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Beyond Planet Earth

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ABSTRACT

Power Rangers, Jetsons, and Ninja Turtles are familiar icons in our students' lives. Space is a familiar frontier in the television and movie industries and has peaked the interests of many students. This unit is designed to capture, harness, and explore this interest in space through questioning, experimentation, and observation.

BEYOND PLANET EARTH is a multisensory thematic unit which will introduce and explore the solar system. While this unit is intended for students with special needs, early primary teachers in grades PreK through second grade may find this information appropriate for their students. BEYOND PLANET EARTH will integrate all curriculum areas around the common theme of our solar system. This unit will provide the background knowledge necessary to plan lessons in a variety of curriculum areas. In addition teaching methodology, sample lesson plans, and a bibliography with children's literature and educational resources to support the classroom teacher will also be included. Also, recommendations for adjusting the level of difficulty of classroom assignments as well as alternative methods for assessing students with special needs will be included.

INTRODUCTION

BEYOND PLANET EARTH is intended to meet the specific needs of my students. Their ages range between twelve and twenty-one years. I teach a special needs class for students with mental retardation within the severe range. In addition, other significant needs such as expressive/receptive language disorders, significant visual impairment, and gross/fine motor difficulties can present themselves. Many of my students experience receptive language problems which inhibit their ability to comprehend long, complicated verbalizations and multi-step commands or requests. To combat this problem, I use repetitive language with visual and physical cues. In addition, many students experience expressive language problems which limit the students ability to use spoken language. My students use multiple methods to respond to questions such as simple utterances, pointing to objects or pictures, and directing the teacher through physical contact, etc.

Because of the wide range of needs within my class, I use a multisensory, concrete approach to teaching. I

use hands-on lessons and experimentation to reinforce concepts within the thematic unit. An integrated curriculum provides the students with a more complete picture. A topic is explored from a variety of angles with opportunities to reinforce and expand knowledge. Teaching skills in isolation does not seem to benefit my students as the knowledge does not carry over to other areas. The students need to experience the information and how it is used in a functional and concrete manner. Not only does a thematic unit deter one from teaching a skill in isolation, the student is able to benefit from the repetition and overlap between lessons to draw connections and gain knowledge. This technique is called overreaching for the purpose of remembering information by overlearning to place it in long term memory. Through repetition, the student absorbs the information as it becomes second nature.

It has been my experience that science is a wonderful content area to develop topics for thematic units. Because science is based on first principles which are often simple and concrete in nature, I am able to break down a topic to its most basic components for instruction. Then, I am able to expand on that information that I have introduced as an architect would design a building from the foundation on up. With the foundation set, basic scientific principles have been learned. The class is ready to expand on the knowledge learned. New information presented can always be connected to some prior knowledge that the student can relate to.

In addition, the hands-on, inquiry based approach to teaching science is most appropriate for teaching students with special needs as well as primary age children. The teacher designs experiences for the students that incorporate scientific principles through their everyday activity. The students remember and learn from the experiences because they are actively involved in the learning process and having fun. Science becomes one of their favorite subjects.

GOALS AND OBJECTIVES

The overall goal of this unit is to allow students with special needs the opportunity to explore astronomy in a meaningful way. Often, scientific materials are not presented in a manner that allows students with special needs to learn material of a more complex nature. I hope to alleviate that problem with a unit especially prepared for exceptional students. Special Education or Regular Education teachers will have the methodology, resources, and lessons needed to prepare an astronomy unit that will include students with special needs.

Within the context of this unit, students will learn the difference between night and day using concrete terminology. Students will also identify significant heavenly bodies such as the earth, sun, moon, planet, and star; as well as other significant scientific terminology such as astronomy, outer space, constellation, astronaut, space shuttle, rocket, solar system and galaxy. In addition, students will comprehend that the planets circle the sun and moon circles the planet. Students will identify some groups of stars as constellations. Students will identify that there are nine planets that orbit the sun in this solar system. Students will identify the moon and the phases of the moon as well as one of the most significant historical event, the first moon walk.

VOCABULARY

Language is an important tool in the classroom. One must not take for granted the knowledge base and experiences of the students. Many students have not experienced the night sky as a canvas of wonder with the most spectacular lights. Therefore, I plan ahead the language I will be using for this unit. Students must be able to comprehend and form an understanding of the terminology being used. The vocabulary in science is used to define very specific concepts and must be specifically taught.

