



THE MICRONAUT PROGRAM TEACHER'S GUIDE

**Kindergarten through
Third Grade**

**Chabot Space & Science Center
10000 Skyline Blvd
Oakland, CA 94619**

Dear Classroom Educator,

Imagine for a moment that your students are Micronauts (mini astronauts) aboard the International Space Station. One student is examining insects for radioactive contamination in an Isolation Chamber while another is examining rocks under a microscope. Another group of students is working within a glove box to classify objects. The Micronauts program at Chabot Space & Science Center allows your Kindergarten through third grade students the chance to combine their imagination with the skills they have gained through school to simulate a mission in space. This program is separated into two sections that are designed to provide you and your students with an authentic encounter with science and space technology. The students will spend the first part of the class working in pairs at learning stations where they will complete a series of experiments aboard the simulated International Space Station (ISS). In the second half of the class, K-2nd grade students will take an in-depth examination of the Space Transportation System (STS) by creating a take-home model. They will also play a game about the launch sequence and watch a video about living and working in space. Our 3rd grade visitors will examine satellite technology as they work in teams to create a take-home origami satellite. This teacher's guide compiles activities from NASA and other educational organizations to provide a tool to assist in classroom instruction as you prepare to implement an academically rich space science unit. The activities in this guide can be completed before or after your visit to the center and all were chosen to increase the success of your visit to Chabot Space & Science Center. The activities are not organized by grade or skill level so you can choose those that will be most effective and enjoyable for your students. This program meets many of the California State Science Standards and may be correlated with Open Court literacy requirements; a guide to the standards can be found at the end of the packet.

Thank you,

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ACTIVITY 1

MISSION PATCH

Objective:

Students will identify attributes of mission patches. Students will use pictures, numbers and other symbols to design and draw their own mission patch.

Subject Area:

Language Arts, Social Studies and Art

Materials:

- Pictures of NASA Mission patches and / or actual mission patches from the NASA Patches Website
- Drawing supplies
- Paper
- Websites
 - <http://www.abemblem.com/nasa.php>
 - http://history.nasa.gov/mission_patches.html
 - http://www.nasa.gov/audience/forkids/home/CS_Mission_Patch_Search.html

Procedure:

Teacher

1. Divide students into small groups.
2. Show students 2 or 3 different mission patches and explain how the symbols share the story of that particular mission.
3. If students are reading, instruct each team to read about two mission patch descriptions and to observe the symbols of the patches.
4. Student groups will discuss and design their own mission patch. If needed, help the groups decide what recent activity or event to illustrate with their patch.
5. Using shapes, colors, images and words students will work together and create their patch.
6. Display team patches on the wall and allow students to look at each other's patches.

Reflection and Evaluation: Students share their design interpretations with members of the class. The teacher guides students in a class discussion about how pictures can tell a story. If appropriate for your grade level, have students write a descriptive paragraph of their mission patch.

Reading:

True Books Space Stations by Diane M. and Paul Sipiera

Background information for teachers

Mission Patch Example



The Expedition 10 patch uses simple symbolism to describe the mission. The large Roman numeral "X," formed by the American and Russian flags, symbolize the joint nature of this mission, as well as the fact that this flight is the 10th mission to stay on the International Space Station. The current configuration of the Space Station is next to the name of the Station Commander, NASA astronaut Leroy Chiao, while the Soyuz vehicle is placed next to the name of the Soyuz Commander, Russian cosmonaut Salizhan S. Sharipov. The single star and the black background signify this is a space mission.

The STS-114 patch design signifies the return of the Space Shuttle to flight and honors the memory of the STS-107 Columbia crew. The blue Shuttle rising above Earth's horizon includes the Columbia constellation of seven stars, echoing the STS-107 patch and commemorating the seven members of that mission. The crew of STS-114 will carry the memory of their friends on Columbia and the legacy of their mission back into Earth orbit. The dominant design element of the STS-114 patch is the planet Earth, which represents the unity and dedication of the many people whose efforts allow the Shuttle to return safely to flight. Commander Eileen Collins and Pilot James Kelly are named at the top of the insignia, with Mission Specialists Wendy Lawrence and Charles Camarda named below. Against the background of the Earth at night, the blue orbit represents the International Space Station (ISS). Mission Specialists Soichi Noguchi, Stephen Robinson and Andrew Thomas, who will work on the Station during spacewalks, are named on the orbit. The red sun on the orbit signifies the contributions of the Japanese Space Agency to the mission and to the ISS program. The multi-colored Shuttle plume represents the broad spectrum of challenges for this mission, including Shuttle inspection and repair experiments, and International Space Station re-supply and repair.



For a color copy of these patches, search for the mission number (STS-___) on the NASA websites listed above.

ACTIVITY 2

GOOD ENOUGH TO EAT

Objective:

Students construct an edible space shuttle model.

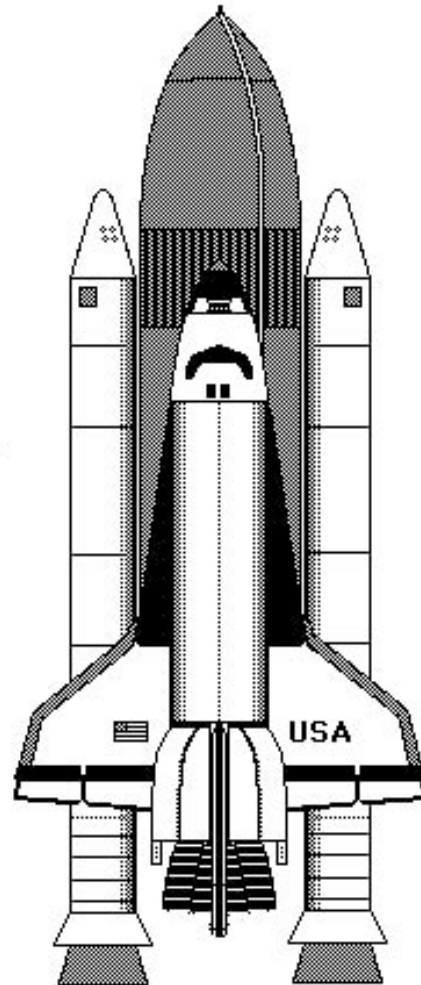
Subject Area:

Mathematics – Symmetry,
Technology, Language Arts,
Health

Materials:

- Carrots washed and cut in half lengthwise (1 per student) that represent the external tank
 - Celery (2 equal sized pieces per student) that represents the two solid rocket boosters
 - White bread (1 slice per student) that represents the orbiter
 - Peanut Butter, marshmallow cream, or soft cream cheese that acts as the glue
- * Determine if any student has a peanut allergy***
- Plastic knives (1 per student)
 - Orbiter template on card stock
 - Paper plates (2 per student)
 - Paper towels
 - Crayons or markers
 - Chart paper
 - Pictures of the Space Transportation System
 - Earth Model

NASA'S
SPACE SHUTTLE



Procedures:

Teacher

- Prepare a paper plate for each student with the vegetables, bread, and peanut butter or alternative spread and a plastic knife. The students will color the other plate to look like the Earth.

- Show students a picture of the STS model. Review with students the background information on the Space Transportation System (STS) and ask students to name each part. Use the STS model to simulate a launch sequence.
- Discuss and compare part sizes. Name the tallest and the shortest part of the STS.
- Distribute the plates with the food materials to each student and tell them they are going to build the STS.

Students:

1. Show the students a picture of the Earth and discuss its features. Have the students design their extra plate to look like the Earth.
2. Students examine the food parts. Students explore which food represents each STS part. The carrot represents the external tank. The celery represents the two solid rocket boosters. The bread represents the orbiter.
3. Students look at the parts and observe that the celery sticks are *equal* in length.
4. Students compare STS parts using the words *tallest* and *shortest*, and *taller* and *shorter*.
5. Students attach each part with peanut butter until all are in position and the STS is complete.
6. When STS models are complete, it is time to launch.

