Free Teaching Guide & Poster

SCHOLASTIC

Grades 6–8

SPACE SCIENCE

ADVENTURE IS WAITING

A Cross-Curricular Science and Language Arts Program

GREAT SWEEPSTAKES!

GREAT PRIZES!
Family Trip to
Kennedy Space Center Visitor Complex
in Florida!

See take-home page.

- Lessons & Reproducibles
- Classroom Wall Poster
- National Standards Matrix
- Take-Home Pages

Coming to theaters this November

ZATHURA

Visit
www.Zathura.com
and click "The Movie"
to arrange a class trip
to experience the
adventure of this
new film when
it opens this
November.

The children's book *Zathura*, by Chris Van Allsburg, is published by

Houghton Mifflin

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COLUMBIA PICTURES

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 0-439-82589-X

Welcome to **Space Science: Adventure Is Waiting,** a dynamic education program to build student skills in both science and language arts. Look inside for easy-to-use, national standards–based lessons and reproducibles, as well as a great sweepstakes with amazing prizes (see the Take-Home pages)!

Developed in cooperation with both NASA and Scholastic, **Space Science: Adventure Is Waiting** has been generously sponsored by Columbia Pictures. The program also provides inspiring images of the upcoming feature film *Zathura.* This adventure film is based on renowned author/illustrator Chris Van Allsburg's acclaimed children's book, published by Houghton Mifflin.

We hope you and your students enjoy this valuable program!

Columbia Pictures • NASA • Scholastic Inc. • Houghton Mifflin

Student Sweepstakes!

Prizes include:

- **Family Trip for four to Kennedy Space Center Visitor Complex in Florida**
- **Plasma TV and DVD Player**
- **Classroom sets of space/science books**

See Take-Home pages for details.

Share This Program with a Colleague!

Printable version available online at www.scholastic.com/spacescience

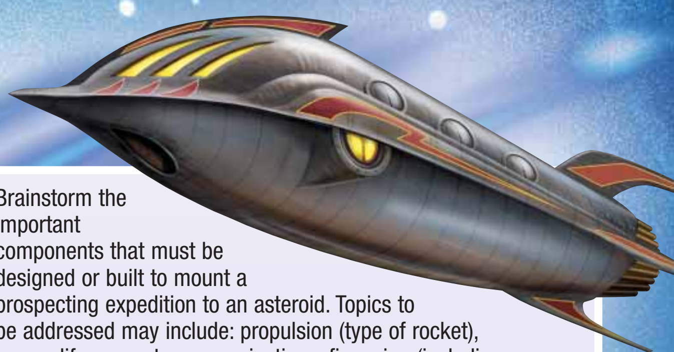
The movie *Zathura* is coming to theaters this November.

Connect Your Classroom Through NASA's Digital Learning Network™

On November 16, 2005, author/illustrator Chris Van Allsburg and a NASA scientist will be participating in three Digital Learning Network events with NASA Explorer School sites as hosted by NASA Langley Research Center. For more information, visit http://nasadln.nmsu.edu/dln

Lesson Overview

This Program Meets National Standards (see matrix on back cover)



Asteroid Resources: The Stepping Stone to Beyond

About This Lesson

In teams, students will research and document some of the requirements for mounting an expedition to an asteroid.

Objectives

Students will:

- Actively explore the potential resources available to space travelers through research, assessment, team cooperation, and exploration simulations.
- Develop the background to make the connection between meteorite research and potential planetary resources.

Exploration Proposal

About This Activity

This is a group-participation simulation based on the premise that water and other resources from the asteroid belt are required for deep space exploration. The class will brainstorm or investigate to identify useful resources, including water, that might be found on an asteroid. Teams of students are asked to take responsibility for planning various aspects of an asteroid prospecting expedition, and to present the results of their planning.

The students should learn that a large project requires the cooperation of many different teams, considering many ideas and needs. They could focus on the simplest aspects of vehicle design, hardware, and personnel, as well as more complicated issues such as financing for the mission, criteria for crew selection, Earth support teams, training, and maintenance, etc.

Objectives

Students will:

- Plan an expedition or other large engineering project.
- Investigate options in many aspects of space flight.
- Present their options, reasoning, and recommendations to the group.

Scenario

Time: Sometime in the next century
Place: Earth

Materials

- Resource materials about: space travel, space resources, asteroids, rockets, space shuttle, spacecraft
- Personal log (journal)
- Art supplies
- Reproducibles 1–4

Procedures

Advance Preparation

1. Read background material.
2. Assemble research materials or know where students may find them.
3. Copy and distribute Reproducibles as needed.