A vocabulary list is also essential to the teacher when nonverbal students are being taught. Communication boards must be designed in preparation of the varied lessons to give the students the opportunity to respond to the lessons being presented. The communication board is tailor-made to the needs of each individual student. The choice of pictures or symbols to represent words, ideas, etc. is carefully considered. For example, some children respond better to black and white drawings versus colored pictures or photographs. In addition, the size of the symbol or picture is important. A student with visual impairment will require larger pictures than a student with no significant visual impairment. Also, the number of picture choices needs to be considered. Some students do not do well with many choices for answers. They may only be able to handle three or four choices at a time. The carefully designed communication board allows the student to respond to questions by pointing to answers that they would be unable to state aloud.

When teaching vocabulary, photo-language cards prove to be an invaluable tool for the teacher. Nouns, verbs, adjectives, and spatial concepts have been taught using these cards. They are especially useful in this unit as one cannot bring students face-to-face with the heavenly bodies and scientific terminology discussed in BEYOND PLANET EARTH. Photo-language cards are purchased through speech and language catalogues or special needs catalogues. Or the creative teacher can collect varied images off the internet and laminate them for continued use. In addition, photos can be found in various astronomy magazines and books. Also, the teacher can write to NASA for information and photographs related to the solar system and space travel. If the teacher prepares for the unit ahead of time, s/he will be able to collect a variety of photos inexpensively for use in language lessons.

BACKGROUND INFORMATION AND STRATEGIES

Our universe has been studied for centuries. The earliest models placed the Earth in the center of the universe. This model continued until Copernicus' revolutionary idea was put forth that the Earth and the other planets revolved around the sun. The experiments of Galileo and the observations of Kepler provided evidence to support Copernicus' theory. Kepler's laws of planetary motion succeed in supporting all known planetary motions in our solar system. The first law states that the orbits of the planets are elliptical with the sun at one focus. The orbits of the planets are not circular as previously believed. The second law states that the speed of the planet's orbit changes depending on its proximity to the Sun. The closer it is to the sun the faster the orbital speed. The third law relates the size of the planet's orbit to the time needed for a planet to complete one revolution around the sun. Kepler's third law provided the justification for the popular use of the astronomical unit to compare distance, diameter, and volume between the Earth and other planetary models.

Our solar system is located in a galaxy called The Milky Way. Our solar system has nine planets that orbit the sun, our closest star. To familiarize the students with the names of the planets, I will write the planet names on oak tag cards which I will laminate for repeated use in the classroom. Each planet name will be written in a different color. I will have the students sort the planets by the first letter of their names. I will make a second set of cards with the addition of the number of its ordinal placement in our solar system using the same

"planet colors" I had chosen for the first set. (For example, Mercury 1, Venus 2, Earth 3, etc.) I would then have each of the students take turns sequencing the planets in the order they are found in the solar system. I would then combine both sets of cards and have the students match the planet names in a game of concentration, a memory game. The cards are mixed up as they are placed face down on the table. Then the students take turns turning over two cards and seeing if they match. If the names do not match, the cards are turned over and another student takes a turn. The student with the most matches wins.

In an effort to reinforce the sequence of planets, and gain a visual representation of our solar system, the class will create a large scale model utilizing our school hallway. At this point, the teacher will determine the equatorial diameter of the planets and their distances from the sun as they relate to the planet Earth. Any measurement such as size, volume, or distance is only as meaningful as it relates to the planet Earth. Therefore, the teacher can determine the equatorial diameter of the planets by dividing planet X's diameter by the Earth's diameter. The teacher can determine distance from the sun by dividing Planet X's distance from the sun by the Earth's distance from the sun. The resulting answers are meaningful in that they relate to Earth and help us to create a relevant model of our solar system. To assist the teacher, I have included the equatorial diameters and distances from the sun in the following charts.

