

Air Curriculum

Life Learning Academy Project-Based Curriculum

Project Title: Air Curriculum

Project Design Team and/or Instructors: Wayne Brock

Subject Area(s): Integrated Science

Grade Level(s): 9th Grade

Project Overview:

This project is divided into two units. The first unit studies atmospheric science. The second unit's focus is on astronomy. Each unit is designed to allow the students to create their own meaning from their experiences. The curriculum challenges the students to use all their senses, visual, auditory, tactile and kinesthetic to experience the relevance of science to the world around them. A large emphasis is placed on developing healthy questioning and scientific curiosity, building a sense of success within the student, using tools effectively, students learning from each other, providing a historical perspective, and encouraging effective oral and written communication while deemphasizing memorization of vocabulary and textbook knowledge. The units also include an emphasis on teaching accepted national and state academic science standards.

The atmospheric science unit begins with allowing students to examine their own experience with weather and develop questions about how weather occurs. The students then explore weather through lab activities, video, maps, images, direct observations of the weather, and text readings. During the time they are studying the wind they are posed the question "What is something useful or fun we could use the wind for?" At least one student will have come up with kite flying as a response. The students will then build a basic sled kite and practice flying it. They will then experience learning to fly many other types of kites. The students will take a kite flying field trip to practice with stunt kites and kite surfing trainer kites. The culminating activity of the unit is students learning how to sail a boat. They will learn about density, air pressure, forces, buoyancy as well as basic sailing terminology during three fieldtrips. They will be the crew of a sailboat and participate in a race to apply what they have learned.

The astronomy unit will begin with the question "Does the sun go around the earth or does the earth go around the sun?" This question and others will be answered by the students through student observations, astronomy reference materials and astronomy computer software. The students will then learn the constellations and their mythology using a portable planetarium. The unit culminates in an overnight camping expedition to a state park where the students plan an astronomical observing session using an 8.5-inch telescope and binoculars. They will apply their knowledge of the constellations to make real astronomical observations.

Educational Standards Addressed:

1. Students know that the Sun is one of many stars in the Milky Way galaxy and that stars may differ in size, temperature and color. CA State [1], 4b, 8, p28
2. Students know how to use astronomical units and light years as measures of distances between the Sun, stars, and Earth. CA State [1], 4c, 8, p28
3. Students know the appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets and asteroids. CA State [1], 4e, 8, p28
4. Students know density is mass per unit volume. CA State [1], 8a, 8, p29
5. Students know how to calculate the density of substances (regular and irregular solids and liquids) from measurements of mass and volume. CA State [1], 8b, 8, p29
6. Students know how to predict whether an object will float or sink. CA State [1], 8d, 8, p29
7. Students will construct appropriate graphs from data and develop quantitative statements about the relationships between variables. CA State [1], 9e, 8, p30
8. Students know the solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years. CA State [1], 2a, 9-12, p48
9. Students know galaxies are made of billions of stars and compromise most of the visible mass of the universe. CA State [1], 2b, 9-12, p48
10. Students know the evidence that the planets are much closer to Earth than the stars are. CA State [1], 1d, 9-12, p48
11. Student will select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data analyze relationships, and display data. CA State [1], 1a, 9-12, p52
12. Students will formulate explanations by using logic and evidence. CA State [1], 1d, 9-12, p52
13. Students will analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem). CA State [1], 1i, 9-12, p52
14. Students know the sun is the major source of energy for phenomena on Earth's surface; it powers winds ocean currents, and the water cycle. CA State [1], 4a, 6, p19

15. Students know differences in pressure, heat, air movement, and humidity result in changes of weather. CA State [1], 4e, 6, p20
16. Students know when liquid water evaporates it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water. CA State [1], 3b, 5, p15
17. Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet or snow. CA State [1], 3c, 5, p15
18. Students know the causes and effects of different types of severe weather. CA State [1], 4c, 5, p16
19. Students know how to use weather maps and data to predict local weather and know that weather forecasts depend on many variables. CA State [1], 4d, 5, p16
20. Technology is essential to science for such purposes as access to outer space and other remote locations... BSL [2], 3A, 6-8, p46
21. Planets change their positions against the background of stars. BSL [2], 4A, 3-5, p63
22. The patterns of the stars in the sky stay the same although they appear to move across the sky nightly, and different stars can be seen in different seasons. BSL [2], 4A, 3-5, p63
23. Telescopes magnify the appearance of some distant objects in the sky, including the moon and the planets. The number of stars that can be seen through telescopes is dramatically greater than can be seen by the unaided eye. BSL[2], 4A, 6-8, p63
24. The sun is a medium-sized star located near the edge of a disk shaped galaxy of stars, part of which can be seen as a glowing band of light that spans the sky on a very clear night. BSL[2], 4A, 6-8, p64
25. Nine planets of different size, composition and surface features move around the sun in nearly circular orbits. Some planets have a great variety of moons and even flat rings of rock and ice particles orbiting around them. BSL[2], 4A, 6-8, p64
26. Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow, and falls again to the surface. BSL[2], 4B, 6-8, p69
27. The moon's orbit around the earth once in about 28 days changes what part of the moon is lighted by the sun and how much of that part can be seen from the earth – the phases of the moon. BSL[2], 4B, 6-8, p69

28. Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats, damage property and harm or kill humans. NSES[3], F, 5-8, p166

29. Heating of the earth's surface and atmosphere by the sun drives the convection within the atmosphere and oceans, producing winds and ocean currents. NSES[3], D, 9-12, p189

Project Goals and Rationale:

Students develop their ability to ask questions about their environment and surroundings.

