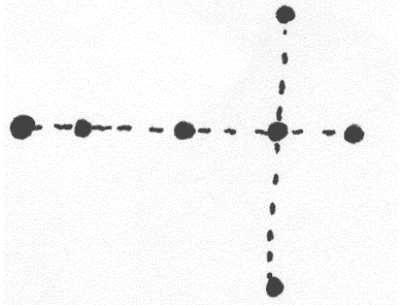
Leo (lion)



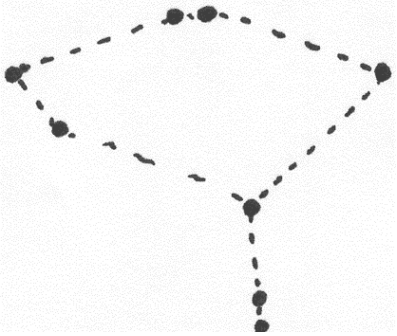
Cassiopeia (maiden)



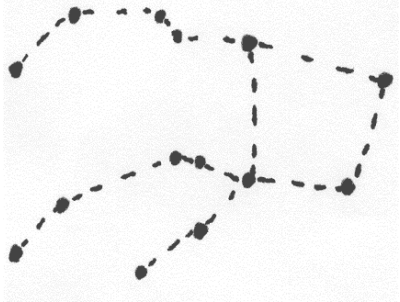
Scorpius (scorpion)



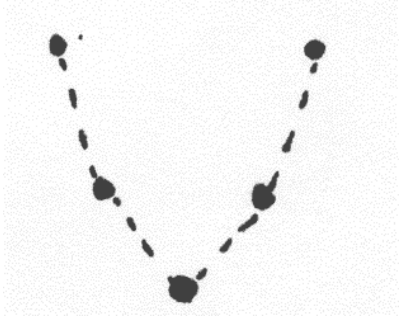
Cygnus (swan)



Aquila (eagle)



Pegasus (winged horse)



Taurus (the bull)

Appendix P
Long Ago

Long ago, people traveled from place to place for adventure, money and simply out of curiosity. The sailors and explorers in these early times did not have today's modern equipment. Many of them did not even have compasses.

The sun helped many people find their way. People knew that the sun rose in the east every morning and set in the west every evening. This information helped many explorers travel in a steady direction during the day.

At night, the stars also helped sailors and explorers. Ancient Greek sailors used the position of the stars in the sky to help them find their way from port to port. The Cheyenne Indians using the rising point of special stars to help them find their way across the plains of North America. One particular star, Polaris, or the North Star has helped people for hundreds of years. For people who live in the Northern Hemisphere, Polaris seems to stay directly overhead all year. Two of the stars in the bowl of the Big Dipper point north to Polaris.

Today we have modern equipment to help us find our way. However, it can be fun to use the ways of people in the past. Go outside in the morning and see where the sun seems to be rising. Go outside in the evening and see where the sun is setting. At night, see if you can find the two stars of the Big Dipper pointing to Polaris.

Adapted from A True Book: Stars by Paul P. Sipiera

Appendix Q
Poetry Potpourri

Ideas for types of poems:

Windspark	Example
I dreamed	I dreamed
I was student decides on a person or animal	I was an astronaut
Write a phrase that begins with a verb in the –ing form	Flying in space
Choose a location	To Pluto
Choose one adverb	Bravely

Acrostic Poem
Student writes a word vertically and writes a phrase or word beginning with each letter of the original word.

Who, What, Where, When, Why, How Poem
Student writes a word or phrase addressing each of the question words and puts them together in one poetic sentence.

Haiku
Student writes a poem with 5 syllables in the first line, 7 syllables in the second line and 5 syllables in the final line.

Cinquain
Start with a one-word title.
Add two adjectives.
Add three verbs (-ing form)
Add four words to describe your feelings
End with a one-word synonym for the title

Free Verse
Students may write a poem with any style, structure and word pattern they choose.

Adapted from Write on Track.

