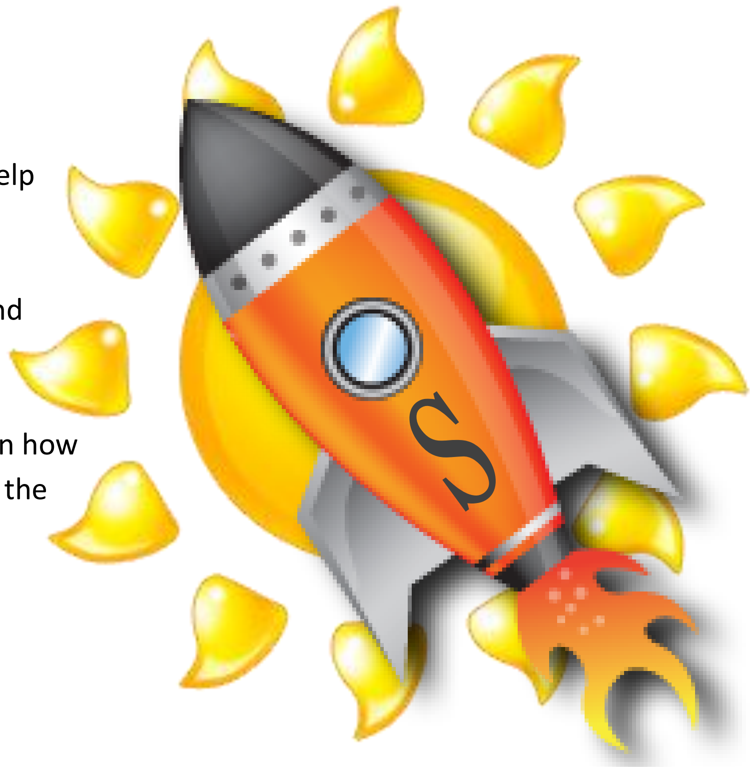
Solar Travels!



Lesson SPI Guidelines:

Use the activities in the lesson materials to help students practice the following grade-level appropriate SPI related skills, among many others. As you read the activities, keep in mind the specifics skills your students need to practice and master in the different grade levels and use them to guide your approach in how you present the activities and what you have the students do. You may add additional SPIs in your plans that are outside the specific ones listed below as appropriate.

2nd Grade:

Science SPIs:

- 7.10.2 Investigate how the sun affects various objects and materials.
- 7.10.1 Identify and explain how the sun affects objects on the surface of the earth.

Math SPIs:

- 6.5.1 Read, interpret, and analyze data shown in tables, bar graphs and picture graphs.
- 6.5.2 Read, interpret, and create tables using tally marks.
- 6.5.3 Explain whether a real world event is likely or unlikely.
- 6.5.4 Predict outcomes of events based on data gathered and displayed.
- 6.4.4 Estimate, measure, and calculate length to the nearest unit: meter, centimeter, yard, foot, and inch.
- 6.1.3 Use strategies to make estimates of time.
- 6.1.4 Solve problems involving elapsed time in hour and half-hour intervals.

RLA SPIs:

Writing

- 1.3.13 Incorporate photographs or illustrations in written work.
- 1.3.1 Write to describe, entertain, and inform.
- 1.3.2 Write in response to literature (e.g., create a new ending to a story, create class books, summarize a story), compose a variety of written works (e.g., friendly letters, journal entries, reports, experience stories) and begin to compose narratives (with a beginning, middle, and end).

- 1.3.3 Brainstorm ideas with teachers and peers, use graphic organizers (e.g., webs, charts, Venn diagrams) independently and/or in group, and use a variety of resources to gather information.
- 1.3.4 Use classroom resources to support the writing process.
- 1.3.5 Compose first drafts using the appropriate parts of the writing process with an emphasis on planning, organizing, and self correcting.
- 1.3.6 Use temporary/creative spelling to spell independently while transitioning to standard spelling in first drafts.
- 1.3.7 Arrange events in a logical and sequential order when writing.
- 1.3.8 Continue to add descriptive words and details to writing.
- 1.3.11 Incorporate suggestions from teachers and peers.

Research:

- 1.4.6 Understand the purpose of reference materials.
- 1.4.7 Write a simple research report that demonstrates a gathering of information.
- 1.4.1 Narrow a research question so that the research process is manageable.

Logic:

- 1.5.4 Compare and contrast information and ideas.

Informational Text:

- 1.6.3 Explore various forms of informational texts (e.g., newspapers, pamphlets, manuals, magazines).
- 1.6.4 Recognize and use text features to comprehend informational texts (e.g., time lines, graphs, charts, maps and legends, illustrations).

Media:

- 1.7.2 Experience and respond to a variety of media (e.g., books, audio, video, ipods, computers, illustrations).
- 1.7.4 Begin to utilize technology to create publications and presentations.

3rd Grade:

Science SPIs:

- CU 7.6.1 Create a model of the solar system depicting the major components and their relative positions and sizes.
- CU 7.6.2 Use a table to compare and contrast the major solar system components.
- SPI 7.6.1 Identify the major components of the solar system, i.e., sun, planets and moons.

Math SPIs:

- 0306.1.6 Identify and use vocabulary to describe attributes of two- and three-dimensional shapes.
- CU 6.4.10 Use reasonable units of length (i.e. kilometer, meter, centimeter; mile, yard, foot, inch) in estimates and measures.
- 0306.1.7 Select appropriate units and tools to solve problems involving measures.
- 0306.4.5 Choose reasonable units of measure, estimate common measurements using benchmarks, and use appropriate tools to make measurements.
- 0306.4.6 Measure length to the nearest centimeter or half inch.
- 0306.4.7 Solve problems requiring the addition and subtraction of lengths.
- 0306.5.2 Solve problems in which data is represented in tables or graphs.
- 0306.5.3 Make predictions based on various representations.

RLA SPIs:

Writing & Research:

- 0401.3.9 Select an appropriate title that reflects the topic of a written selection.
- 0401.3.10 Complete a graphic organizer (i.e., clustering, listing, mapping, webbing) to group ideas for writing.
- 0301.4.1 Identify the most reliable sources of information to support a research topic.
- 0301.4.2 Complete a simple graphic (e.g., chart, web) organizing information from text or technological sources.
- 0301.4.3 Select appropriate sources from which to gather information on a given topic.
- 0301.3.1 Identify the purpose for writing (i.e., to entertain, to inform, to respond to a picture, story, or art).

Communication & Media

- 0301.7.2 Select the most appropriate medium or media for accessing information, writing a report, or making a presentation.
- 0301.7.4 Choose the most effective medium to enhance a short oral presentation (e.g., still pictures, a model, short video clip, recording).

Logic

- 0401.5.1 Locate information to support opinions, predictions, and conclusions.

Informational Text:

- 0301.6.3 Indicate which illustration or graphic best supports a particular text.
- 0301.6.4 Locate information using available text features (e.g., charts, maps, graphics).

4th Grade:

Science SPIs:

- CU 7.11.1 Identify the position of objects relative to fixed reference points.
- SPI 7.11.1 Describe the position of an object relative to fixed reference points.

Math SPIs:

- 0406.2.10 Solve contextual problems using whole numbers, fractions, and decimals.
- 0406.1.4 Compare objects with respect to a given geometric or physical attribute and select appropriate measurement instrument.
- 0406.4.6 Determine situations in which a highly accurate measurement is important [or is not].
- 0406.4.7 Determine appropriate size of unit of measurement in problem situations involving length, capacity or weight.
- 0406.4.8 Convert measurements within a single system that are common in daily life (e.g., hours and minutes, inches and feet, centimeters and meters, quarts and gallons, liters and milliliters).
- 0406.5.1 Depict data using various representations (e.g., tables, pictographs, line graphs, bar graphs).
- 0406.5.2 Solve problems using estimation and comparison within a single set of data.
- CU 6.4.12 Estimate the size of an object with respect to a given measurement attribute (length, perimeter, area, or capacity).
- CU 6.4.13 Compare objects with respect to a given attribute such as length, area, and capacity.

RLA SPIs:

Writing and Research:

- 0401.3.1 Identify the purpose for writing (i.e., to entertain, to inform, to share experiences).
- 0401.3.2 Identify the audience for which a text is written.
- 0401.3.3 Choose a topic sentence for a paragraph.

- 0401.3.4 Select details that support a topic sentence.
- 0401.3.9 Select an appropriate title that reflects the topic of a written selection.
- 0401.3.10 Complete a graphic organizer (i.e., clustering, listing, mapping, webbing) to group ideas for writing.
- 0401.4.1 Select appropriate sources from which to gather information on a given topic.
- 0401.4.2 Rank the reliability of sources on a given topic.
- 0401.4.3 Complete a graphic organizer (e.g., chart, web) organizing material collected from text or technological sources.
- 0401.4.4 Differentiate among the kinds of information available in a variety of reference materials (i.e., dictionary, thesaurus, atlas, encyclopedia).

Communication & Media:

- 0401.7.1 Select the most appropriate and reliable media for accessing information, writing a report, or making a presentation.
- 0401.7.3 Choose the most effective medium to enhance a short oral presentation (e.g., still pictures, model, diorama, PowerPoint, recording).

Logic:

- 0401.5.1 Locate information to support opinions, predictions, and conclusions.

Informational Text:

- 0401.6.1 Select questions used to focus and clarify thinking before, during, and after reading text.

5th Grade:

Science SPIs:

- SPI 7.6.1 Distinguish among the planets according to their known characteristics such as appearance, location, composition, and apparent motion.
- SPI 7.6.2 Select information from a complex data representation to draw conclusions about the planets.
- SPI 7.12.1 Explain and give examples of how forces act at a distance.

Math SPIs:

- 0506.1.1 Given a series of geometric statements, draw a conclusion about the figure described.
- 0506.4.3 Identify a three-dimensional object from two-dimensional representations of that object and vice versa.
- 0506.4.6 Record measurements in context to reasonable degree of accuracy using decimals and/or fractions.
- 0506.4.8 Convert measurements
- 0506.2.1 Read and write numbers from millions to millionths in various contexts.
- 0506.5.1 Depict data using various representations, including decimal and/or fractional data.
- 0506.5.2 Make predictions based on various data representations.

RLA Standards:

Writing and Research

- 0501.3.1 Identify the audience for which a text is written.
- 0501.3.2 Identify the purpose for writing (i.e., to entertain, to inform, to share experiences, to persuade, to report).
- 0501.3.3 Choose the supporting sentence that best fits the context and flow of ideas in a paragraph.
- 0501.3.7 Select details that support a topic sentence.

- 0501.3.8 Select vivid and active words for a writing sample.
- 0501.3.9 Choose the sentence that best supports the topic sentence and fits the flow of ideas in a paragraph.
- 0501.3.10 Select appropriate time-order or transitional words/phrases to enhance the flow of a writing sample.
- 0501.3.11 Rearrange paragraphs in a narrative writing selection in sequential and chronological order.
- 0501.3.12 Select an appropriate title that reflects the topic of a written selection.
- 0501.3.13 Complete a graphic organizer (i.e., clustering, listing, mapping, webbing) to group ideas for writing.
- 0501.4.1 Identify the most reliable information sources available for preparing a research report.
- 0501.4.2 Identify information that should or should not be included in a citation.
- 0501.4.3 Complete a graphic organizer (e.g., chart, web) organizing material collected from text or technological sources.
- 0501.4.4 Select appropriate sources from which to gather information on a given topic.

Communication & Media

- 0501.2.1 Identify the audience for a given speech.
- 0501.2.4 Organize ideas in the most effective order for an oral presentation.
- 0501.7.1 Select the most appropriate medium or media for accessing information, writing a report, or enhancing an oral presentation.

Logic:

- 0501.5.1 Locate information to support opinions, predictions, and conclusions.
- 0501.5.6 Make inferences and draw appropriate conclusions from text.
- Informational Text:
- 0501.6.1 Select questions used to focus and clarify thinking before, during, and after reading text.

6th Grade:

Science SPIs:

- CU 7.6.1 Use data to draw conclusions about the major components of the universe.
- CU 7.6.2 Construct a model of the solar system showing accurate positional relationships and relative distances.
- SPI 7.6.1 Use data to draw conclusions about the major components of the universe.
- SPI 7.6.2 Explain how the relative distance of objects from the earth affects how they appear.

Math SPIs:

- 0606.1.1 Make conjectures and predictions based on data.
- 0606.1.3 Use concrete, pictorial, and symbolic representation for integers.
- 0606.2.5 Transform numbers from one form to another (fractions, decimals, percents, and mixed numbers).
- 0606.4.4 Calculate with circumferences and areas of circles.
- 0606.4.1 Identify, define or describe geometric shapes given a visual representation or a written description of its properties.
- 6.3.4 Generate data and graph relationships concerning measurement of length, area, volume, weight, time, temperature, money, and information.

RLA SPIs:

Writing and Research

- 0601.3.1 Identify the purpose for writing (i.e., to inform, to describe, to explain, to persuade).
- 0601.3.2 Identify the audience for which a text is written.
- 0601.3.3 Select an appropriate thesis statement for a writing sample.
- 0601.3.5 Select illustrations, descriptions, and/or facts to support key ideas.
- 0601.3.6 Choose the supporting sentence that best fits the context flow of ideas in a paragraph.
- 0601.3.7 Identify sentences irrelevant to a paragraph's theme or flow.
- 0601.3.8 Select appropriate time-order or transitional words/phrases to enhance the flow of a writing sample.
- 0601.3.9 Select an appropriate concluding sentence for a well-developed paragraph.
- 0601.3.10Select an appropriate title that reflects the topic of a written selection.
- 0601.3.11Complete a graphic organizer (e.g., clustering, listing, mapping, webbing) with information from notes for a writing selection.
- 0601.4.2 Rank research resources according to reliability.
- 0601.4.3 Determine the most appropriate research source for a given research topic.

Communication and Media:

- 0601.2.1 Identify the purpose of a speech (i.e., to inform, to describe, to explain, to persuade, to entertain).
- 0601.2.2 Identify the targeted audience of a speech.
- 0601.2.7 Organize ideas in the most effective order for an oral presentation.
- 0601.7.1 Select the medium that best reinforces a viewpoint or enhances a presentation.
- 0601.7.2 Select the visual image that best reinforces a viewpoint or enhances a presentation.

Logic:

- 0601.5.7 Make inferences and draw conclusions based on evidence in text.

7th Grade:

Science SPIs:

- SPI 7.11.4 Identify and explain how Newton's laws of motion relate to the movement of objects.

Math SPIs:

- 0706.1.3 Recognize whether information given in a table, graph, or formula suggests a directly proportional, linear, inversely proportional, or other nonlinear relationship.
- 6.2.8 Apply ratios, rates, proportions and percents (such as discounts, interest, taxes, tips, distance/rate/time, and percent increase or decrease).
- 0706.5.1 Interpret and employ various graphs and charts to represent data.
- 0706.2.7 Use ratios and proportions to solve problems.
- 0706.1.4 Use scales, ex. to read maps.
- 0706.4.3 Apply scale factor to solve problems involving area and volume.

RLA SPIs:

Writing and Research

- 0701.3.1Identify the purpose for writing (i.e., to inform, to describe, to explain, to persuade, to entertain).
- 0701.3.2Identify the audience for which a text is written.
- 0701.3.3Select an appropriate thesis statement for a writing sample.

- 0701.3.5 Select the appropriate time-order or transitional words/phrases to enhance the flow of a writing sample.
- 0701.3.6 Choose the supporting sentence that best fits the context and flow of ideas in a paragraph.
- 0701.3.7 Identify the sentence(s) irrelevant to a paragraph's theme or flow.
- 0701.3.8 Select an appropriate concluding sentence for a well-developed paragraph.
- 0701.3.9 Select illustrations, explanations, anecdotes, descriptions and/or facts to support key ideas.
- 0701.3.10 Select an appropriate title that reflects the topic of a written selection.
- 0701.3.12 Complete a graphic organizer (e.g., clustering, listing, mapping, webbing) with information from notes for a writing selection.
- 0701.4.1 Select the most focused research topic.
- 0701.4.2 Identify levels of reliability among resources (e.g., eyewitness account, newspaper account, supermarket tabloid account, Internet source).
- 0701.4.3 Determine the most appropriate research source for a given research topic.

Communication & Media:

- 0701.2.1 Identify the purpose of a speech (i.e., to inform, to describe, to explain, to persuade, to entertain).
- 0701.2.2 Identify the targeted audience of a speech.
- 0701.2.3 Identify the thesis and main points of a speech.
- 0701.2.4 Determine the most effective methods for engaging an audience during an oral presentation (e.g., making eye contact, adjusting speaking rate).
- 0701.2.5 Organize ideas in the most effective order for an oral presentation.
- 0701.7.2 Select the visual image that best reinforces a viewpoint or enhances a presentation.

Informational Text:

- 0701.6.1 Formulate clarifying questions before, during, or after reading.
- 0701.6.3 Use text features to locate information and make meaning from text (e.g., headings, key words, captions, footnotes).
- 0701.6.4 Interpret factual, quantitative, technical, or mathematical information presented in text features (e.g., maps, charts, graphs, time lines, tables, and diagrams).

8th Grade:

Science SPIs:

- 7.12.6 Identify factors that influence the amount of gravitational force between objects.
- 7.12.7 Explain how the motion of objects in the solar system is affected by gravity.
- SPI 7.12.5 Determine the relationship among the mass of objects, the distance between these objects, and the amount of gravitational attraction.
- SPI 7.12.6 Illustrate how gravity controls the motion of objects in the solar system.

Math SPIs:

- 0806.1.1 Solve problems involving rate/time/distance (i.e., d = rt).
- 0806.1.2 Interpret a qualitative graph representing a contextual situation.
- 0806.1.3 Calculate rates involving cost per unit to determine the best buy.
- 0806.4.4 Convert between and within the U.S. Customary System and the metric system.

