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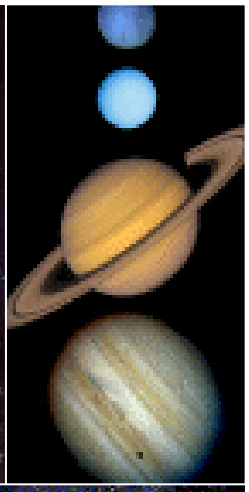
#10697
THE OUTER SOLAR SYSTEM: COMETS

AIMS MULTIMEDIA, 2003
Grade Level: 6-12
10 Minutes



AIMS MULTIMEDIA
TEACHING MODULE

CAPTIONED MEDIA PROGRAM RELATED RESOURCES

#2469 EXPLORING OUR SOLAR SYSTEM
#3177 SHOOTING STARS
#8849 OUR SOLAR SYSTEM
#10698 THE OUTER SOLAR SYSTEM: ASTEROIDS

Funding for the Captioned Media Program is provided by the U.S. Department of Education

The Space Files: The Outer Solar System

INTRODUCTION TO THE AIMS TEACHING MODULE (ATM)

INTRODUCING *The Space Files: The Outer Solar System*

PREPARATION FOR VIEWING

AFTER VIEWING THE PROGRAM

Congratulations!

You have chosen a learning program that will actively motivate your students and provide you with easily accessible and easily manageable instructional guidelines and tools designed to make your teaching role efficient and rewarding.

The AIMS Teaching Module (ATM) provides you with a video program correlated to your classroom curriculum, instructions and guidelines for use, plus a comprehensive teaching program containing a wide range of activities and ideas for interaction between all content areas. Our authors, educators, and consultants have written and reviewed the AIMS Teaching Modules to align with the Educate America Act: Goals 2000.

This ATM, with its clear definition of manageability, both in the classroom and beyond, allows you to tailor specific activities to meet all of your classroom needs.

RATIONALE

In today's classrooms, educational pedagogy is often founded on Benjamin S. Bloom's "Six Levels of Cognitive Complexity." The practical application of Bloom's Taxonomy is to evaluate students' thinking skills on these levels, from the simple to the complex:

1. Knowledge (rote memory skills),
2. Comprehension (the ability to relate or retell),
3. Application (the ability to apply knowledge outside its origin),
4. Analysis (relating and differentiating parts of a whole),
5. Synthesis (relating parts to a whole)
6. Evaluation (making a judgment or formulating an opinion).

The AIMS Teaching Module is designed to facilitate these intellectual capabilities, and to integrate classroom experiences and assimilation of learning with the students' life experiences, realities, and expectations. AIMS' learner verification studies prove that our AIMS Teaching Modules help students to absorb, retain, and to demonstrate ability to use new knowledge in their world. Our educational materials are written and designed for today's classroom, which incorporates a wide range of intellectual, cultural, physical, and emotional diversities.

ORGANIZATION AND MANAGEMENT

To facilitate ease in classroom manageability, the AIMS Teaching Module is organized in three sections:

I. Introducing this ATM
will give you the specific information you need to integrate the program into your classroom curriculum.

II. Preparation for Viewing
provides suggestions and strategies for motivation, language preparedness, readiness, and focus prior to viewing the program with your students.

III. After Viewing the Program
provides suggestions for additional activities plus an assortment of consumable assessment and extended activities, designed to broaden comprehension of the topic and to make connections to other curriculum content areas.

AIMS Teaching Module written by Patricia A. Peirson.

AIMS Multimedia is a leading producer and distributor of educational programs serving schools and libraries since 1957. AIMS draws upon the most up-to-date knowledge, existing and emerging technologies, and all of the instructional and pedagogical resources available to develop and distribute educational programs in videocassette and CD-ROM.

Persons or schools interested in obtaining additional copies of this AIMS Teaching Module, please contact:

AIMS Multimedia at:
Toll Free: 1-800-367-2467
Fax: 818-341-6700
Web: www.aimsmultimedia.com
Email: info@aimsmultimedia.com

FEATURES
INTRODUCING THE ATM

Your AIMS Teaching Module is designed to accompany a video program written and produced by some of the world's most credible and creative writers and producers of educational programming. To facilitate diversity and flexibility in your classroom and to provide assessment tools, your AIMS Teaching Module features these components:

Themes

This section tells how the AIMS Teaching Module is correlated to the curriculum. Themes offers suggestions for interaction with other curriculum content areas, enabling teachers to use the teaching module to incorporate the topic into a variety of learning areas.

Overview

The Overview provides a synopsis of content covered in the video program. Its purpose is to give you a summary of the subject matter and to enhance your introductory preparation.

Objectives

The ATM learning objectives provide guidelines for teachers to assess what learners can be expected to gain from each program. After completion of the AIMS Teaching Module, your students will be able to demonstrate dynamic and applied comprehension of"" the topic.

Preparation for Viewing

In preparation for viewing the video program, the AIMS Teaching Module offers activity and/or discussion ideas that you may use in any order or combination.

Introduction To The Program

Introduction to the Program is designed to enable students to recall or relate prior knowledge about the topic and to prepare them for what they are about to learn.

Introduction To Vocabulary

Introduction to Vocabulary is a review of language used in the program: words, phrases, and usage. This vocabulary introduction is designed to ensure that all learners, including limited English proficiency learners, will have full understanding of the language usage in the content of the program.

