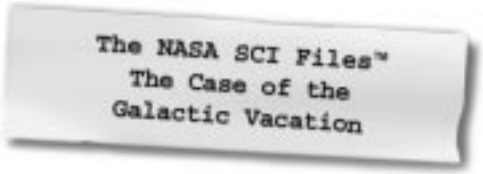


Segment 2

As the tree house detectives continue to search for the perfect "dock-of-call" for their out-of-this-world vacation, they have the opportunity to speak with the Expedition Six astronaut crew that is living and working on the International Space Station (ISS). Expedition Six Commander Kenneth Bowersox and Flight Engineers Donald Pettit and Nikolai Budarin describe the fun and the difficulties of learning to cope with microgravity and the very different environment known as space. The detectives decide that because the Moon is so close, it would make a perfect destination. To learn more about the Moon, they meet with Ed Prior from NASA Langley Research Center at the Virginia Air and Space Museum in Hampton, Virginia. Mr. Prior explains the phases of the Moon and how the Moon affects Earth's tides. The tree house detectives decide that before they can travel in space, they need to learn a little more about the harshness of an alien environment and some of the requirements to live there. They head to Dr. D's lab, and he helps them understand that environments in space are very different from Earth and what it would take to live in an alien environment. The tree house detectives decide that it is off to Mars, so they visit Robert Braun at NASA Langley Research Center. Mr. Braun describes Mars and discusses how it is similar, but very different from Earth.

Objectives

The students will

- understand the difficulties of working and living in space.
- learn the phases of the Moon.
- understand how the craters were created on the surface of the moon.
- learn that gravity varies on planets.
- compare and contrast Earth and Mars.

Vocabulary

Apollo Program—space program that began in 1961 with the goal of landing a man on the Moon before the end of the decade. On July 16, 1969, Neil Armstrong stepped onto the surface of the Moon (Apollo 11).

axis—an imaginary line around which an object spins

crater—a hole or depression roughly circular or oval in outline. On the Moon, most are of impact origin.

gravity—the attraction between two objects because of their mass

illuminate—to supply with light

Moon phases—the changes in appearance of the Moon as it orbits Earth every 27-1/2 days (new Moon, waxing crescent, first quarter, waxing gibbous, full Moon, waning gibbous, third quarter, and waning crescent)

polar ice cap—frozen region around the North and South Poles of a planet

tide—the periodic change in the surface level of the oceans due to the gravitational force of the Sun and Moon on Earth

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 2 of *The Case of the Galactic Vacation*, discuss the previous segment to review the problem and what the tree house detectives have learned thus far. Download a copy of the Problem Board from the NASA SCI Files™ web site in the educator area under the "Tools" section. Have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 1 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 1. Use tools located on the web, as was previously mentioned in Segment 1.
4. Focus Questions–Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes while viewing the program to answer the questions. An icon will appear when the answer is near.
5. What's Up? Questions–Questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and how the information learned will affect the case. These questions can be printed from the web site ahead of time for students to copy into their science journals.

View Segment 2 on the Video

For optimal educational benefit, view *The Case of the Galactic Vacation* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students reflect on the "What's Up?" questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Have students work in small groups or as a class to discuss and list what new information they have learned about the solar system, stars, and how to measure distances in space, to the Moon and Mars.
4. Organize the information and determine if any of the students' questions from Segment 1 were answered.
5. Decide what additional information is needed for the tree house detectives to design their "out-of-this-world" vacation. Have students conduct independent research or provide students with information as needed. Visit the NASA SCI Files™ web site for an additional list of resources for both students and educators.
6. Choose activities from the educator guide and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.
7. For related activities from previous programs, visit the "Educator Area" and click on "Activities/Worksheets" in the menu bar at the top. Scroll down to"2001-2002 Season" and click on *The Case of the Inhabitable Habitat*.
   a. In the educator guide you will find
      a. Segment 1—*Earth Versus Mars, How Fast Does It Need To Go?*
      b. Segment 3—*Newton Would Have Understood the GRAVITY of the Situation, Star Training, Vomit Comet, and Properly Gloved*
   b. In the "Activities/ Worksheet" Section you will find
      a. *Wish You Were Here!*
      b. *All You Do is Train*
      c. *Creating Microgravity*
8. If time did not permit you to begin the web activity at the conclusion of Segment 1, refer to number 6 under "After Viewing" (page 15) and begin the Problem-Based Learning activity on the NASA SCI Files™ web site. If the web activity was begun, monitor students as they research within their selected roles, review criteria as needed, and encourage the use of the following portions of the online, Problem-Based Learning activity:
   - **Research Rack**–books, internet sites, and research tools
   - **Problem-Solving Tools**–tools and strategies to help guide the problem-solving process
   - **Dr. D's Lab**–interactive activities and simulations
   - **Media Zone**–interviews with experts from this segment
   - **Expert's Corner**–listing of Ask-An-Expert sites and biographies of experts featured in the broadcast
9. Have students write in their journals what they have learned from this segment and from their own experimentation and research. If needed, give students specific questions to reflect upon as suggested on the PBL Facilitator Prompting Questions instructional tool found in the educator's area of the web site.
10. Continue to assess the students' learning, as appropriate, by using their journal writings, problem logs, scientific investigation logs, and other tools that can be found on the web site. For more assessment ideas and tools, visit the Educators' area and in the menu bar click on "Instructional Tools."

Careers

astronaut
researcher
inventor

Resources

Books

Branley, Frankly Mansfield: *What the Moon Is Like (Let's Read and Find out Science Series)*. Harper Trophy, 1986, ISBN: 006445052X.