Teacher: - Demonstrate how to launch the edible STS.

7. Students count down for lift off "...10, 9, 8, 7, to 1 and lift off!"
8. Students lift their STS model off the plate.

Teacher: - Soon after lift off, simulate the separation of the solid rocket boosters (SRBs).

9. Students pull celery away from the bread and lay the celery back on the Earth plate.

Teacher: - Simulate the separation of the carrot external tank. Lay it back on the plate.

10. Students pull the carrot off and lay it back on the Earth plate.

Teacher: - Simulate the orbiter circling the Earth and then land the orbiter like a plane on the plate.

11. Students pretend their orbiter is flying in a circle around earth and then land like a plane on the plate.

Reflection and Evaluation:

Students draw, tell, and record the sequence of events using first, second, third, etc. The teacher will check student work for accuracy in sequencing of events.

Math Extension:

Count the number of celery sticks in the class counting by 2's. Discuss how the STS is symmetrical.

Health Extension:

Discuss healthy food choices as students eat the STS for a snack.

Language Arts Extension:

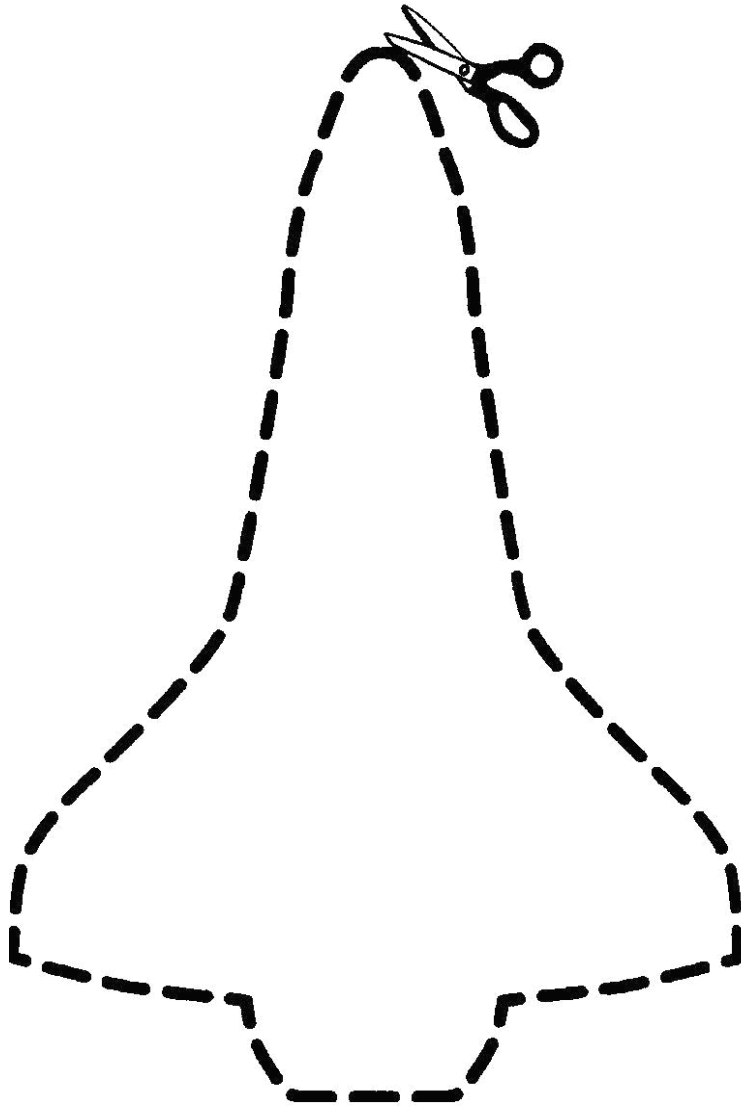
Students write a story paragraph explaining the launch sequence and read to the class.

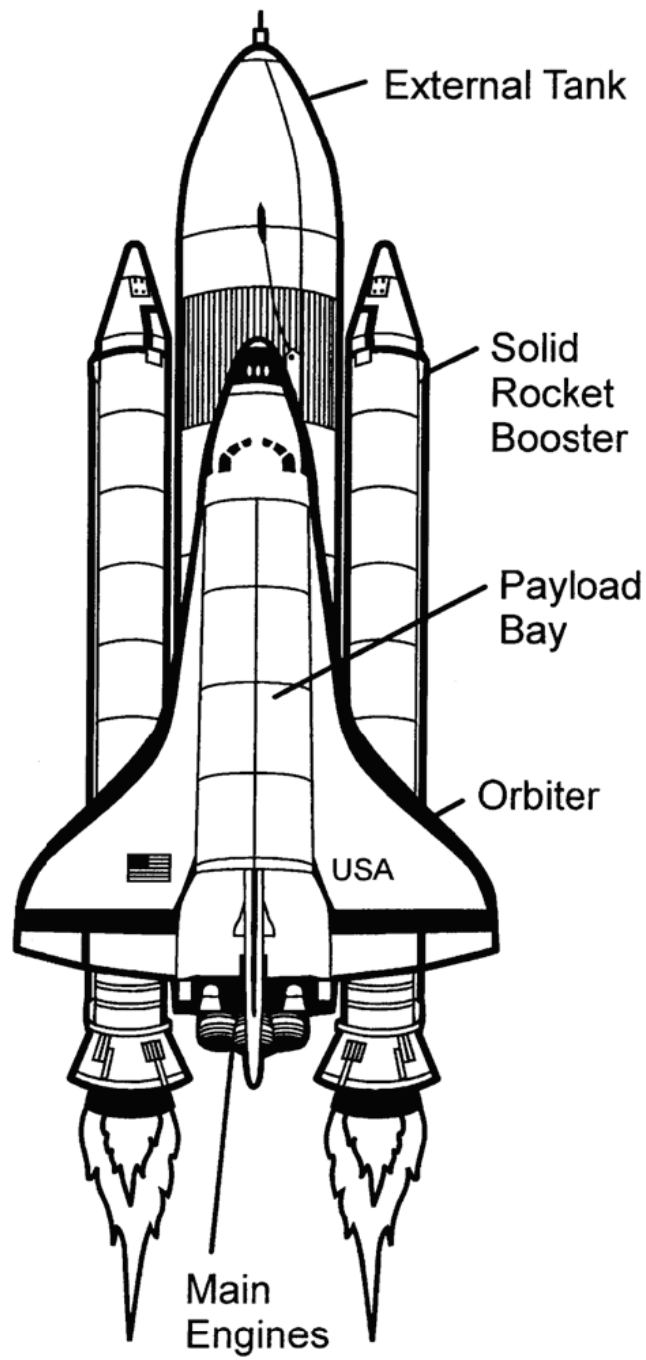
Reading:

The Space Shuttle by Jacqueline Langille and Bobbie Kalman

Best Book of Spaceships by Jan Graham

This template may need to be shrunk on your copier to fit it to a piece of bread.





ACTIVITY 3

DESTINATION: STATION

Objective:

Students identify the International Space Station (ISS) and different types of rockets as objects in the sky built by humans.

Standards:

Science, Mathematics, Technology, Language Arts.

Materials:

- Drawing of the ISS colored
- Drawings of space shuttle colored
- Drawings of Proton and Soyuz colored
- Photographs of the ISS, rockets, and space shuttle
- Picture or drawing of the Sun
- Pictures or drawings of objects in the sky, some built by humans and some not built by humans
- Globe
- Chalkboard and chalk
- Bulletin board paper or floor graph
- Markers, crayons, and pencils
- Paper, 2 pieces per student

Educator Information:

- This activity requires two class periods to complete.
- Before the lesson begins, read the background information on the ISS, the space shuttle, and rockets. Be prepared to share this information with students.
- Collect pictures or drawings of objects in the sky, some built by humans and some not built by humans. Laminate drawings and photographs for future use.
- Prepare a floor graph with two columns or make a graph out of bulletin board paper. Draw a line to create two columns on the bulletin board paper. Label columns on the graphs with the titles yes or no.