RLA SPIs:

Writing & Research:

- 0801.3.1 Identify the purpose for writing (i.e., to inform, to describe, to explain, to persuade, to entertain).
- 0801.3.2 Identify the targeted audience for a selected passage.
- 0801.3.3 Select an appropriate thesis statement for a writing sample.
- 0801.3.5 Select appropriate time-order or transitional words/phrases to enhance the flow of a writing sample.
- 0801.3.6 Choose the supporting sentence that best fits the context and flow of ideas in a paragraph.
- 0801.3.8 Select vivid words to strengthen a description (adjective or adverb) within a writing sample or passage.
- 0801.3.9 Select illustrations, explanations, anecdotes, descriptions and/or facts to support key ideas.
- 0801.3.10 Select an appropriate title that reflects the topic of a written selection.
- 0801.3.12 Complete a graphic organizer (e.g., clustering, listing, mapping, webbing) with information from notes for a writing selection.
- 0801.4.2 Identify levels of reliability among resources (e.g., eyewitness account, newspaper account, supermarket tabloid account, Internet source).
- 0801.4.3 Determine the most appropriate research source for a given research topic.
- 0801.4.4 Distinguish between primary (i.e., interviews, letters, diaries, newspapers, autobiographies, personal narratives) and secondary (i.e., reference books, periodicals, Internet, biographies, informational texts).

Communication & Media:

- 0801.2.1 Identify the purpose of a speech (i.e., to inform, to describe, to explain, to persuade, to entertain).
- 0801.2.2 Identify the targeted audience of a speech.
- 0801.2.3 Identify the thesis and main points of a speech.
- 0801.2.4 Determine the most effective methods of engaging an audience during an oral presentation (e.g., making eye contact, adjusting speaking rate).
- 0801.7.2 Select a visual image that best reinforces a viewpoint or enhances a presentation.

Informational Text:

- 0801.6.1 Formulate appropriate questions before, during, and after reading.
- 0801.6.3 Use text features to locate information and make meaning from text (e.g., headings, key words, captions, footnotes).
- 0801.6.4 Interpret factual, quantitative, technical, or mathematical information presented in text features (e.g., maps, charts, graphs, time lines, tables, and diagrams).

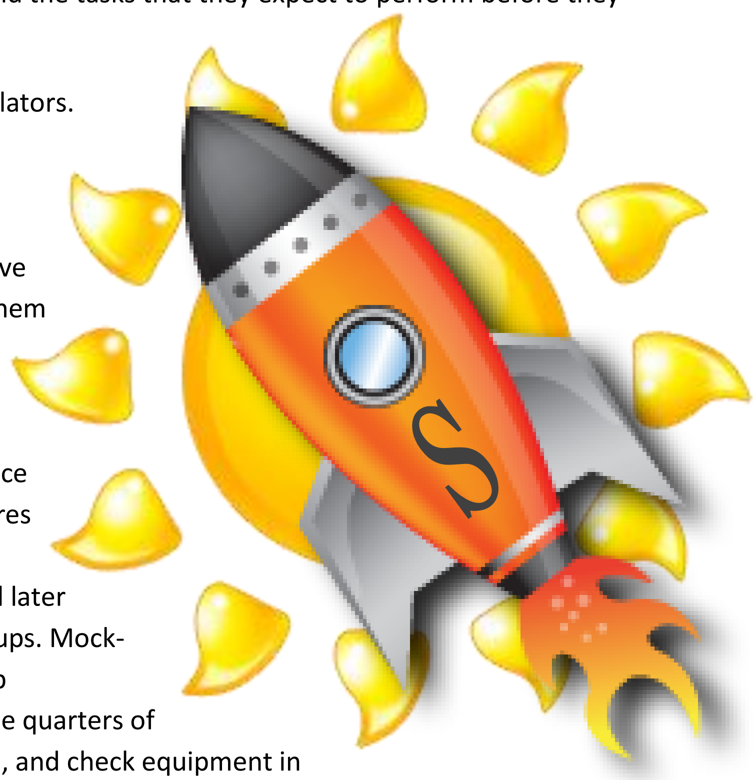
Solar Travels!

Activity ideas and directions found at http://www.asdk12.org/depts/science/PlanetWalkWEBQUEST.HTM. Accessed 10/25/11.

Many science fiction stories involve everyday people traveling in space. Right now, that privilege is reserved for trained astronauts and robotic devices. And for now, most of that exploration, at least the human component of it, is occurring only in low Earth orbit. That will be changing soon.

What do astronauts have to go through to get ready for space?

An astronaut is a person who pilots a spacecraft or works in space to complete a mission. Russian astronauts are called cosmonauts. French astronauts are called spacetionauts. The word astronaut comes from Greek words that mean sailor among the stars. Cosmonaut means sailor of the universe. All astronauts in space shuttles must be able to speak English. There is no age limit, but all candidates must pass the NASA space flight physical. They also must be between 5 feet 4inches and 6 feet 4 inches tall. Astronauts have to train for every possible emergency. They also need to become familiar with the spacecraft and instruments that they will be using and the tasks that they expect to perform before they go into space.



Astronauts spend most of their time training in simulators. Simulators are devices that reproduce/recreate the conditions of space flight. Crewmembers spend as many as eight hours a day in simulators rehearsing every part of their mission. Instructors continually give the crew problems to solve and correct to prepare them for all possible emergency situations. Astronauts spend more time in simulators than they ever will in space. All phases of a mission including launch, docking to the space station, releasing satellites, space walks, landing and even emergency bailout procedures have to be thoroughly practiced. They think of the simulators as valuable preparation for what they will later face on actual flights. Astronauts also train in mock-ups. Mock-ups are full sized models of the spacecraft. They help crewmembers practice working and living in the close quarters of the spacecraft. Astronauts store items, prepare food, and check equipment in the mock-ups. They also practice entering and leaving the spacecraft. Rookie astronauts may spend as long as 18 months training for a mission. Astronauts who already have traveled in space may need only 6 months of training before they are ready to fly again.

- One way astronauts train for spacewalks is by going for a swim. Floating in space is a lot like floating in water. Astronauts practice spacewalks underwater in the world's largest swimming pool (202 feet wide, 202 feet long, over 40 feet deep and holding over 6 million gallons of water.. Astronauts train seven hours in the pool for every one hour they will spend on a spacewalk. Give students a glimpse by watching: http://science.discovery.com/videos/how-do-they-do-it-space-training-astronauts.html

- Another way astronauts practice for a spacewalk is by using virtual reality. This is sort of like playing a video game. Astronauts wear a helmet with a video screen inside. They also wear special gloves. A video of what they will see during a spacewalk is shown on the screen inside the helmet. When the astronaut moves, the special gloves allow the movements to be shown with the video. The virtual reality simulation looks and feels just like a spacewalk.

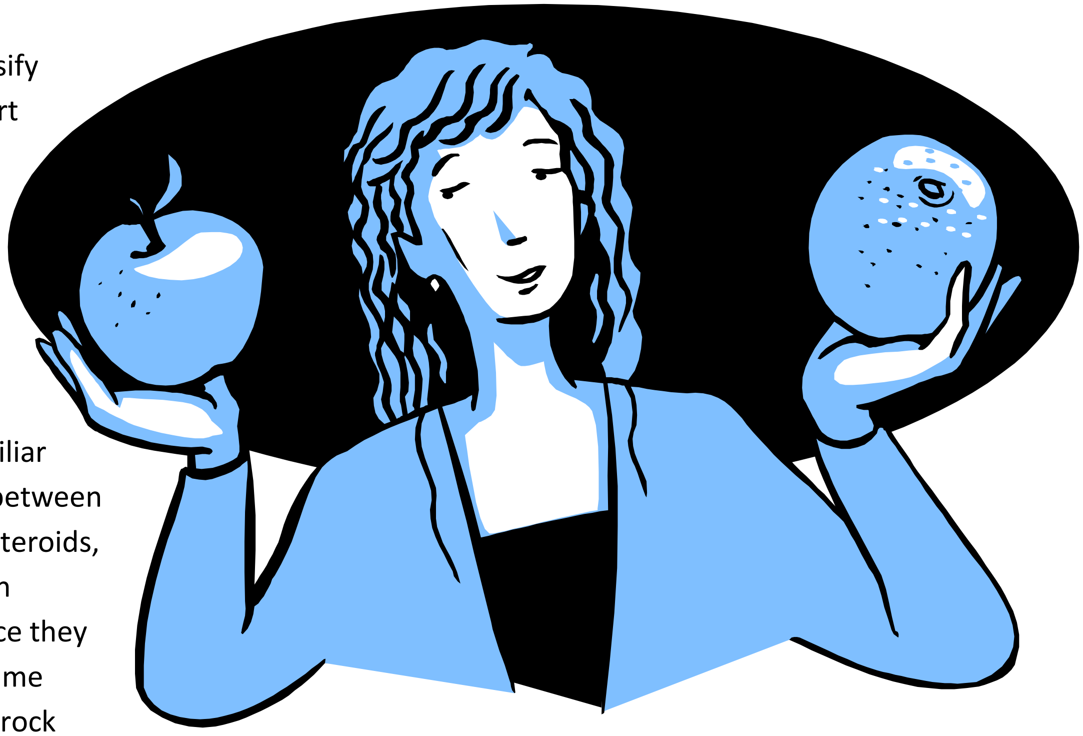
The following activities may be done in several ways and adjusted to fit the skill and time parameters of your group.

For example:

- This may be done as an individual or small group project, the instructor having chosen several or more components out of the following projects for students to complete and assigned [or randomly drawn out] celestial bodies for groups to focus on. If you have a large number of teams, you can include some of the moons of the solar system, or comets and asteroids, [Sample Additional Destinations: the "Tenth Planet" Titan, Europa, Io, Ganymede, Callisto, the moon, the asteroid belt, Phobos, Deimos, Titania, Oberon, Umbriel, Ariel, Miranda, Triton, Charon, Halley's Comet, Comet Kohoutek, Shoemaker-Levy Comet, other comets.]
- Or, it may be done as a whole class project, (or ½ class, meaning two large groups, depending on class size) with groups assigned to complete one component, or several components, though all students will learn about each topic. Ex. One group, the Rocketeers, are assigned rocket design for the project, though all students participate in creating paper rockets and learning about how rockets work. Another group, The Travel Agents, may be assigned the brochure, etc.

Each project should include real facts about the solar system object, but may use "far-out" features to form the basis of unusual recreation opportunities. When everyone is finished, regardless of how you structured it (whole class or smaller groups) each team presents its product to the rest of the class.

What's the Difference?

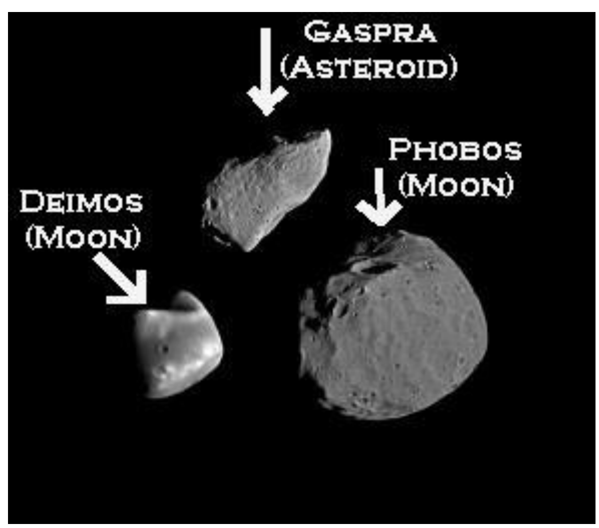


It is important to classify objects, it's simply part of the scientific endeavor. Biologists classify life, while chemists classify compounds and so on.

If students are unfamiliar with the differences between Asteroids [Comets, asteroids, and meteors are often grouped together since they are all basically the same thing: small pieces of rock and/or ice that aren't part of a major planet], Moons, & Planets have them use, or work together as a class using the included graphic organizer to research and discuss similarities and differences.

Sample Data:

Asteroid: An asteroid is an object in space that orbits around the sun, made of rock and metal, they can also contain organic compounds. Some, like Ceres, can be very large, while others are as small as a grain of sand. Due to their smaller size, asteroids do not have enough gravity to pull themselves into the shape of a ball. Astronomers group asteroids into different categories based on the way they reflect sunlight. There is one asteroid named Ida that is unique. Ida is a neat little asteroid about 36 miles wide. It is unique because it has its own little moon called Dactyl.



Moon: A natural satellite of a planet. Conventionally it is designated as any object orbiting a planetary object. Moons actually share much in common with planets in general, but there is one important distinction; namely that it orbits a body other than our Sun. There is actually no strict definition of what a moon is, but there are some commonalities between those objects considered moons, also called satellites. They all are:

- Distinct, whole objects
- Solid objects
- In orbit around a more massive body (that presumably orbits a star)

But moons also come in all shapes in sizes. We tend to think of objects like our Moon that are large and round, but moons like Phobos and Deimos (the Moons of Mars) look more like small irregularly shaped asteroids.

Planet: Planets can be wildly different from each other, so our current clumping of all the round, non-star, non-moon objects in our solar system is not ideal. According to the International Astronomical Union [IAU], in order to earn the designation of planet:

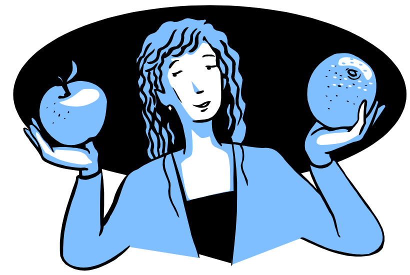
- The object must have sufficient gravity to become round.
- It orbits a sun/star.
- It cannot be so massive that it ignites nuclear burning like a star
- It has cleared its orbital path of debris. [This is what got Pluto in trouble, it hasn't cleared its orbit of debris, and thus, according to the IAU, is a dwarf planet. Not all scientists agree with this, there's a lot of arguing going on in the scientific community about just what Pluto is.]

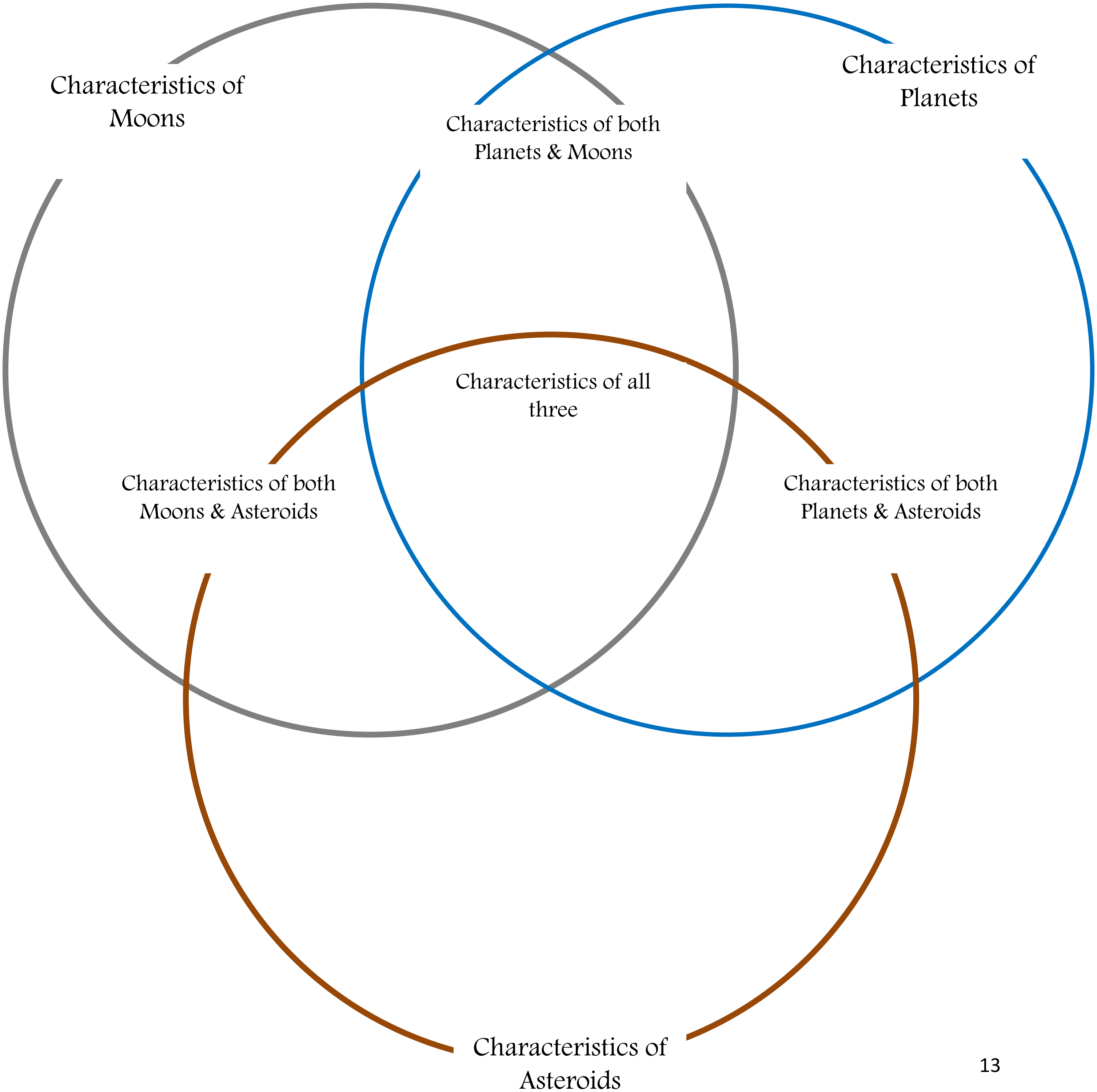
Variations:

- Have students do a simple compare/contrast with just two of the objects.
- You can have students illustrate/animate the characteristics instead of writing them out.
- Form groups and have a debate about which of the three has the most interesting characteristics.