Emberley, Barbara; Ed Emberley; Franklyn Mansfield: *The Moon Seems to Change (Let'S-Read-And-Find-Out Science Book)*. Harper Trophy, 1987, ISBN: 0064450651.

Fowler, Allan: *So That's How the Moon Changes Shape (Rookie Read-About Science Series)*. Children's Press, 1991, ISBN: 0516449176.

Gibbons, Gail: *The Moon Book*. Holiday House, 1998, ISBN: 0823413640.

Ride, Sally and Tam O'Shaughnessy: *The Mystery of Mars*. Crown Publishers, 1999, ISBN: 0517709716.

Seymour, Arlene: *The Moon Book: A Lunar Pop-Up Celebration*. Universe Books, 2001, ISBN: 0789306441.

Simon, Seymour: *Destination: Mars*. Morrow Junior, 2000, ASIN: 068815770X.

Skurzynski, Gloria: *Discover Mars*. National Geographic, 1998, ISBN: 0792270991.

Willis, Shirley: *Tell Me Why the Moon Changes Shape (Whiz Kids)*. Franklin Watts, Inc., 2000, ISBN: 0531159809.

Yolen, Jane: *Owl Moon*. Philomel Books, 1987, ISBN: 0399214577.

Web Sites

Moon Trees
Scattered around our planet are hundreds of creatures that have been to the Moon and back again. None of them are human. They outnumber active astronauts 3:1, and most are missing. They're trees, "Moon Trees." Learn all about these missing trees.
http://science.nasa.gov/headlines/y2002/13aug_moontrees.htm?list79629

International Space Station (ISS) Crew
Visit this web site to learn about the ISS and the astronauts (past and present) that live and work there. Read the crew's biographies, see what they planned for their daily menus, and even ask them questions. There is also a great section to learn more about the ISS and how to become an astronaut.
http://spaceflight.nasa.gov/station/crew/exp6/

The Young Astronaut Council
The Young Astronaut Council program includes multimedia, kit-based curriculum, annual contests, international conferences, a satellite television course, and a CD-ROM. Visit the Young Astronaut web site to learn how to start a chapter in your state or how to become a member.
http://www.yac.org/yac/

NASA Mars Exploration Classroom Resources
This page has an extensive list of classroom resources about Mars. There are classroom activities, posters, and a rich list of online materials.
http://mars.jpl.nasa.gov/classroom/teachers.html

Windows to the Universe
A wealth of information is listed on this site for both students and educators. Visit some of the windows to learn more about space missions, the solar system, the Moon, the universe, a time line of discoveries, and the various myths associated with the planets, Sun, and Moon. Written in three levels with lots of really cool stuff.
http://www.windows.ucar.edu/tour/link=/windows3.html

Space World
This site will keep the students fascinated for hours. Take a closer look at the Sun, label the Moon phases, and much more. http://www.gigglepotz.com/space.htm

Whoosh!
Visit this site to learn all about the planets and the Sun and even play a space mission game.
http://www.abc.net.au/children/space/default.htm

Astronomy for Kids
Easy-to-read fact pages about the planets, Moon, Sun, and other space-related topics.
http://www.frontiernet.net/~kidpower/astronomy.html

Torino Impact Hazard Scale–Planetary scientists have developed the Torino Impact Hazard Scale, a new means of conveying the risks associated with asteroids and comets that might collide with the Earth.
http://neo.jpl.nasa.gov/torino_scale.html

Space.Com
Visit this web site to learn what phase of the Moon you will see each day of the month. There is a sky calendar, planet watch, and much more.
http://www.space.com/spacewatch/sky_calendar.html

Activities and Worksheets

In the Guide

On the Web

My Life as an Astronaut
Conduct research on astronauts to identify interests, skills, and education needed to become an astronaut.

Moonlight of the Night
Observe the night sky and keep a class journal to observe the phases of the Moon.

Too Short?
Simulate the effect of gravity on an astronaut's spinal cord.

Astronaut Geography

Problem

To discover the states where astronauts were born and to identify these states on a map

Materials

Astronaut List
U.S. map
atlas (optional)
map pencils

Background

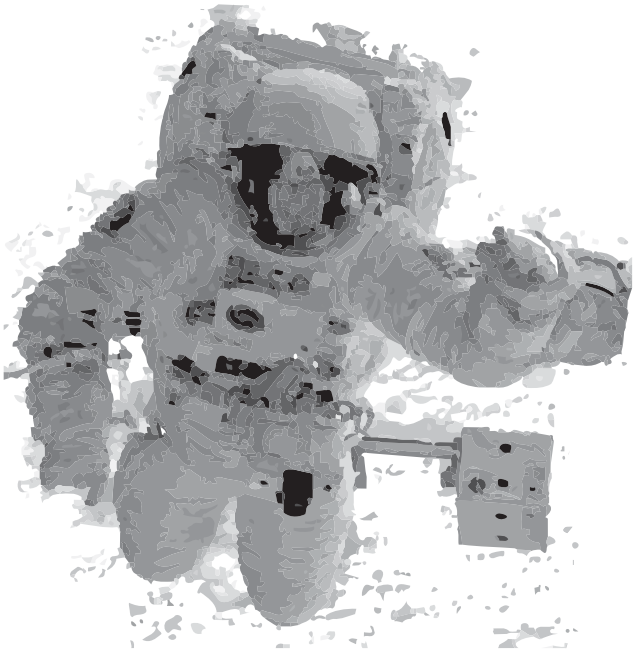
The term "astronaut" comes from the Greek words meaning "space sailor," and refers to all who have been launched as crewmembers aboard NASA spacecraft bound for orbit and beyond. Since the inception of NASA's human space flight program, we have also maintained the term "astronaut" as the title for those selected to join the NASA corps of those who make "space sailing" their profession. The term "cosmonaut" refers to those space sailors who are members of the Russian space program. For this exercise, only astronauts born in the continental United States have been used.