Procedure:

First Class Period:

1. Introduce the drawing of the ISS. Ask students if they can identify the drawing. Have students share what they know about the space station.
2. Share the background information provided on the ISS. Discuss that humans are building the station in space. If necessary, define the word, human.

3. Ask students to think about where the ISS is at this moment. Remind students that the station is constantly circling or orbiting the Earth. Use a globe to demonstrate how the station continuously circles the Earth every 90 minutes. If appropriate, introduce the word "orbit." If you have access to a computer with the internet, connect to:

http://www.nasa.gov/mission_pages/station/main/index.html

to find out what is currently happening in the ISS. There is also a link on this page to connect to information on the current position of the station.

4. Discuss the size of the space station. Ask students to generate ideas about how the station goes to space. Share with them that the station goes to space in pieces. Tell them that rockets play an important role in building the station. You may also want to discuss the International partnerships required to complete the station.

5. Share the drawings of the Proton and Soyuz rockets and the STS (Space Transportation System), or space shuttle. Tell students that these are all rockets that go into space and take people, supplies, and parts to the ISS.

6. Look at the drawings of the ISS, Proton, Soyuz, and space shuttle. Ask students to generate ideas about who made these objects in the sky. Explain to students that people from different countries construct these space vehicles. The ISS, Proton, Soyuz, and space shuttle are all objects in the sky built by humans.

7. Ask students to think of other objects in the sky that people build. Ideas may include airplanes, hot air balloons, helicopters, satellites, and kites. Write a list of student ideas on the chalkboard.

Second Class Period:

1. Using the drawings and pictures of the ISS, Proton, Soyuz, and space shuttle, review the concept of objects in the sky built by people. Review the list of human-built objects in the sky that students generated.

2. Show students a picture or drawing of the Sun. Ask students if people built the Sun. Explain to students that there are objects in the sky that are not built by humans. People are building the ISS, but people did not build the Sun. Introduce the word "natural," if appropriate, to describe objects not built by humans.

3. Have students think of other objects in the sky that people did not build. Ideas may include birds, clouds, stars, lightning, and rainbows. Write a list of student ideas on the chalkboard.

4. Show students the pictures or drawings of objects in the sky. Explain to students that they will use a graph to sort or classify the pictures as objects in the sky built by people or not built by people. Use the floor graph with two columns or the bulletin board paper with two columns. One column is labeled with the title, yes. The second column is labeled with the title, no. Read and discuss the titles with the class.

5. Show students a picture or drawing of an object in the sky. Ask the question, "Is this object built by people?" Discuss the answer and look at the words "yes" and "no" on the graph. Demonstrate placing the picture in the appropriate column.

6. Distribute the remaining pictures and drawings to students. Have students look at their picture or drawing, and ask, "Is this object built by people?" Students then answer the question. Have students place the picture or drawing in the appropriate column. Continue until each student has a turn.

Assessment:

- Observe students as they place the pictures or drawings in the appropriate columns.
- Request that students draw two pictures, one of an object in the sky built by humans and one of an object not built by humans. Observe as students complete the drawings.
- The educator or the student can write the name of the object on each drawing.
- Observe students as they place their drawings in the appropriate column on the floor graph or the bulletin board paper graph.

Enrichment:

- Have students collect and bring in magazine pictures of objects in the sky. Allow them to share the pictures with the class. Ask students to determine whether the picture is of an object built by humans.
- Allow students to sort the collected pictures using the floor graph or the bulletin board paper graph. Ask students if they can think of other methods to sort the pictures. Ideas may include placing pictures in circles or in boxes with appropriate labels.
- When complete, the ISS will be the largest object built by people in space. The completed ISS will be the brightest object made by humans in the night sky. If a football field is available close to the school, take students outside to look at the field. Tell them that when it is complete, the space station will be approximately the size of two football fields placed side by side. Ask them to imagine how large a rocket would have to be to carry the ISS into space at one time.
- Students can see the space shuttle and the ISS in the sky. The Spaceflight web site has information on sighting opportunities
<http://www.jsc.nasa.gov/sightings/index.html>.
- Begin a class discussion about the size of objects in the sky. Using an airplane as an example, ask students if a plane appears smaller on the ground or in the sky. Based on their experience, most students will state that the plane appears smaller in the sky.
- Encourage students to generate ideas about why the plane looks smaller in the sky. Objects that are farther away appear smaller than objects that are closer. Help students reach the conclusion that the plane appears smaller because it is far away. If appropriate, take students outside to the playground. Have one student hold a drawing of the space station. Request that the other students stand close to the drawing and then slowly walk away. Ask students if the drawing appears smaller, the farther away they are. Remind students that when they see the space shuttle or the ISS in the sky, these objects will appear to be very small because they are far away.
- Choose books from the Suggested Reading list or from other sources on space travel, rockets, and the space station. Share the books with the class. Ask students to look at the books and find pictures or drawings of objects in the sky. Encourage students to decide whether humans built these objects.

Background information for teachers **International Space Station**

Orbiting the Earth at an average distance of about 240 miles, traveling 17 miles an hour, and orbiting the earth every 90 minutes, the International Space Station (ISS) represents the most complex international scientific venture in history. It is also the most grand construction project ever undertaken in space. Sixteen international partners, including the United States, Canada, Russia, Japan, Brazil, and the eleven nations of the European Space Agency, are working together, sharing resources and expertise, to build this orbiting research facility.

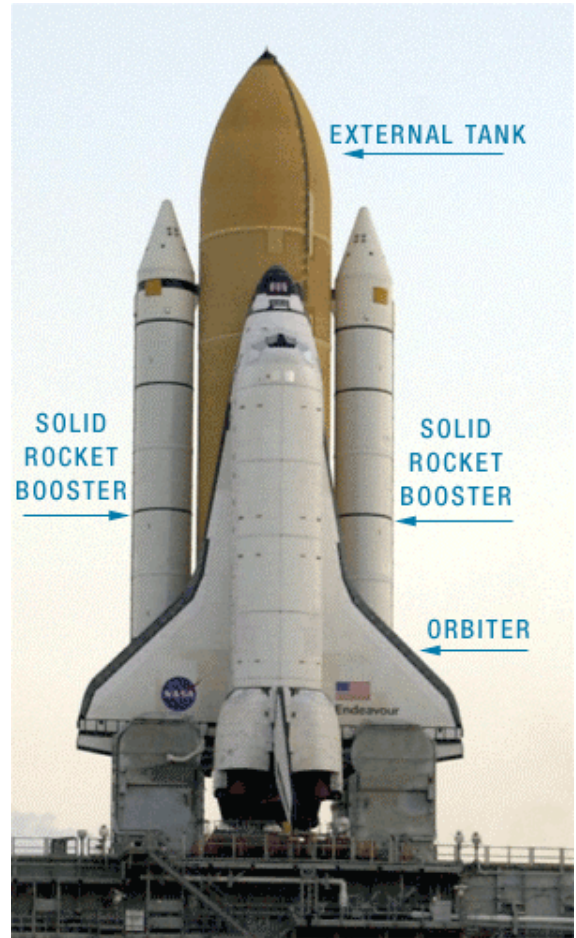


Construction of the ISS began in 1998. The station, when complete, will be roughly the size of two football fields placed side by side. The living and working areas will be about the size of three average American homes. The completed station will weigh approximately 1,000 pounds. Since there are no launch vehicles or rockets capable of carrying an object of this size into space at one time, the ISS must be constructed in space one section at a time. Individual parts, such as laboratories, living areas, equipment and storage areas, and solar arrays, are carried into space by American and Russian launch vehicles and are pieced together by humans during space walks. Giant solar arrays (panels) provide electricity for the space station. The electricity generated is enough to power about ten average American homes. Water will be recycled on the ISS. While astronauts float in this microgravity environment, they will find the station to be at “shirt sleeve” temperatures.