What's the Difference?

Use this graphic organizer to identify and compare / contrast the characteristics of Moons, Planets, and Asteroids.





Designing the Mission:

Tell students they have been hired by Solar Travels, Inc. They and their team are in charge of a new company division that will put together a vacation package that can safely deliver the company's very important clients (V.I.C) to the ultimate vacation destination. There are many other groups in the company competing to be in charge of this new division, but they want to their group take the lead and win the bonus and be the official head of the new Space Vacations Division.

Explain that the class will work in groups to create complete vacation packages for different planets in our solar system. This will include all nine planets, and possibly other celestial bodies. (Explain that Earth is included because as we begin to explore and live on other planets, settlers on those planets will not consider Earth as their home. They can visit Earth as a vacation. You may determine, due to group size or preference, whether or not you wish to include Pluto, due to its recent demotion to "dwarf planet")

Image Credit: CG Artist Mathias Pederson. www.MathiasPedersen.com http://blenderartists.org/forum/showthread.php?96164-Poor-Pluto.

Encourage each group to consider the various problems associated with civilian space travel as well as the factors that might influence people to choose to risk such travel.

Have the groups brainstorm a space related name for the group, this name will be used to associate with their group throughout the course of the unit, and the positions of each person, though all will have to participate in planning each part. For example, their team could consist of a rocket specialist, space suit designer, travel agent and astronomer.

Ex: Astronomer: They will be considered the team's expert on the physical conditions of the planet and how these conditions affect the ability of humans to live and breathe on this planet.

During each phase, or for each section, of the project:

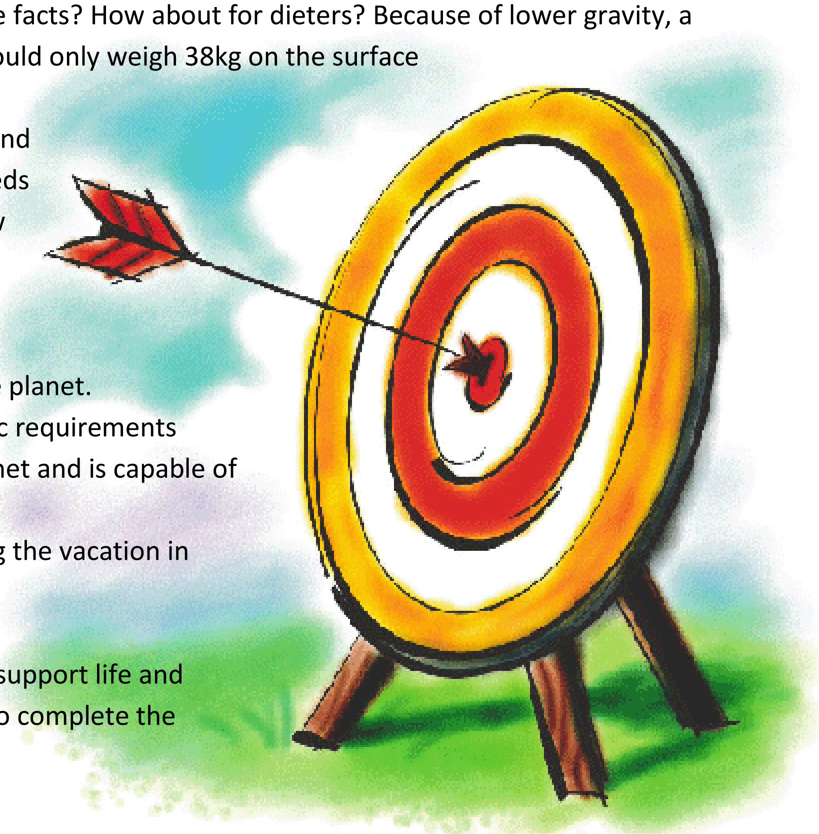
- Brochure,
- Space Suit,
- Rocket,
- Flag,

- Anthem,
- Video

The project's overall goals include the following:

Students will:

- Research their planet, identify the challenges it presents to living things, and create realistic and/or humorous or fantastic solutions to overcome the challenges. For example: If they had Saturn, which has no solid surface, would they have to take travelers to one of Saturn's moons instead? Which one? For example, the largest, Titan, is the only moon in the Solar System with a substantial atmosphere. Or could they have their tourists swim in hydrogen (very explosive) and helium (with squeaky voices)?
- Each project should include real facts about the solar system object, but may use "far-out" features to form the basis of unusual recreation opportunities. [ex. The only planet that rotates on its side like a barrel is Uranus. The only planet that spins backwards relative to the others is Venus. What could be done with those facts? How about for dieters? Because of lower gravity, a person who weighs 100kg on earth would only weigh 38kg on the surface of Mars. Instant weight loss!]
- Consider the needs of human beings and whether the means to meet those needs exists on that planet. If they don't how will they get them there?
- Create a division logo and tagline.
- Produce a complete vacation package highlighting the special features of the planet.
- Invent a spacesuit that meets the basic requirements for living things on your particular planet and is capable of enduring the trip.
- Generate a travel brochure advertising the vacation in detail.
- Design a paper rocket and launch it.
- Design a rocket that has the ability to support life and special features that would enable it to complete the vacation and return safely.
- Create a flag for their planet.
- Create a (humorous) planetary anthem.
- Voyage to their planet if possible (Option: have this be part of the Planet Walk field trip).



- Present their vacation package to a group of investors and potential customers [their classmates] interested in providing funding for and participating in their project.
- Be prepared to answer any questions the investors may ask.

Come Fly With Me, Come Fly Away!

Creating a Brochure

Inform students their task is to create a travel brochure like they might find in a travel agency. Tip: provide some examples of real travel brochures or websites with travel ads available for students to preview.
View one student sample at:

http://townsendps.schoolwires.com/7227010419756/lib/7227010419756/Space_Travel_Brochure.pdf

Have students keep in mind the make-up and special features of their destination, taking into account the environmental conditions, and thinking about some of the recreational activities and adventures that could be possible there, Ex. Olympus Mons Volcano on Mars. Remind them, they are trying to convince their very picky public that their destination is the best place to go on vacation! They want to be creative and use a hook to get their audience to come and visit their planet/comet/moon. They want to make the data sound extraordinary but keep the information factual. i.e. Mercury's period of rotation is 59 Earth days long, they can use this information to their advantage. 'Do you like the warmth of summer and its sunshine, looking for that great tan? Then you need to come to the planet Mercury, were the sun shines for 59 days straight and never sets.'

Students may "cut and paste" a brochure on plain paper, or you can have them create one on the computer. Brochure templates are available through Microsoft Word, Microsoft Publisher and sometimes free online.

The brochure should contain the following:

• Information about the physical characteristics of the planet

Examples:

- Name of destination
- Distance from the Sun
- Surface temperature range
- Orbital period (length of year in Earth days or years)

- Rotational period (length of day in Earth hours or days)
- Main components of the atmosphere
- Gravity
- Moons
- Rings
- Key attractions (volcanoes, hurricanes, craters, etc.)
- Any other interesting facts that visitors should be aware of

• Historical information about planet (significance of planet's name, visits by space probes, important discoveries about planet)

• Descriptions of the uniqueness of your planet

• Retell, summarize, or provide a synopsis of a mythological account from any culture about this planet

• Division name, logos, and taglines: Students should use their artistic skills to design a unique logo that visually represents their division and/or their planet (see the two created samples in this section, and the one real organization logo). Students can free draw and/or use Clip Art, text boxes, and interesting fonts to help.

- Graphics (include at least three pictures)

The brochure may also include the following:

• How information about the various planets has been gathered

• Technical information using graphs, charts, and graphic organizers

• Build a scale model of your planet

• Additional creative ideas, ex.

  - Ratings by travel magazines: Wild Blue Yonder magazine rated "Spark, inc." the number one outer-space travel company, giving 5 of 5 stars!
  - Comments from past travelers who used their service on past voyages: "I highly recommend Saturn Siesta tours. They provide information and experience that is above and beyond other space travel companies!" - A. Learner (Schools, USA)
    "You get a real bang for your buck! I hope to become an annual voyager." – Star. Y. Trekker (Smalltownville, USA)

AGENCIA ESPACIAL MEXICANA

Spark

Start Something

Saturn Siestas!

You really need some Space

Sample Layout: Travel Brochure [Outside]

Fun Planet Fact

Pictures of various activities available on the planet for tourists

Caption describing picture above

Solar Destination Travel Division:

Brochure Template

Company Division Name

Street Address
City, State, Zip Code
Phone Number
Fax Number
E-mail address
Website

Your company logo

PLANET NAME

Planet nickname or famous features

Planet Photo

Creative saying that will interest people in visiting this planet.

Sample Layout: Travel Brochure [Inside]

Planet Slogan or Rhyming Phrase…

Picture of planet's unique physical features

Caption describing picture above

Planet Characteristics

When readers open the brochure, this is the first text they will see, making this a good place to briefly but effectively summarize the best features of your planet.

Make this text interesting so that readers will want to read the rest of the brochure.

Include:

- Size
- Color
- Temperature
- Orbit and rotation speed
- Visual features
- Planet composition
- Distance from the Sun

Reviews

- Three testimonials from previous tourists

Photo of happy tourists on the planet

Caption describing picture above

Tour Features

- Views of Moons, etc.
- Trip includes…
- Sightseeing of physical traits of planet
- Description of food and lodging
- Costs for trip
- Anything else you can think of…

Reservation Information

Clear instructions for making reservations to visit the planet.

We Lost the Tourists?!

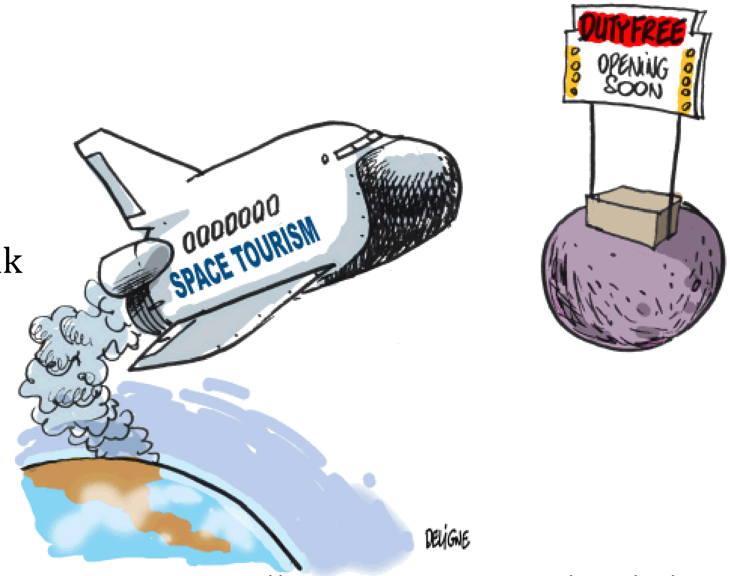


Image Credit: http://rghadawala.blogspot.com/2010/10/issues-opportunities-and-challenges.html.

When you're in charge you have to think of every possible scenario, the good, the bad, and the terrifying. You are doing your first tour, hoping everything goes right, and then you get the following message… Fill in the blanks with words of your choice or those from your friends & then read the Mission Control Log out loud.

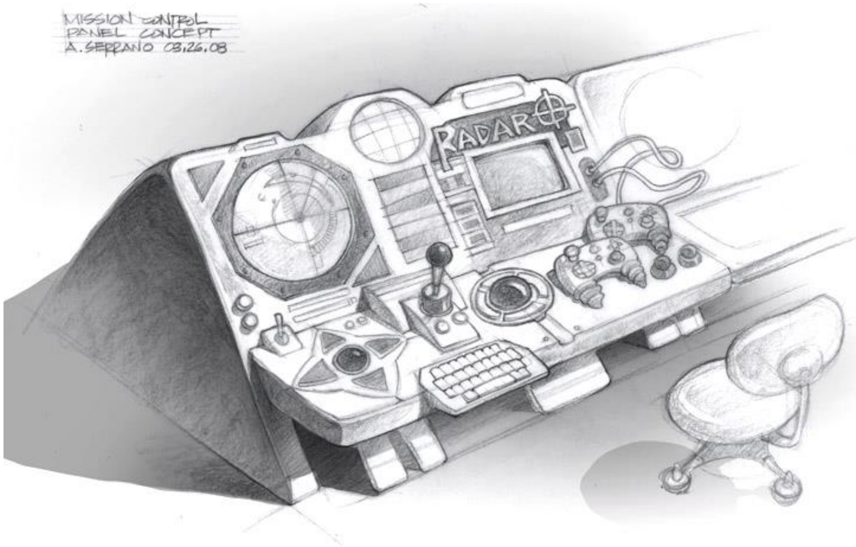
> Noun- A word that represents a person, place, thing, or idea.
> Adjective- A word that describes a noun.
> Verb- A word that expresses action (i.e.: jump, run, drink) or a state of being (i.e.: was, were, are, etc.).
> Adverb- A word that describes a verb, usually ending in "-ly."
> Exclamation- A word that represents a sound, outcry, gasp, emotion, etc.

Mission Control! Mission Control, this is __________________________ (famous person) contacting you from our space ____________ (noun). Our blast off was _______________ (adjective). We reached a traveling speed of ___________________ (number) miles per ____________ (unit of time), and we think we are now orbiting and ______________ (verb) around ___________________ (Planet) . It is _________________________ (adjective) here and we were amazed to see that this _____________________ (noun) rotates much more ____________________ (adjective) than Earth.

The gravitational pull is ___________________ (adverb/adjective) and we're having a hard time _________________________ (verb ending in –ing). Our ____________ (plural nouns) are very _________________________ (adjective) because it takes ___________________(number) hours to revolve around the _________________________ (noun). If our trajectory is correct, we will be ____________ (verb ending in –ing) to _________________________ (location) in _________________________ (number) _________________________ (unit of time) . Please tell our _________________________ (plural noun) that we miss them and will _________________________ (verb) them soon. Once we are back on Earth, the first thing we will do is ____________________ (verb) to our ____________________ (plural noun) and then say "_________________________! (exclamation)"

Choose your own Mission Control response: ______________________________________

____(Concluding sentence(s)).



Visual Development by ARMAND SERRANO for *Arthur Christmas*. ©Sony Pictures Animation

Now, CREATE YOUR OWN LOGS!
Write your own log to or from Mission Control. Remove some of the words and replace with a blank. Under each blank, or next to it, write the type of word that goes needs to be replaced.

Lost in Space?

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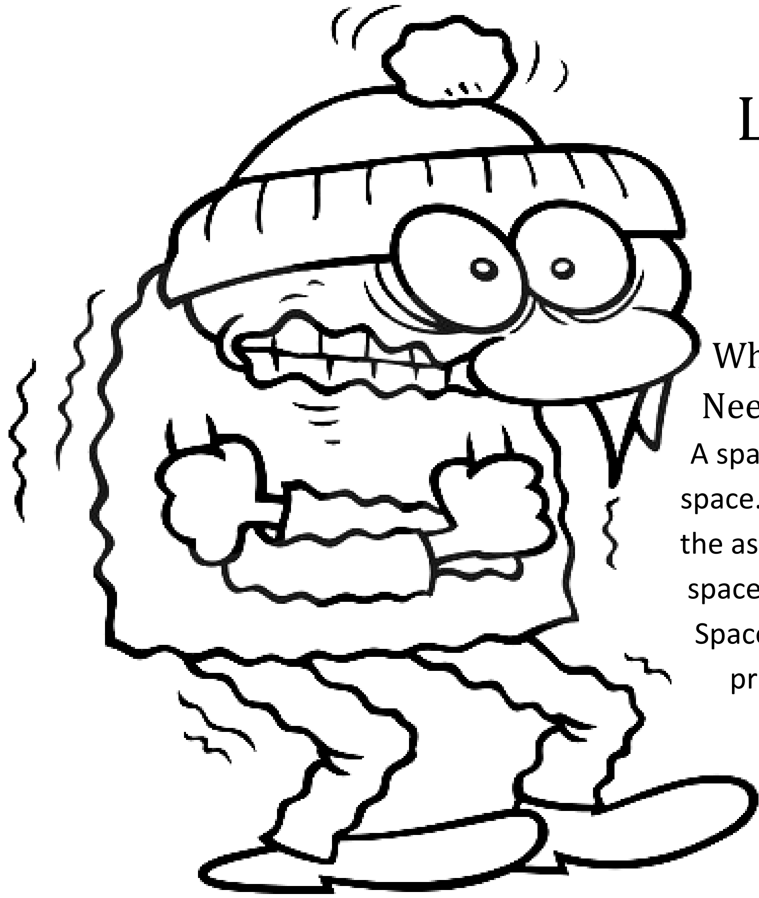


Layer Up, it’s Cold Out There!

Spacesuits

Why Do Astronauts or Space travelers Need Spacesuits?

A spacesuit is more than clothes astronauts wear in space. The suit is really a small spacecraft. It protects the astronaut from the dangers of being outside in space.

Spacesuits help astronauts in many ways. The suits protect astronauts from getting too hot or cold. Spacesuits also give astronauts oxygen to breathe while they are working in space. The suits hold water to drink. They also keep astronauts from getting hurt by space dust. Space dust may not sound very dangerous. But when it moves faster than a bullet, the dust can hurt someone. The suits even have special gold-lined visors to protect eyes from bright sunlight.

What are some of the parts of a spacesuit?