Appendix R
Poetry Rubric

	Unsatisfactory	Partially Proficient	Proficient	Advanced
Poetry Forms	Used no form for poems (0 points)	Used 1 different form for poems (2 points)	Used 2 different forms for poems (3 points)	Used 3 different forms for poems (4 points)
Scientific Facts	Poems include less than 1 fact about each object. (0 points)	Poems include at least 1 fact about each object (2 points)	Poems include at least 2 facts about each object (3 points)	Poems include at least 3 facts about each object (4 points)
Conventions	Spelling errors in poems interfere with meaning. (0 points)	Poems have many spelling errors. (2 points)	Poems include a few spelling errors. (3 points)	Poems have no spelling errors. (4 points)
Presentation	Poems are sloppily written. (0 points)	Poems are fairly neatly written. (2 points)	Poems are neatly written. (3 points)	Poems are neatly written and have attractive details. (4 points)
Total Points				/12

	Unsatisfactory	Partially Proficient	Proficient	Advanced
Poetry Forms	Used no form for poems (0 points)	Used 1 different form for poems (2 points)	Used 2 different forms for poems (3 points)	Used 3 different forms for poems (4 points)
Scientific Facts	Poems include less than 1 fact about each object. (0 points)	Poems include at least 1 fact about each object (2 points)	Poems include at least 2 facts about each object (3 points)	Poems include at least 3 facts about each object (4 points)
Conventions	Spelling errors in poems interfere with meaning. (0 points)	Poems have many spelling errors. (2 points)	Poems include a few spelling errors. (3 points)	Poems have no spelling errors. (4 points)
Presentation	Poems are sloppily written. (0 points)	Poems are fairly neatly written. (2 points)	Poems are neatly written. (3 points)	Poems are neatly written and have attractive details. (4 points)
Total Points				/12

Appendix S
Incoming!

Name: _____ Date: _____

1. Fill a large cake pan with flour. Put the cake pan in the center of a large sheet.
2. Take a golf ball and drop it from ankle height into the flour. Measure the width and depth of the crater it makes in the flour. Record your measurements in the chart below.
3. Drop the golf ball from knee height into the flour. Measure the width and depth of the crater. Record your measurements in the chart below.
4. Drop the golf ball from waist height into the flour. Measure the width and depth of the crater. Record your measurements in the chart below.
5. Repeat steps 2-4 using a ping-pong ball.

	Golf ball	ping pong ball
Drop from ankle height	Width: Depth:	Width: Depth:
Drop from knee height	Width: Depth:	Width: Depth:
Drop from waist height	Width: Depth:	Width: Depth:

6. On the back of this paper, write a summary of what you observed about how weight of an object and distance the object drops affects the size of a crater.

Adapted from Our Amazing Solar System Science Book published by Educational Design, Inc.

Appendix T
Darkness in the Daytime

Throughout history, people have viewed eclipses in many different ways. The Chinese believed a dragon was swallowing the sun. They would set off firecrackers and yell to scare the dragon away. The people in India also believed a dragon was swallowing the sun. They would immerse themselves in water hoping their act of worship would aid the sun and moon in fighting off the dragon. In Japan, people would cover their wells during an eclipse. This was to keep out any poison from the darkened sky that might drop into the well and destroy the water. The Chippewa Indians worried that the sun's flame was going out. They would shoot flaming arrows into the sky to light the sun again. The ancient Greeks believed an eclipse was a warning from heaven to make peace with anyone they were warring against. In 585 BC two groups had been at war for five years. When the moon blocked the sun, the leaders decided to make peace. The Inuit Indians believed that the sun and moon were leaving the sky so they could make sure everything on earth was going well. Whatever methods people used in response to the eclipses, they seemed to work keeping people believing these and other myths for many, many years.

Adapted from "Eclipse" by Bryan Brewer at www.earthview.com/ages/myths.htm
And "Eclipse Crazy" at
www.chron.com/content/interactive/space/astronomy/eclipse/crazy.html

Appendix U
Make Your Own Eclipse

Cut out a circle with a diameter of 12" to represent Earth.

Cut out a circle with a diameter of 6" to represent the moon.

Use a flashlight to demonstrate a lunar eclipse.

The earth will block all light from reaching the moon, so the moon will be completely in shadow.

Show how the earth usually blocks only a portion of the light.

Use the flashlight to demonstrate a solar eclipse.

The moon will block the light from the sun. There will be a shadow of light on part of the Earth. Remind the students that during a solar eclipse all light is blocked in only one area of the world, not the whole Earth.

Eclipse Notes

During a total solar eclipse, the moon looks like a cookie sliding across the face of the sun. As the sky darkens, stars can be seen. Animals that sleep during the day will awaken. Animals that sleep at night will go to sleep.

Appendix V
Space Travel Begins

Since the earliest of times, humans have wanted to fly. Humans have also been fascinated with outer space. In the 1960's man began to fly into outer space.