In 2000, the first international crew of three people went to live and work on board the station. Habitation of the space station marked the carrying on of long-term human presence in space since the Mir space station. Crews, who live and work on the station for four to six months and perhaps eventually even longer, must be ferried back and forth to Earth. The United States National Aeronautics and Space Administration (NASA) uses a reusable space transportation system (STS) to transport personnel, supplies, hardware, and station components to and from the ISS. The STS will be retired when the ISS is finished. Two different Russian rockets, the Proton and the Soyuz, take people, supplies, and parts to the ISS. In the future, a variety of new vehicles will visit the station to ferry crews and supplies. The International Space Station is a working science laboratory in space. Experiments being conducted on board the ISS allow research in biology, chemistry, physics, ecology, and medicine in a microgravity environment that may contain benefits for people on Earth. Astronauts living on the ISS are also discovering what happens to the body after living and working in space for an extended period of time. This will help us in our quest to live and work on the moon and Mars.

Space Transportation System

NASA's reusable space transportation system (STS) consists of several parts. One of the parts is the orbiter. The crew lives and works in the orbiter. There may be as many as seven people on a crew. The orbiter is the only part of the STS that orbits the earth. The orbiter needs special rockets to reach earth orbit. Two solid rocket boosters attach to the external tank. The external tank attaches to the orbiter and supplies fuel to the three main rocket engines at the aft end of the orbiter. The payload bay of the orbiter stores new components bound for the space station. A docking port in the payload bay allows the orbiter to join, or dock, with the ISS. After docking, a robotic arm lifts a new piece or module out of the payload bay and attaches it to the station. Astronauts then perform space walks, or extravehicular activities (EVAs), to help attach new components to the ISS. The STS will be retired around the year 2010, when the ISS is completed. Although the STS has been an effective vehicle for space travel since the mid 1970's, recent operational problems and the increased cost of fuel are leading to the development of a new space transportation vehicle, currently called the Orion.



ACTIVITY 4

HEARING IT ALL

Objective:

Students make a tool to investigate sound and learn that an ear cone uses a large surface area to direct more sound to the ear.

Subject Area:

Science—Sound Waves

Materials:

- 1 large 11x14 piece of heavy paper or poster board per two students
- Rulers
- Masking tape
- Crayons



Procedure:

Teacher:

1. Engage students in a discussion about sound.
 - What do you think will happen to the sound I hear if I cup my hand to my ear?
 - Demonstrate to students how to cup the hand behind the ear.
 - Have students listen to sounds without cupping the ear with their hand.
 - Ask students to listen to sounds with their ear cupped and compare to listening to sounds without the ear cupped.
2. Students will work in groups of two.
3. Go over the instructions for constructing the cone ear.
 - Roll the paper into a loose, large cone shape. It should have a small opening at one end and a large wide opening on the other end.
 - Demonstrate the process.
 - Carefully tape each paper ear cone so it will hold its shape.
 - Decorate and personalize the large ear cones.
4. Instruct students to hold the ear cone up to the ear and listen. Move the ear cone in different directions: up, down, and side-to-side while you stand still and listen.
5. Have students test their ear cones inside and outside the classroom. Take the students out into nature and have them use the cones to focus on sounds from insects, etc.
6. Have students talk loudly and whisper to another student using the ear cone.

Reflection and Evaluation:

Ask the students the following questions:

- What do you hear?
- Why does the ear cone make sound seem louder?

Extension:

Have students sit quietly in a large circle with their eyes closed. Pause. Ask what they think is making each sound they hear and the direction the sound is coming. Students can imitate the sounds they hear and draw pictures of what they think made the sounds.

Reading:

Did You Hear That? by Caroline Arnold and illustrated by Cathy Trachok



**ACTIVITY 4
HEARING IT ALL**

Student Data log

1. Listen to the sounds around you. Write three sounds you hear.

2. Predict what will happen to the sound you hear when you use your ear cone.

3. Listen to sounds with your ear cone. Describe what you hear.

4. Compare listening to sounds without the ear cone to listening to sounds with the ear cone.

5. What did you discover?

6. Does the ear cone make sound seem louder? Explain.

ACTIVITY 5

ROCKET RHYMES AND SONGS

Objective:

Students use rhymes, chants, songs, and creative movement to practice rhyming words.

Subject Area:

Social Studies, Language Arts, Music

Materials:

- Chart paper
- Sentence strips
- International Space Station picture (<http://www.src.le.ac.uk/projects/lobster/iss3.jpg>)
- Soyuz picture (<http://images.encyclopedia.msn.com/xrefmedia/shared/targets/images/pho/t054/T054674B.jpg>)
- Proton picture (http://apod.nasa.gov/apod/image/0007/zvezdalaunch_nasa.jpg)
- Small rocket drawing (included below)
- Crayons or markers
- Craft sticks (5 per student)
- Glue or glue sticks
- Pictures of rockets (www.nasa.gov)

Procedure:

1. Write the songs, rhymes, and chants on chart paper or sentence strips for students to read as they sing.
2. Draw, color, and laminate the ISS and rockets for later use.
3. Make a teacher set of five rockets cut out and glued to craft sticks to show students.
4. Make copies of small rockets so that each student has a set of five.
5. Students color and cut out their five rockets and glue them to a craft stick.
6. Introduce one song, chant, or rhyme at a time. Hum the tune to the song so the students can get the tune.
7. Repeat the song substituting the new words.
8. Develop movements to go along with the song.
9. Everybody sing and dance!

Extension:

Simple addition and subtraction in counting rockets as they liftoff.

Reading:

Blast Off! A Space Counting Book by Norma Cole and Illustrated by Marshall Peck III
Wood-Hoopoe Willie by Virginia Kroll and illustrated by Katherine Roundtree

ACTIVITY 7 ROCKET RHYMES AND SONGS (continued)

Songs

Tune: *Have You Ever Seen a Lassie?*

Did you ever see a rocket?
A rocket, a rocket?
Did you ever see a rocket go
This way and that?
Go this way and that way, go
This way and that way,
Did you ever see a rocket go
This way and that?

--Repeat the song, Substitute the word "station" for the word "rocket". Hold and move a drawing of a Proton or Soyuz rocket or the ISS while singing the song.

Tune: *I'm a Little Teapot*

I'm a little rocket,
Tall and thin,
Here is my nose cone.
Here is my fin.
When I get all fired up,
Launch begins,
Watch me rise
And see me spin!

--Develop movements to accompany the song.

Tune: *Twinkle, Twinkle Little Star*

Rocket, rocket in the sky
Flying fast and flying high,
Off to find the ISS
What's in it? Can you guess?
Rocket, rocket in the sky,
Flying fast and flying high.

--Substitute the words "Proton", "Soyuz" or "shuttle" for the word "rocket". Develop movements to accompany the song.

--Hold and move a drawing of a Proton, Soyuz, shuttle or the ISS while singing the song.

Chants and Rhymes

I'm a little rocket (*child squats*)
Pointing toward the sky (*points arms upward*)
4...3...2...1 (*repeat slowly*)
Blast off! Fly! (*Springs into the air*)

5 little rockets ready to zoom,
The first one says, "There's not enough room."
It starts its engine; ready to fly,
Looks at the others and waves good-bye
4 little rockets
3 little rockets
2 little rockets
1 little rocket

--Students may use their fingers or five copies of the small rocket to represent the five rockets in the rhyme. Have students color, cut out the rockets, and glue them to wooden craft sticks.
--Discuss the simple subtraction problems in this rhyme. Have students create movements to go with the words in the rhyme.