Classroom Procedure

1. Present Reproducible 1, "Lesson Background," so that students may familiarize themselves with basic information. Reproducible 2, "Name Those Asteroids!" can be distributed to reinforce information on asteroids and other small bodies in space.
2. Present Reproducible 3, "Lesson Scenario," and then brainstorm about what facts about asteroids might be needed to prepare for a mission that would prospect for water, oxygen, or metals.
3. Brainstorm the important components that must be designed or built to mount a prospecting expedition to an asteroid. Topics to be addressed may include: propulsion (type of rocket), power, life support, communications, financing (including valuable things that could be mined on an asteroid and returned to Earth), crew selection (including human vs. robotic), ground support, vehicle design, maintenance, prospecting tools, and training.
4. Each team selects a topic from those suggested—all members of the team should reach consensus.
5. Teams will research and document their topics, keeping a log of sources investigated, relevant data found, relevant conversations, meetings, etc. The research should include a "major points" outline, visual aids, references used, and list of possible problems to be resolved through research. Teams should also list "interfaces" with other aspects of the expedition design (e.g., the electrical power team needs to know how large the crew is, how the life-support system runs, and whether the prospecting tools require electricity).
6. Team results should include the basic questions or trade-offs for their part of the prospecting expedition, advantages and disadvantages for each option (e.g., power from solar cells versus power from a nuclear reactor), and a recommendation of which option is best for the expedition. Groups should present their results to the class.
7. Once presentations are complete, distribute Reproducible 4, "Brainstorm," to get students thinking about space exploration.

Teaching with the Poster

There are all kinds of objects that orbit the Earth, the Sun, and other planets. Could a house launch into orbit, as the poster depicts? Could it travel through space? Show students the poster, and encourage them to come up with questions the image raises. *(How much force is required to lift a house that far into space? How fast would the house need to be traveling, and in what direction? What would prevent the house from burning up in our atmosphere?)*

While you discuss these questions, keep track of science topics raised in the discussion. Keep a list on the board. Areas of interest might include: *acceleration, satellite, meteor, asteroid, orbit, gravity, jet propulsion,* and *velocity.*

Students can then visit **www.nasa.gov** to conduct research and explore their questions.

ADDITIONAL TEACHER RESOURCES

Visit www.nasa.gov and use the search function on the main page to access additional teacher resources that provide the latest information on the science of space. Resources found on www.nasa.gov can be used to provide students with a subject background before proceeding with the lesson, to amplify students' knowledge of specific topics, or to supplement the lesson as you progress through it.

Visit www.Zathura.net for a language arts lesson plan based on *Zathura*, plus links to other lesson plans on books by Chris Van Allsburg.

Reproducible

ACTIVITY 1

Name_____________________________ Date__________

Lesson Background

Most meteorites are thought to be broken fragments of asteroids — small "planets" or bodies of rock or ice orbiting around the Sun. The largest asteroid is Ceres, 940 km in diameter, much smaller than our Moon (3,500 km). Ceres was the first asteroid discovered (in 1801), and about 6,000 have been discovered since then. Asteroids are so small that telescopes on Earth can see them only as points of light.

The Galileo spacecraft passed close to the asteroids Gaspra and Ida and sent us pictures of them. Both are irregular masses of rock, seemingly broken and covered with impact craters. As indicated by their colors (reflectance spectra), most asteroids are mixtures of metal and silicate minerals, possibly like chondrite meteorites. A few are made of basalt rock, just like the basalt meteorites (example: 1983RD in this lesson).

Most asteroids orbit in the asteroid belt between 2.2 and 3.2 times the Earth's distance from the Sun; their orbits are ellipses, oval-shaped curves that carry them nearer and farther from the Sun. Only a few asteroids follow orbits that get near the Earth, and these asteroids are probably the sources of some meteorites. An asteroid that crosses the Earth's orbit could collide with the Earth and cause a devastating impact explosion. About 200 of these Earth-crossing asteroids are known, and it is estimated that 20–40 percent of them will collide with the Earth over the next million years. No known asteroid will hit the Earth for at least 200 years. We will likely have many years of warning before an asteroid collision like this. The Earth is really a very small target. But when there are a million shots, over a long time, one is likely to hit.

To hunt for asteroids, astronomers photograph the night sky and look for "stars" that move, compared to real stars. A long exposure photograph would show a background of stars as spots, with a streak from an asteroid, due to the asteroid's motion across the sky. To discover the orbit of an asteroid, it is not necessary to observe the asteroid as it follows its whole orbit; knowing its location a few times, over several weeks or months, is sufficient.

Reproducible

ACTIVITY 2

Name ______________________ Date __________

NAME THOSE ASTEROIDS!

There are many cool objects flying around in space. Do you know the difference between an asteroid, a comet, a meteor, and a meteorite? Try the activity below to learn more!