Discussion Ideas

Discussion Ideas are designed to help you assess students' prior knowledge about the topic and to give students a preview of what they will learn. Active discussion stimulates interest in a subject and can motivate even the most reluctant learner. Listening, as well as speaking, is active participation. Encourage your students to participate at the rate they feel comfortable. Model sharing personal experiences when applicable, and model listening to students' ideas and opinions.

Focus

Help learners set a purpose for watching the program with Focus, designed to give students a focal point for comprehension continuity.

Jump Right In

Jump Right In provides abbreviated instructions for quick management of the program.

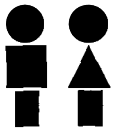
After Viewing the Program

After your students have viewed the program, you may introduce any or all of these activities to interact with other curriculum content areas, provide reinforcement, assess comprehension skills, or provide hands-on and in-depth extended study of the topic.

SUGGESTED ACTIVITIES

The Suggested Activities offer ideas for activities you can direct in the classroom or have your students complete independently, in pairs, or in small work groups after they have viewed the program. To accommodate your range of classroom needs, the activities are organized into skills categories. Their labels will tell you how to identify each activity and help you correlate it into your classroom curriculum. To help you schedule your classroom lesson time, the AIMS hourglass gives you an estimate of the time each activity should require. Some of the activities fall into these categories:

Meeting Individual Needs



These activities are designed to aid in classroom continuity. Reluctant learners and learners acquiring English will benefit from these activities geared to enhance comprehension of language in order to fully grasp content meaning.

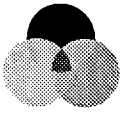
Curriculum Connections

Many of the suggested activities are intended to integrate the content of the ATM program into other content areas of the classroom curriculum. These cross-connections turn the classroom teaching experience into a whole learning experience.

Critical Thinking

Critical Thinking activities are designed to stimulate learners' own opinions and ideas. These activities require students to use the thinking process to discern fact from opinion, consider their own problems and formulate possible solutions, draw conclusions, discuss cause and effect, or combine what they already know with what they have learned to make inferences.

Cultural Diversity



Each AIMS Teaching Module has an activity called Cultural Awareness, Cultural Diversity, or Cultural Exchange that encourages students to share their backgrounds, cultures, heritage, or knowledge of other countries, customs, and language.

Hands On

These are experimental or tactile activities that relate directly to the material taught in the program. Your students will have opportunities to make discoveries and formulate ideas on their own, based on what they learn in this unit.

Writing

Every AIMS Teaching Module will contain an activity designed for students to use the writing process to express their ideas about what they have learned. The writing activity may also help them to make the connection between what they are learning in this unit and how it applies to other content areas.

In The Newsroom

Each AIMS Teaching Module contains a newsroom activity designed to help students make the relationship between what they learn in the classroom and how it applies in their world. The purpose of In The Newsroom is to actively involve each class member in a whole learning experience. Each student will have an opportunity to perform all of the tasks involved in production: writing, researching, producing, directing, and interviewing as they create their own classroom news program.

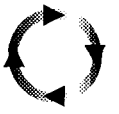
Extended Activities

These activities provide opportunities for students to work separately or together to conduct further research, explore answers to their own questions, or apply what they have learned to other media or content areas.

Link to the World

These activities offer ideas for connecting learners' classroom activities to their community and the rest of the world.

Culminating Activity



To wrap up the unit, AIMS Teaching Modules offer suggestions for ways to reinforce what students have learned and how they can use their new knowledge to enhance their worldview.

ADDITIONAL ATM FEATURES

Vocabulary

Every ATM contains an activity that reinforces the meaning and usage of the vocabulary words introduced in the program content. Students will read or find the definition of each vocabulary word, then use the word in a written sentence.

Checking Comprehension

Checking Comprehension is designed to help you evaluate how well your students understand, retain, and recall the information presented in the AIMS Teaching Module. Depending on your students' needs, you may direct this activity to the whole group yourself, or you may want to have students work on the activity page independently, in pairs, or in small groups. Students can verify their written answers through discussion or by viewing the video a second time. If you choose, you can reproduce the answers from your Answer Key or write the answer choices in a Word Bank for students to use. Students can use this completed activity as a study guide to prepare for the test.

Reproducible Activities

The AIMS Teaching Module provides a selection of reproducible activities, designed to specifically reinforce the content of this learning unit. Whenever applicable, they are arranged in order from low to high difficulty level, to allow a seamless facilitation of the learning process. You may choose to have students take these activities home or to work on them in the classroom independently, in pairs or in small groups.

Checking Vocabulary

The checking Vocabulary activity provides the opportunity for students to assess their knowledge of new vocabulary with this word game or puzzle. The format of this vocabulary activity allows students to use the related words and phrases in a different context.

Test

The AIMS Teaching Module Test permits you to assess students' understanding of what they have learned. The test is formatted in one of several standard test formats to give your students a range of experiences in test-taking techniques. Be sure to read, or remind students to read, the directions carefully and to read each answer choice before making a selection. Use the Answer Key to check their answers.

Additional AIMS Multimedia Programs

After you have completed this AIMS Teaching Module you may be interested in more of the programs that AIMS offers. This list includes several related AIMS programs.

Answer Key

Reproduces tests and work pages with answers marked.

JUMP RIGHT IN

Preparation

- Read Title **Themes, Overview,** and **Objectives** to become familiar with program content and expectations.
- Use **Preparation for Viewing** suggestions to introduce the topic to students.

Viewing

- Set up viewing monitor so that all students have a clear view.
- Depending on your classroom size and learning range, you may choose to have students view Title together or in small groups.
- Some students may benefit from viewing the video more than one time.