Students learn to satisfy their curiosity and answer questions about the world around them by making direct observations, using tools, technology, maps, images, books, magazines and videos.

Students increase their self-esteem and confidence in their ability to learn about the world around them by having success in a variety of contexts.

Students develop skills at working as team to solve problems and accomplish goals.

Project Objectives and Student Outcomes:

Students generate questions about the things around them.

Student make observations of the weather using data acquisition equipment, study and interpret weather maps, identify cloud types, observe Jupiter, four of its moons, Saturn, the moon galaxies, and clusters through a telescope, find the constellations in the sky, read books, magazines, and watch video to answer questions.

Students build and fly a variety of kites ranging from a simple sled kite to dual line stunt kites and kite surfing trainer kites. Students sail a boat and run the controls themselves directly observing the results of their inputs to the boats controls.

Students participate in a boat race working with their fellow students as crew to attempt to win the race.

Project Outline/Detailed Description:

See Project Outline.

Assessment Methods and/or Tools:

Assessment methods are located in the Project Outline.

Texts and Supplemental Instructional Materials:

1. *Science Content Standards for California Public Schools*, ed. S. Bruton and F. Ong. 2000, Sacramento CA: California Department of Education.
2. *Benchmarks for Science Literacy*. 1993, New York, NY: Oxford University Press.
3. *National Science Education Standards*, ed. L.R. Paulson. 1999: National Academy Press.
4. Wittliff, B., *The Perfect Storm*, W. Peterson, Editor. 2000, Warner Bros. Pictures: Burbank, CA.
5. *Storm of the Century*, M. Haluley, Editor. 2000, Artisan Home Entertainment: Santa Monica, CA.
6. Williams, J., *The Weather Book*. 1997, New York: Vintage Books.
7. Simons, P., *Tornado! Hurricane! Flood!*, Y. Abbas, R. Burke, and M. Gorst, Editors. 1996, Discovery Channel Video: Bethesda, MD.
8. Greger, M., *Kites for Everyone*. 1988.
9. Pelham, D., *Kites*. 2000, New York: The Overlook Press.
10. Eden, M., *The Magnificent Book of Kites*. 2002, New York: Sterling Publishing Co., Inc.
11. *Astronomy and More: A Comprehensive Curriculum and Users Guide for the Starlab and other Planetaria.*, ed. P.S. Andrea Colby, Gary D. Kratzer and Joyce Kloncz. 2000, Somerville, MA: Learning Technologies Inc.
12. Spaulding, N.E. and S.N. Namowitz, *Earth Science*. 1999, Evanston IL: D.C Heath and Company.
13. Dickinson, T., *Night Watch: A practical Guide to Viewing the Universe*. 1998, Buffalo, NY: Firefly Books.

Lesson #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
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Atmospheric Science Unit Outline

1 S/B 18,28	Students compare two videos “The Perfect Storm” and “The Storm of the Century” that cover the same event and look for differences and similarities.	<p>Introduce the videos (2 min)</p> <p>Show excerpts of “The Perfect Storm” (20 min)</p> <p>Field questions and comments about first video (5min)</p> <p>Show excerpts of “The Storm of the Century” (20min)</p> <p>Class discussion of the differences and similarities they found. (10min)</p>	<p>Videos “The Perfect Storm” [4]and “The Storm of the Century” [5]</p> <p>Video equipment</p> <p>Worksheet with guiding questions and places for the students to write down things they notice during the videos.</p>	<p>Prepare videotape with selected scenes or program DVD player for selected scenes.</p> <p>Prepare guiding questions.</p>	Students keep worksheet with their comparisons in their notebooks
2 S/B 19	Students write about their most “extreme weather experience” and develop questions about weather	<p>Ss write a short paragraph about their most extreme weather experience (15 min)</p> <p>Ss Share their experiences with the class (20 min)</p> <p>Whole class brainstorms as many types of weather they can (10 min)</p> <p>Using the weather section of the newspaper have students pick out the main components of the forecast and questions they have about weather (15 min)</p>	Current weather sections of the paper	Tear out or make copies of weather section of local paper	Ss keep their writing and responses in their notebooks