RELATIVE EQUATORIAL DIAMETER

PLANET EQUATORIAL DIAMETER AS IT RELATES TO EARTH
Mercury .38
Venus .95

Earth 1.00

Mars .53

Jupiter 11.20

Saturn 9.40

Uranus 4.00

Neptune 3.90

Pluto .18

RELATIVE DISTANCE FROM THE SUN

PLANET DISTANCE AS IT RELATES TO EARTH

Mercury 0.4 AU

Venus 0.7 AU

Earth 1.0 AU

Mars 1.5 AU

Jupiter 5.2 AU

Saturn 9.6 AU

Uranus 19.3 AU

Neptune 30.3 AU

Pluto 39.7 AU

Please note that the distance chart uses the abbreviation AU which represents astronomical unit. The term astronomical unit is the mean distance between the Sun and the Earth. The other planetary distances from the Sun are related to the Earth's distance so that we are able to make meaningful comparisons. For example, Mars is 1.5AU from the Sun or Mars is one and one half times farther from the Sun than the Earth.

Using the information in the chart, the teacher can create scaled representations of the planets from construction paper. I would multiply the relative diameter of each planet by 10 cm. This larger scale would create planets that could be easily seen and colored by my students. I would show them pictures of the planets and then assign each student a planet to color. As a math activity, I would have the students sort their planets by size and ask them guided observation questions such as: Which planet is the biggest?; Which planet is the smallest?; Which planets are about the same size? I would then convert the relative distances of the planets to meters and tape the planets in order from the sun according to their scaled relative distance. I would use our longest hallway for this part of the activity. In this manner, the students have created a scaled model of the solar system.

To reinforce the concept of orbiting the sun, I would reuse the scaled relative distance information from the scaled model of the solar system. I would cut string to the relative distance in meters for each planet. I would then take my class outside and assign each of them to be a planet or sun. I would have each of the "planets" hold on to their distance string and have the "sun" hold on to all the ends of the string. Then the class will march around the sun like a maypole and experience the concept of orbiting the sun. Then, I would place hats with propellers on their heads with a "moon" attached to the propeller. Then I would have the propellers spin as they march around the sun. The class will experience the concept of moons orbiting the planets as the planets orbit the sun. This activity will lead us to the next section of our unit, the moon.

The moon has been observed and studied for centuries. It has long been used as a means for determining the passage of time. The moon orbits around the earth in 27.3 days. Twenty-seven point three days is also the amount of time the moon takes to rotate on its axis. This is called a synchronous orbit. Because of this type of orbit, the moon always shows us the same side. Until space travel, we had no idea what the other side of the moon looked like. While the moon appears to have a crust, mantle, and core, it lacks a hydrosphere, an atmosphere, and a magnetosphere. When observing the moon, one can see craters and plains of varying sizes. The plains, called maria, resulted from the spread of lava during an earlier volcanic period on the moon. The craters resulted from the impact of some past meteoroids.

After discussing the moon and its surface using photos from magazines, the Internet, and NASA, we will read the book entitled WHAT THE MOON IS LIKE by Franklyn M. Branley. This children's book gives us information on what "life" is like on the moon. It discusses land formations, temperature, gravity, and what the astronauts found on their moon walks. After reading the book to the class, I will have the students create their own models of the moon surface. We will collect shoe boxes, sand, and rocks to form a lunar surface. We will then add footprints for the astronauts and a small American Flag to represent our presence on the moon. We will then display our lunar models in our science center.

Our next topic for study will be the phases of the moon. I will use the book entitled THE MOON SEEMS TO CHANGE by Franklyn M. Branley. This children's book discusses the phases of the moon and offers an activity that the class can experiment with to visually illustrate this concept. The moon undergoes a series of predictable changes or phases that takes about 29 days to complete. The cycle begins with the new moon which is invisible in the sky. Then the moon appears to grow a little each night forming a crescent which gets bigger and bigger. Half of the moon can be seen about one week after the new moon. This phase is called the quarter moon. During the following week, the moon continues to grow until the full moon is visible. Then the moon seems to get smaller, shrinking to a quarter moon, then a crescent moon, and then back to a new moon.

The moon does not actually grow and shrink in size. It is always the same size. What changes is the amount of light that is available for us to view the moon. The moon does not emit its own light. It reflects light from the sun. Half of the moon is always in the sunlight, however because of the moon's orbit and rotation, we cannot always see all of the moon that is in the sunlight. For example, when the moon is between the sun and the earth, it is a new moon with its lunar disk facing us being devoid of sunlight. When the earth is between the sun and the moon, it is a full moon with its lunar disk facing us brightly reflecting the light from the sun.