Many nations,
Build a station,
A science place,
A home in space,
Where people stay,
And work each day



On this page, you will find an image of the Saturn V Rocket.



ACTIVITY 8

GLITTER GERMS

Objective:

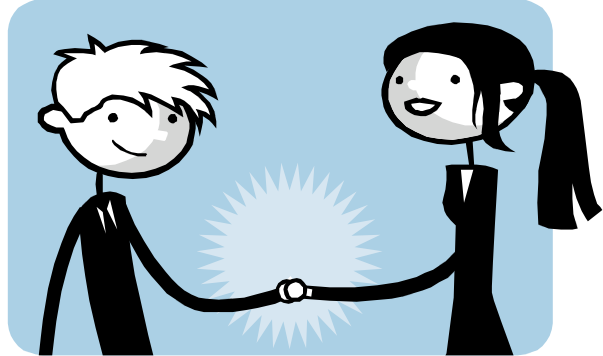
Students use glitter to create a simple experiment to show how easily germs can spread and learn about the importance of washing their hands.

Subject:

Health, Science

Materials:

- Glitter (5 different colors)
- 5 flat containers for each group (shoe box tops or paper plates could be used)
- 5 paper towels or white cloths for each group



Procedure:

1. Students will work in groups. This activity is set up for five groups.
2. Fill each container with a different color of glitter. Ask each student in a group to choose one of the colors of glitter.
3. Help each student spread the white cloth or paper towel on each table.
4. Group members take turns placing one hand flat (palm side down) into the glitter.
5. Then have students shake hands firmly with the all the other members of the other groups.
6. After all group members have shaken hands rub off as best you can the different colors of glitter from your hands onto the white cloths or paper towels.
7. Have students fill out the student data logs.
8. Discuss the relation of the different colors of glitter to germs transferred through touch.
9. Discuss the importance of washing hands.

Extension:

Invite the school nurse to participate in this activity to share expertise. Students participate in a proper hand washing exercise.

Reading:

Germs Make Me Sick by Melvin Berger and illustrated by Marilyn Hafner.

The Germ Busters by Rosemary Wells and illustrated by Jody Wheeler

ACTIVITY 8

GLITTER GERMS

Student Data Log

1. What colors of glitter are on the cloths or paper towels?

2. Were you able to get all the glitter off of your hand?

3. Do you see more of one color on the paper towel?

4. What does this investigation reveal about the ways germs are spread?

5. What did this experiment teach you about the importance of washing your hands?

ACTIVITY 9

BULLETIN BOARD

Objective:

Students recount their Micronaut experience at Chabot Space & Science Center, using drawings and captions to share their new knowledge.

Subject Area:

Art – Drawing

Language Arts – Writing and Communication

Materials:

- Construction Paper of various colors
- Pencils
- Crayons, Markers
- Lined Paper
- Poster tape/stapler/poster putty
- Bulletin Board/Open wall space

Procedure:

Pre-mission –

- Discuss “snapshots” with students (a snapshot is a picture taken either with a camera, or in this case, a visual memory of a situation).
- Have students practice taking “snapshots” at recess or during other activities.
- When students return from the activity, allow them to draw their “snapshot.”
- Discuss the details of their pictures- colors, people, things, background
- Have students write a one-sentence caption for their snapshot.

Mission –

- During the on-site mission activities, remind students to take their “snapshots.” No more than one or two snapshots are needed per each portion of the Micronauts class.

Post-Mission –

- Have students choose one (or more) snapshot(s) from their day at the Chabot Space & Science Center.
- Ask them to draw a detailed picture of their snapshot(s).
- Ask students to write a one-sentence caption for their picture(s). It should describe the activity and/or people in the picture(s).
- Post snapshots and captions on the open wall space/bulletin board.
- Invite parents, a “buddy” class, and/or school administrators to view the students’ work. Have students lead “tours” of the bulletin board.

Extensions:

Social Studies –

Have students research careers that involve the work done by students while at Chabot Space & Science Center. For example, entomologists study bugs, geologists study rocks and the Earth, and meteorologists study weather (including temperature). Check out NASA's career website for kids:

<http://mgs-mager.gsfc.nasa.gov/Kids/careers.html>

Reading –

I Want to Be A Pilot by Dan Liebman

Mae Jemison by Nancy Pole

ACTIVITY 10

A BOOK OF MY OWN

Objective:

Students will share what they have learned during the *Micronauts* mission at Chabot Space & Science Center by making their own books.

Subject Area:

Language Arts – Writing

Art – Drawing

Materials:

- Book Template worksheets (one for each student) for beginning readers and writers
- Construction paper/writing Paper (one or two pages per student) for more advanced readers and writers
- Pencils
- Crayons/Markers
- Scissors
- Stapler

Procedure:

For beginning readers and writers:

- Pass one copy of the Book Template to each student.
- Have student authors write their name on the cover “page.”
- Read the prompt on page one of the book aloud. Students should complete the sentence.
- Ask students to draw a picture that shows one activity they described in their sentence.
- Do the same for pages two and three.
- Have students cut out the pages along the dotted lines.
- Put the pages in order.
- Staple the pages together along the left side.
- Invite a buddy class from your school and have your students share their book with a student from that class.

For more advanced readers and writers:

- Pass out construction paper/lined writing paper to students. Cut paper in halves or quarters in advance depending on what size you would like their book to be.
- Let students know that they are making a book describing their experience as a Micronaut at the Challenger Learning Center.
- Ask students to come up with a title for their book and design a cover page with artwork.
- For the pages of their book, write the following prompts on the board:
 - “What did you learn in class before going to Chabot Space & Science Center to be a Micronaut?”
 - “What experiments did you perform while on the simulated mission to space?”
 - “What did you learn about in the classroom portion of the program at Chabot Space & Science Center?”

- “How much did you enjoy the experience of being a Micronaut?”
- Ask students to use the prompts to help them write their book.
- Have students illustrate their pages.
- Ask students to put their pages in order.
- Staple pages together along left side of the book.
- Invite a buddy class from your school and have your students share their book with a student from that class.

ACTIVITY 11

PRESS CONFERENCE

Objective:

Students will share what they have experienced and learned before, during and after their Micronauts field trip.

Subject Areas:

Science – Communicating results

Language Arts – Writing and communicating orally

Materials:

- “Press Room” – Classroom set up with tables/desks and chairs up front for micronauts, chairs set up for “reporters”
- Tables/Desks
- Chairs
- Video camera
- Video tape/DVD
- Mission Report Form (1 for each pair of students)
- Pencils
- Lined paper
- Folder/binder/notebook

Procedure:

Teacher

1. Provide a Mission Report Form to each student pair (their partner from the *Micronauts* Program).
2. Have student pairs fill out the Mission Report Form together.
3. Collect Mission Report Forms and redistribute them randomly to other student pairs.
4. Ask students to review the Report Form and come up with two or more questions to ask the original students who filled out the form. Have them write their questions in the space provided at the bottom of the form.
5. Recollect forms.
6. Divide class in “reporters” and “micronauts.”
7. Give Report Forms to reporters. Have each reporter choose one question from the Report Form(s) they are given. Have micronauts set up the “press conference” area.
8. Choose the order in which reporters will ask questions.
9. Videotape the press conference to show to a buddy class. (Or invite buddy class to watch the press conference live.)

Mission Report Form

Names: _____

Answer the following questions using complete sentences.

1. What activities did you complete while working in the International Space Station?

2. What did you learn from these activities?

3. What skills did you use while performing these activities?

Report Review: Write two or more questions that you want to ask the micronauts who filled in this form.