Procedure

1. Choose 17 different colors and/or patterns to complete the US Map Key. For example, color "0" red, and color "1" as red stripes.
2. Look at the "Astronaut List" (p. 31) and count the number of astronauts for each state. Write the number beside each state.
3. Use the US Map Key you created to color the states the appropriate color and/or pattern as determined by the number of astronauts born in that state. For example, Kentucky (KY) has one. Following the example in step 1, KY would be colored in red stripes. Use an atlas if you need help with state abbreviations or locations.

Conclusion

1. How many states did not have any astronauts?
2. How many states have fewer than 10 astronauts?
3. Which state has the most astronauts?
4. How many astronauts are from your state?
5. Why would some states have many more astronauts than other states?



Astronaut Geography (continued)

ALABAMA
Hartsfield
Hire
Jemison
K.Thornton
James Voss
C. Williams

ARIZONA
Creamer
S. Smith

ARKANSAS
Covey
Parazynski

CALIFORNIA
Caldwell
Chilton
Clifford
Coats
Hauck
Lindsey
Love
McCool
McCulley
Melroy
Morgan
Ochoa
O'Connor
Olivas
Poindexter
Ride
Robinson
Sturckow
Van Hoften
Walheim
Young

COLORADO
Brand
Carpenter
Carr
Lounge
Rominger
Roosa
Swigert

CONNECTICUT
Barry
Burbank
Mastracchio
Spring
Thuot

DELAWARE
Currie

FLORIDA
Boe
Davis
Lawrence
Lenoir
R. Richards
W. Scott
Thagard

GEORGIA
Bridges
Carter
Hammond
Kilrain
Walker

HAWAII
K. McArthur
Onizuka

KENTUCKY
Wilcutt

LOUISIANA
Gorie
Halsell

MAINE
Hobaugh

MARYLAND
Curbeam
Ivins
Jones
Reightler
Virts

MASSA - CHUSETTS
Apt
Bowen
Duffy
Linnehan
Loria
Lu
McCandless
Musgrave
O'Leary
Precourt
Wilson

MICHIGAN
Antonelli
Bloomfield
Chaffee
Jett
Leestma
Linenger
Lousma
McMonagle
Searfoss
Shaw
Worden

MINNESOTA
Cabana
Carey
D. Gardner
Nyberg
Stefanyshyn
-Piper

MISSISSIPPI
Haise
Peterson
Truly

MISSOURI
Akers
Behnken
Godwin
Kavand i
Springer

NEBRASKA
C. Anderson

NEW HAMPSHIRE
Morin
Shepard

NEW JERSEY
Aldrin
Ham
M. Kelly
S.Kelly
Polansky
Reisman
Schirra
Schweickart
Sullivan
Zamka

NEW MEXICO
Gutierrez
Schmitt

NEW YORK
Adamson
M. Anderson,
Bobko
Cagle
Camarda
Cleave
E. Collins
A. Fisher
Fullerton
Garan
E. Gibson
R. Gibson
Grabe
W. Gregory
Hoffman
Hurley
Kregel
Massimino
Melnick
Parker
Runco
Stott
Swanson
Wetherbee
Wheelock

NORTH CAROLINA
E. Baker
Brady
C. Brown
Duke
Helms
W. McArthu
rM. Smith
W. Thornton

NORTH DAKOTA
Buchli
Hieb

OHIO
Armstrong
Bassett
Cameron
Eisele
Foreman
Gernhardt
Glenn
Good
Harbaugh
Henize
Henricks
Lovell
Low
Overmyer
Resnik
Sega
D. Thomas
Walz
Weber
Williams

OKLAHOMA
Cooper
Garriott
Herrington
Pogue
Stafford

OREGON
Griggs
Petit

PENNSYL-VANIA
A. Allen
Bagian
Bluford
Bursch
Conrad
Ferguson
Feustel
Fincke
Freeman
Frick
Hart
Robertson
Horowitz
Irwin
P. Richards
Tani
Weitz

RHODE ISLAND
Readdy

SOUTH CAROLINA
Bolden
Casper
Coleman
Culbertson
Fossum
McNair

SOUTH DAKOTA
Gemar
Fossum

TENNESSEE
M. Baker
Bull
Jernigan
Seddon
Shepherd
Wilmore

TEXAS
Ashby
Bean
Blaha
Cockrell
Creighton
Crippen
Fabian
W. Fisher
Forrester
Givens
Harris
Holmquest
Husband
Kopra
Lockhart
Mitchell
Mullane
D. Scott
See
White

UTAH
Lind

VERMONT
Graveline

VIRGINIA
Bowersox
D. Brown
Edwards
Gardner
Melvin
Oefelein
Phillips
Wisoff

WASHINGTON
Barratt
Dunbar
Gordon
G.C. Johnson
Oswald
Scobee

WEST VIRGINIA
McBride

WISCONSIN
Brandenstein
Chiao
Lee
Michel
Slayton
J. Williams

WASHINGTON DC
Drew
F. Gregory
Nowak
Stewart

Astronaut Geography (concluded)