After Viewing

- Select Suggested Activities that integrate into your classroom curriculum. If applicable, gather materials or resources.
- Choose the best way for students to work on each activity. Some activities work best for the whole group. Other activities are designed for students to work independently, in pairs, or in small groups. Whenever possible, encourage students to share their work with the rest of the group.
- Duplicate the appropriate number of Vocabulary, Checking Comprehension, and consumable activity pages for your students.
- You may choose to have students take consumable activities home, or complete them in the classroom, independently, or in groups.
- Administer the Test to assess students' comprehension of what they have learned, and to provide them with practice in test-taking procedures.
- Use the Culminating Activity as a forum for students to display, summarize, extend, or share what they have learned with each other, the rest of the school, or a local community organization.

The Space Files: The Outer Solar System

Themes

These six programs focus on the outer solar system, the celestial region from the Asteroid Belt and its closest gas giant, Jupiter, to dark, diminutive Pluto and the region of icy debris known as the Kuiper Belt. A close-up look at comets and asteroids is also featured, with an examination of the latter's likely role both in altering Earth's geological history and in the evolution of life on our planet. As their central theme, the SpaceFiles: Outer Solar System programs provide in-depth examination of the orbits and rotation, atmosphere, climate, topography, and relative position of each Jovian planet, as well as the origins, composition, and cosmic movement of comets and asteroids. Likelihood of the potential for or existence of life on the moons of Jupiter and Saturn is also discussed. Graphic animation and the latest telescopic, radar, fly-over, and surface images provide students with up-to-date images. The exciting format of each program serves to foster an interest in space exploration and appreciation of this diverse corner of the universe within reach of our own remarkable planet.

Overview

The SpaceFiles Series encompasses the fundamentals of space and astronomy. The six Outer Solar System titles deal with the nonterrestrial planets, or gas giants, asteroids and the Asteroid Belt, and comets.

Note: Many of the activities and assessments contained in this teaching module may be used with all six programs in the SpaceFiles - The Outer Solar System series. Other additional activities and consumables are meant for specific Outer Solar System videos, and are labeled as such.

Beginning with the largest of the Jovian planets, Outer Solar System: Jupiter examines the giant gas ball which first lies beyond the vast ring of rocky fragments known as the Asteroid Belt. Composed mainly of hydrogen, this magnificent planet is larger than all the other planets of our solar system combined. With its numerous moons and several rings, the Jupiter system is a "mini-solar system." Water has been detected in the planet's turbulent atmosphere and below the glacial surface of its three largest moons, suggesting the intriguing possibility of life. A proposed exploratory mission by the Jupiter Icy Moons Orbiter would make detailed studies of the moons' makeup, history and potential for sustaining life.

Next, Outer Solar System: Saturn takes us to the sixth planet from the Sun and second largest in the solar system. Taking nearly thirty years to complete its solar orbit, Saturn spins so quickly on its axis that its day spans less than eleven hours. With no solid surface, the planet is composed of five cloud layers surrounding a liquid metallic core of hydrogen, and encircled by the dramatic ring system - the most extensive and complex in our solar system - extending hundreds of thousands of kilometers from the planet.

Outer Solar System: Neptune and Uranus brings us first to the seemingly bland Jovian planet of Uranus, discovered in 1781 by astronomer William Herschel. Spinning backwards at a crazy tilt, this third-largest planet is a surprisingly dynamic world with no solid surface, some of the brightest clouds in the outer solar system, and eleven rings. Neptune is revealed as a cold, windy place, with temperatures of minus 220(Celsius and constant cyclonic storms. Eighth planet from the Sun, Neptune was the first planet located through mathematical predictions rather than through regular observations of the sky. Smallest of the gas giants, its volume could still hold sixty Earths.

Outer Solar System: Pluto explores the smallest, coldest, and most distant planet from the Sun, discovered in 1930 by American astronomer Clyde Tombaugh - the last person thus far to find a new planet. His laborious search for "Planet X" and the excitement of the scientific discovery are vividly portrayed, as is the subsequent discovery of Pluto's dark moon, Charon, by astronomer James Christy in 1978. Though no spacecraft have visited Pluto as yet, NASA is currently considering a mission called New Horizons that would explore both Pluto and the Kuiper Belt region, often called our solar system's "final frontier."

Outer Solar System: Comets presents the cosmos' wandering nomads. Travelers from the farthest reaches of the solar system, comets catch our attention when they blaze across the night sky. Some are never seen again, while others - such as Halley's Comet - revisit us periodically. On a collision course with destiny, comets plunge towards the planets and the Sun. Some are immolated in planetary atmospheres, while others strike the surface, forming craters to mark their passage. They are among the least-changed objects in our solar system and, as such, may yield important clues about its formation.

Outer Solar System: Asteroids takes a close look at the Asteroid Belt - the vast ring of rocky fragments found between Mars and Jupiter. Without Jupiter's gravitational pull, these fragments of ancient space rubble might pull together and form a planet. Collisions between asteroids send fragments

hurtling through space. When their trajectories cross Earth's orbit, some strike the planet's surface. The extinction of the dinosaurs sixty-five million years ago has been linked to a devastating impact near the Yucatan Peninsula in Mexico. NASA and the USAF monitor the skies, devising methods to ward off impact should another potentially deadly visitor approach.