The first American mission to space was Project Mercury. The first Project Mercury capsule was empty and it was launched on December 19,1960. The second Project Mercury capsule held a three-year-old chimpanzee. He was in space for eighteen minutes and performed all of the tasks he was told to do. On May 5, 1961, Alan B. Shepard, Jr. became the first American in space. He went into space about one month after a Russian man; Yuri Gagarin became the first man in space. On a later Mercury mission, John H. Glenn became the first Mercury astronaut to orbit the earth. He was in space for almost five hours and orbited the earth three times. With the success of the Mercury missions, NASA decided to improve the spacecraft for future missions.

The next series of flights into space were known as Project Gemini. The first Project Gemini launch held no astronauts. Since it was successful, future Project Gemini rockets would hold two astronauts instead of one. On March 23, 1965, Virgil I. Grissom and John W. Young traveled to space. They were the first astronauts to use controls to change their orbit, proving that man could control a space capsule. On June 3, 1965, Edward H. White II used another feature of the Gemini spacecraft, a door that the astronauts could open while in space. Edward White took a space walk outside of the capsule for the first time in history. There were many other successful events in the Gemini program, which led to man's dream of going to the moon being fulfilled.

The missions to the moon were part of Project Apollo. The first Apollo mission was a failure and three astronauts were killed. NASA had to work out some serious problems. The Apollo 8 Mission was ready to go to the moon. The Apollo 8 astronauts reached the moon on December 24,1968 and orbited it for 20 hours. The Apollo 9 and 10 missions were used to practice landing on the moon, without actually touching the moon. The most famous Apollo mission was Apollo 11. This Apollo mission landed on the moon and Neil Armstrong became the first man to walk on the moon. His first words were "One small step for man, one giant leap for mankind." There were other Apollo missions that helped us learn more about the moon after Apollo 11.

Adapted from A True Book: Project Mercury, A True Book: Project Gemini and A True Book: Project Apollo by Diane M. and Paul P. Sipiera.

Appendix W
Meet Mae Jemison

Host: Today we will look at the life of Mae Jemison, the first African American woman in space. We will hear about her life from those who knew her personally. First, we will talk with her parents. Mr. and Mrs. Jemison, how did you encourage Mae to become an astronaut?

Mr. Jemison: We always told Mae she could do whatever she wanted in life if she was willing to work hard.

Mrs. Jemison: Mae was always interested in science, so we encourage her to study many different fields in science while she was young.

Host: Thank you, Mr. Jemison. Let's talk to one of Mae's college professors. What did Mae study in college?

Professor: Mae studied chemical engineering and African American history while she attended Stanford University. Then, she decided to study medicine. While she was still a medical student, she wanted to help people in countries where there aren't enough doctors.

Host: Thank you, professor. Let's meet one of the doctors that worked with Mae in West Africa. What was it like working with Mae in Africa?

Doctor: Mae was a very hard working doctor. She was always willing to work long hours to help the people who came to see us. She also encouraged everyone around her to do his or her best.

Host: I'm sure the people of Africa miss her very much. After working in Africa, Mae went on to become an astronaut. We will meet one of NASA's trainers. Can you tell us about Mae's time with NASA?

Trainer: Mae was not accepted the first time that she applied to NASA. But, she continued to work hard and was later accepted to NASA's astronaut program.

Host: Once she was accepted, what did her training involve?

Appendix W, page 2
Meet Mae Jemison

Trainer: We use a big plane called the KC-135. It flies up and down in "u" shaped patterns. You have about 20 seconds of weightlessness with this plane. We also help the astronauts learn exercises they can use on the shuttle to stay fit. The astronauts all receive training in landing the space shuttle on land and in water.

Host: How long did Mae's training last?

Trainer: Mae spent five years training before she went on a space shuttle mission.

Host: With her training behind her, Mae finally went on a space shuttle mission in 1992. Let's hear from one of the other astronauts on her mission.

Astronaut: The Space Shuttle Endeavour took six astronauts out into space. We performed 43 different experiments. One of the things we focused on for this mission was studying space sickness, the sickness most astronauts get during the first few days in space. Mae's medical training was very useful for this study.

Host: Let's bring out Mae Jemison. Mae, what are you doing now that you have retired from NASA?

Mae: I formed a group called the Jemison Group. One of our main focuses is to improve health care in Africa.

Host: Is there any advice you'd like to give our listeners?

Mae: "Don't let anyone rob you of your imagination, your creativity or your curiosity. It's your place in the world, it's your life. Go on and do all you can with it, and make it the life you want to live."

Adapted from www.nsf.gov/od/pa/nstw/kids/cards/world/mae.html and http://starchild.gsfc.nasa.gov/docs/StarChild/shadow/whos_who_level2/jemison.html

Appendix X
Astronomy Test

Name:_____

Write correct letter on the blank.