A spacesuit is made up of many parts. One part covers the astronaut's chest. Another part covers the arms and connects to the gloves. The helmet protects the head. And the last part covers the astronaut's legs and feet. Some parts of the suit are made of many layers of material. Each layer does something different. Some keep oxygen in the suit while others protect astronauts from space dust.

Under the suit, astronauts wear another piece of clothing. It covers their entire body except for the head, hands and feet. Tubes are woven into it and water flows through the tubes to keep the astronaut cool.

On the back of the spacesuit is a backpack. A huge and important improvement from early space suits, astronauts now have the ability to travel outside of the space station without limited maneuverability (motion). It wasn’t always that way, astronauts/cosmonauts used to be attached by umbilical cords to the ship or station, just like a baby is to its mother, giving them power and oxygen. **What might be some dangers in having astronauts connected to the ship**

by long cords? Have students watch the video at http://science.discovery.com/videos/big-bigger-biggest-space-suits.html to see how, and why, these improvements came about.

The backpack holds oxygen so astronauts can breathe. It also removes carbon dioxide that astronauts have breathed out. The backpack also supplies electricity for the suit. A fan moves the oxygen through the spacesuit. A water tank holds the cooling water. Connected to the back of the suit is a tool called SAFER. SAFER has several small thruster (pushing) jets. If an astronaut floated away from the space station, he or she could use SAFER to fly back.

Make it Their Own: Space Suits

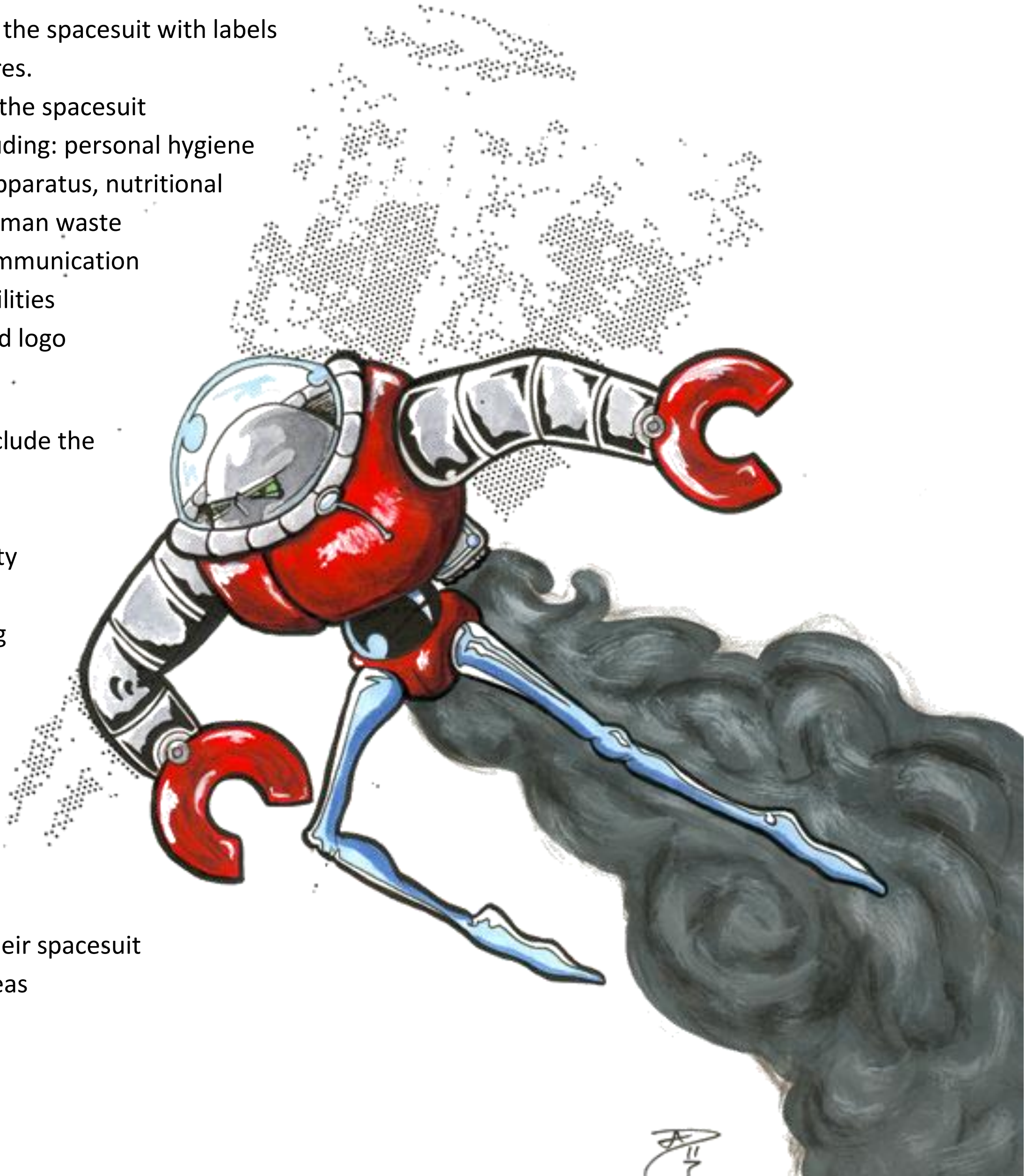
The spacesuit each group designs needs to contain the following:

- Design features that counteract the challenges of the physical environment for humans vacationing on that planet
- A drawing or painting of the spacesuit with labels pointing out special features.
- A written description of the spacesuit
- Instructions for use including: personal hygiene capabilities, a breathing apparatus, nutritional and hydration support, human waste elimination features, a communication device, and movement abilities
- Their division's name and logo

Creative Bonus:

The spacesuit may also include the following:

- Cleaning instructions
- Fire and accident safety features
- Advertisements noting special features of the spacesuit
- Comfort and stylish design
- Corporate sponsors (like on Nascar drivers uniforms)
- Build a 3D model of their spacesuit
- Additional creative ideas



Rocket Man Image Credit: Joseph A. Dinunzio of The Salty Slug. http://thesaltyslug.blogspot.com/2011/12/rocket-man.html. [Copyright 2011](#). All Rights Reserved.

Thirsty? Welcome to Hydration Station

Throughout this lesson, emphasize the steps involved in the scientific method.
Problem: How can I identify different levels of hydration?
Solution: Create simulated urine!

Materials:

Per class:

- One water bottle picture
- 2-3 bandanas
- Urine color chart
- Projector
- Computer with internet access

Per groups of 3-4 students:

- One poster board or chart paper
- One set of Markers
- Two computers with internet access
- One Hydration/Dehydration chart or poster
- Four clear plastic cups
- One disposable 8 inch plate
- Two toothpicks
- One small bottle of Yellow, Red and Green food coloring each
- One Urine hydration color chart
- One set of Hydration cards
- Hydrate the Astronaut
- Urine hydration color chart
- Pencil

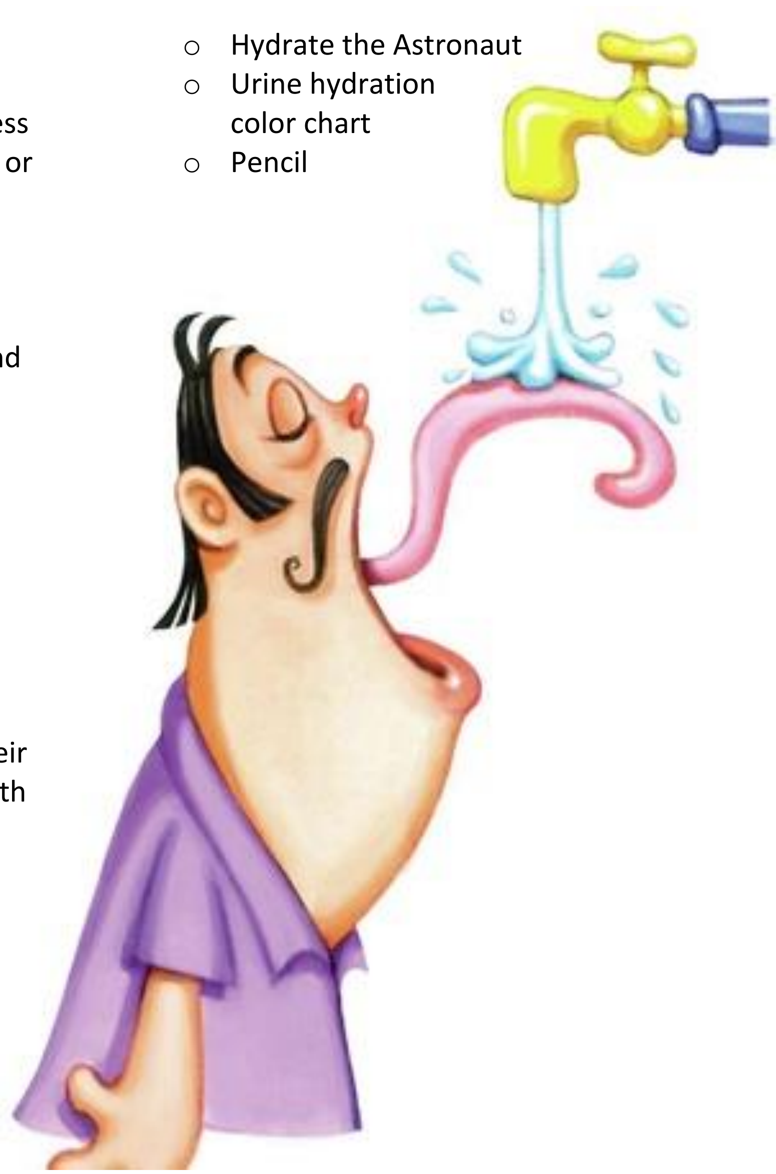
Per student:

- Hydration Student Section

Pre-lesson Preparation

(To be done before the activity.)
Hydration Web-Poster:
Gather material for groups to work on their hydration web poster. Provide an area with computers for students to do research.
Hydrate the Astronaut:
Gather material to play Hydrate the Astronaut.
Materials include:

- LCD Projector connected to a computer
- Blindfold
- Water bottle picture (Option: laminated)



- Masking Tape
- Colored pencils for each team
- Students will do this activity as an individual in the class, no groups will be needed.
- Print out hydrate the Astronaut for each student in your class.

Simulated Urine:

- Gather material to do simulated urine activity.
- Print out urine color chart for each group.
- Print out hydration cards for each group

Discuss with students: Our bodies are made up of 50 to 70% water, it is essential to drink plenty of fluids to keep our bodies healthy. Water plays many important roles in keeping our body in peak performance by giving nutrients to our cells, muscles, joints, our brain, skin and kidneys. Water also regulates our body temperature, and helps our heart function properly. Dehydration can affect an athletic performance and increase the risk of a medical emergency. During athletic events or physical activity most athletes do not make it a priority to drink sufficient liquids to prevent dehydration. However, athletes are not the only ones who are at risk. The elderly, children, labors and individuals enjoying outdoor activities are also at risk of suffering the symptoms of dehydration. Children sweat less than adults. This makes it harder for children to cool off. Dehydration is a major cause for hospitalization among the elderly. Elderly are more susceptible to dehydration due to less fluid content in the body, they carry about 10 percent less than the average adult body. The elderly also have a reduced sense of thirst and loss of appetite that can trigger dehydration.

Space explorers must maintain proper hydration levels while on an exploration missions and while in space. As astronauts complete their tasks on an exploration mission, whether inside or outside the space exploration vehicle, astronauts need adequate hydration to maintain proper health. As astronauts reach the space environment, they stop feeling the pull of gravity. The normal functions of the body begin to change as the fluids in the body begin to shift towards the head. As the body detects the extra fluid in the upper body, the body believes there is too much fluid and the body begins to get rid of what it thinks are extra fluids. This large loss of fluids can result in dehydration for astronauts. In order to avoid this dehydration, astronauts must drink lots of fluids while in orbit. Dehydration can be very dangerous, astronauts must make sure they are not dehydrated while completing their tasks on a mission, whether inside or outside the space exploration vehicle, just like they do on earth

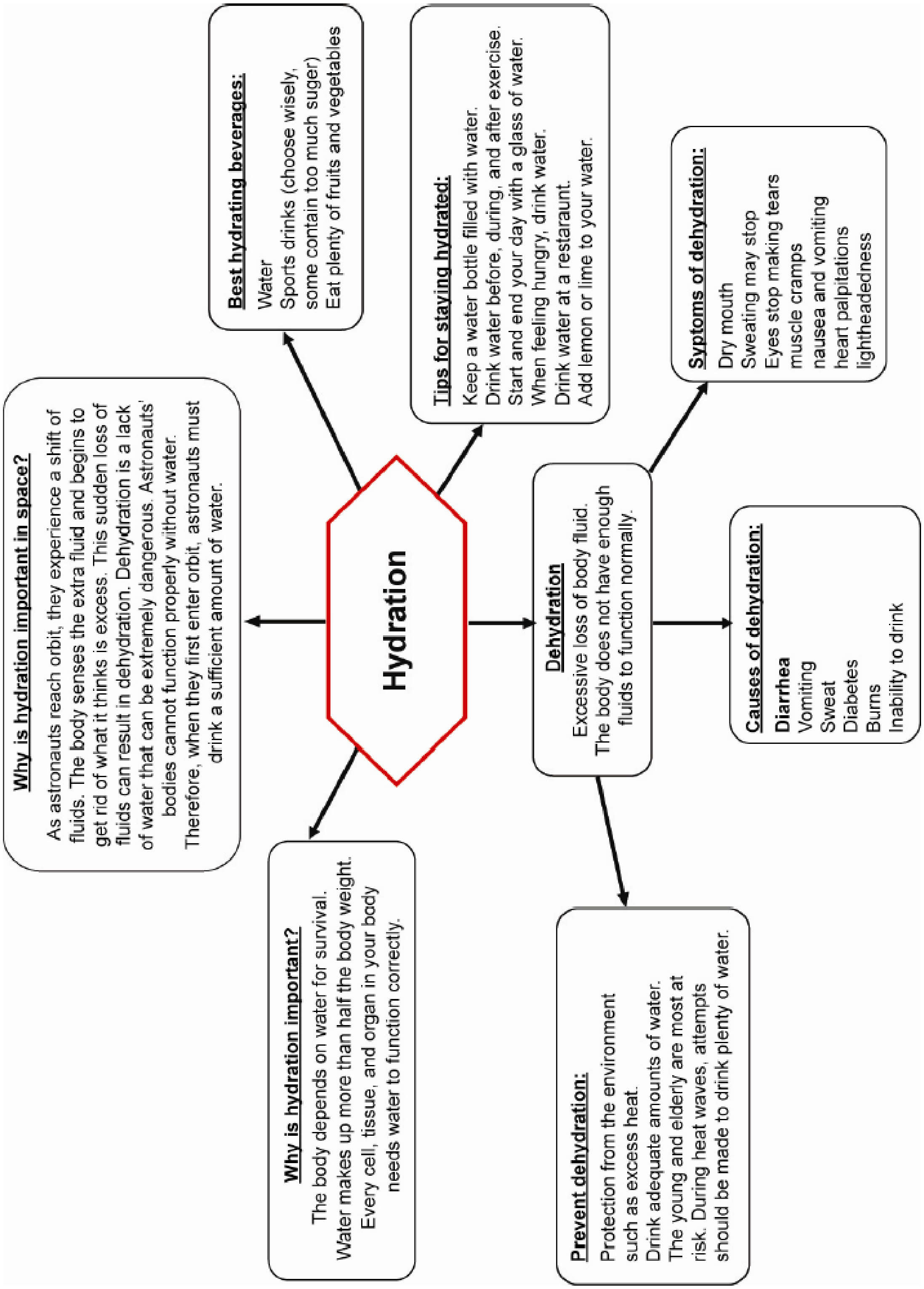
Hydration Poster Project:

Have the students discuss and make observations about Hydration by designing and creating a hydration web poster. Use the hydration poster to help students organize prior knowledge, identify interests, and make real world connections.

1. Have students pick up all materials needed by their group to complete their hydration poster.
2. While students create their group poster encourage them to keep the following questions in mind as they are creative with their poster.

a. What is dehydration?
b. What are the causes of dehydration?
c. What are the signs of dehydration?
d. How can dehydration be prevented?
e. Why is it important to keep your body hydrated?
f. What are the best beverages to stay hydrated?
g. Do you think hydration is important to astronauts while they are in space?
h. When should an astronaut be concerned about hydration in space?

Sample Hydration Web



Hydrate the Astronaut

1. If possible, project the Astronaut silhouette on a white board or screen.

2. Give each student their own copy of Hydrate the Astronaut.

3. Blindfold a student and spin the student three times. Have the student place the water bottle on the Astronaut.

4. The student will return to their desk and take a seat.

5. Depending on where the water bottle landed, ask the following questions:

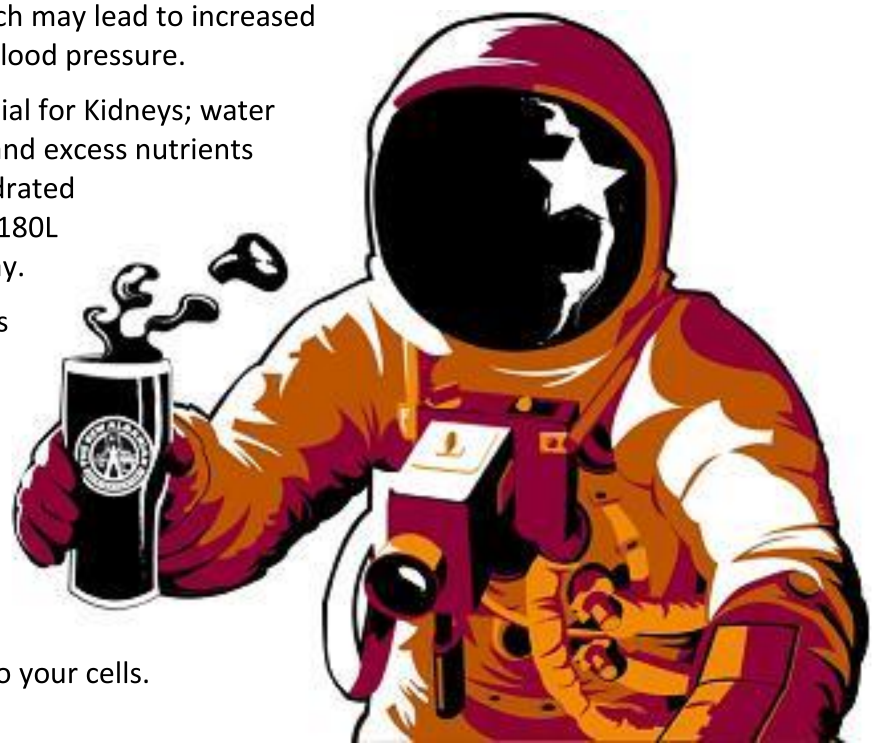
- Where did the water land?
- How is water helping this particular body part function properly.
- How would dehydration affect your health if this organ or body system was not getting enough water to function?