Objectives

- To explore the non-terrestrial planets, or gas giants, of the solar system
- To examine the unique surface and atmospheric features of each celestial body
- To learn about the size, relative position, and orbit of each planet in the outer solar system
- To discuss the potential for life on the moons of Jupiter and Saturn
- To provide up-to-date information on space probes, and the planned purpose of future probes
- To examine the origins and physical components of the Asteroid Belt, as well as the important relationship between asteroid trajectories and planet Earth
- To explore the origins and physical components of comets
- To encourage a deeper appreciation of astronomy and further exploration of the solar system and beyond

Introduction to the Program

Ask students to share what they know about the origins of the Sun and planets in the solar system. Review with students the names of the nine planets and their positions relative to the Sun. Ask students to explain the basic difference between terrestrial planets and non-terrestrial planets, or gas giants. Ask students what area in our solar system lies between Mars and Jupiter (the Asteroid Belt). Explain to students that the programs they will be viewing involve comets, asteroids, and the planets and moons of the outer solar system - Jupiter, Saturn, Uranus, Neptune, and Pluto.

Introduction to Vocabulary

Write the following words on the board and explain that they will be referenced in the video. Ask the class to discuss the meaning of each word, and review the terms that are unfamiliar to students. You may wish to have students look up terms in a dictionary or encyclopedia.

axis
Celsius (a measure of temperature; 32∫ F = 0 ∫ C [freezing point]; 212∫ F = 100∫ C [boiling point])
diameter
elliptical
kilometer (a measure of distance; 1 kilometer equals 0.6214 miles; 1 mile = 1.609 kilometers)
Kuiper Belt (disk-shaped region of icy debris beyond the orbit of Neptune; source of short-period comets)
moon
orbit
Oort Cloud (a vast shell of icy bodies about 50,000 times farther from the Sun than the Earth)
planet
rotation
solar system

Discussion Ideas

Ask one or more of the following questions to prompt discussion about space exploration: Why do you think we study the planets and other celestial bodies (such as asteroids and comets) in our solar system? (Sample answers might include: to discover how the solar system came into being; how it is changing; how it might end, etc.) How do you think we can relate what we learn about our own solar system to the rest of the universe? What are the necessary components to sustain life as we know and understand it? (atmosphere, light, heat, cold, water, soil, and air, all occurring in delicate balance) What can study of the solar system tell us about formation of life on Earth and the potential of life elsewhere? What would be your reaction if we found proof of life on other planets in other solar systems?

Focus

Help students review basic data concerning Earth's size, atmosphere, topography, orbit and rotation, tilt, distance from the Sun, relative size of Earth's moon, etc. Encourage students to watch for similarities and differences between other planets and Earth or Earth's moon. Ask them to keep in mind each Jovian planet's position relative to the Sun and the significance of the elemental composition of these planets and/or their moons. For the programs on comets and asteroids, ask students to keep in mind the dangerous interaction that these objects have had, or yet may have, with Earth.

SUGGESTED ACTIVITIES

30 Minutes

All Outer Solar System Programs
Meeting Individual Needs

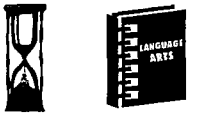
Following the viewing of each program, ask students to recall some of the highlights and specific information presented. List their responses on the board. Clarify information as needed. If necessary, provide suggestions of your own to trigger additional responses and stimulate discussion.

45 Minutes

All Outer Solar System Programs
Connection to Social Studies

There is an on-going controversy concerning the value of space exploration. Some people believe that such exploration is a needless waste of money, a drain on our Federal budget, and has produced little that benefits the day-to-day life of the individual. Others would argue that valuable information is being gathered regarding the formation of our solar system, how life formed on Earth, the potential for life elsewhere in the universe, how life on Earth may end, etc.

Have students research the pros and cons of space exploration. Organize a class debate to discuss these issues.



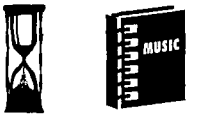
30 Minutes

All Outer Solar System Programs
Connection to Language Arts

Mythology: Our ancestors believed that the sky was the home of gods, goddesses, and other supernatural beings. The planets themselves were thought to be these immortal creatures. We use their names for the planets and moons today.

Using library, Internet or other resources, have students research the myths associated with Jupiter, Saturn, Uranus, Neptune, or Pluto. (Useful keyword: planetary mythology.) More advanced students may wish to research how the early Greeks attempted to explain the movement of heavenly bodies through their myths. Some students may enjoy researching the names of the Jovian planet moons, which draw from both mythology and literature.

Have students share their findings in an informal discussion or through presentation of oral reports. Discuss with students how such myths originated as our ancestors attempted to understand the world.



20 Minutes

All Outer Solar System Programs
Connection to Music Appreciation

Gustav Holst's "The Planets" (composed during World War One) is a classical interpretation of the worlds which compose our solar system. It is an orchestral showpiece that takes the listener on a journey to seven planets (four of which are relative to this series). As planets in the series are studied individually, or upon completion of the series, introduce students to the corresponding piece(s). Following each piece, allow time for students to jot down their impressions of the music - the images or emotions inspired by it.

Mythology and astrology served as inspiration for Holst's music. Does scientific exploration and discovery detract from the enjoyment of such artistic expression?

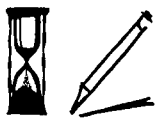
All Outer Solar System Programs
Extended Activity


Extended

Provide students with the names of the space probes mentioned in the programs (list provided below). Individually or in small groups, have students prepare a multimedia presentation that includes pictures of the space probe or its concept design, the significance of its name, the launch date (actual or proposed), its purpose, and - if applicable - its discoveries and some images sent back to Earth. Conclude with an analysis of the success or failure of the completed space probe, or the potential significance of the planned probe.