Student Sheet

Procedure

1. Use the chart to color each state on the map.
2. Answer the questions on this page after coloring the map.

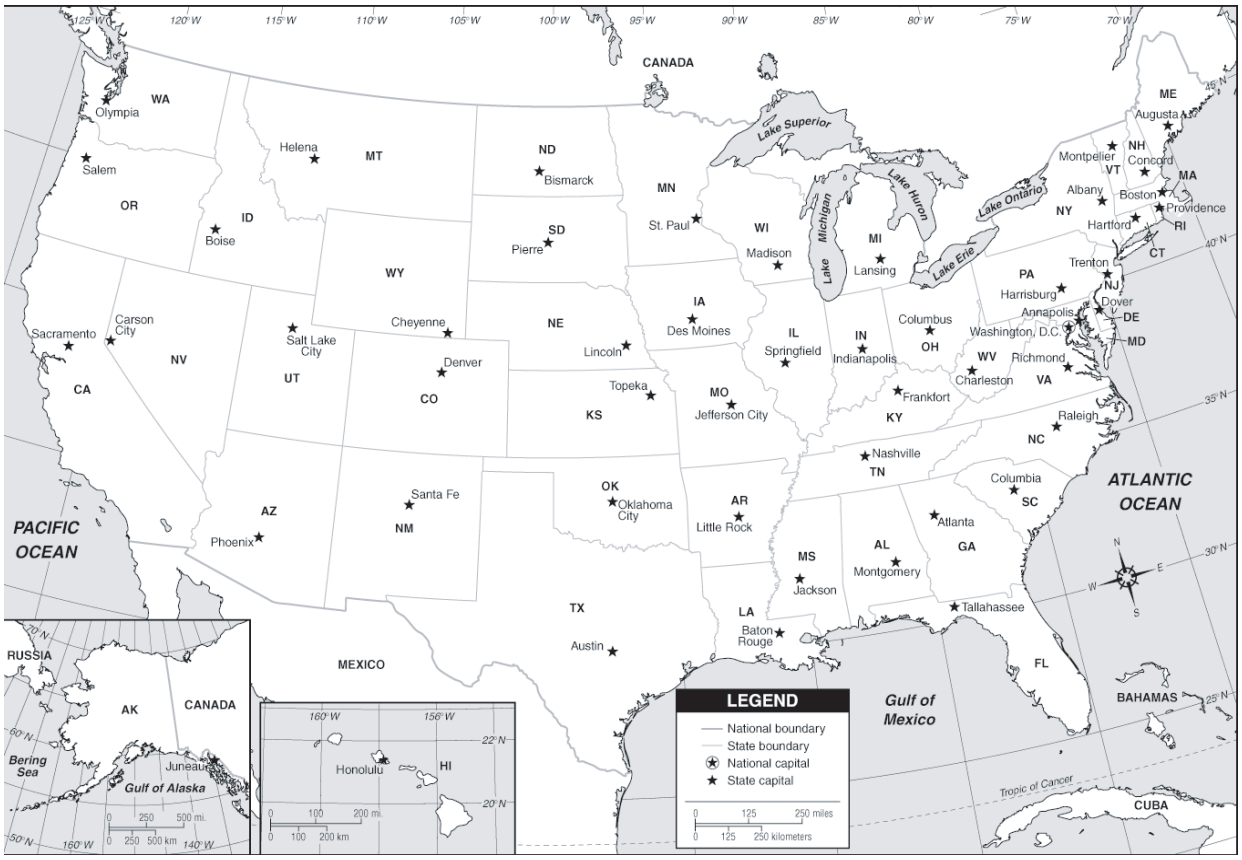
Questions

1. How many states have more than 20 astronauts?
2. How many states do not have any astronauts?
3. How many states have fewer than 10 astronauts?
4. Which state has the most astronauts?
5. Which states have six astronauts?
6. How many astronauts are from your state?

Map Key

#	COLOR	#	COLOR
1		10	
2		11	
3		12	
4		13	
5		14	
6		15	
7		16	
8		17	
9			

United States



The Taste of the Matter

Problem

To determine the acceptability of food products for space flight

Materials

paper plates
plastic spoons
food samples
drink samples
drink pitchers
small cups
water
crackers (5-8 per student)
pencil
napkins

Teacher Prep

Select 3-5 food samples from products that must be hydrated. For example, pudding mix, soup mix, instant oatmeal, and so on. Select 2-3 drink samples such as crystal drink mix, punch mix, instant tea, and so on. Calculate the approximate amount of food to be prepared for each student to have a small sample. Just before the test is conducted, prepare the products according to package directions. Either prepare test sample plates for each student, or place a spoon in each dish and have the students get their own samples. Give each student one cracker for each sample.

Background

Astronauts select their menus for space travel about five months before they fly. These foods will be stored in the galley. It does not help astronauts to take foods into space that they do not like and will not eat. Therefore, a special taste panel is set up for the astronauts to taste a variety of foods when they are selecting their menus. Foods are tested for appearance, color, odor, flavor, and texture. This taste panel helps to reduce the amount of waste from uneaten or partially eaten foods and ensures that the astronauts will eat well in space.

Procedure

1. Read the guidelines on the "Taste Panel Evaluation Form" (p. 34). Choose one food sample from your plate and write its name on the form at the top of the second column from the left.
2. Observe the food sample. Record its appearance, color, and odor in the correct columns.
3. Taste the food sample and record your observations for flavor and texture.
4. Rate this food sample using the scale at the bottom of the chart.
5. Write any comments you wish to make. Use the descriptive words given or your own.
6. To clear the taste of that food sample from your mouth, eat one cracker.
7. Repeat steps 1-6 with the other food samples.
8. Repeat steps 1-6 with the drink samples.
9. Clean up and restore your area.
10. Share your observations and results with the class.
11. Create a class chart of the scores given to each food and drink sample.
12. Create a graph depicting the results.