6. The students should color in the organs that are being described and write a short paragraph about hydration needs for this organ in their mission journal.

7. Continue this procedure until you have covered all the body systems and organs described below.

Here are some organs or body systems that require water to function properly.

- **Brain:** Dehydration can impair your ability to concentrate. It may also affect your brain's processing and abilities as well as impair your short term memory.
- **Heart:** Fluids play a role in keeping your blood pressure normal. Dehydration can decrease cardiac output which may lead to increased heart rate and reduce your blood pressure.
- **Kidneys:** Hydration is essential for Kidneys; water helps remove waste, toxins and excess nutrients from the body. A healthy hydrated kidney filters approximately 180L (190quarts) of water each day.
- **Digestive System:** Water aids in the digestion of food, It's found everywhere in your digestive track from your saliva to the solution of enzymes of your lower intestine. Water helps dissolve nutrients that are absorbed into your bloodstream and delivered to your cells.



- **Cells:** Hydration is critical for transporting carbohydrates, vitamins and minerals to your cells. Your cells then produce energy to help keep your going.
- **Muscles and Joints:** Water is important for your muscles and joints, it helps cushion joints and keeps muscles working properly. Your Muscles are made up of 70-75% water.
- **Temperature:** Your body's water helps dissipate heat, regulating your overall body temperature. When you get too hot your body releases water by perspiring, thus removing heat from your body. If you do not replace the water you lose through perspiration your body can become dangerously overheated.
- **Skin**: Staying well hydrated will help preserve your skin's elasticity, softness and coloring.

Simulated Urine

*(Students will **test** their hypotheses following this procedure. These steps were taken from the Hydration Student Sheet. Educator specific comments are in italics.)*

1. You should work in groups of three or four during this lab.
2. Collect the following materials with your group.
    a. Four plastic cups
    b. Yellow, red, and green food coloring
    c. A permanent marker
    d. Make sure your group has access to water.
    e. Urine color chart
    f. Hydration cards
    g. toothpicks
3. Label your cups 1-4
4. Fill each cup with 2oz of water
5. In cup 1 use 1 toothpick to add 1 dab of yellow food coloring.
6. In cup 2 use a toothpick to add 2 dabs of yellow food coloring.
7. In cup 3 add 1 drop of yellow food coloring.
8. In cup 4 add 1 drop of red food coloring 2 drops of yellow food coloring and 1 drop of green food coloring.
9. Compare your simulated urine to the Urine color chart.
10. Arrange your simulated samples into the four hydration levels.
    a. Optimal
    b. Well Hydrated
    c. Dehydrated
    d. Seek Medical Aid
11. Identify each sample of hydration levels by placing the hydration card next to the appropriate simulated urine. *By making their own observations, students now understand how to determine their own level of hydration.*

Record Data

1. You will keep a 12 hour hydration log to determine your own hydration levels. You will determine if you are drinking enough liquids to maintain healthy hydration. *Explain the 12 hour hydration log to students. They will be documenting the following:*
   - *What time they drink*
   - *How much they drink*
   - *Physical activity levels*
   - *Urine hydration level: Students will make an observation of their own urine. Students will determine what category their own urine would fall under. For Example is it Optimal, Well Hydrated, Dehydrated or do they need to Seek Medical Aid. Students can use the Hydration color chart to make this determination.* ***Remind students that at no time will they bring a urine sample into the classroom.***

2. Make observations of your own urine to determine what category your urine would fall under. Is your urine Optimal, Well Hydrated, Dehydrated or do you need to See Medical Aid. Use your Hydration color chart to help you determine your hydration level.

3. **At NO time will you bring an actual urine sample into the classroom.** *After making all their observation,* study data *by answering the questions following the Data Sheet. Using this information, ask the students to determine if the data supports or refutes their hypothesis.*

Study Data

After completing all investigations, study data by answering the following questions.

1. Why is hydration important to you? *Answers may vary*

2. What color best describes your urine color? *Answers may vary*

3. Would you consider yourself to be hydrated or dehydrated? What do you need to do to reach optimal hydration? Answer may vary

4. In your opinion, what can change your urine colors? *Foods you have eaten, Drugs or vitamins you have taken, Health issues*

5. Why should you be concerned if your urine is a darker color rather than a light yellow to clear color? *More than likely you are dehydrated and you body needs more water, dehydration can cause heat illnesses. If you urine is a dark yellow or even going into the brown colors you should see a doctor.*

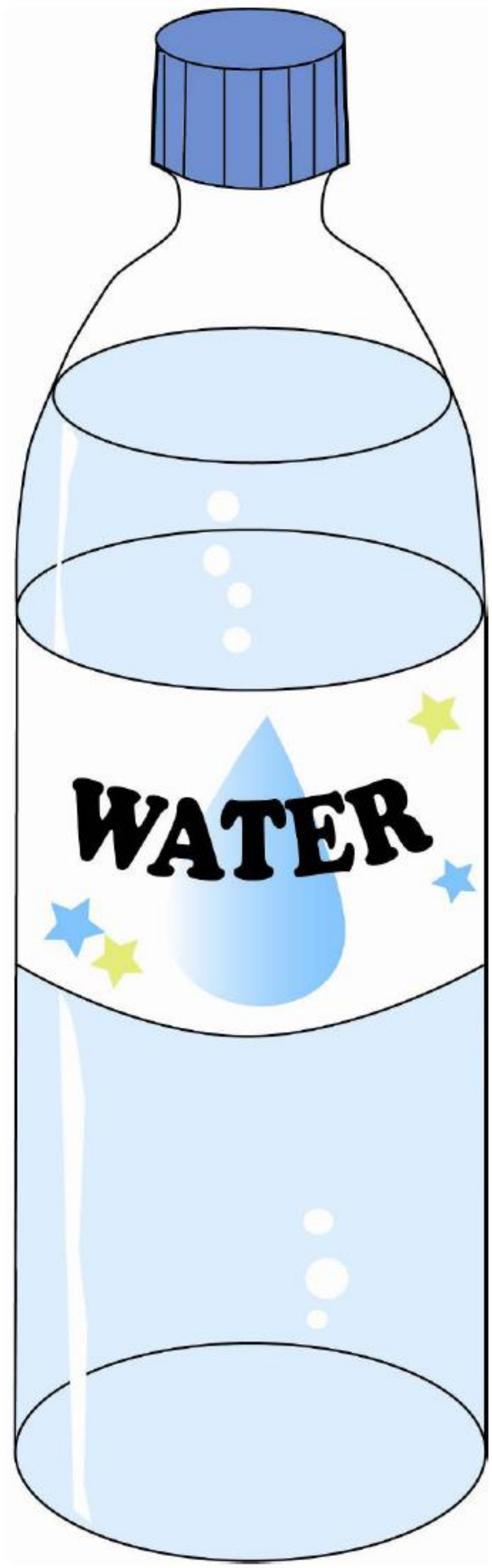
6. After observing your hydration levels for 12 hours, what time of the day did you find you were dehydrated the most? *Answers will vary*

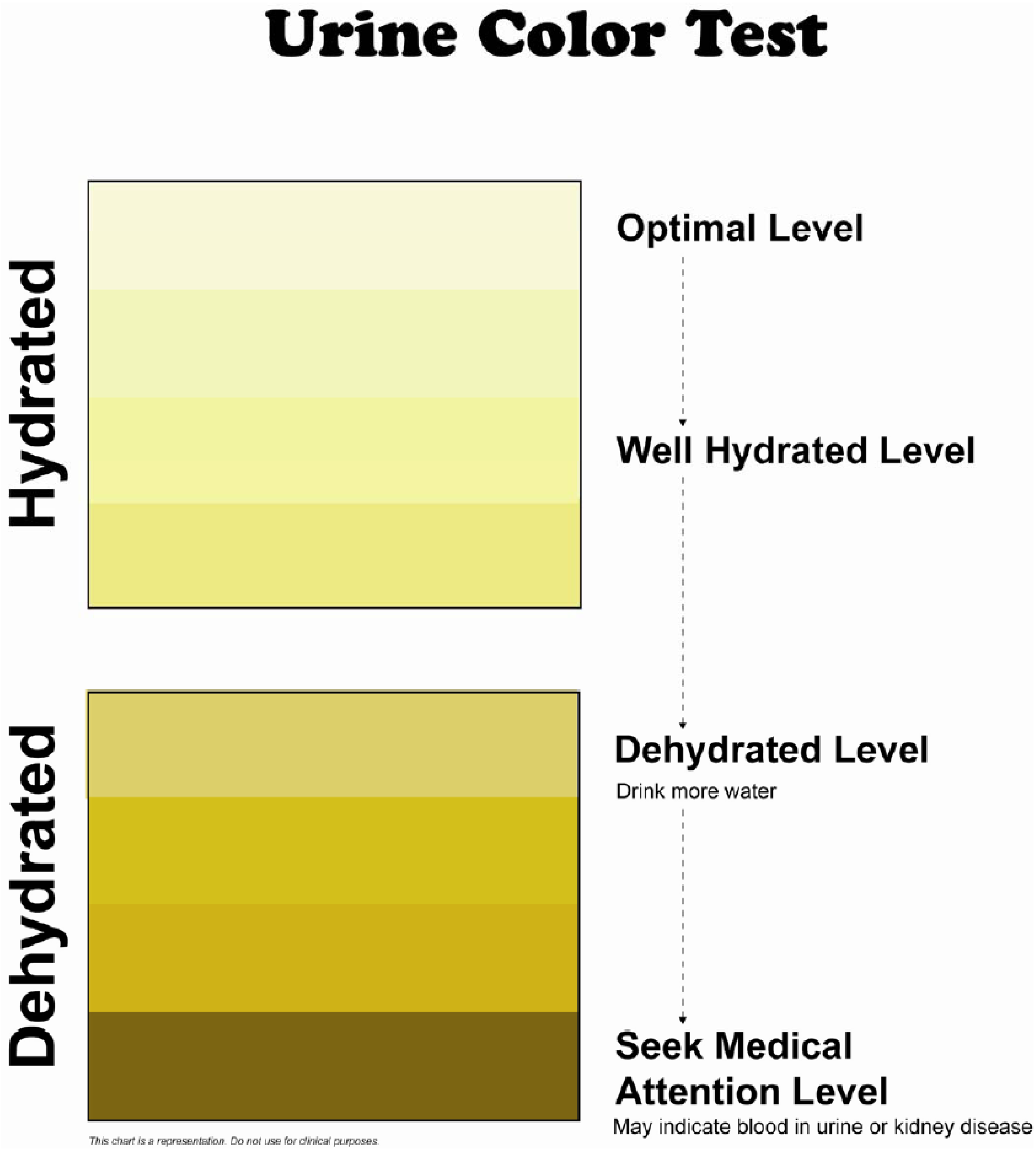
7. What circumstances do you think made your urine a darker color at this time of day? *Answers will vary.*

8. What actions did you take to change your hydration levels to have healthy hydration levels? *Answers will vary.*

Conclusion

Discuss the answers to the Study Data questions in the Hydration Student Section. Have the students restate their hypothesis and explain what happened during testing, including their results. Ask students to compare their group data to the class data. What patterns can be found? Ask students what they wonder now. Encourage students to design their own experiments.


WATER


Urine Color Test
Hydrated
Dehydrated
Optimal Level
Well Hydrated Level
Dehydrated Level
Drink more water
Seek Medical
Attention Level
May indicate blood in urine or kidney disease
This chart is a representation. Do not use for clinical purposes.

Optimal Hydration Level

Well Hydrated Level

Dehydrated Level

Seek Medical Attention Level

Hydration Station Projects Student Sheet

Hydration Poster

1. As a class you discussed the importance of staying hydrated, what are some risks of dehydration and the best methods to keep hydrated?

____

____

2. You will discuss and make observations about hydration by designing and creating a hydration web poster. While creating your group poster keep the following questions in mind. Be ready to present your group poster to the class.
   - What is dehydration?
   - What are the causes of dehydration?
   - What are the signs of dehydration?
   - How can dehydration be prevented?
   - Why is it important to keep your body hydrated?
   - What are the best beverages to stay hydrated?
   - Do you think hydration is important to astronauts while they are in space?
   - When should an astronaut be concerned about hydration in space?

Hydrate the Astronaut

1. As you play hydrate the human write a small paragraph in your mission journal about the organ explaining why this body system depends on water to function properly. Color in the body systems as they are hydrated during the game.

Simulated Urine

Hypothesis

Based on your observations answer the problem question with your best answer.

Problem: How can I create simulated urine to identify different levels of hydration?

____

Test Procedure

1. You should work in groups of three or four during this experiment.
2. Collect the following materials with your group.
   a. Four plastic cups
   b. Yellow, red, and green food coloring
   c. A permanent marker
   d. Make sure your group has access to water.
   e. Urine color chart

    f. Hydration cards
    g. toothpicks

3. Label your cups 1-4
4. Fill each cup with 2oz of water
5. In cup 1 use a toothpick to add 1 dab of yellow food coloring.
6. In cup 2 use a toothpick to add 2 dabs of yellow food coloring.
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11. Identify each sample of hydration levels by placing the hydration card next to the appropriate simulated urine.

Record Data

1. You will keep a 12 hour hydration log to determine your own hydration levels. You will determine is you are drinking enough liquids to maintain healthy hydration.
2. Make observations of your own urine to determine what category your urine would fall under.
    - Is your urine Optimal, Well Hydrated, Dehydrated or do you need to See Medical Aid. Use your Hydration color chart to help you determine your hydration levels.
3. At NO time will you bring an actual urine sample into the classroom.

Study Data:

After completing all investigations, study data by answering the following questions.

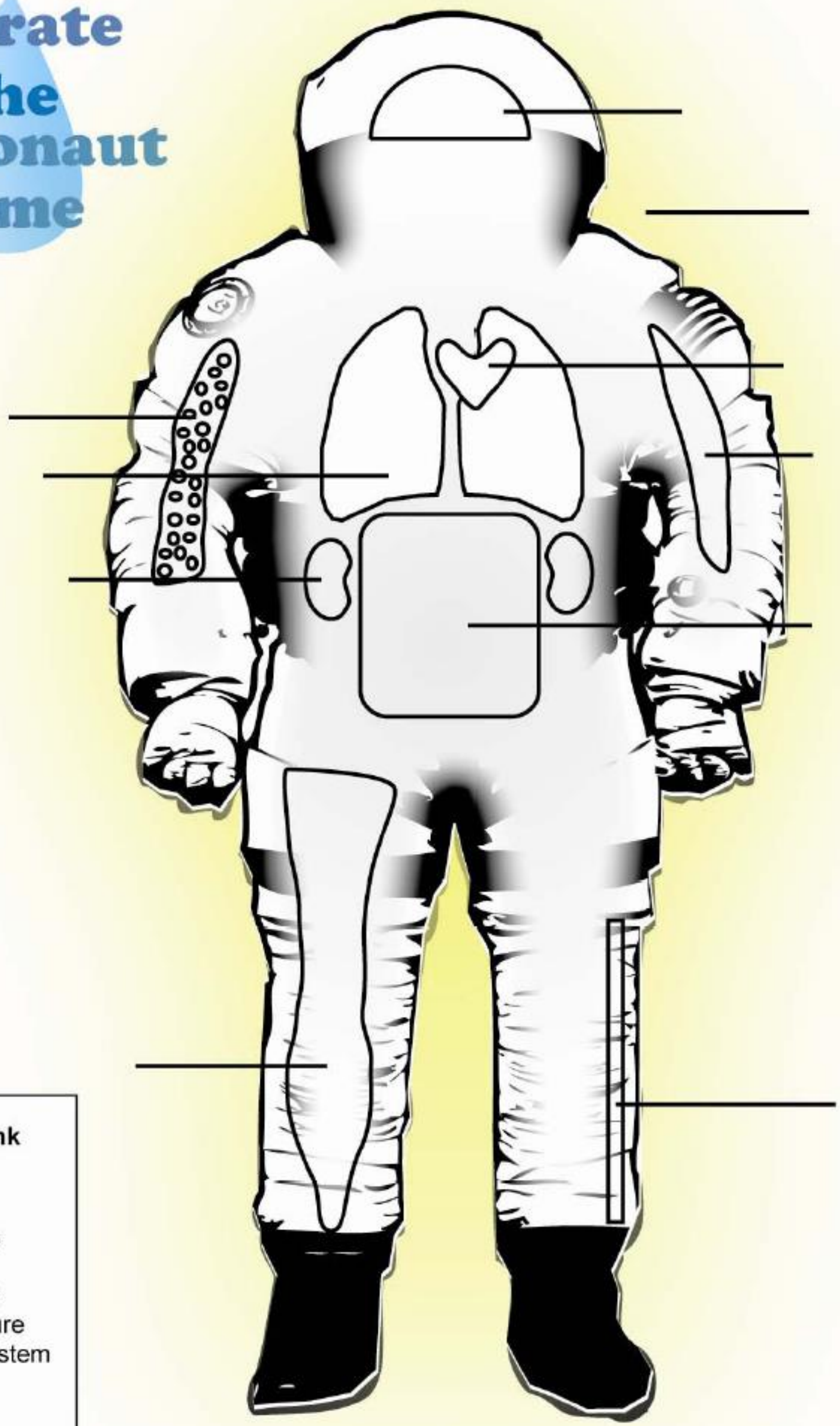
1. Why is hydration important to you?
2. What color best describes your urine color?
3. Would you consider yourself to be hydrated or dehydrated? What do you need to do to reach optimal hydration?
4. In your opinion, what can change your urine colors?
5. Why should you be concerned if your urine is a darker color rather than a light yellow to clear color?
6. After observing your hydration levels for 12 hours, what time of the day did you find you were dehydrated the most?
7. What circumstances do you think made your urine a darker color at this time of day?
8. What actions did you take to change your hydration levels?