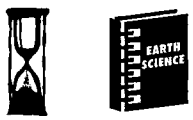
Galileo spacecraft
Cassini spacecraft
Jupiter Icy Moons Orbiter
Cassini orbiter/ Huygens Probe
Voyager I
Voyager II
New Horizons
Stardust
Deep Impact

All Outer Solar System Programs
Creative Writing


Extended

Using the information gathered in the above research on life forms which exist under extreme conditions, discuss the possibility of life therefore existing in some form on one of the other planets or moons (such as Europa or Callisto) explored in this series of programs. Ask them to consider also whether the chemical elements that might "seed" life elsewhere might somehow arrive within the fragments of an asteroid or comet striking the surface of another planet. Next, ask students to write a short fiction story with this topic as its theme. Have students present finished stories to the class. Teachers may wish to compile and photocopy the stories to create a class science fiction short story booklet.

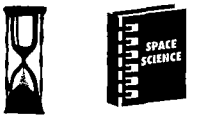
Outer Solar System Programs - Jupiter, Saturn, Neptune and Uranus, Pluto
Connection to Earth Science



45 Minutes

The chances of Earth being unique in the universe keeps shrinking as astronomers continue to raise the estimate on how many planets are out there. The newest findings estimate that twenty-five percent of Sun-like stars have planets - meaning that, in our galaxy alone, there are at least one hundred million stars with planets. Considering the hundred billion or so galaxies in the observable universe, the idea of life on other planets is not so far-fetched. Recent discoveries on our own planet have revealed that life exists on the Earth under the most "unlifelike" conditions. For example, we have discovered anaerobic life, and life existing in all temperature extremes, in toxic gas environments, inside a rock, or in a pool of acid. Using the library and Internet resources, have students research recent discoveries of life-forms which exist under unexpected and extreme conditions on Earth, and have them present their findings to the rest of the class. This may be done during a general class discussion or as a formal oral report.

Outer Solar System: Jupiter
Connection to Space Science



40 Minutes

Review information presented in the program regarding NASA's planned Jupiter Icy Moons Orbiter, including the questions that scientists will seek to answer. (How did the moons Ganymede, Callisto, and Europa evolve? Do they have oceans? Can they sustain life? Where is the thinnest ice on Europa?) Ask students to do some follow-up research on NASA's planned mission in preparation for discussion of the following questions: What do they believe exploration will reveal? If life similar to primitive life-forms on Earth is discovered, what impact will this have? How would such a discovery change their personal views of the universe?

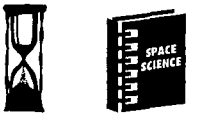
Outer Solar System: Jupiter
Creative Writing


60 Minutes

Imagine yourself standing on Io - the closest moon to Jupiter. In contrast to standing on our own Moon, with Earth looking like a distant blue marble surrounded by space, the enormity of Jupiter would fill your whole view. It is likely that, as an inhabitant of Io, you would have no idea that anything more than that wall of clouds existed. (Like our Moon, the same side would always face the planet surface.) There would be no "beyond," no space, no stars, no "out there." What would happen to the first inhabitant who suggested that more might exist, or who (like Columbus) set out to prove there was a "beyond," an "out there"?

Have students use this premise to write a short story. As they create their stories, encourage students to keep in mind what their world and their sky would look like - what they would and, more importantly, would not, see or suspect about the universe. Have students share their finished stories with the rest of the class.

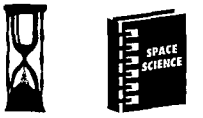
Outer Solar System: Saturn
Connection to Space Science



Extended

Have students research the specific features of Saturn's mysterious satellite, Titan. Then ask them to create a "travel guide" to this largest moon of Saturn, including pictures and day trips to nearby cosmic destinations, such as the rings of Saturn, other satellites of interest, or the planet itself. Have students share or display their finished guides.

Outer Solar System: Neptune and Uranus
Connection to Space Science



50 Minutes

Spacecrafts Voyager 1 and Voyager 2 are responsible for much of our current understanding of Neptune and Uranus. As their journeys of discovery continue, Voyager 1 has become the most distant human-made object in the universe, and Voyager 2 is close on its heels. In their continuing mission, the two spacecrafts will seek to study the region in space where the Sun's influence ends and the dark recesses of interstellar space begin. Using Internet and library resources, have students research and prepare a report on what these two crafts have discovered about the nature and compositions of Neptune and Uranus, as well as the latest information which is being sent back from their current explorations, and any future expectations for their remarkable journeys.

Outer Solar System: Pluto
Connection to Space Science

50 Minutes

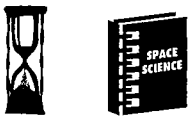
Is Pluto really a planet? Recent discoveries of Pluto-like objects in the outer solar system have sparked debate about the nature of the tiniest "planet." Using library and Internet resources, have students research this topic and prepare a report. Reports may simply discuss the dilemma, or take a position either in favor of Pluto retaining its classification as a planet, or of stripping it of that rank. As an alternative to written reports, teachers may wish to organize a debate on the subject.