1.

2.

3.

ACTIVITY 12

WHAT IS THIS TOOL?

Objective:

Students explore the tools used by scientists to learn more about the world around us.

Subject Area:

Science – Technology and Inquiry

Materials:

- Scientific Tools Memory Cards
- Rules
- Blank index cards (unlined)
- Scissors
- Glue sticks
- Student Data Log

Procedure:

Teacher:

- Photocopy the Scientific Tools Memory Cards pages (one set of photocopies per four students).
- Divide class into groups of four.
- Pass out one set of photocopied cards to each group.
- Have students cut out cards.
- Have students glue one card to each blank index card.
- Set cards aside to dry.
- Pass out Student Data Logs.
- As a class, go over each scientific tool. Have students write the name of each tool next to its picture. If using the second Data Log, have students write one complete sentence about what the tool does.
- Pass out Rules sheets to students.
- Go over Rules with class.
- Once cards are dry, have students play Scientific Tools Memory Game.

Extension:

Language Arts

Have students choose one scientific tool to write a three-sentence paragraph about how they would use that tool.

Social Studies

Have students research scientists who have used these various tools. Examples:

- Edwin Hubble (telescope)
- Marie Curie (test tubes)
- Robert Hooke (microscopes)

Alexander Fleming (petri dishes)

Art

Find a set of microscopes for the class to use. Find a variety of objects to view under the microscope. Have each student choose their favorite object and draw a picture of what they see in the microscope.

Reading

Looking Through a Microscope by Linda Bullock

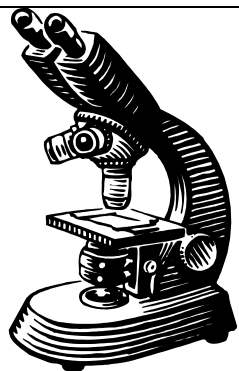
Looking Through a Telescope by Linda Bullock

Using Computers: Machine with a Mouse by John Burstein

What is a Thermometer? By Lisa Trumbauer

You Can Use a Balance by Linda Bullock

Scientific Tools Memory Game Cards



Microscope



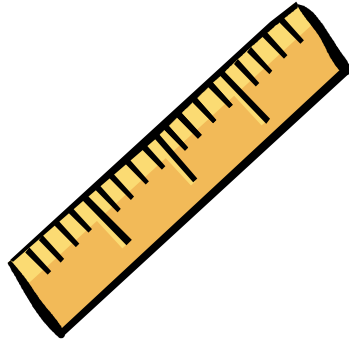
Telescope



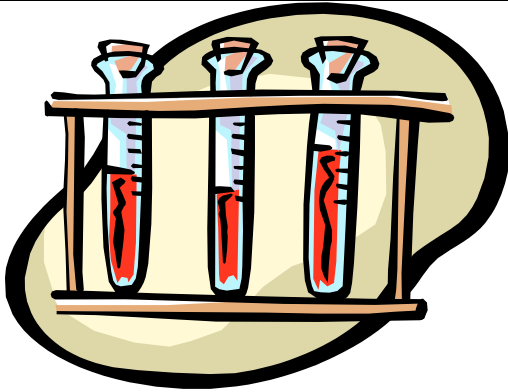
Magnifying Glass



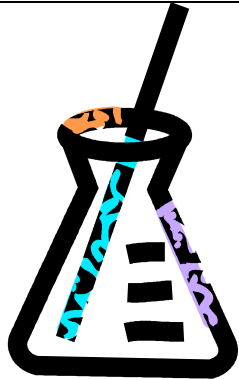
Balance



Ruler



Test Tubes



Flask



Beaker



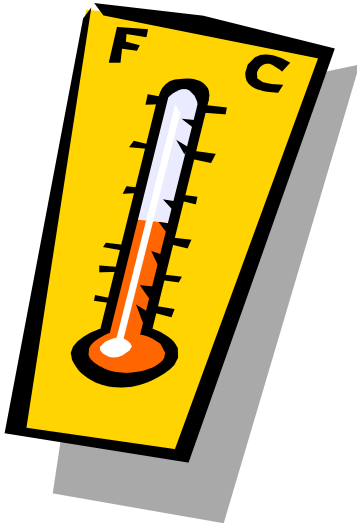
Gloves



Calculator



Petri Dish

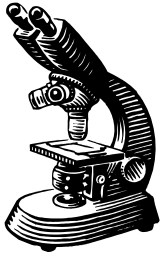


Thermometer

Scientific Tools Memory Game Rules

1. Lay out all the cards face down.
2. The first player should turn over TWO cards.
3. Try to match a picture card with its vocabulary word card.
4. If the cards do not match, turn them back over.
5. If the cards match, the player gets another turn.
6. The next player turns over two cards.
7. Play until all cards have been matched.

Scientific Tools Student Data Log



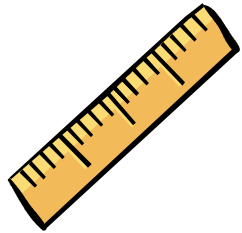
What is the name of this tool? _____



What is the name of this tool? _____



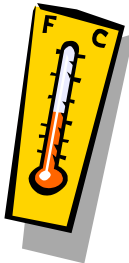
What is the name of this tool? _____



What is the name of this tool? _____



What is the name of this tool? _____



What is the name of this tool? _____



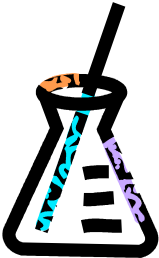
What is the name of this tool? _____



What is the name of this tool? _____



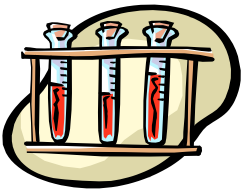
What is the name of this tool? _____



What is the name of this tool? _____

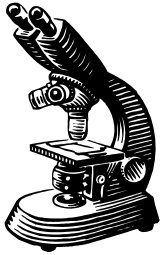


What is the name of this tool? _____



What is the name of these tools? _____

Scientific Tools Student Data Log



What is the name of this tool? _____

What is the purpose of this tool? _____



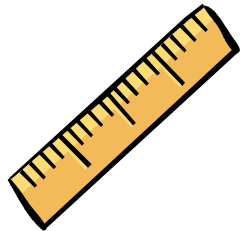
What is the name of this tool? _____

What is the purpose of this tool? _____



What is the name of this tool? _____

What is the purpose of this tool? _____



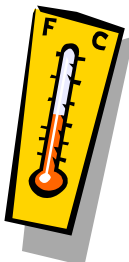
What is the name of this tool? _____

What is the purpose of this tool? _____



What is the name of this tool? _____

What is the purpose of this tool? _____



What is the name of this tool? _____

What is the purpose of this tool? _____



What is the name of this tool? _____

What is the purpose of this tool? _____



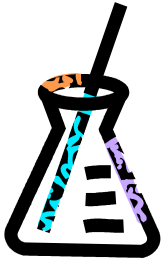
What is the name of this tool? _____

What is the purpose of this tool? _____



What is the name of this tool? _____

What is the purpose of this tool? _____



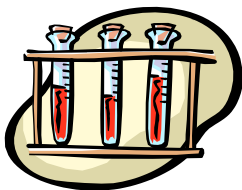
What is the name of this tool? _____

What is the purpose of this tool? _____



What is the name of this tool? _____

What is the purpose of this tool? _____



What is the name of this tool? _____

What is the purpose of this tool? _____

ACTIVITY 9

LIGHT AND RAINBOWS

Objective:

Students will learn that light is made up of the colors of the rainbow, and that prisms “bend” light to show those colors.