The students will create their own record of the phases of the moon by creating book which we will call THE PHASES OF THE MOON. The teacher will pass out pages where the phases of the moon have been drawn and labeled for them. The teacher will encourage the students to say something about the pictures which s/he will write down for them. The students will color their moons and lace the pictures together with yarn to create a book with a front and back cover.

Another activity for the class is to have a moon watch for a month. Because the moon is visible during the daytime, the class will track the phases of the moon during the school day and for homework. During the school day, we will use a telescope and observe the moon and its phases from the parking lot or school field. (It is important for the teacher to note that one SHOULD NOT DIRECTLY OBSERVE THE SUN WITH A TELESCOPE. Damage to the eyes will result from looking at the sun. Teachers should be sure to warn their students of the danger and closely monitor the use of the telescope.) For homework, the students will take home a worksheet with the phases of the moon drawn on the paper. The instructions will be for the student to circle the correct phase of the moon as it is directly observed.

There are times when the sun, earth, and moon line up precisely and we can observe a lunar eclipse. When the sun and the moon are exactly opposite each other, the shadow of the earth blankets the moon, temporarily blocking the sunlight and causing an eclipse. A solar eclipse occurs when the moon passes directly in front of the sun, temporarily blocking the sunlight during the day time. It is much more difficult for us to observe these eclipses. The solar eclipse can only be observed from a small part of the earth. The lunar eclipse can be observed from the entire planet but only during the night. Therefore, as a class activity, observing eclipses is not likely.

Next, we will discuss the difference between day and night. First we will discuss the characteristics of the day sky. For example, it is light out and we have the sun in the sky. We will read the book entitled THE SUN OUR NEAREST STAR by Franklyn M. Branley. The sun has been shining down on us for millions of years. The sun is our source for light and heat in order for life to be maintained on our planet. The sun is a star which means that it is a ball of gas that glows. The gas is held together by the gravity of the sun as is powered by nuclear fusion in the center of the sun. The sun rotates on its axis. We can determine the amount of time the sun takes to rotate by observing the sun spots and timing their apparent movements. At its equator, the sun

rotates every 24.9 days. The sun is made up of gases that absorb and transmit radiation. It does not have a hard surface. The surface temperature of the sun is hot enough to melt any known material at 5780 K. The radius of the sun is more than 100 Earth radii. The sun is very different from the planets and moons in our solar system. Scientists have a great opportunity to study a star in action by observing the sun and its properties.

Now, we will discuss the characteristics of the night sky. For example, the sky is black; it has stars; we see the moon. We will then read the book entitled THE SKY IS FULL OF STARS by Franklyn M. Branley. This book talks about being a stargazer and directly observing the stars and lights of the night sky. Some stars are brighter than others. This may be due to the distance of the stars from us or the temperature and/or size of the stars. In addition, this book discusses how groups of stars form pictures in the night sky. These pictures are called constellations. We have 88 constellations in our galaxy. Depending on our position in the earth's orbit, there are different stars and constellations in our view. Constellations can also be compared to a connect-the-dots worksheet, a familiar item in the student's lives. Another children's book that reinforces this concept is entitled THE BIG DIPPER by Franklyn M. Branley.

After discussing the differences between day and night, we will experiment by using plants to illustrate the importance of light to our planet by observing the growth of two plants. One plant will be devoid of all light, while the other will receive all the light that is required. The students will directly observe the effects of a light-free environment as they observe a plant die from not having any light. In addition, we will use another experiment to determine the cause of day and night. The teacher will require a globe, yellow sticker, and a bright light. The teacher will place the yellow sticker where we are located on the globe. Then the teacher will turn off the light and shine the bright light on the globe. Then the teacher will rotate the globe to illustrate that part of the globe is dark and part of the globe is light. Class will discuss that the times when part of the globe is light is daytime and the times when part of the globe is dark is nighttime. The class will locate themselves on the globe by finding the yellow sticker and observe its location as the globe rotates. The students will then answer the questions, "Is it daytime or nighttime? How do you know?"