Outer Solar System: Comets
Connection to Space Science

45 Minutes

Identification and confirmation of the region from which most short-period comets come is a fairly recent occurrence. In 1951, Gerard Kuiper hypothesized that some comet-like debris from the formation of the solar system should exist just beyond Neptune. The existence of the Kuiper Belt remained theory until 1992. The planet Pluto is now considered the largest object in this region. This vast reservoir of icy bodies beyond the orbit of Neptune holds keys to the formation of our solar system. Impacts from comets played a major role in the evolution of the Earth, primarily during its early history billions of years ago. Some scientists believe that they brought water and a variety of organic molecules to Earth. Ask students to research the latest findings in the Kuiper Belt and prepare a fact sheet. Use this as the basis for discussion of current discoveries, what may yet be discovered, and why such research is important.

Outer Solar System: Asteroids
Connection to Space Science



60 Minutes

Divide students into groups of three or four. Assign each group one of the meteorite impact sites mentioned in the program (Gosses Bluff, Australia; Meteor Crater, a.k.a. Barringer Crater in Arizona; Chicxulub - the Yucatan Peninsula impact). Additional sites of interest could be added to the list, such as Sudbury Structure in Ontario, Canada; the Popigai crater in Siberia; or the Tswaing meteorite crater in South Africa, where an object half the size of a soccer field hit the Earth at four thousand kilometers per hour hundreds of thousands of years ago. Have each group research their assigned crater and prepare a report on its origins, size, impact site location and dimension, time of the impact, results, etc. Using the library and Internet as resources, ask students to provide visuals to their presentation, such as maps, photographs of the site, artist conceptions, and the like. The following website offers an excellent quick look at major impact sites. The database can be viewed by name, diameter, or location: http://www.unb.ca/passc/ImpactDatabase/CIDiameterSort.html

All Outer Solar System Programs
Culminating Activity


Extended

If possible, arrange for students to visit a planetarium or a museum which has a space exhibit. As an alternative, ask a local astronomer to speak to the class about his or her experience and observations, or arrange for a traveling planetary show to visit your school. Following the activity of choice, discuss with students what they learned, most enjoyed or found the most interesting about the experience.

Name

ALL OUTER SOLAR SYSTEM PROGRAMS
VOCABULARY CHECK

The following terms are relative to ALL of the programs on the outer solar system. Fill in the number of each term next to its closest definition. Use a dictionary or encyclopedia if necessary. (Teachers Note: This worksheet should not be used until all programs have been viewed.)

1. asteroid
2. Asteroid Belt
3. atmosphere
4. auroras (aurorae)
5. axial tilt
6. comet
7. crater
8. ellipse
9. hydrogen
10. Kuiper Belt
11. meteorite
12. Oort Cloud
13. orbit
14. rotation

_____ the path followed by an object in space as it goes around another object

_____ bowl-shaped depression formed by the impact of a meteor

_____ the lightest and most abundant element which composes most of four of the outer planets

_____ a medium-sized rocky object orbiting the Sun; smaller than a planet, larger than a meteoroid

_____ a vast cloud of cometary bodies at the outer reaches of the solar system

_____ a glow in a planet's ionosphere caused by the interaction between the planet's magnetic field and charged particles from the Sun

_____ essentially a circle that has been stretched out of shape; the shape of planetary orbits

_____ the turning or spinning of a body around an axis running through it

_____ a chunk of frozen gases, ice, and rocky debris that orbits the Sun

_____ a region of the solar system between the orbits of Mars and Jupiter in which most asteroids are located

_____ a rock of extra-terrestrial origin found on Earth

_____ gases surrounding any of the bodies in space; also known as air

_____ a region of icy bodies beyond the orbit of Neptune

_____ the inclination angle of a planet's rotation axis in relation to its orbital plane (Earth's is 23.4∫)

ANSWER KEY for page 12

ALL OUTER SOLAR SYSTEM PROGRAMS
VOCABULARY CHECK

The following terms are relative to ALL of the programs on the outer solar system. Fill in the number of each term next to its closest definition. Use a dictionary or encyclopedia if necessary. (Teachers Note: This worksheet should not be used until all programs have been viewed.)

1. asteroid
2. Asteroid Belt
3. atmosphere
4. auroras (aurorae)
5. axial tilt
6. comet
7. crater
8. ellipse
9. hydrogen
10. Kuiper Belt
11. meteorite
12. Oort Cloud
13. orbit
14. rotation

13 the path followed by an object in space as it goes around another object

7 bowl-shaped depression formed by the impact of a meteor

9 the lightest and most abundant element which composes most of four of the outer planets

1 a medium-sized rocky object orbiting the Sun; smaller than a planet, larger than a meteoroid

12 a vast cloud of cometary bodies at the outer reaches of the solar system

4 a glow in a planet's ionosphere caused by the interaction between the planet's magnetic field and charged particles from the Sun

8 essentially a circle that has been stretched out of shape; the shape of planetary orbits

14 the turning or spinning of a body around an axis running through it

6 a chunk of frozen gases, ice, and rocky debris that orbits the Sun

2 a region of the solar system between the orbits of Mars and Jupiter in which most asteroids are located

11 a rock of extra-terrestrial origin found on Earth

3 gases surrounding any of the bodies in space; also known as air

10 a region of icy bodies beyond the orbit of Neptune

5 the inclination angle of a planet's rotation axis in relation to its orbital plane (Earth's is 23.4∫)

Name

ALL OUTER SOLAR SYSTEM PROGRAMS
WORD SEARCH

The following words can be found in the maze below. The letters may be arranged horizontally, vertically, diagonally, or backwards.