Conclusion

1. Which food would you prefer to take with you into space?
2. Which food received the highest score? Why? Lowest score? Why?
3. Why do you think it is important to test the food before it is taken into space?

Extension

1. From the evaluation forms, choose a meal of your choice and write a paragraph explaining why you chose those foods. Use descriptive words from the "Taste Panel Evaluation Form" (p. 34).
2. Use a food pyramid to evaluate your choices and determine if you chose a healthy, well-balanced meal.

The Taste of the Matter (concluded)

Taste Panel Evaluation Form

The following guidelines should be followed when rating a food product:

1. Emphasis is on quality of the food product rather than your own personal likes and dislikes.
2. If you absolutely dislike the product because of personal preferences, do not rate it.
3. The overall rating is your general impression of the product.
4. Do not compare notes with other taste testers.
5. In the comments section, explain why you rated the product as you did.

ITEM:				
Appearance				
Color				
Odor				
Flavor				
Texture				
Overall Rating				
Comments				

Ratings

1—Dislike Extremely
2—Dislike Very Much
3—Dislike Moderately
4—Dislike Slightly
5—Neither Like nor Dislike
6—Like Slightly
7—Like Moderately
8—Like Very Much
9—Like Extremely

Descriptive Comments

Here is a list of descriptive terms that can be used to describe the food samples.

Taste/Odor	Texture		Color/Appearance
bitter	crisp	pasty	dull
sweet	soft	rubbery	sparkling
sour	hard	sticky	bright
salty	stringy	stiff	light
rancid	tough	tender	dark
stale	chewy	greasy	greasy
tasteless	firm	juicy	glossy
flat	grainy		cloudy
musty	gummy		old
	lumpy		pale

Round and Round the Earth We Go

Problem

To use a model to observe how the phases of the Moon are created

Background

As Earth's only natural satellite, the Moon has long been an object of fascination and confusion. Over the course of a 28-day cycle (lunar cycle), the Moon shows us many different faces (shapes). These different shapes are called phases, and they are the result of the way the Sun lights the Moon's surface as the Moon orbits Earth. The Moon can only be seen as a result of the Sun's light reflecting off it. It does not produce any light of its own.

Materials

lamp without shade
table (optional)
tennis ball
darkened room

Procedure

1. Place the lamp (represents the Sun) on a table or have your partner hold the lamp up high.
2. After the lamp has been turned on, darken the room.
3. With your body representing Earth, hold the tennis ball, representing the Moon, in your left hand and at arms' length slightly overhead. See diagram 1. It is this inclined orbit that allows us to see a full Moon even when the Earth is between the Sun and the Moon.
4. Face the Sun.
5. Observe the ball. Note that the lamp has lit up the side of the Moon away from you (Earth) and you only see dark. This phase is called a new Moon, and it occurs when the Moon is between the Sun and Earth. You only see dark from Earth.

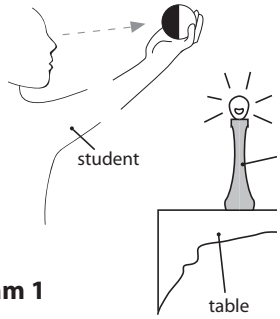


Diagram 1

6. While you (Earth) are still facing the Sun, hold the Moon straight out to the side and note which side of the Moon is lit. The Moon has now revolved one-quarter of the way around Earth. This takes approximately one week after a new Moon.
7. For the next phase, place your back to the Sun and hold the Moon straight out in front of you (Earth) keeping it slightly overhead. See diagram 2. The entire surface of the ball is lit, and this is a full Moon. The Moon has not completed half of its revolution around Earth.

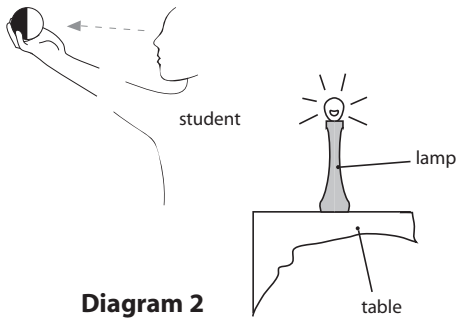


Diagram 2

8. Move the Moon to your right hand. Now move the right arm into a position straight out to the side. Once again, only half the Moon is lit. Note which half is lit. This phase is known as a third-quarter Moon and it appears approximately three weeks after a new Moon.
9. Face the Sun again and hold the Moon straight out in front and slightly overhead. Once again, you only see the darkened side of the Moon. The lunar cycle starts over again.
10. In your science journal, describe and illustrate what you observed.
11. Repeat with your partner as the Moon and you as the Sun.

Conclusions

1. What happened as you revolved around the "Sun?"
2. Why did the shadows change?
3. The Moon rotates on its axis once every 28 days, and it revolves around Earth once every 28 days. Knowing this information, explain why we only see one side of the Moon. Hint: Mark a spot on the ball (Moon) and revolve it around you (Earth) without letting it rotate about its axis. Note what you observe about the side of the ball (Moon) facing you (Earth). Now repeat while rotating the ball (Moon).

Extension

1. Research the phases of the Moon and create a diagram using the word bank below, that shows the phases of the moon as it orbits the earth.