Subject Area:

Science – Inquiry, Physical Science

Materials:

- Prisms
- Crayons/markers
- Pencils
- Colored chalk/dry erase markers
- Student Data Log

(For Extension)

- Pre-washed white t-shirts
- Sharpie markers (all colors)
- 70% Rubbing alcohol
- Medicine dropper/dropper bottle

Procedure:

Teacher

Begin by activating prior knowledge.

Ask the following questions:

“Have you seen a rainbow before?”

“How are rainbows formed?”

(Light from the sun meets raindrops; the raindrops bend the light to show the colors of the rainbow)

“What colors are in a rainbow?”

[Red, orange, yellow, green, blue, indigo, violet (ROY G. BIV)]

- Pass out Student Data Logs.
- Have students draw a rainbow (with all the proper colors) on their Student Data Log.
- Have students write the colors of the rainbow on the lines on their Student Data Log (red, orange, yellow, green, blue, indigo, violet).
- Pass out prisms to students. (If you do not have prisms, you may use a glass pie plate filled halfway with water on an overhead projector)
- Explain that the prism will act like a raindrop and “bend” the light.
- On their Student Data Logs, have students predict what they will see if they hold the prism in white light (sunlight). **DO NOT HAVE THEM LOOK DIRECTLY AT THE SUN.**
- Ask students to hold the prism in sunlight.
- On their Student Data Logs, have students draw what they see.

Extension:

Art

Materials

- Pre-washed white t-shirt
- Sharpie® Permanent Markers (Red, Orange, Yellow, Green, Blue, Purple)
- Plastic Cup
- Rubber Band
- Rubbing Alcohol (70% from the Drug Store)
- Dropper Bottle or medicine dropper

What does it teach?

Experiment with the chemistry used to create colorful fabrics, while expressing your creative whims! Learn all about colors and what happens when they mix and run through material fibers.

This activity was created by Bob Becker of St. Louis, Missouri. Click the links below for more details on the project.

- [Experiment](#)
- [Video](#)

Prodedure:

- Place the plastic cup inside the middle of the t-shirt. Position the opening of the cup directly under the section of the shirt that you want to decorate. Stretch the rubber band over the t-shirt and the cup to secure the shirt in place.
- Place about 6 dots of ink from one marker in a circle pattern about the size of a quarter in the center of the stretched out fabric. If you like, use another color maker to fill in spaces in between the first dots. There should be a quarter size circle of dots in the middle of the plastic cup opening when you are finished.
- Slowly squeeze approximately 20 drops of rubbing alcohol into the center of the circle of dots. As the rubbing alcohol absorbs into the fabric, the ink spreads in a circular pattern expanding outward from the center. The result is a beautiful flower-like pattern, however, students often remark that the design looks like the colorful surface of a compact disc.
- Apply as much or as little rubbing alcohol as desired, but do not let the pattern spread beyond the edges of the cup. Allow the developed design to dry for 3 to 5 minutes before moving on to a new area of the shirt.

You'll enjoy experimenting with various patterns, dots sizes, and color combinations. Instead of using dots, try drawing a small square with each side being a different color, or use primary colors to draw a geometric shape, and accent it with dots of secondary colors. Half circles, wavy lines, and polygons all make unique patterns when rubbing alcohol travels across the ink. Your designs are only limited by your imagination. Try as many different patterns as you like. The

secret is to keep your patterns small and in the center of the design area on the shirt. DO NOT flood the design area with rubbing alcohol. The key is to drip the rubbing alcohol slowly in the center of the shirt and allow the molecules of ink to spread outward from the center.

How does it work?

This is really a lesson in the concepts of solubility, color mixing, and the movement of molecules. The Sharpie markers contain permanent ink, which will not wash away with water. However, the molecules of ink are soluble in another solvent called rubbing alcohol. This solvent carries the different colors of ink with it as it spreads in a circular pattern from the center of the shirt.

Additional Info

It's important to heat set the colors by placing the shirt in the laundry dryer for approximately 15 minutes. Teachers have also suggested rinsing the shirt in a solution of vinegar and water as a means of setting the colors. CAUTION: Rubbing alcohol is very flammable and must be kept away from any open flames or heat. This experiment must be conducted in a well-ventilated area, preferably outdoors or in a room with open windows. *Reference: This activity is the creation of Bob Becker, a chemistry teacher in Kirkwood, Missouri.*

*Copyright SteveSpanglerscience.com

Language Arts

Have students write a descriptive story using all the colors of the rainbow.

Reading

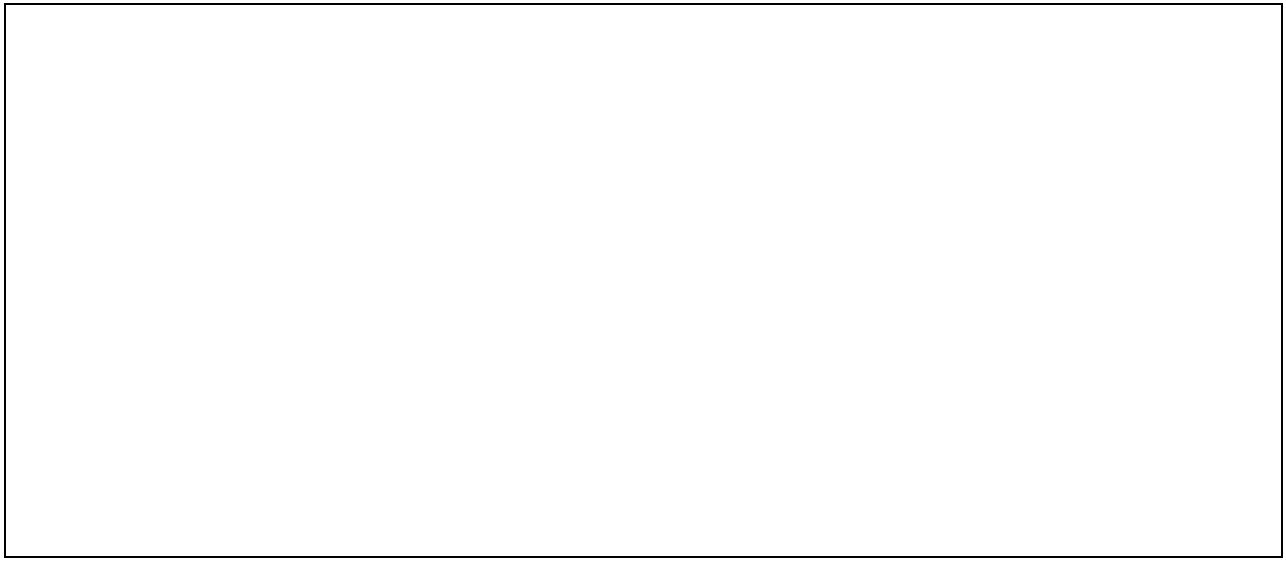
All About Light by Lisa Trumbauer

A Rainbow of My Own by Don Freeman

Student Data Log

Light and Rainbows

Draw a rainbow in the box below.



What are the colors in the rainbow?

Predict what you will see using a prism to bend light:

Draw what you see using the prism to bend light:



ACTIVITY 12

FAHRENHEIT AND CELSIUS: TEACHING TEMPERATURE

Objective:

Students will learn to read a thermometer in degrees Fahrenheit and Celsius. Students will learn the freezing and boiling points of water in Fahrenheit and Celsius. Students also will learn to associate temperature with appropriate clothing.