Read the sentences below to learn about three asteroids that were named after famous people. Conduct an Internet search to find out who these people were. Use the information to complete the sentences.

1. **The asteroid 3352 McAuliffe is named after Christa McAuliffe, who was ____.**

2. **The asteroid 2266 Tchaikovsky is named after a Russian music composer who ____.**

3. **The asteroid 2578 Saint-Exupéry is named after Antoine de Saint-Exupéry, who ____.**

BONUS!

On a separate sheet of paper, can you explain why the following asteroids are famous?

- **433 Eros**
- **1 Ceres**
- **4 Vesta**
- **2060 Chiron**
- **3200 Phaethon**
- **1862 Apollo**

Do You Know the Difference Between an Asteroid, a Comet, and a Meteor?

Asteroids are generally large chunks of rock that come from the Leonid asteroid belt. Comets look like asteroids, except they are covered with compounds that make a fuzzy, cloud-like shell. A meteor is the flash of light that we see in the night sky when smaller bits of asteroids or comets burn up as they pass through Earth's atmosphere.

Asteroids Can Have Three Names!

An asteroid's first name: When an asteroid is found, it is given a temporary name, showing what year it was found.

An asteroid's second name: After the asteroid's orbit is known well, it gets assigned a number.

An asteroid's third name: Finally, an asteroid can be given a "real" name by the person who found it.

For example: The asteroid named "3551 1983RD" has a first name (1983RD, which shows it was discovered in the year 1983) and a second name, which is actually a number (3551). This asteroid doesn't have a "real" name yet.

This educational content developed by NASA.

Reproducible

ACTIVITY 3

Name________________________ Date__________

LESSON SCENARIO

Time: Sometime in the next century
Place: Earth

National and international space agencies are cooperating to plan for human exploration of the outer Solar System. Their intention is to send expeditions to the moons of Jupiter, Saturn, Uranus, and Neptune to explore, collect samples, and search for clues to the beginnings of the Solar System. It is impractical to send all the rocket fuel and consumables (drinking water, air, food) from the Earth because they are heavy, bulky items. Therefore, the space agencies are looking for sources of rocket fuel and consumables at an intermediate destination, the asteroid belt. Your class has been selected to plan a prospecting expedition to the asteroids to look for resources that could be turned into rocket fuel, drinking water, etc.

What can we get from an asteroid?
Two types of materials on asteroids appear to be attractive for mining: metals and volatiles. Both of these are essential for space travel. The cost of launching any material from the Earth is extremely high, so useful materials that are already in space can be very valuable. Most of the asteroids are found in orbits between Mars and Jupiter. However, several hundred have orbits that bring them close to the Earth. Rocket trips to some of these “near-Earth” asteroids would use even less fuel than a trip to the Moon, though the travel time to an asteroid might be much longer because the asteroid is not orbiting Earth.

Metals—An asteroid of the composition of an ordinary chondrite could be processed to provide very pure iron and nickel. Valuable by-products would include cobalt, platinum, gallium, and germanium. These metals are basic to the production of steel and electronic equipment. Some metals from an asteroid mine might even prove valuable enough to be returned to Earth. Iron meteorites are high-grade ores.

Volatiles—Water, oxygen, and carbon compounds are useful in any space settlement, both for life support and for producing rocket fuel. These volatiles could be found in an asteroid that resembles a carbonaceous chondrite or the nucleus of a former comet. Water contents may range from 5–10% by weight for a chondrite to 60% by weight for a comet nucleus. In some asteroids large quantities of sulfur, chlorine, and nitrogen may also be available.

Reproducible

ACTIVITY 4

Name ______________________ Date __________

BRAINSTORM

1. Why do humans explore? ______________________

2. Where does the money for space exploration come from? ______________________

3. What are possible economic benefits of space exploration? ______________________

4. Might a lunar base be cheaper to run than a space station in low-Earth orbit?

5. What are the advantages/disadvantages of gender-mixed crews? ______________________

6. What are the different abilities of human crews and robotic instruments (e.g., compare initiative, adaptability, hardiness, need for life support)? ______________________

7. What types of support teams (on Earth or other home base) are necessary to a mission? Consider human and/or robotic crews. ______________________

8. How does destination and crew selection affect vehicle design? ______________________

9. What skills/programming would astronauts/robots need during each phase of a mission? ______________________

10. Imagine some emergencies that might occur in flight. How might we plan to deal with them? What kinds of problems could not be fixed in a spacecraft millions of miles from home base? ______________________

This educational content developed by NASA.