12-Hour Hydration Log

Track your liquid intake within 12 hours. Use your Urine Color Test chart to categorize your urine. You will complete the log on your own. At no time should you bring an actual urine sample into the classroom.

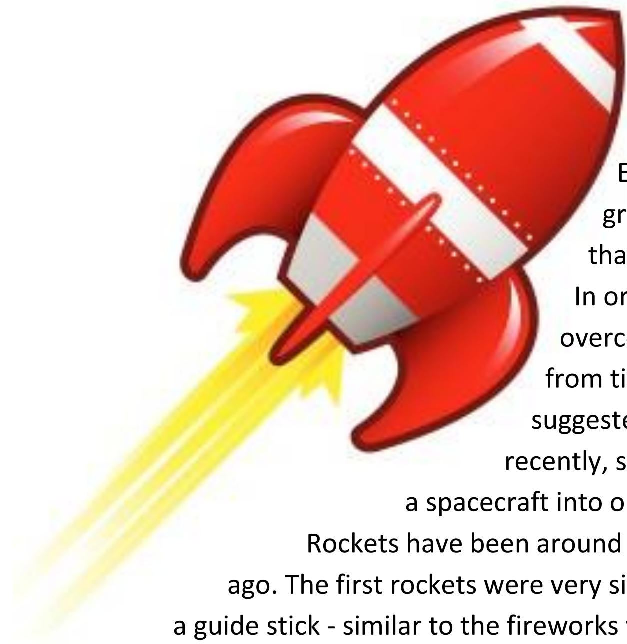
Bathroom Time (hr)	**Urine Color**	**Urine Category**	**What I drank**	**How much I drank**	**Physical Activity (None, Low, Moderate, High)**

Hydrate The Astronaut Game



Word Bank

Cells
Heart
Muscles
Brain
Kidneys
Temperature
Digestive System
Skin
Lungs



Rock It, Man!

Everything on Earth – including us – is held down by the force of gravity. Without gravity, we would all float off into space. It is said that Isaac Newton discovered gravity when an apple fell on his head. In order to reach space, we use a rocket-powered launcher to overcome the pull of Earth's gravity. Other ideas have been put forward from time to time. In 1865, the science fiction writer Jules Verne suggested using a powerful gun to send people to the Moon. More recently, scientists have been studying the use of powerful magnets to send a spacecraft into orbit.

Rockets have been around a long time. They were invented in China, more than 800 years ago. The first rockets were very simple – a cardboard tube packed with gunpowder and attached to a guide stick - similar to the fireworks we use today.

In 1232, the Chinese used these 'fire arrows' to defeat the invading Mongol army. The knowledge of how to make rockets soon spread to the Middle East and Europe, where they were also used as weapons. Later, they also became popular for spectacular firework displays.

So, What is a rocket? The word "rocket" can mean different things. A rocket in its simplest form is a chamber enclosing a gas under pressure.

How Does a Launcher Work?

Have you noticed what happens if you let the air out of a balloon? The air goes one way and the balloon moves in the opposite direction. Rockets work in much the same way. Exhaust gases coming out of the engine nozzle at high speed push the rocket forward. A small opening at one end of the chamber allows the gas to escape, and in doing so provides a thrust that propels in the opposite direction. A good example of this is a balloon. **Show students a balloon and blow it up.**

Air inside a balloon is compressed by the balloon's rubber walls. The air pushes back so that the inward and outward pressing forces are balanced. When the nozzle is released, air escapes through it and the balloon is propelled in the *opposite direction*. **Release the balloon, which way does the air go, which way does the balloon go?**

When we think of rockets, we rarely think of balloons.

Instead, our attention is drawn to the giant vehicles that carry satellites into orbit and spacecraft to the Moon and planets. Nevertheless, there is a strong similarity between the two. The only significant difference is the way the pressurized gas is produced. With space rockets, the gas is produced by burning propellants that can be solid or liquid in form or a combination of the two. Most modern launchers, such as those used by NASA, are very complicated and weigh hundreds of tons at liftoff. Most of this weight is fuel, such as liquid hydrogen and liquid oxygen

How Does a Rocket Engine Work?

Like most engines, rockets burn fuel. Most rocket engines turn the fuel into hot gas. Like a balloon, the engine pushes the gas out its back. The gas makes the rocket move forward. A rocket is different from a jet engine. A jet engine needs air to work. A rocket engine doesn't need air. It carries with it everything it needs. A rocket engine works in space, where there is no air.

There are two main types of rocket engines. Some rockets use liquid fuel. Other rockets use solid fuels. Fireworks and model rockets also fly using solid fuels, some use air.

Image Credits: Campbell Whyte. Originals are available to purchase here. http://www.campbellwhyte.com/tag/space-ship/.

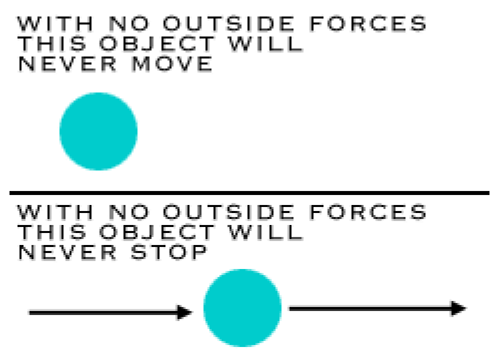
Why Does a Rocket Work?

In space, an engine has nothing to push against. So how do rockets move there? Rockets work by a scientific rule called Newton's third law of motion. English scientist Sir Isaac Newton listed three Laws of Motion, more than 300 years ago. Isaac Newton discovered three laws of motion and the law of gravity. They explain motions observed on Earth and in space. These three basic ideas that are applied to the physics of most motion and the ideas have been tested and verified (proven to be true) so many times over the years, that scientists now call them Newton's Three Laws of Motion. All three laws are really simple statements of how things move. But with them, precise determinations of rocket performance can be made.

Starting at the beginning: The First Law

The first law says that an object at rest tends to stay at rest, and an object in motion tends to stay in motion, with the same direction and speed, this is called inertia. Objects tend to want to "keep on doing what they're doing." Demonstrate that tendency with the following activity: Chain Gang

Rest and motion can be thought of as being opposite to each other. Rest is the state of an object when it is not changing position in relation to its surroundings. If you are sitting still in a chair, you can be said to be at rest. This term, however, is relative (can be qualified, or amended). Your chair may actually be one of many seats on a speeding airplane. The important thing to remember is that the object is not moving in relation to (in comparison to) its immediate surroundings.



Motion (or lack of motion) cannot change without an unbalanced force acting.

In rocket flight, forces become balanced and unbalanced all the time. A rocket on the launch pad is balanced. The surface of the pad pushes the rocket up while gravity tries to pull it down and they equal out. As the engines are ignited, the thrust from the rocket unbalances the forces, and the rocket travels upward, even though gravity is still trying to pull it down. Later, when the rocket runs out of fuel, it slows down, stops at the highest point of its flight, then falls back to Earth, thanks to gravity.

If nothing happened to the rocket sitting on the launch pad, and nothing does happen, the rocket will never go anywhere. If the rocket is going in a specific direction, unless something happens to it, ex. running out of fuel, the rocket will always go in that direction. Forever.

You can see good examples of this idea when you see video footage of astronauts. Have you ever noticed that their tools float? They can just place them in space and they stay in one place. There is no interfering force to cause anything to change. The same is true when they throw objects for the camera. Those objects move in a straight line. If they threw something when doing a spacewalk, that object would continue moving in the same direction and with the same speed forever unless interfered with; for example, if a planet's gravity pulled on it.

Now that students are familiar with the terms and ideas, Newton's First Law can be restated in the following way. If an object, such as a rocket, is at rest, it takes an unbalanced force to make it move. If the object is already moving, it takes an unbalanced force, to stop it, change its direction from a straight line path, or alter its speed.

So, talking about it is one thing, now let's bring Newton's first law to life…

To See a Law . . .You Have to Break a Few Eggs?

The Egg Drop is a classic science demonstration that illustrates Newton's Laws of Motion, namely inertia. The challenge sounds so simple... just get the egg into the glass of water, but there are a few obstacles. The egg is perched high above the water on a cardboard tube, and a pie plate sits between the tube and the water. Still think it's easy? Sir Isaac Newton does.

Materials

- Small ball to practice with, if desired (a plastic Easter egg with a few pennies inside (4 or 5) makes a great "practice egg.")

- Cardboard tube(s)
- Pie pan(s)
- Raw eggs (they add much more intensity to the moment, and hold attention)
- Water
- Large drinking glass(es)
- Oh, you might need a few paper towels to clean up your practice mess!

Tip: If you're feeling nervous, watch the video before doing the demonstration for your students at http://www.stevespanglerscience.com/experiment/egg-drop-inertia-trick

Warning: Always wash your hands and have students wash their hands well with soap and water after handling raw eggs. Some raw eggs contain salmonella bacteria that can make you really sick!

1. Fill the large drinking glass about three-quarters full with water and center the pie pan on top of the glass. Place the cardboard tube on the plate, positioning it directly over the water. Carefully set the egg (or, for the nervous, a practice ball) on top of the cardboard tube.
2. With their writing hand, have them smack the edge of the pie pan **horizontally**. Make sure they follow-through (tennis, anyone?). It's important that they use a pretty solid hit, so plan on chasing the plate and tube.
3. Your astonished students will watch the egg plop nicely into the water and want to try it themselves. Science is so cool!

Try testing longer tubes, more or less water, different liquids in the glass, different water containers, and heavier or lighter falling objects.

How does it work?

Credit for this one has to go to Sir Isaac Newton and his *First Law of Motion*. Let's apply it to this experiment. He said that since the egg is not moving while it sits on top of the tube, that's what it wants to do - not move. The students did what? They applied enough force to the pie pan to cause it to zip out from under the cardboard tube (there's not much friction against the drinking glass). The edge of the pie pan hooked the bottom of the tube, which then sailed off with the pan. Basically, they knocked the support out from under the egg. For a brief nanosecond or two, the egg didn't move because it was already stationary (not moving). But then, as usual, the force of gravity took over and pulled the egg straight down toward the center of the Earth.

Also, according to Mr. Newton's First Law, once the egg was moving, it didn't want to stop. The container of water interrupted the egg's fall, providing a safe place for the egg to stop moving so they could recover it unbroken. The gravity-pushed egg caused the water to splash out, thanks to displacement (the egg took up the space where the water was). Did someone get wet?

Second Law

Newton's first law tells us that a force is required to accelerate an object. Newton's second law answers the question about how much force is required.

If you have ever tried pushing a car, you know that even with the brake off and the transmission in neutral it is very hard to push a car and start it moving from a stop. You must push with a great deal of force. Pushing a refrigerator, even one on wheels, across the kitchen floor is easier than the car, but still hard. Finally pushing a toy car is fairly easy. Very little force is needed to accelerate it. Why the difference?

The key is the mass. The mass of the real car is many more kilograms than the mass of the toy car. So it is much harder to accelerate the more massive real car; it takes more force. The refrigerator's mass is between that of the toy and real car, so the force needed to accelerate it is between that of the toy and real car.

Notice that **the difference is mass not size**. For example a very large bag of feathers might be as large as a car but relatively easy to push. Feathers are not very tightly squeezed, so a large bag of feathers will still have a relatively small mass. It is takes less force to accelerate a bag of feathers the size of a car than the car. Mass and size are different things and the force needed to accelerate something depends on the mass not the size.

Newton's second law tells us that the more massive an object is, the more force is needed to accelerate it. The more **mass**ive the rocket, the harder the push needed to get it started.

Newton's second law can be expressed as a mathematical formula for the amount of force needed to accelerate an object. It is: Force equals mass times acceleration, or F=ma.

From this formula we can find the force needed to accelerate an object. If the object has a mass of 5 kilograms and the acceleration is 3 meters per second squared, then the force needed to get this acceleration is 15 kilogram meters per second squared, which is also 15 newtons.

Newton's second law of motion can be restated in the following way: The greater the mass of rocket fuel burned, and the faster the gas produced can escape the engine, the greater the thrust of the rocket.

Third Law of Motion

You may be familiar with the words for Newton's third law: For every action there is an equal and opposite reaction. This statement is fairly well known, but there is a difference between memorizing the words and really understanding what they mean.
A rocket can lift off from a launch pad only when it expels gas out of its engine. The rocket pushes on the gas, and the gas in turn pushes on the rocket. So, with rockets, the action is the expelling of gas out of the engine. The reaction is the movement of the rocket in the opposite direction. To enable a rocket to lift off from the launch pad, the action, or thrust, from the engine must be greater than the mass of the rocket. In space, however, even tiny thrusts will cause the rocket to change direction.
One of the most commonly asked questions about rockets is how they can work in space where there is no air for them to push against. The answer to this question comes from the third law. Imagine the skateboard again. On the ground, the only part air plays in the motions of the rider and the skateboard is to slow them down. Moving through the air causes friction, or as scientists call it, drag. The surrounding air impedes the action-reaction.
As a result rockets actually work better in space than they do in air.

Talking about it is one thing, now let's bring Newton's third law to life…

Squeeze Bottle Rocket: Force and motion are a blast!

It's easy to turn a juice bottle into a rocket launcher. How? Grab a few straws, some modeling

clay, and an empty juice bottle to make a launcher that will send the straw rocket soaring across the room. Ok, your students will learn something about Newton's Third Law of Motion at the same time.
Note: This experiment was designed using the Kool-Aid Bursts juice product. While other flexible juice bottles may work, the Kool-Aid product works very well. The larger of the two straws should fix loosely over the smaller straw. There should be no friction or resistance at all or the straw will not be able to launch. If you're tired of searching for straws, just stop by a coffee shop to enjoy a drink and pick up a few extra straws.

Materials

- Kool-Aid Burst juice bottle (flexible plastic bottle)
- Modeling clay

- 2 straws - one large and one small. The larger diameter straw must be able to slip over the smaller straw. The large and small straws from coffee shops, like Starbucks®, work well

1. First of all, someone has to drink some juice! After they're done, clean and dry the bottle.
2. Push the smaller straw into the opening of the bottle. The straw should fit snugly in the hole at the top of the bottle.
3. Use modeling clay to seal any possible leaks between the straw and the hole in the bottle. The clay will also make the straw more stable and less likely to wobble.
4. Push one end of the bigger straw into another piece of modeling clay. This "plug" will seal the end of the straw.
5. Cover the plugged end with something soft like a Styrofoam packing peanut to keep the straw rocket from hurting anyone in case they accidentally get hit.
6. It's time to launch... Place the larger straw over the smaller straw. Ready, aim, squeeze! The larger straw launches off the smaller straw and the room erupts in a chorus of oohs, ahhhs, and "Are we going to get to do that?"

How does it work?

While you're having fun launching straws, you're actually learning and teaching about Newton's Third Law of Motion. Remember, according to our friend Newton, for every action there is an equal and opposite reaction. As they squeeze the bottle, air is forced out of the straw and pushes against the clay plug in the larger straw. The resulting force causes the straw to "launch" through the air.

Additional Information:

Have students be careful! Law down your own laws that they are to never point the straw rocket at anyone, the goal here is to launch the rocket up in the air (not at someone). Be sure to provide them materials to cover the plugged end of the straw with something soft and round to protect someone from accidentally getting hurt by a sharp edge.
Be creative! Once they've mastered the simple straw rocket, challenge your students to a straw rocket design contest. Have them add a nose cone, some fins, a few decorations, see how it affects flight (does it take more force to launch?) and don't forget to name their straw rocket!

Putting Newton's Laws of Motion Together

What have we learned, besides the fact that Newton's Laws are a blast? In Summary: An unbalanced force must be exerted for a rocket to lift off from a launch pad or for a craft in space to change speed or direction (first law). The amount of thrust (force) produced by a rocket engine will be determined by the mass of rocket fuel that is burned and how fast the gas escapes the rocket (second law). The reaction, or motion, of the rocket is equal to and in the opposite direction of the action, or thrust, from the engine (third law).

When Were Rockets Invented?

The first rockets we know about were used in China in the 1200s. These solid rockets were used for fireworks. Armies also used them in wars. In the next 700 years, people made bigger and better solid rockets. Many of these were used for wars too. In 1969, the United States launched the first men to land on the moon using a Saturn V rocket.

How Does NASA Use Rockets?

NASA uses rockets to launch satellites, space shuttles, and people. It also uses rockets to send probes to other worlds. NASA uses smaller "sounding rockets" for scientific research. These rockets go up and come back down. They do not fly into orbit.

New rockets are continually being developed by scientists, to launch astronauts on future missions and take supplies to the International Space Station. NASA also is working on a powerful new rocket called a heavy lift vehicle. This rocket will be able to take big loads into space.