Subject Area(s):

Science, Mathematics

Materials:

- Large demonstration thermometer with Fahrenheit and Celsius markings
- Large classroom thermometer with Fahrenheit and Celsius markings
- Pencils
- Printer paper
- Markers
- Student Data Log
- Index Cards
- Temperature Flash Cards
- Clothing Cards

Procedure:

1. Assess prior knowledge by asking students to define temperature (a measure of the warmth or coolness of an object or substance). Discuss with students the metric system and English Standard Units.
2. Use the large demonstration thermometer to show various Fahrenheit and Celsius readings (focusing on freezing and boiling points of water).
3. Have students take turns reading temperatures from the demonstration thermometer. Students should read BOTH Fahrenheit and Celsius.
4. Hand out printer paper to students. Ask students to fold the paper in half three times.
5. Have students open the paper and fill in the boxes as shown:

	Fahrenheit	Celsius
Freezing point of water	32°	0°
Boiling point of water	212°	100°

6. Pass out the Student Data Log.
7. Ask students to record the classroom (indoor) temperature in degrees Fahrenheit and Celsius. Take the thermometer outdoors during recess. Before coming back inside, have students

read and remember the outdoor temperature in degrees Fahrenheit and Celsius. Record these when they return to their desks. Do this everyday for a week.

8. Have students label the Y-axis as "Temperature." Work with the class to choose the temperature increments to be used on the Y-axis of the bar graph/line plot. Have students choose the colors that they will use to represent indoor and outdoor temperatures on their graph. Each day, have students fill in the bar graph/line plot with the temperatures that they recorded for the day.
9. Make two copies of the Clothing Cards and one copy the Temperature Cards. Cut them out and paste them onto index cards. Laminate them if you plan on using these sets year to year.
10. Divide the class into two teams. For this relay race, you will hold up a Temperature Card and the student at the front of the team will choose from their team set of Clothing Cards an appropriate piece of clothing for a day with that temperature. That student must quickly take the card up to the board.
11. For a more challenging game, have students work as a team to choose an entire outfit for the given temperature. An entire ensemble should include footwear, bottoms, a top, and an accessory.

Extensions:

Social Studies

Have students research which countries use the metric system and which countries use the English Standard System for measurement.

Communication Arts & Social Studies

Have students write a paragraph describing how they would be dressing for the seasons if they were living in Missouri or Illinois in 1900.

Math

Have students practice converting temperatures from degrees Fahrenheit to degrees Celsius and vice versa. Use the following formulas:

$$(F-32) \times \frac{5}{9} = C$$

$$(C \times \frac{9}{5}) + 32 = F$$

Students may check their answers at the National Weather Service website:

<http://www.wbuf.noaa.gov/tempfc.htm>

Reading

Hot and Cold by Angela Royston

What is a Thermometer? By Lisa Trumbauer

Wild Weather: Hurricanes! By Lorraine Jean Hopping

Wild Weather: Tornadoes! By Lorraine Jean Hopping

Hottest, Coldest, Highest, Deepest by Steve Jenkins

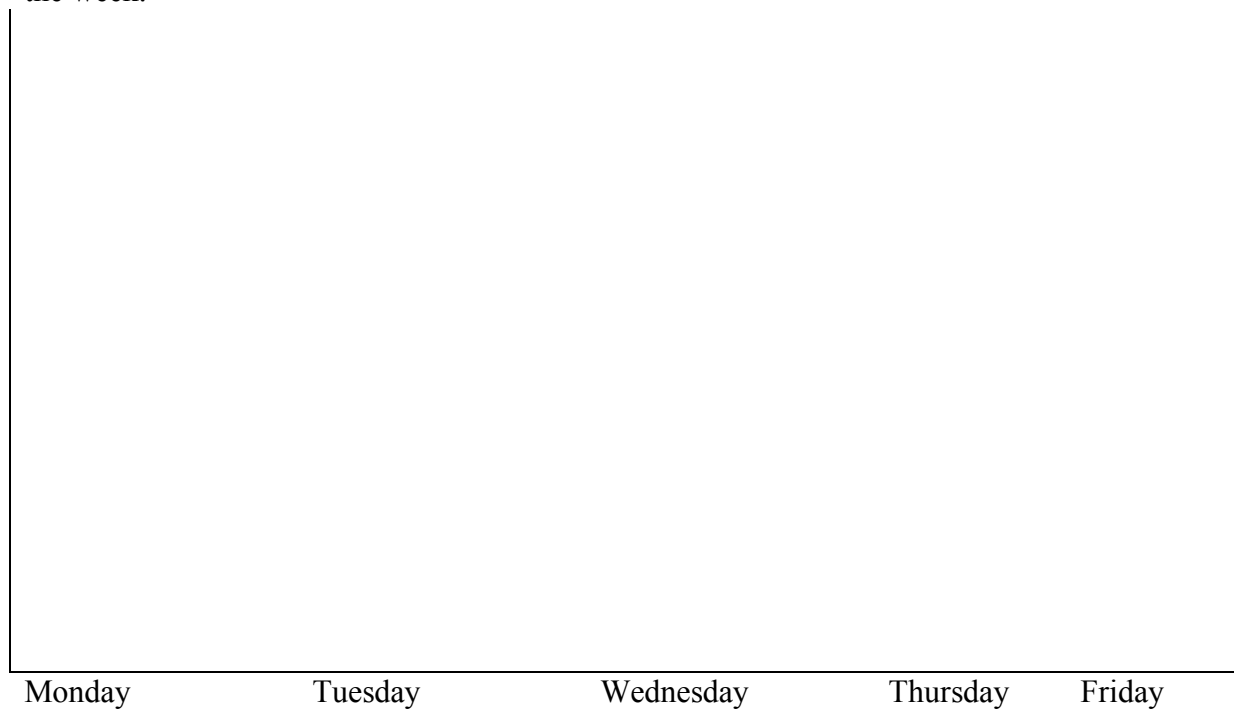
Fahrenheit and Celsius

Student Data Log

For one week, record the indoor and outdoor temperatures in degrees Fahrenheit and Celsius in the table below.

Date	Location	°Fahrenheit	°Celsius
	Indoor Outdoor	_____ _____	_____ _____
	Indoor Outdoor	_____ _____	_____ _____
	Indoor Outdoor	_____ _____	_____ _____
	Indoor Outdoor	_____ _____	_____ _____
	Indoor Outdoor	_____ _____	_____ _____

Make a bar graph or line plot below that compares the indoor and outdoor temperatures for the week.



Days of the Week

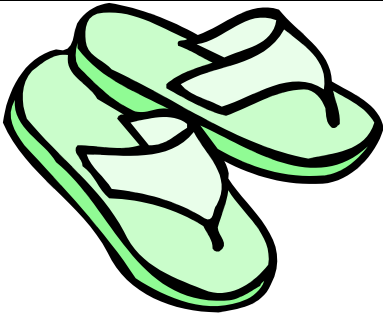
Temperature Flash Cards

85° F 29° C	20° F -7° C
56° F 13° C	73° F 23° C
83° F 28° C	3° F -16° C
62° F 17° C	71° F 22° C
95° F 35° C	35° F 2° C

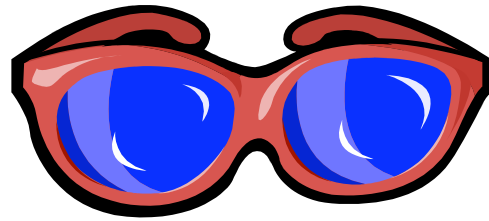
Temperature Flash Cards Page 2

68° F 20° C	64° F 18° C
79° F 26° C	41° F 5° C
72° F 22° C	53° F 12° C

Clothing Cards



Sandals



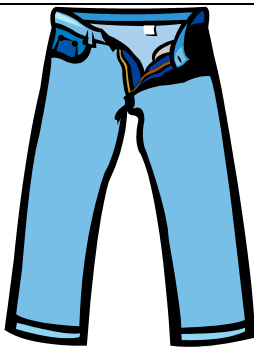
Sunglasses



T-shirt



Sneakers



Pants



Umbrella



Hat



Shorts



Long-sleeve shirt



Sweater



Jacket



Mittens



Boots



Winter coat