At this point in the unit, I plan to take my class on a field trip to the planetarium at Southern Connecticut State University. Dr. James Fullmer has an astronomy program for primary to intermediate age students in New Haven, CT. Having observed him at the planetarium, I found him informative and entertaining as he taught on the solar system using a variety of techniques. He seemed adept at knowing his audience and teaching to the level necessary for the students to understand the information. After spending a significant amount of time studying the solar system, my class should be able to understand and enjoy this highly educational field trip.

At the end of this unit, I will read THE MAGIC SCHOOL BUS LOST IN THE SOLAR SYSTEM by Joanna Cole. This book is about a class trip to the solar system. We will then discuss how people travel in space and visit the moon. The Earth sends highly educated people to space who are called astronauts. They have studied a long time to be able to travel in space. These men and women must know how to use and fix many complicated computers and machines on the space shuttle and rockets. Twelve of these people have actually set foot on the moon. Astronauts wear special space suits and masks because space is extremely cold and does not have any air to breathe. The astronauts must bring their own food, air, water, heat and fuel with them on any given trip off the planet. Most trips to space are only for a few days. Sometimes a couple of astronauts will spend a few months in space by living on the Russian Space Station Mir. The space station must have plenty of supplies to support life for months on end. Occassionally, a ship may travel to space to bring extra supplies for the astronauts or cosmonauts living on the space station. In addition, scientists conduct experiments in space and businesses and governments send satellites in space for mass communication and observation purposes.

At this time, I will show the class a video entitled I WANT TO BE AN ASTRONAUT which demonstrates the training and study involved in becoming an astronaut. It also shows astronauts living and working in space. The students will see astronauts floating in space, eating special foods, wearing special clothes, and using complicated instruments and computers.

As a class project, we will write our own story about our trip to space. We will decide where we want to go and what we will need for our trip. We will need to bring air and special food for our trip. We will wear special clothing and ride in a special vehicle for space. I will ask the students if there is anything special to each of them that they would like to bring on the trip. Perhaps, they may want to bring a picture of their family or a special toy. Using magazines, students will find and cut out pictures of items that they would pack for their trip and create a collage to represent their story. Then, we will talk about what they will find in the solar system when we get there. This culminating activity will provide a means of assessing what the students have learned and remembered from the lessons and activities in class.

LEVEL OF DIFFICULTY

This unit can be adapted to teach many types of students ranging from special needs to regular education. One can increase the difficulty level by providing more detailed information and experimentation in regards to the solar system. In addition, the students could be required to write laboratory reports and observation reports during the experimentation lessons. The amount of detail required in the reports could be adapted to the level of writing ability of the students. The teaching methodology used in this unit would be appropriate for any student in the primary level of education. Exploration, questioning, and hands on lessons are always appropriate for any student as it addresses the need for multi-modality teaching.

ASSESSMENT

Assessments are a vital tool in education. However, due to the severe nature of my class, my assessments look different. I observe behaviors and skills using checklists. I assign projects using cooperative learning techniques. Cooperative learning places different students with differing abilities together to work on a project. Each student contributes what he or she is able to in the completion of the project. All students in the group share the grade of the project. With this technique, many students can be included in the lessons. Cooperative learning also provides students with opportunities for practicing social skills, sharing, resolving conflicts, etc. In addition, verbal questioning strategies can also be used to address assessment. With careful preparation, picture boards can be created to provide a forum of potential answers to choose from with either pointing or naming.

I often use a "Jeopardy" game to assess the knowledge my students have gained during an instructional unit. I gather the information presented to my students and create categories and questions for my students to answer. (In my "Jeopardy" game, I ask the questions and the students point to a picture or verbally respond to the question with an answer.) For example, I may assess vocabulary by creating a category of heavenly bodies. Each question would include a picture of some body in space (i.e. moon, planet, sun, star, earth, etc). I would then ask the question, "What is this called?" My students always enjoy playing this game because is a fun and painless may to do work in the classroom. It is also a way to the students actively involved in the learning and assessing process.

CONCLUSION

BEYOND PLANET EARTH is a hands-on, inquiry based approach to teaching about the solar system. This unit is designed to meet the needs of students with exceptional needs and/or primary age students. Background information is included for the teacher as s/he prepares lessons for the class. This unit includes children's literature, video, and experiments that can be done with the class. In addition, ideas for the location of inexpensive materials and pictures have been given as a means for supporting the teacher. Sample lessons are also included. The solar system is an exciting topic for students to study and therefore, this unit should be enjoyed by many special needs or primary classes.