___ 1. What is the name of our galaxy?
- a. Milky Way
- b. Halley
- c. Andromeda
- d. Pluto

___ 2. The sun gives us heat and _____.
- a. plants
- b. animals
- c. sound
- d. light

___ 3. We have one sun and nine _____ in our solar system.
- a. asteroids
- b. comets
- c. planets
- d. meteors

___ 4. The Earth is the _____ planet from the sun.
- a. first
- b. third
- c. ninth
- d. twentieth

___ 5. A galaxy close to our own.
- a. Halley
- b. Copernicus
- c. Andromeda
- d. Big Dipper

___ 6. The _____ is the center of our solar system.
- a. sun
- b. moon
- c. asteroid belt
- d. Earth

___ 7. One of the most famous comets is _____ Comet.
- a. Copernicus'
- b. Halley's
- c. Mae Jemison's
- d. Aristotle's

___ 8. Chunks of rock that float in space.
- a. stars and planets
- b. comets and stars
- c. comets and planets
- d. meteors and asteroids

Appendix X, page 2
Astronomy Test

Write the letter to match each word and its definition and description.

___ 9. stars	a. a collapsed star whose gravity is so strong even light cannot escape
___ 10. comets	b. balls of dirty ice, rocks etc. that orbit the sun. They have a tail.
___ 11. Mae Jemison	c. balls of hot, glowing gases
___ 12. orbit	d. the first black woman in space
___ 13. black holes	e. a tool used to see things in space more clearly
___ 14. eclipse	f. a planet's path around the sun
___ 15. telescope	g. when the moon block the sun's light to Earth for a short time

16. What was Copernicus' discovery?

17. How are rockets and space shuttles different?

18. What did Neil Armstrong say when he took his first step onto the moon?

Match each word with its correct definition or description.

___ 19. Apollo 11	a. to spin on an axis causing day and night
___ 20. Big Bang	b. a huge group of stars that spins around a common center of gravity
___ 21. galaxy	c. the largest space rocks
___ 22. rotate	d. a theory that the universe started from an explosion
___ 23. revolve	e. to travel around the sun
___ 24. asteroids	f. the trip when man first walked on the moon
___ 25. meteors	g. small space rocks that enter our atmosphere

Appendix X, page 3
Astronomy Test

Choose the correct answer for each question or statement.

___ 26. The force that pulls objects in the universe together.
- a. friction
- b. gravity
- c. galaxy
- d. rotation

___ 27. We often call these shooting stars.
- a. asteroids
- b. comets
- c. meteors
- d. planets

___ 28. A group of stars that make a picture.
- a. constellation
- b. meteor shower
- c. rockets
- d. satellites

___ 29. An object that orbits around the Earth.
- a. Jupiter
- b. satellite
- c. asteroid
- d. Sun

___ 30. Everything in space and the space between those things.
- a. galaxy
- b. universe
- c. solar system
- d. asteroid belt

Name the nine planets in order. They must be spelled correctly.

1. 6.

2. 7.

3. 8.

4. 9.

5.

Extra Credit: List facts about a planet on the back of this paper.

Appendix Y
Solar System Quiz Key and Astronomy Assessment Key

Quiz Key

1. Mercury
2. Venus
3. Jupiter
4. Neptune
5. Venus
6. Earth
7. Mars
8. Mars
9. Uranus
10. Pluto
11. Saturn
12. Neptune

Assessment Key

1. a. Milky Way
2. d. light
3. c. planets
4. b. third
5. c. Andromeda
6. a. sun
7. b. Halley's
8. d. meteors and asteroids
9. c. balls of hot, glowing gases
10. b. balls of dirty ice, rocks, etc.
11. d. the first black woman in space
12. f. a planet's path around the sun
13. a. a collapsed star…
14. g. when the moon block the sun
15. e. a tool used to see things…
16. That the sun is the center of the Solar System.
17. Rockets travel once and a space Shuttle can make many trips.
18. "One small step for man, one giant leap for mankind."
19. f. the trip when man first walked…
20. d. the theory that the universe …
21. b. a huge group of stars that spins…
22. a. to spin on an axis
23. e. to travel around the sun
24. c. the largest space rocks
25. g. small rocks that enter…
26. b. gravity
27. c. meteors
28. a. constellation
29. b. satellite
30. b. universe

Planets:

1. Mercury
2. Venus
3. Earth
4. Mars
5. Jupiter
6. Saturn
7. Uranus
8. Neptune
9. Pluto