Together, these new rockets will make it possible to explore other worlds.

Make it Their Own: Mini Rocket Mock-Up

Rocket Requirements:

Have students focus on an amazing design and the practical questions on human spaceflight: What do you eat? What do you wear? How do you sleep? Where do you get water? How do you defend yourself? How do you get into it? Out of it?
The rocket students create needs to contain the following:

• written description of the rocket
• A drawing or painting of the rocket with labels indication special features
• Rocket design must take into consideration communication, fuel, lodging of guests, medical facilities, the guests need for exercise, waste disposal, food storage or production, as well as safety features.

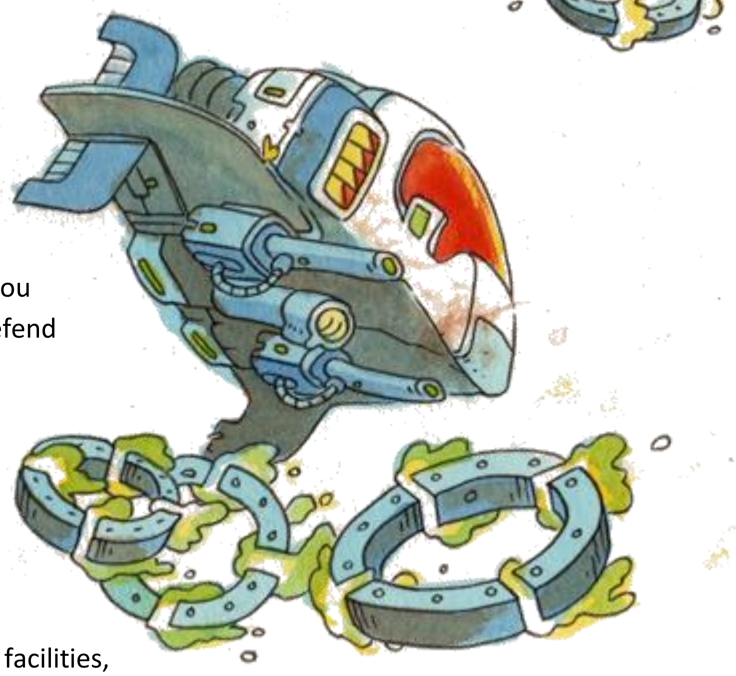
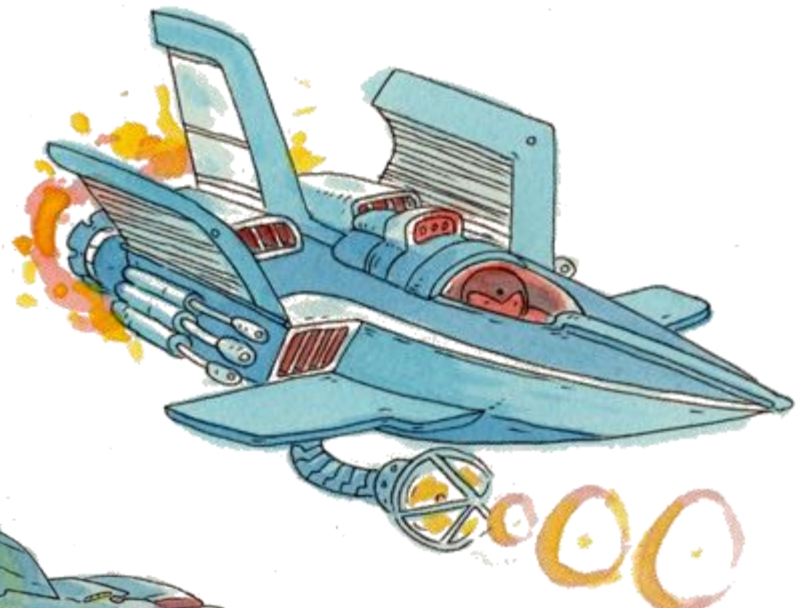


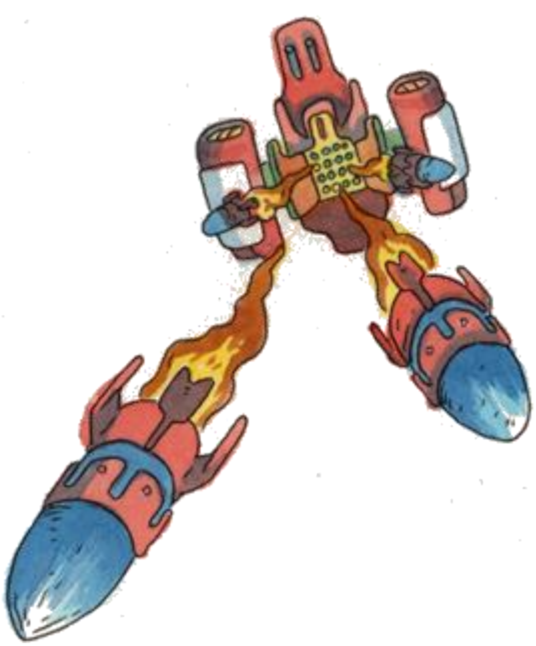
Image Credits: Campbell Whyte. Originals are available to purchase here. http://www.campbellwhyte.com/tag/space-ship/. Copyrights 2012. All Rights Reserved.

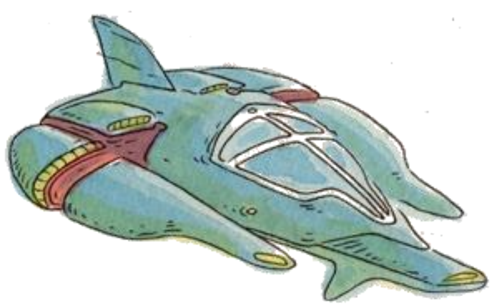
Creative Bonus:

Include:

• Entertainment features
• Comfort and unique design
• Build a model of the rocket
• Additional creative ideas







Flying High! Flying Free! Flags for Planets, You and Me!

Students use their knowledge of the solar system to design a flag for one the planets. This is an open ended activity that allows students to use their creativity and to apply their knowledge.

Note: Many students may not be familiar with flags besides countries flags such as U.S., MX, and/or the local state flag. While showing examples, discuss with students how some flags are very abstract and tell their story through colors and shapes only, while others include pictures and symbols.

Materials:

- 8-1/2 x 11 sheets of white paper and/or construction paper for the flags
- Magic markers, colored pencils, or crayons
- Images/Books about flags
- (Optional) Some dowel rods or skewers and tape to attach the flags

Tell students that some day, when people have begun to live on other planets or their moons, these worlds might develop their own flags. In this activity, students get to design a flag for their favorite, or assigned, world.

There are no rules yet for how to design a planet flag. The flag can just have colors and symbols, like many Earth flags do, or it might highlight some of your planet's most interesting places to visit.

For example, a Mars flag might have a red background, because the rusty sands of Mars look red from space. It could have some symbols representing weapons on it, because Mars was the god and planet of war in ancient mythology. Or, if they hope the planet's future will be more peaceful, they could put one of the red planet's most spectacular tourist sights on the flag, such as the giant volcano called Mount Olympus, which is almost three times the height of Mount Everest, the tallest mountain on Earth.

If they ended up on a world with no

solid surface to stand on (such as Jupiter or Neptune), they might also have to come up with a way to display their flag. Is a flag without a flagpole OK? What would be some ways to show the flag that don't involve having solid ground?

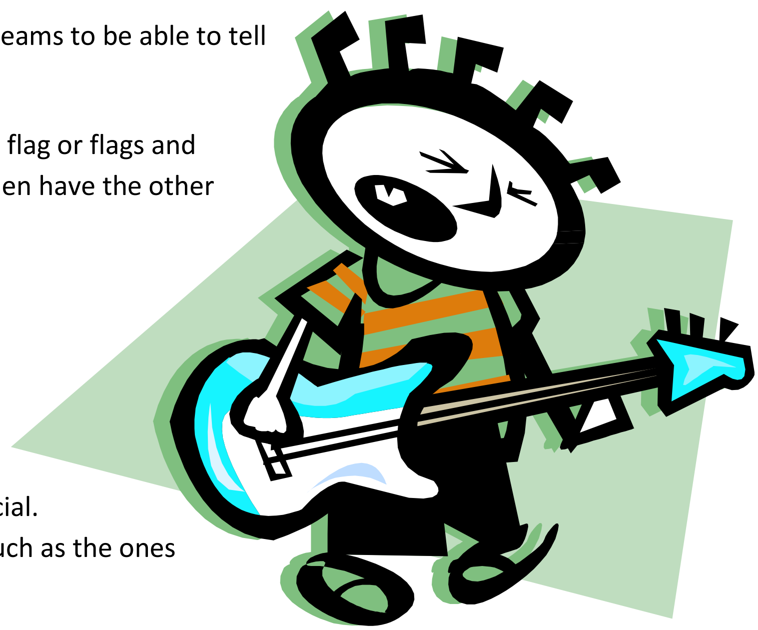
After student teams have chosen or been assigned their planet, suggest they look at the materials on the table, and discuss what kind of flag they want to make.

Note: Have enough paper available so that each student could make his or her own flag (just in case the kids don't all want to work together.)

Remind them about flags on Earth – not just flags for countries and states, but flags for cities, religious and civic organizations, and even sports teams. Have the students describe some flags they have seen. Can they tell you any flags that have astronomical symbols on them? (For example, the Alaska state flag shows the Big Dipper, with its pointer stars pointing to Polaris, the North Star. Alaska is the northernmost of the U.S. states, and thus the state where the North Star is seen highest in the sky.) Emphasize that, since there are no rules for planet flags yet, they can use their imaginations and knowledge to create the most interesting flag possible.

Challenge them with the goal that they want the other teams to be able to tell which planet the flag was for just by looking at it.

When everyone is done, ask each group to hold up their flag or flags and describe what is on them without naming the planet. Then have the other teams guess which planet the flag is designed for.



Oh, say can you see, any air I can breathe?

Now that each team's world has a flag, doesn't it need an anthem? An anthem is the official song or poem, something that tells the universe why your world is special. Read aloud and show several (five or six) kids' poems, such as the ones shown on below.

Sample: The Angry Red Planet Anthem

Mars is the planet that is so red/

Without a spacesuit, you'll be dead/

There was water there in the past/

Doesn't have much gravity, so it didn't last!

Mars has a small rocky body and a layered crust/

Raging planet-wide storms made out of dust!/

Effects of these tempests are pretty dramatic/

Making hurricanes on Earth rather anticlimactic!

Sample: Pluto's Not a Planet Anymore

http://www.jeffspoemsforkids.com/s1.php?id=22
Since 1930, quite a run
It was always the smallest one,
And oh so distant from the sun
But Pluto’s not a planet anymore

Astronomers who had a look
Said “go re-write your science book”
They gave it the celestial hook
Now Pluto’s not a planet anymore

Listen James and Janet
Some experts said to can it
Now Pluto’s not a planet
No, Pluto’s not a planet
Anymore

Uranus may be famous
But Mercury’s feeling hot
For Pluto was a planet,
And somehow now it’s not

Listen James and Janet
Some experts said to can it
Now Pluto’s not a planet
No, Pluto’s not a planet
Anymore

Neptune’s nervous, Saturn’s sad,
And jumpin’ Jupiter is hoppin’ mad
Eight remain of nine we had
Pluto’s not a planet anymore

They held the meeting here on Earth
Mars and Venus proved their worth
But puny Pluto lacked the girth
So Pluto’s not a planet anymore

They met in Prague and voted
Now Pluto’s been demoted
Oh, Pluto’s not a planet anymore
--Jeff Mondak

Note: Jeff Mondak wrote this one as a song/anthem, so it has a bit different form that most of his poems. You can hear the song version, performed by Alex Stangl, at http://www.songramp.com/mod/mps/viewtrack.php?trackid=49124

As students listen to and read the above poetry, and others, you want them to see and hear immediately that a poem:

- Can be about anything
- Can use few words or a lot
- Has a unique form and shape
- May or may not have rhythm and a beat
- Often ends with a punch
- Has a title
- May use invented spelling
- Let's us get to know the poet
- Is easy to create
- May be serious or humorous
- Usually expresses important personal feelings

After reading a poem, ask students, "What do you notice? What do you like?" Comment on what the writer did and note many of the following as you discuss the poem as a whole:

- Topic
- Word choice
- Expression of feelings
- Rhythm
- Shape
- Line breaks Title
- Ending line
- Special or missing punctuation

Rather than asking every student what he or she is going to write about (which is time consuming and allows for only a brief response), ask several to talk in detail on what they think they might like to write a poem/anthem about for their planet. With the whole class "listening in," talk with each poet. These one-on-one conversations encourage each student to pursue a topic in which he or she is interested about his/her planet, and to think about word choice, beginnings, endings, and so on

Word Warm-Ups:

Just as you would stretch before you go running, students need to warm up before you start writing poetry/anthems. To get them started have students use the graphic organizer to do the three exercises to help them stretch their minds:

- Object Observations
- Word Play
- Synonym Silliness

Tips for students:

- If you're writing poems, don't worry about trying to make them rhyme (even if that's your goal, to make a rhyming poem, don't worry about it at first). It's much more important to say what you really want to say.
- Try writing two or three different poems about the same subject. Use different points of view.
- Don't expect to get things right the first time. You do sometimes, but it's definitely the exception. Rewriting is an important step.
- Sometimes, no matter how hard you try to write, nothing comes out. Forget about writing on this subject for a few minutes, and go off and do some research about your subject. It's a lot easier than writing about things you know little or nothing about. Then try writing again, maybe you'll have some new ideas.

Object Observations

Look at your planet: Then write down everything you notice about that planet.

Planet:

What does it feel like?

Describe it:

What do you see?

What do you hear?

Synonym Silliness

Think of adjectives that describe your planet, such as those you used above , or ones happy, soft, hot, frozen, or sleepy. Then write down all the words you can think of that have the same meaning as that adjective. (Using a thesaurus will really help.) This list will help a lot when you're trying to describe your planet.

Word Play

Pick a word, any word, that you might want to use, or used to describe your planet and think of all the words that rhyme with that word. Try first with one-syllable words, and then with words of two or more syllables..

Like an Azure Marble on a Tattered Black Rag

Are they all warmed up? Now, have students think about how they can incorporate exaggerations, similes and metaphors into their anthems. These allow them to be expressive, turn their words and ideas into descriptive and powerful anthems, and create word associations that add an extra layer of description and they go really well with “length, weight, mass, size, etc”. Perfect for planets! People automatically use similes and metaphors to describe the length and weight and size of things anyway. For a sample of metaphor , you may want to read the following poem by Jack Prelutsky among others.

Louder Than a Clap of Thunder

Louder than a clap of thunder,
louder than an eagle screams,
louder than a dragon blunders,
or a dozen football teams,
louder than a four alarmer,
or a rushing waterfall,
louder than a knight in armor
jumping from a ten-foot wall.
Louder than an earthquake rumbles,
louder than a tidal wave,
louder than an ogre grumbles
as he stumbles through his cave,
louder than stampeding cattle,
louder than a cannon roars,
louder than a giant's rattle,
that's how loud my father SNORES!

Discuss: He could have just said, “My father snores really loud.” How does the poem give you a clearer idea of just how loud that really is?

Rap songs about planets are fun too. For an example of a “rap song” about the planets, written by a professional astronomer (but not a threat to any real rap artists) see: http://www-astro.phast.umass.edu/directory/ people/rap.html

Work as a group with students to create poem-starters. They can use it to get going, and add as many stanzas of their own as they like. Now they're ready to write their own anthem poem.

Sample Anthem/Poem Starter:

When I awoke one morning,
An alien was on my head. I asked, "What are you doing there?"
It looked at me and said . . .

Hint: Students can use substitution to make it their own. They may change the word **was** to "sat," "stood," "snoozed," "perched," “landed,” or any other verb they think is appropriate.

Revising Guidelines

By now, students should have a first draft of their poem, thoughtfully conceived but quickly written with minimal revision, which means they're ready to begin revising. Rewriting is the most important part of writing because nothing ever comes out right the very first time. Here are some tips for revising:

1. Rewrite your poem at least once. Some poems take revising at least four or five times. Some I've even rewritten as many as 100 times!

2. Don't rush! Poems and anthems can take time to write.

3. How will you know when your poem is done? Many times you find that the poem lets you know when it's done. It's just like being full when you eat. Sometimes if you take one more bite, you get a stomachache. But, if you don't take that extra mouthful, you'll feel perfectly satisfied. Well, it's the same with poetry — you'll just know when it feels right.

4. When you get frustrated, and feel that the poem is not coming out the way you'd like, put it aside and do something else for a while. Work on another poem or illustrate your anthem!

Planning the Vacation!

Discuss the following questions with your students:
Congratulations, your division is now in business! As the company president, I have a few questions for you.

1. After listening to each group's proposal, which planet would you want to visit on vacation, and why?
2. What was the most interesting thing about your planet you learned?
3. What part of your project do you feel went well?
4. What could you or members of your group have done differently?
5. Offer advice to future employees who may participate in the project.

Further Discussion: Who Will Own the Moon or the Planets?

If you have time, you might want to have a short discussion about whether the planets should become private property eventually. In the old days, when explorers planted a flag, they were usually claiming the territory for the country they represented. Sometimes wars were fought when two or more countries wanted the same desirable territory.

Do we want the same thing to happen when we explore the Moon, or the planets and their satellites? Or are we ready to regard these other worlds as the territory of all humanity?

In 1967, the U.S. and many other countries put together the Outer Space Treaty, which says "…outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or other occupation, or by any other means." This means that no country can claim another world for itself. Ninety-six countries have officially ratified this treaty and 27 others have signed it. How do the students feel about this? You might ask them a question like this: Suppose that your family's grandchildren or great grandchildren gets to go to another world that has a surface to stand on (not all the planets have solid surfaces). Should they be able to own land there, just as people can own land on Earth? Or should these other planets be jointly owned by all of humanity?