Q	W	T	L	E	B	X	R	E	P	I	U	K	Z	E
T	X	K	A	U	R	O	R	A	E	Q	Y	P	M	L
P	R	N	Q	Y	K	G	J	X	N	W	M	O	K	L
W	Q	A	H	Z	D	A	S	T	E	R	O	I	D	I
O	M	X	J	N	Y	B	W	M	H	N	J	Q	G	P
O	Y	K	M	E	T	E	O	R	I	T	E	W	Z	S
R	G	H	P	W	C	Z	Q	N	Y	V	X	H	K	E
T	Q	N	Y	K	X	T	H	G	W	H	N	Q	M	N
W	J	Z	M	D	P	J	O	R	B	I	T	G	X	O
C	R	A	T	E	R	Q	Y	R	Z	K	W	P	Y	I
L	O	N	X	W	V	O	K	D	Y	G	H	Z	V	T
O	W	M	Q	K	Y	V	G	Z	N	X	S	I	X	A
U	G	P	E	H	M	N	Y	E	D	Q	G	H	K	T
D	K	Z	N	T	W	Q	M	P	N	Y	X	J	W	O
X	Y	E	R	E	H	P	S	O	M	T	A	Z	Q	R

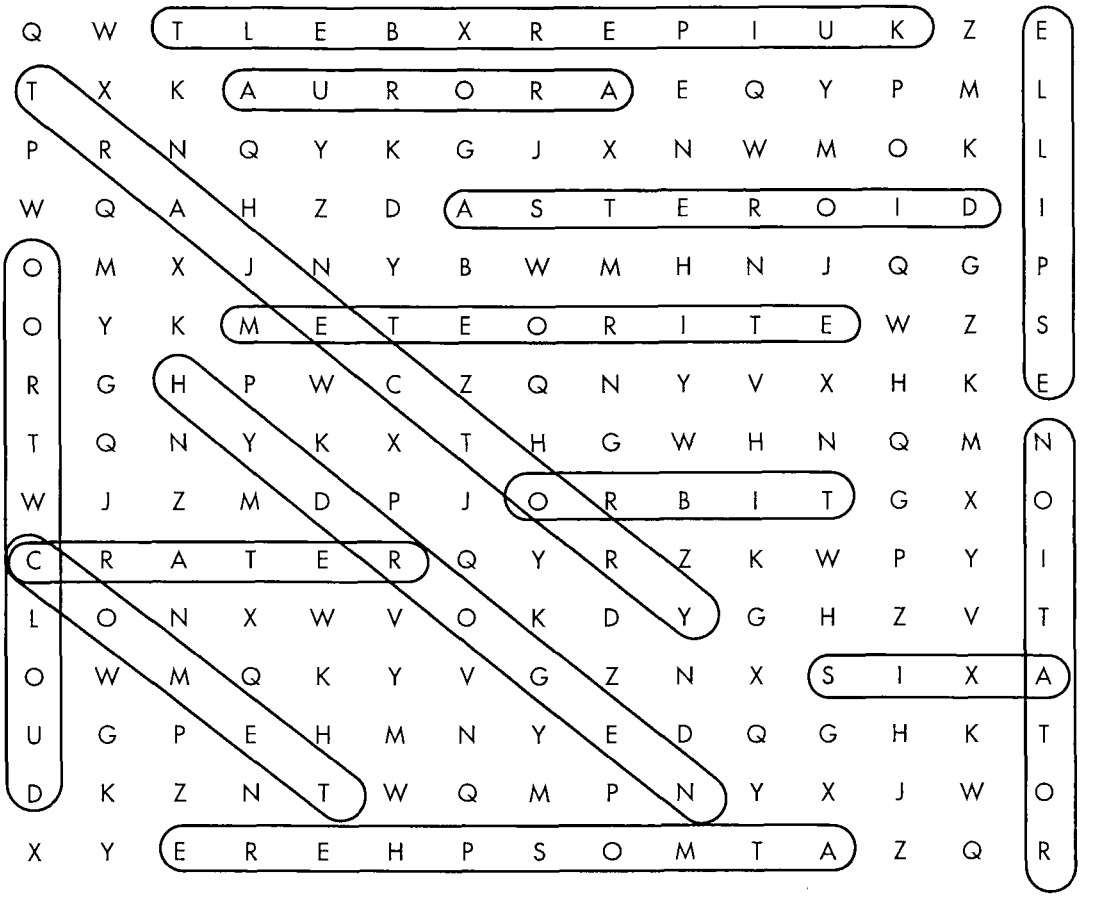
WORD BANK

asteroid
atmosphere
aurorae
axis
crater
comet
ellipse
hydrogen
Kuiper Belt
meteorite
moon
Oort Cloud
orbit
rotation
trajectory

ANSWER KEY for page 13

ALL OUTER SOLAR SYSTEM PROGRAMS
WORD SEARCH

The following words can be found in the maze below. The letters may be arranged horizontally, vertically, diagonally, or backwards.



WORD BANK

asteroid
atmosphere
aurorae
axis
crater
comet
ellipse
hydrogen
Kuiper Belt
meteorite
moon
Oort Cloud
orbit
rotation
trajectory

Name

OUTER SOLAR SYSTEM: COMETS
CHECKING COMPREHENSION: FILL IN THE BLANK

From the Word Bank below, fill in the missing information in the following statements. NOTE: Not all words will be used.

Atmosphere
Deep Impact
dust grains
Earth
Formation
Hale-Bopp
Halley's Comet
ices
Kuiper Belt
least changed
newest
Oort Cloud
solar system
Stardust
the Sun
universe

1. Comets are dirty-ice leftovers from the formation of our _____ around 4.6 billion years ago.

2. They are among the _____ objects in our solar system, and therefore may yield important clues about the _____of our solar system.