Word Bank:
New Moon, Waxing Crescent, Full Moon, Waning Crescent, Third Quarter, First Quarter, Waxing Gibbous, Waning Gibbous

Doesn't Phase Me

Problem To understand the phases of the Moon

Materials

28 3" x 5" index cards
compass
metric ruler
pencil
black marker
stapler
hole-punch (optional)
2 brads (optional)

Teacher Note An alternative to index cards is to print the Moon Journal sheet from the NASA SCI Files™ web site http://scifiles.larc.nasa.gov in the "Educator" area under "Activities and Worksheets" for *The Case of the Galactic Vacation*. For a better flipbook, copy the sheet onto card stock and have students cut out the individual squares. You will need to copy approximately 3 sheets for each student or group.

Procedure

1. Discuss the phases of the Moon.
2. Place all index cards so that the unlined side of each card is facing up.
3. From the right side of each card, measure 1 cm from the edge halfway up and down the card and place a small pencil mark. See diagram 1.
4. Set your compass to draw a 6-cm diameter circle.
5. Place the pencil point of your compass on the mark you made in Step 3. Make sure the compass point is halfway up and down the card. See diagram 2.
6. Draw a circle.
7. Repeat Steps 4-6 until all cards have circles.
8. Using 8 cards, shade in the following Moon phases:
   a. new Moon
   b. waxing crescent
   c. first quarter
   d. waxing gibbous
   e. full Moon
   f. waning gibbous
   g. third quarter
   h. waning crescent
9. The changes in the Moon phases happen slowly over a 28-day period of time. To simulate the gradual change, progressively shade in the remaining cards using at least 2 but not more than 3 cards between each phase listed above. You might want to decide upon the number of cards between each phase before you begin.
10. Place the cards in order, with the new Moon on top and the circles on the right side.
11. On the left side, staple through all 28 cards in three places. Optional: If you are unable to staple through all the cards, punch holes on the left side of each card, making sure that the holes will align. Place brads through the holes to secure cards in place.
12. Flip the cards and watch the phases of the Moon.

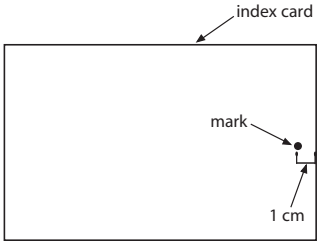


Diagram 1

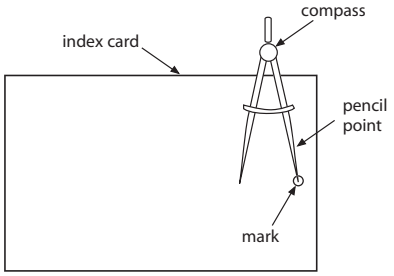
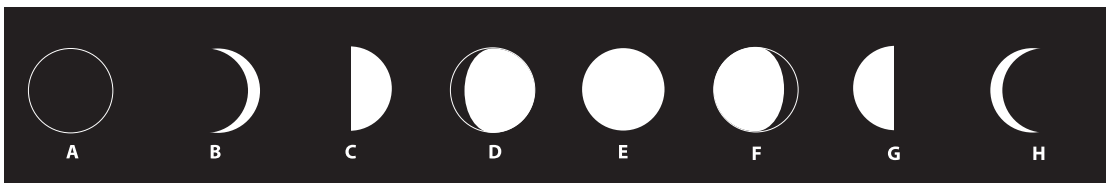


Diagram 2



Moon Craters

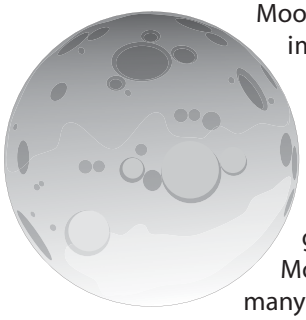
Problem

To learn how craters are formed on the Moon

Materials

large metal pan
flour or sand
dry tempera paint or colored powdered drink mixes
sifter (optional)
metric ruler
meter stick
newspaper
various sized balls (marbles, golf ball, ping-pong ball, and so on)
science journal

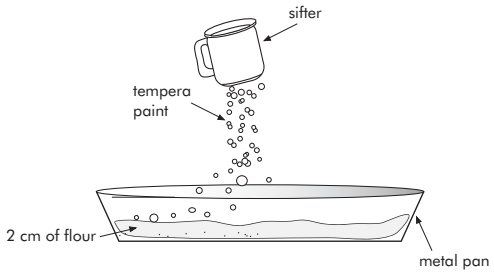
Background

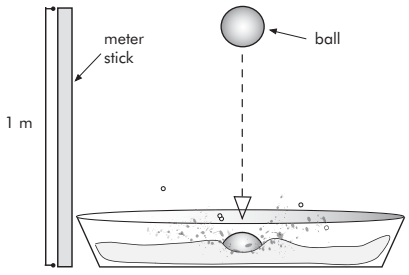


Have you ever looked at the Moon and thought it had a bad case of acne? Just what are all those circular features on the Moon's surface? They are impact craters formed when impactors, such as meteorites, smashed into the surface of the Moon. The explosion created by the impact caused the soil and rocks to be spattered out, leaving a hole. Around the circular hole, piles of rock (called ejecta) were created as well as bright streaks of target material (called rays) thrown for great distances. Impact craters are not unique to the Moon. They are found on all the inner planets and on many moons of the outer planets. Due to weathering and erosion, impact craters on Earth are not as easily recognized but there are several famous ones, including Meteor Crater in Arizona.