ASSESSMENT RUBRIC

	Excellent	Good	Satisfactory	Needs Improvement
Lesson Background (Reproducibles 1 and 2)	• Student demonstrates a complete understanding of background material through appropriate class discussion and participation • Student demonstrates a complete understanding of the appropriate vocabulary to use for lesson	• Student demonstrates an understanding of background material through appropriate class discussion and participation • Student demonstrates an understanding of the appropriate vocabulary to use for lesson	• Student demonstrates a limited understanding of background material through appropriate class discussion and participation • Student demonstrates a limited understanding of the appropriate vocabulary to use for lesson material through appropriate class discussion and participation	• Student demonstrates a lack of understanding of background material through appropriate class discussion and participation • Student demonstrates a lack of understanding of the appropriate vocabulary to use for lesson
Lesson Activities (Reproducibles 3 and 4)	• Student remains completely on task and finishes activities in timely manner • Student completes activity with total accuracy and with full supporting, detailed information • Student presents complete scientific accuracy in supporting details in collaborative group • Student uses appropriate skills and strategies of the writing process completely	• Student remains on task, but finishes activities with teacher's encouragement • Student completes activity with some accuracy and some supporting, detailed information • Student presents some scientific accuracy in supporting details in collaborative group • Student uses most of the appropriate skills and strategies of the writing process	• Student struggles to stay on task, and finishes with difficulty • Student completes assignment with little accuracy and little supporting, detailed information • Student presents little scientific accuracy in supporting details in collaborative group • Student uses little of the appropriate skills and strategies of the writing process	• Student lacks focus on task and does not complete activity • Student either does not complete assignment and/or lacks accuracy and/or supporting, detailed information • Student presents a lack of scientific accuracy in supporting details in collaborative group • Student uses a lack of appropriate skills and strategies of the writing process completely

NATIONAL STANDARDS AND BENCHMARKS

NATIONAL STANDARDS	BENCHMARKS	LESSONS 1	2	3	4
SCIENCE					
Strand A: Science as Inquiry					
Has ability to do scientific inquiry	Knows that scientific inquiry and research lead to answers and solutions to issues scientists try to solve	x	x	x	x
	Thinks critically and logically to make the relationships between evidence and explanations			x	x
Has understandings about scientific inquiry	Knows how questions are to be asked and answered that allow the student to find solutions to scientific investigations	x	x	x	x
Strand B: Physical Science					
Understands the motion of objects in relation to the forces applied on that object	Knows ways in which an object's motion is affected by natural and physical forces being applied to it, i.e. gravity, centrifugal force, and inertial forces	x	x	x	x
Understands the concept of transfer of energy	Knows that energy is transferred (electrical, heat, light, etc.) as it moves, interacting with objects in space	x	x	x	x
Strand D: Earth and Space Science					
Understands the Earth's place in the Solar System	Knows the Earth's place in the Solar System in relation to the objects in the Solar System and universe, i.e., the Sun, Moon, planets, asteroids, comets, black holes, etc.	x	x	x	x
Understands that the history of the Earth has been changing in life and form	Knows that events in the past have been influenced by occasional catastrophes, i.e., impacts by asteroids or comets	x	x	x	x
Strand E: Science and Technology					
Has basic understandings about science and technology	Knows that scientific inquiry and technological design have similarities and differences, and one tends to drive the other further in advancements and in pursuit of finding solutions to scientific research	x	x	x	x
Strand F: Science in Personal and Social Perspectives					
Understands the potentiality of natural hazards to human society	Knows that natural hazards, i.e., asteroid impacts, have the potential to destroy human and wildlife habitats and the attempt to journey to one	x		x	x
Strand G: History and Nature of Science					
Understands that science is a human endeavor	Knows that science and technology have been practiced for a long time, that there is much more about the Solar System and universe that needs to be researched, and in that, science will never be finished	x	x	x	x
LANGUAGE ARTS					
1. Uses general skills and strategies to acquire new information	Knows how to use appropriate reading skills to interpret and comprehend scientific material	x	x	x	x
4. Use of spoken, written language to communicate effectively with a variety of audiences and for different purposes	Knows how to listen and respond to information and questions discussed during lesson	x	x	x	x
	Knows how to communicate through speaking and in written form to effectively present conclusions and theories	x	x	x	x
5. Uses a wide range of strategies during the writing process appropriately to communicate with different audiences for a variety of purposes	Knows how to communicate and use the written form to present a science-based fictional work in a creative and compelling story			x	x
8. Uses technological and information resources for research purposes	Knows how and where to find appropriate research material for scientific inquiry, i.e., texts and Internet	x	x	x	

SOURCES:

NCTE—The National Council of Teachers of English
www.ncte.org/about/over/standards/110846.htm

IRA—International Reading Association
www.reading.org/resources/issues/reports/learning_standards.html

NSTA—National Science Teachers Association
National Science Education Standards
www.nap.edu/books/0309053269/html/103.html