LESSON PLAN #1 (LANGUAGE, MATH, & SCIENCE)

OBJECTIVES:

1. The students will use vocabulary related to the phases of the moon.

2. The students will practice fine motor skills by cutting out predrawn moons.

3. The students will sequence the phases of the moon in their correct order.

MATERIALS: MARCELLA AND THE MOON by Laura Jane Coats

The phases of the moon drawn on paper
A large piece of paper folded into 5 sections
Scissors
Glue

PROCEDURE:

1. The teacher will read MARCELLA AND THE MOON, a story about a duck who paints the phases of the moon.

2. The teacher will direct the students to the phases of the moon as they are presented in the story to review vocabulary (new moon, crescent moon, quarter moon, crescent moon, full moon).

3. The teacher will direct the students to the picture in the story which shows all the paintings of the phases of the moon in their correct order.

4. The teacher will pass out the moon phases drawings, scissors, glue, and a large piece of construction paper folded into 5 sections.

5. The students will use the scissors to cut out the phases of the moon.

6. The students will sequence the phases of the moon onto the five sections of the construction paper. The students will leave the first section of the construction paper empty because the new moon is "invisible" to us.

7. The students will glue the phases of the moon in their correct sequence on the sections of construction paper.

8. The students will hang their finished work in the science center.

LESSON PLAN # 2 (ART)

OBJECTIVES:

1. Students will review the difference between day and night.

2. Students will cut out predrawn shapes.

3. Students will sort shapes into day and night to create a scene.

MATERIALS:

Predrawn shapes
Scissors
Glue
Crayons
A large piece of construction paper 1/2 sky blue, 1/2 black

PROCEDURE:

1. Students will review the differences between night and day. (For example: There is sun in the daytime. There are clouds in the daytime. There is a moon at night. There are stars at night.)

2. The teacher will pass out the paper with the predrawn shapes.

3. The students will verbally identify the shapes that they recognize on the paper. (Sun, moon, star, clouds, houses, cars, etc.)

4. The students will color the shapes appropriately.

5. The students will use the scissors to cut out the shapes.

6. The students will discuss what they might find during the daytime and what they might find during the night time. The students will choose the sky blue for the daytime scene and the black for the night time scene.

7. The students will arrange the cut shapes to form daytime scenes and night time scenes.

8. The students will glue the pieces in their chosen spots.

9. The students will hang their finished work in the hallway for a classroom exhibit.

LESSON #3 (MATH & SCIENCE)

OBJECTIVES:

1. The students will become observers of the phases of the moon.

2. The students will keep track of the phases of the moon by placing a moon phase cut out on a calendar on a daily basis for two months.

3. Students will predict what phase of the moon will be next.

MATERIALS:

Laminated moon phase cut outs
Two large, blank calendar

PROCEDURE:

1. During morning circle, the teacher will include a moon watcher section on a daily basis for two months.

2. The teacher will ask a student to determine what the moon looks like today. (The moon can be seen during the daytime).

3. The teacher will ask the student to use the correct terminology to describe the phase of the moon.

4. The student will choose the correct laminated moon phase cut out to depict the moon.

5. The student will place the moon phase cut out on the correct date of the calendar.

6. When the two months are completed, the teacher will ask the students to compare the two months. How are they the same and how are they different.
a. Do both months have all of the phases of the moon?
b. Do the phases of the moon occur in the same sequence each month?
c. Do you think that the same sequence would occur next month? Why?

ANNOTATED REFERENCES

ADULT REFERENCES

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A children's book that discusses the properties of the sun.

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A children's book that discusses constellations.

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A wonderful first book about space with amazing photographs.

Lippincott, Kristen. EYEWITNESS SCIENCE: ASTRONOMY. 1994. DK Pub. Inc. NY

Another wonderful science book with great photos.

CLASSROOM MATERIALS

Video: I Want to Be an Astronaut

Chronicles the training needed to become an astronaut.

Video: The Magic School Bus Out of This World

Chronicles a class field trip to the solar system.

Computer Program: The Magic School Bus Lost in The Solar System

An interactive children's computer program that explores the solar system.