Procedure

1. Spread several newspapers on the floor and put the metal pan in the center.
2. Pour flour into the metal pan to a depth of approximately 2 cm.
3. Shake the pan to evenly distribute the flour.
4. Dust the top of the flour with dry tempera paint. Use sifter to better distribute the dry paint.
5. Hold one of the balls 1 meter above the pan and release.
6. Observe the impact crater created and measure its diameter. Note the ejecta and rays. Record your observations in your science journal.
7. Using the other balls, repeat steps 5 and 6. If your surface is too small for all your balls, gently shake the flour to smooth it out and dust the surface again between drops.
8. Try dropping the balls from different heights and throwing them at different angles.





Conclusion

1. What happened when you increased the drop height of the balls?
2. At 1 meter, which ball made the largest crater? Smallest? Why?

Extension

Look at several different pictures of the Moon and compare and contrast the various craters.

Dressing for Space

Problem

To understand the complex nature of a space suit

Background

Before astronauts can venture out into space, they must put on several layers of special clothing. The first layer is like a pair of long underwear that has water-cooling tubes running all through it. This layer keeps the astronaut at a comfortable temperature. The space suit itself is also made of several layers. These layers were designed to protect the wearer from the many dangers found in space, such as extreme temperatures, radiation, and micrometeorites, or space dust. The inside layer is a pressure bladder – like a flat balloon that is filled with oxygen. Next, there is a layer of plastic for strength and several layers of fireproof material and thin sheets of metal. Early space suits were connected to the life-support system of the spacecraft by a tube called an umbilical. Space suits worn today have a life support system backpack built right into the upper part of the suit.

Teacher Prep

Have students bring in the following articles of clothing or provide them: tights or long underwear, pants, boots, long-sleeved T-shirt, knit hat, gloves, and a helmet. You will also need a long piece of rope.

Note: To make this experiment more realistic, attach the pieces of clothing together. Attach the socks to the bottom of the pants legs and then place the boots over the socks. Attach the long-sleeved T-shirt to the top of the pants and make it a "one-piece" space suit. If a snowsuit is available, you can also place the pants and T-shirt inside the snowsuit, and then attach the socks and boots to make it really bulky!

Procedure

1. Imagine that you are an astronaut who has a task to perform outside the spacecraft. You are inside an airlock on the space shuttle, and it is time to get into your space suit. Follow the directions below for getting into your "space suit."
   a. Long underwear: This is the first layer of your space suit. To put it on is like pulling on a pair of long underwear, but this underwear would have tubes running all through it, so it is not very easy to get into. First, put your legs in one at a time and then wiggle the suit high enough to get your arms into the openings and fasten this layer closed.
   b. Space Trousers—These are thick and bulky and have boots connected to them. Climb into the trousers and wiggle your feet into the socks and boots.
   c. Space Shirt—To cover your upper body (torso), put your arms into the shirt and close.
   d. For your communications carrier (a headset built into a cap), put on the stocking cap. Adjust so that it fits snugly over your ears.
   e. Gloves—Put on the thick gloves and wiggle your fingers.
   f. Helmet—Place the helmet on over your stocking cap.
2. In real life, you would have to connect many hoses and set many dials as you dressed. But for our pretend journey, you are ready to climb out of the hatch of the airlock into the cargo bay of the shuttle.
3. Attach your lifeline and pretend that you are floating in space inside your thick space cocoon!

Conclusion

1. Why are so many layers needed in a space suit?
2. What do you think it would be like to perform tasks in space in a space suit?

The Red Planet

Purpose

To understand why Mars is a reddish color

Background

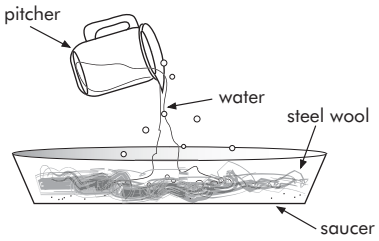
Mars earned its nickname "the Red Planet" because it looks red to observers in the sky. The color comes from the iron in its rusty-orange rocks and fine red sand. The planet's atmosphere of carbon dioxide is too thin to stop the heat from the Sun escaping into space. Mars is a cold desert.

Materials

- a piece of clean steel wool
- water
- dish or saucer
- rubber gloves
- science journal

Procedure:

1. Place the rubber gloves on your hands.
2. Stretch the wool to loosen the fibers.
3. Put the wool pad in a dish and pour enough water on it to wet it thoroughly but not soaked.
4. Let it stand for 3-5 days.
5. Observe the pad each day and record your observations in your science journal.
6. On the last day, pick up the wool pad and examine it closely. Record your observations.



Conclusions:

1. What happened to the steel wool in the pad?
2. What caused this reaction?
3. Using the same analogy, explain why the rocks on Mars appear to be red.

Mission to Mars

In his 1991 State of the Union message, President George Bush announced that a U.S. goal would be to send a human expedition to Mars by the 50th anniversary of the first human landing on the Moon. That anniversary will be in the year 2019!