3. Most come from a region of icy bodies beyond the orbit of Neptune called the _____.

4. Some comets come from a very distant region - from a shell of icy clouds which envelopes the solar system called the _____.

5. The orbit of comets is directed by the gravitational pull of _____.

6. The tail of a comet is ancient _____ vaporizing and streaming off.

7. Meteor showers are _____ from comets entering and burning up in Earth's _____.

8. The most famous comet is _____, which was first photographed in 1910.

9. _____ is the first space mission dedicated solely to studying a comet and the first mission to return with material from a comet.

10. The _____ mission will blast a hole in a comet, creating a crater as big as a football field, to study the resulting icy debris, as well as the interior material exposed by the impact.

ANSWER KEY for page 24

OUTER SOLAR SYSTEM: COMETS
CHECKING COMPREHENSION: FILL IN THE BLANK

From the Word Bank below, fill in the missing information in the following statements. NOTE: Not all words will be used.

Atmosphere
Deep Impact
dust grains
Earth
Formation
Hale-Bopp
Halley's Comet
ices
Kuiper Belt
least changed
newest
Oort Cloud
solar system
Stardust
the Sun
universe

1. Comets are dirty-ice leftovers from the formation of our **(solar system)** around 4.6 billion years ago.

2. They are among the **(least changed)** objects in our solar system, and therefore may yield important clues about the **(formation)** of our solar system.

3. Most come from a region of icy bodies beyond the orbit of Neptune called the **(Kuiper Belt).**

4. Some comets come from a very distant region - from a shell of icy clouds which envelopes the solar system called the **(Oort Cloud)**.

5. The orbit of comets is directed by the gravitational pull of **(the Sun).**

6. The tail of a comet is ancient **(ices)** vaporizing and streaming off.

7. Meteor showers are **(dust grains)** from comets entering and burning up in Earth's **(atmosphere)**.

8. The most famous comet is **(Halley's Comet)**, which was first photographed in 1910.

9. **(Stardust)** is the first space mission dedicated solely to studying a comet and the first mission to return with material from a comet.

10. The **(Deep Impact)** mission will blast a hole in a comet, creating a crater as big as a football field, to study the resulting icy debris, as well as the interior material exposed by the impact.

Name _____

OUTER SOLAR SYSTEM: COMETS
TEST

Circle the letter of the correct answer for each question.

1. Comets:
   a) are the least-changed objects in our solar system.
   b) are objects which come from beyond the Oort Cloud.
   c) cannot penetrate Earth's atmosphere.
   d) are drawn into our solar system by the gravitational pull of the planets.

2. Meteor showers are the result of:
   a) comets passing through Earth's atmosphere and hitting the surface.
   b) the ancient ices of a comet's tail vaporizing and streaming off.
   c) dust grains from a comet entering and burning up in Earth's atmosphere.
   d) all of the above.

3. Halley's Comet has an elliptical orbit of only _____ years.
   a) 65
   b) 76
   c) 35
   d) 48

4. The purpose of the space probe Stardust will be to:
   a) create a crater in a comet.
   b) collect matter that pre-dates the solar system.
   c) bring a small comet back to Earth.
   d) discover the origins of comets.

5. Comets are made up of:
   a) icy chunks of frozen gases.
   b) cosmic dust.
   c) small rocks.
   d) all of the above.

6. Why can study of comets reveal information about the formation of the solar system?

_____

_____

_____

_____

_____

ANSWER KEY for page 25

OUTER SOLAR SYSTEM: COMETS
TEST

Circle the letter of the correct answer for each question.

1. Comets:
   a) are the least-changed objects in our solar system.
   b) are objects which come from beyond the Oort Cloud.
   c) cannot penetrate Earth's atmosphere.
   d) are drawn into our solar system by the gravitational pull of the planets.

2. Meteor showers are the result of:
   a) comets passing through Earth's atmosphere and hitting the surface.
   b) the ancient ices of a comet's tail vaporizing and streaming off.
   c) dust grains from a comet entering and burning up in Earth's atmosphere.
   d) all of the above.

3. Halley's Comet has an elliptical orbit of only _____ years.
   a) 65
   b) 76
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   d) discover the origins of comets.

5. Comets are made up of:
   a) icy chunks of frozen gases.
   b) cosmic dust.
   c) small rocks.
   d) all of the above.

6. Why can study of comets reveal information about the formation of the solar system?

Comets are dirty-ice left over from the formation of our solar system around 4.6 billion years ago. They are among the least-changed objects in our solar system and, as such, may yield important clues about its formation.

ADDITIONAL AIMS MULTIMEDIA PROGRAMS

You and your students might also enjoy these other AIMS Multimedia programs:

#2877-EN-VID	*Inner Solar System: The Sun*
#2878-EN-VID	*Inner Solar System: Mercury*
#2879-EN-VID	*Inner Solar System: Venus*
#2880-EN-VID	*Inner Solar System: Earth*
#2881-EN-VID	*Inner Solar System: The Moon*
#2882-EN-VID	*Inner Solar System: Eclipses and Auroras*
#2883-EN-VID	*Inner Solar System: Mars*
#2590-EN-VID	*Astronomy: Facts and Fun*
#8285-EN-VID	*Solar Activity*
#8480-EN-VID	*Space Probe and Starships*
#9082-EN-VID	*The Universe: The Vast Frontier*
#9084-EN-VID	*The Solar System: Our Neighbors in Space*