Tourist Attractions:

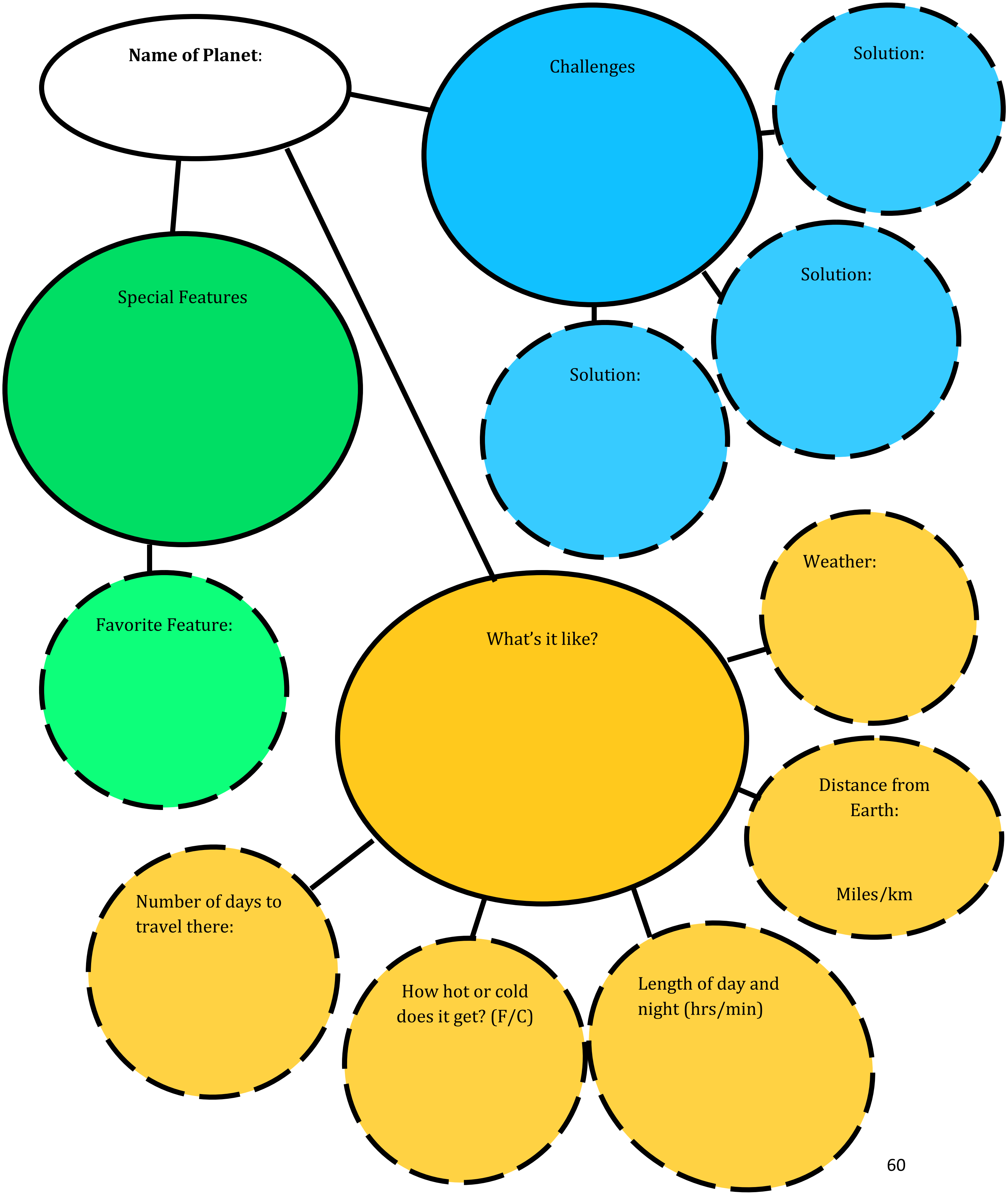
A couple of centuries from now, a family vacation might really include visits to monuments at Chryse Planitia, Utopia Planitia, and, of course, Ares Vallis — the Valley of Mars. Wearing pressure suits to provide air and protect them from the frigid Martian temperatures, the visitors would wander among some of the most important artifacts on Mars — the Viking landers of the 1970s, and Mars Pathfinder of the 1990s.

No one can say for sure whether humans will ever settle on Mars — or travel to the Red Planet at all, for that matter. But it's almost certain that if our descendants DO colonize Mars, they'll turn the landing sites of historic space missions into parks or monuments.

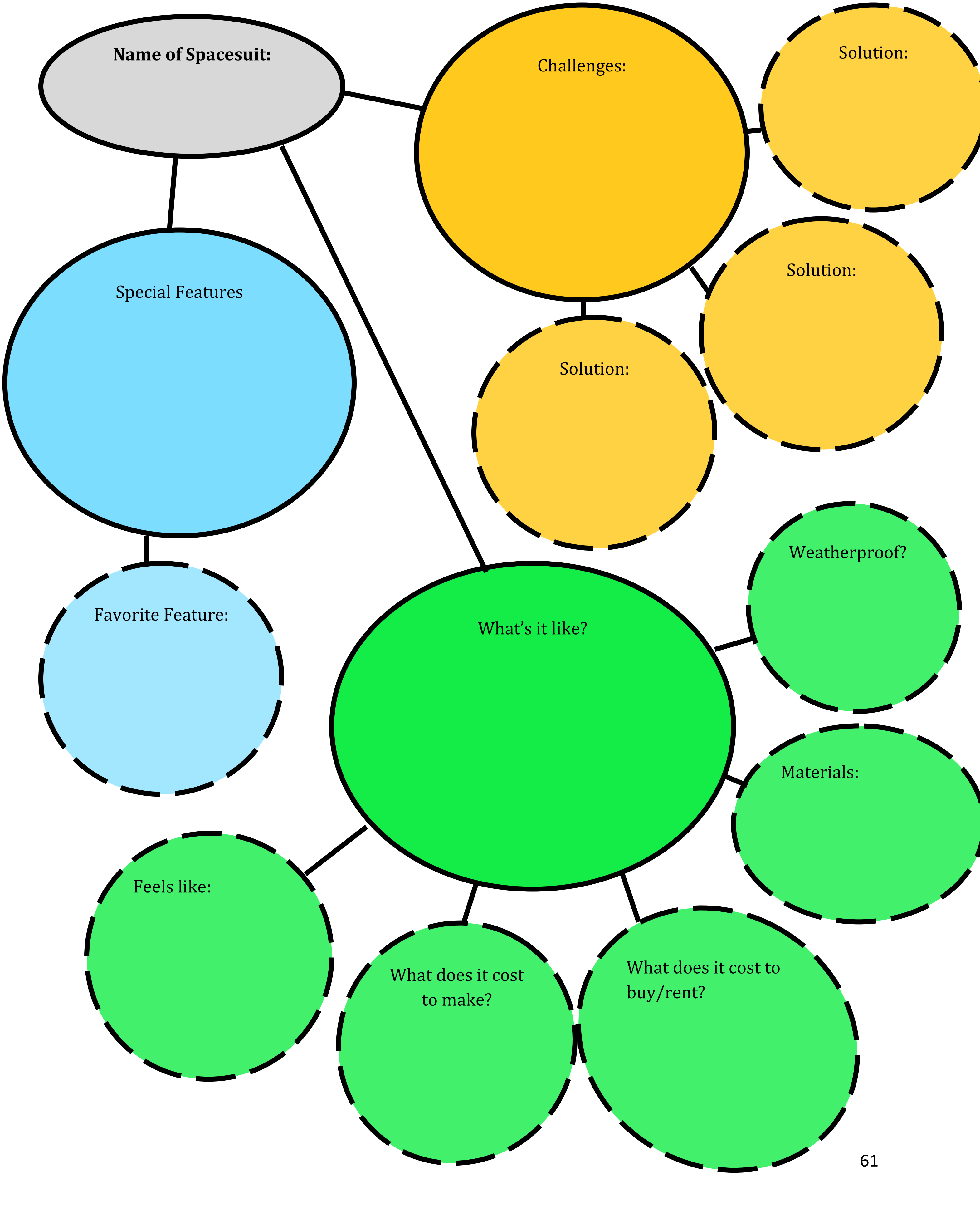
Here in the United States, national monuments showcase the beach where the Wright brothers flew the first airplane...the path that Lewis and Clark followed through the western wilderness...and the section of track that completed the transcontinental railroad. It's a good bet that the first Mars exploration sites will receive the same honors.

Preserving an old spacecraft on Mars will be challenging. Dust storms could damage the landers, or even bury them beneath the red Martian soil. And since Mars has no protective ozone layer, ultraviolet energy from the Sun could damage the craft, too. Eventually, Mars Pathfinder and the Sojourner rover might need to be moved indoors — to protect them from the Martian environment they helped explore.

These are interesting topics to think about as we move into the second century of the space age.



Name of Planet:
Challenges
Solution:
Solution:
Solution:
Special Features
Favorite Feature:
What's it like?
Weather:
Distance from Earth:
Miles/km
Number of days to travel there:
How hot or cold does it get? (F/C)
Length of day and night (hrs/min)


Name of Spacesuit:
Challenges:
Solution:
Solution:
Solution:
Special Features
Favorite Feature:
What's it like?
Weatherproof?
Materials:
Feels like:
What does it cost to make?
What does it cost to buy/rent?

MEMO: Commercial Enterprises

A new memo containing an additional assignment came in from the company president this morning. He loves your ideas so far, but he thinks potential customers watch a lot of the Travel Channel, and he wants a 2-5 minute commercial spot advertising a trip to your planet that he can run on that network.

Students will turn in a typed script and storyboard showing how they plan to film their movie before gaining access to the camera. Older students may run the camera, younger students may be filmed by the teacher. Their projects should be factual, fun, and creative.

Each video must/may include the following information as well as features of previous projects (ex. their planet's anthem as intro music, etc):

- The diameter of your planet, moon, or sun
- The distance from earth and direction from earth
- How long will it take to get there
- How long will it take to travel around the sun one revolution
- If I wanted to see sunset to sunset, how many earth days or hours would that be?
- The number of moons (if applicable)
- A general description of your tourist attraction (range of temperatures, atmosphere, color, rings, topographic features, etc)
- What should tourists pack?
- Pictures of your tourist attraction
- Logo that represents their tourist attraction

Process:

- Rough Draft:
    - Story board
    - Script
- Final movie

Script:

SAMPLE:

Woman: "Oh, I'm so tired of doing the same old things every day. And our vacations don't feel like vacations any more, just the same old places doing the same old things."

Friend: "Me too! I wish there was somewhere new to go. Somewhere romantic and fun with great views."

Travel Agent: "Want to go somewhere new and fun, out of the ordinary, and not so dull? Visit Phobos! Small and cozy, Phobos orbits the fourth planet from the Sun in less than eight hours. From your observation deck on Phobos, you will have a superb view of Mars. You will see its mountains, polar ice caps, and the largest volcano in the solar system. Call your Spark! cosmic tours and travel agent today!"

…

There is no page limit, however, their script needs to be neat, clean, and well organized:

- The names of their group members should be at the top.
- Each line labeled with the name of the character/person speaking
- Each group member needs to have a speaking part and roughly the same number of lines.
- Include a list of required materials for their video
- Should be typed.

Storyboard:

Storyboards Are Like Comics…Mostly

Students will use the provided storyboard worksheet to illustrate the scenes in their movie. Tell students not to worry about their drawing abilities. Crude stick figures will work just as good for hashing out their ideas pre-production. For them, the most important thing is just to storyboard the script.

- Each square represents a scene in their movie.
- Give a brief description of each scene in the lines below each square.
- Must match their script, if it’s not in the script, they can’t draw it.

Game: Rite or Roid?

Students use logic and quick thinking to outsmart their opponent and win the match for their team.

Have students practice these signs prior to playing the game:

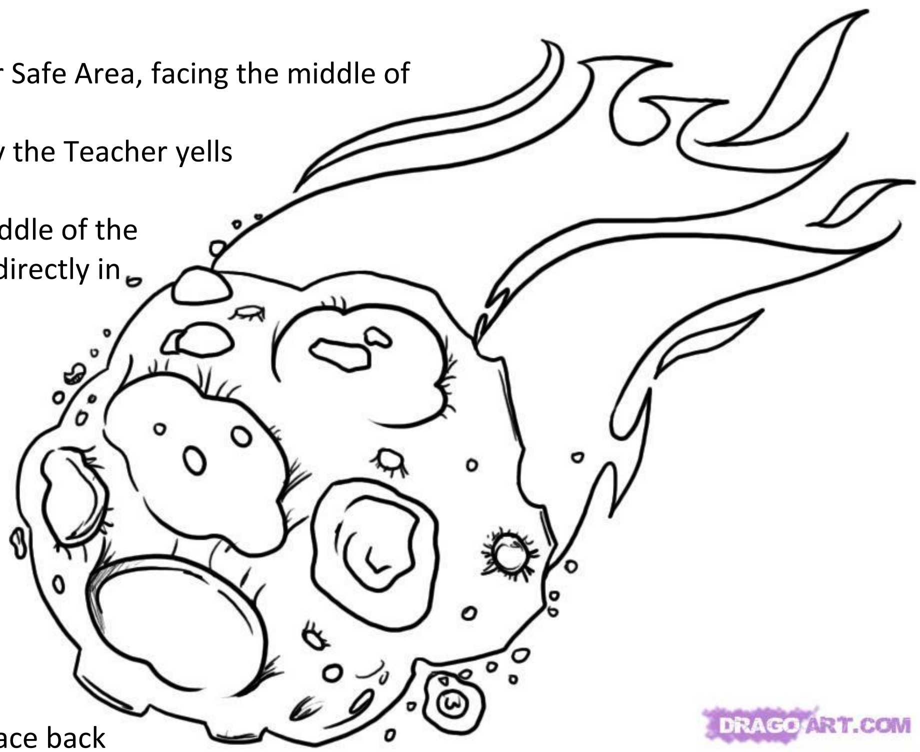
- **Meteoroid** – hands over head
- **Meteor** – arms around self
- **Meteorite** – smash fist in hand

Which wins?

- **Meteoroid** beats **Meteor** because it's not stuck in Earth's atmosphere.
- **Meteor** beats **Meteorite** because it's too hot to handle.
- **Meteorite** beats **Meteoroid** because the journey has come to an explosive end.

How to Play:

1. Both teams line up in their Safe Area, facing the middle of the room.
2. When the teams are ready the Teacher yells "Rite or Roid, 1, 2, 3."
3. Both teams race to the middle of the playing space and line up directly in front of a player of the opposing team.
4. Each player throws their sign (like rock, paper, scissors.) See signs above.
5. If a player loses, they squat down. If they win, they remain standing.
6. For each round, the team with the most players standing wins!
7. After each round, teams race back to their Safe Areas and start again. The team that wins the most rounds, wins the game!



Game: Sun Sue Says

Students will understand orbital mechanics by replicating the motions found in the Universe.

Before you begin, the children should be taught the commands which the activity involves (see below). Have students learn the following actions based on Solar System vocabulary

- Gravity: everyone falls to the floor
- Rotation: everyone spins around
- Revolution: find a partner and orbit around each other, like a "do-si-do"
- Magnetize: everyone runs to the Sun and forms a giant clump
- Propulsion: everyone jumps in the air
- Trajectory: Everyone does a diagonal leap towards a corner

Make up new and additional fun actions based on Space oriented vocabulary.

SAMPLES

- Alien Attack: The children crouch and cover their head for 'protection'. They are not able to get up until 'All clear' is called. Anyone who gets up or moves before the 'all clear' is out.
- Captain's Wife: Everyone curtseys (boys think this is hilarious!).
- Captain's Coming!: Children stop and salute and must continue to stand to attention until the instruction 'Captain's gone' - giving opportunities for catching children out!

How to Play:

1. Students start by forming a line (one behind the other) or form a group directly in front of the teacher (Sun). The teacher then shouts a command and the children have to perform the activity associated with that command.
2. Whoever doesn't follow the command correctly or is the last to follow the command, becomes Pluto and must run an orbit/lap around the Solar System.
3. After one lap, they can then return to the game.

4. After several rounds, choose a new Sun. whoever lasted the longest without becoming Pluto won, or whoever was Pluto the least number of times.

Variation: All can be played just as directed above, but also include the rules for 'Simon Says', i.e. if Sun Sue Says the action then it has to be done. If Sun Sue does not say then the children have to ignore the command and follow the previous one. Very good for improving concentration skills. Also add a little extra to the concentration skills needed by pointing in the 'wrong' direction and watching the children who have the courage of their convictions rather than just following the majority of the class!"

Helpful Websites:

Solar System Simulator [http://space.jpl.nasa.gov/]

See a view of a planet from any other planet at any time, day, or even year. Use the arrows to select the time, date, etc., and the computer does the rest. This allows students to get different views of the planets.

Maps of the Solar System [http://maps.jpl.nasa.gov/]

This site has lots of images. Many are of the planets' outer atmospheres. There are surface images for most of the terrestrial planets.

The Stellarium Project: [http://www.stellarium.org/ OR https://spoon.net/stellarium-0.10]

Take your class to the stars! Just set your coordinates and go. Use Stellarium to view the galaxy up close and personal. Stellarium features a catalog of over 600,000 stars with upgrade packages to boost the count up to 210 million. View constellations from 10 different cultures, along with illustrations and explanations of what the ancients might have seen in the night sky. Also included are a catalog of nebulae; eclipse simulations; and dawn, dusk, and atmosphere background imagery.