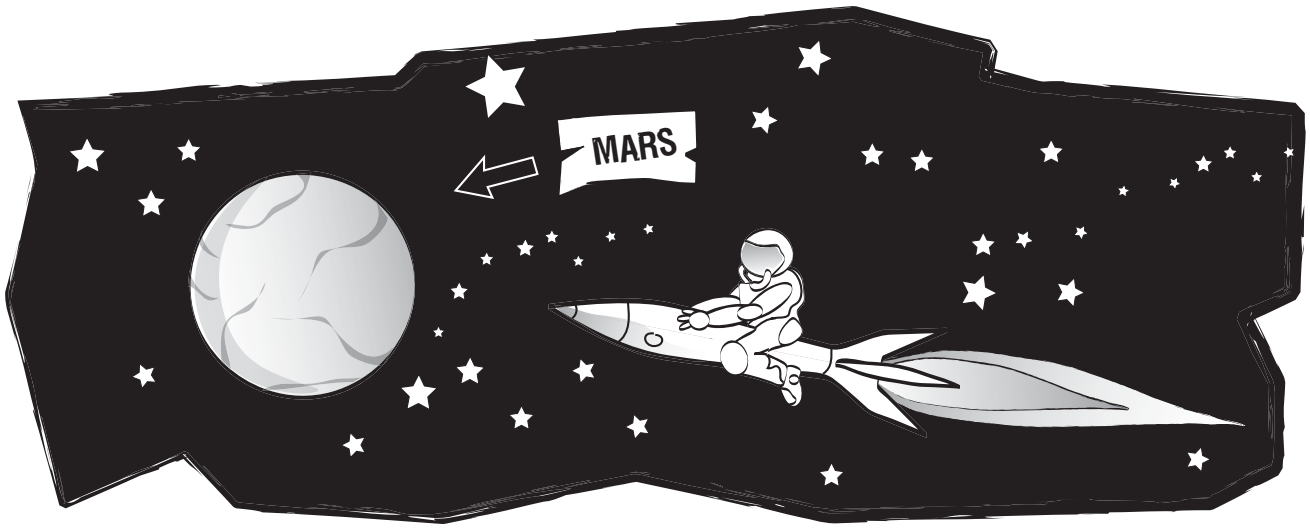
A trip to Mars will probably take nine months. The crew will have to spend about two months on Mars before they can head back to Earth. The return trip will also be nine months. The entire trip will be almost two years.

Before humans can be sent from Earth to Mars, it will be necessary to determine what types of professional people will be needed to properly establish the Mars colony. Your task is to create a list of the first crew and to justify your choices.

In your group, discuss and answer the following questions:

1. How many people should go on this first mission to Mars?
2. Which of the professions listed below are most necessary to the success of the mission? Which are the least?
   a. Doctor, geologist, chemist, zoologist, nurse, astronomer, botanist, computer expert, journalist, geographer, teacher, electrical technician, pilot, telecommunications expert, construction worker, dentist, physical fitness trainer, engineer, law enforcement officer, and lawyer
3. Should the crew be all military, all civilians, or a mixture of both?
4. Should the crew be all females, all males, or a mixture of both?
5. Who will be the first person to step on the surface of Mars? What should his/her first words be? Remember that everyone on Earth will be listening. Consider Neil Armstrong's message from the Moon, "That's one small step for man, one giant leap for mankind!" Write your own message.

Share your decisions and justifications with the class in the form of a written report, poster, video, Power Point presentation, or in some other appropriate way.



Answer Key

Astronaut Geography

1. There are nine states that do not have astronauts. They are Alaska, Idaho, Illinois, Indiana, Iowa, Kansas, Montana, Nevada, and Wyoming.
2. Thirty-three states have fewer than 10 astronauts.
3. California has the most astronauts with 21.
4. Answers will vary.
5. Answers will vary but might include that the populations of the various states might influence the number of astronauts, that different states may have programs that encourage space careers, and so on.

The Taste of the Matter

1. Answers will vary.
2. Answers will vary.
3. Answers will vary but should include that having astronauts taste the food prior to their going into space helps to ensure that the astronauts will have foods that they like and will eat and will also help ensure that they will receive a balanced diet.

Round and Round We Go

1. As you revolved around the "Sun," you saw different areas of the "Moon" illuminated.
2. The shadows changed because from where you were able to observe the "Moon," you could not always see the entire lit surface. Sometimes you just saw part of the lit half of the Moon.
3. We only see one side of the Moon because the Moon rotates at the same rate it revolves. For example, as the Moon revolves halfway around the Earth, it also rotates halfway around its axis, and the same side remains facing the Earth. Try it!

Moon Craters

1. When you increased the drop height of the balls, the crater became larger in diameter.
3. Answers will vary.

Dressing for Space

1. Many layers are needed to protect the astronaut. The underwear with tubes is used to cool the astronauts, and the many layers of the suit are to protect the astronaut from radiation, micrometeorites, and other hazards of space.
2. Answers will vary but should include that it would be very difficult to move and perform tasks in such bulky clothing.

The Red Planet

1. The steel wool in the pad became fragile and crumbly, leaving a reddish-orange residue (rust or iron oxide).
2. This reaction is caused as the iron in the steel wool mixes with water and oxygen in the air, thus creating the rust. Many rocks on Mars contain iron-bearing minerals. These minerals have slowly rusted, leaving a ruddy dust on the surface and in the atmosphere.

On the Web

Moonlight of the Night

1. After a full Moon, the Moon began to get smaller. From Earth, we are able to see less and less of the lit surface of the Moon.
2. After a new Moon, the Moon began to get larger. From Earth, we are able to see more and more of the lit surface of the Moon.
3. Waxing means to grow larger, stronger, fuller, or more numerous. When the Moon goes from a new Moon to a full Moon it is waxing. Waning means to grow gradually smaller or less. As the Moon goes from a full Moon to a new Moon it is waning.

Too Short?

1. The balloon on the baby food jar bulged upward when you pulled the neck of the balloon on the large jar upward.
2. Pushing down on the balloon made the balloon sink in.
3. On Earth, gravity holds the separate discs in the spinal cord tightly together. In a low-gravity environment such as space, a reduction in gravity allows the spinal cord to separate and pull apart.
4. The separating and pulling apart of the spinal cord in a low-gravity environment would result in an instant growth spurt.