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3 S/B 7, 16	Observing the physical states of matter and determining the boiling and freezing points of water	<p>Introduce lab and go over lab procedure. (10 min)</p> <p>Students place ice in a beaker, place it on a hot plate, and measure initial temperature of the ice. The student set the hot plate at medium-high and record temperature measurements of the water every minute. After the measurements stay the same for 4 readings turn off the hot plate and let the beaker cool. (35 min)</p> <p>Ss answer a series of questions about their observations such as, “Why do you think the temperature stopped rising? What do you think was inside the bubbles that formed in the liquid? What do you think would happen to the temperature if the boiling continued?” (10 min)</p> <p>Ss clean up and put away materials (5 min)</p>	Beakers, hot plates, thermometers, ice, timer	<p>Collect and check lab equipment</p> <p>Practice lab procedure, photocopy lab handouts</p>	Ss fill in data and answer questions on lab
4 S/B 7, 16	Graphing states of matter	<p>Review what happened in the States of matter lab. (5 min)</p> <p>Ss graph data and answer questions about lab (25 min)</p> <p>Whole class discussion about the data and observations (20 min)</p>	Rulers and graph paper for graphing		Ss graph and data included with their lab sheet

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		Recap the students discoveries and vocab introduced during the lesson (10 min)			
5	Ss observe sublimation of Dry ice.	<p>Teacher raises question “What happens to the dry ice.” (5 min)</p> <p>Ss do a series of activities and record observations: a) dry ice in film canister, b) dry ice in a balloon, c) touching dry ice with metal spoon, d) dry ice in warm water, e) dry ice in vegetable oil, f) Carbon dioxide gas poured onto a candle. (40 min)</p> <p>Ss clean up and finish writing observations on lab sheet. (10 min)</p> <p>Discuss what happens to the Dry ice when it sublimates. (5 min)</p>	<p>Film canisters</p> <p>Metal spoons</p> <p>Balloons</p> <p>Candles</p> <p>Vegetable oil</p> <p>Dry ice</p>	<p>Prepare lab and materials</p> <p>Pick up dry ice</p> <p>Photocopy lab handouts</p>	Ss responses and observations on their lab sheets
6 S/B 16, 17, 12, 26	Water cycle demo	<p>Teacher poses the question “Where does water go when it dries up (evaporates)?” and “Where does the water on the side of an ice cold soda come from?”</p> <p>Ss write down their theories. (5 min)</p> <p>Start Demonstration of water heating in a flask with a clear tube that takes water vapor and condenses it in another container. (20 min)</p>	<p>Erlenmeyer Flask</p> <p>Rubber stopper</p> <p>Clear hose</p> <p>Beaker</p> <p>Food coloring</p> <p>Hot Plate</p>	Set up equipment	Ss observations and responses on their lab sheets

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		Have the Ss write down their observations and revise their answers to the above questions (15 min)			
7 S/B 16	Ice Cream Lab	<p>Introduce activity (5 min)</p> <p>Have Ss assist with set up of ice cream freezer (5 min).</p> <p>While ice cream is freezing have Ss record the temperature drop of the ice salt mixture. Class discussion of what is happening to the ice cream. Go over vocabulary. (40 min)</p> <p>Eat ice cream (10 min)</p>	<p>Ice cream freezer</p> <p>Rock salt</p> <p>Pre mixed cream sugar and milk</p> <p>Ice</p> <p>Bowls and spoons</p>	<p>Mix cream, milk and sugar</p> <p>Make photocopies of lab handout</p>	Ss record diagram of ice cream freezer and observations on lab sheet.
8 S/B 16,17	Clouds	<p>Show a series of clouds and have student describe what they look like in their own words (15 min)</p> <p>Introduce cloud naming vocabulary (5 min)</p> <p>Have student use the cloud naming system to convert their descriptions into cloud names. (15 min)</p> <p>Ss read about cloud types (15 min)</p>	Computer with LCD projector	Download images of clouds from internet	Ss fill out sheet with descriptions of the clouds and descriptions converted into official cloud names.
9 S/B	Weather data tracking	Video of local newscast weather forecast. Ss record what types of data are shown. (10 min)	Video VCR/TV Pasport™ data	Record a weather forecast the	Students will analyze data in future lesson.

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11,14,15		<p>Reading assignment from text covering Humidity, dew point, barometric pressure etc. (25 min)</p> <p>Show Ss weather data instruments. Set up instruments outside and start tracking weather data (15 min)</p> <p>(Data will be used in a future lesson)</p>	acquisition equipment.	<p>evening before the lesson.</p> <p>Set up weather instruments.</p>	
10 S/B 15	Wind Speed measurement and Analyze Weather data	<p>Introduce Buefort scale (5 min)</p> <p>Ss use Beufort scale to figure out wind speeds. (10 min)</p> <p>Demonstrate anemometer. Take class outside and have a volunteer take 3 wind measurements, 2 inches, 5 feet and 8 feet from the ground. Discuss how the wind speed increases as you measure higher from the ground. (10 min)</p> <p>Show Recorded weather data from lesson 9 to the class. Ss answer questions about the data (35 min)</p>	Anemometer	<p>Download data to computer for display to the class</p> <p>Make copies of Beaufort scale from "The Weather Book"[6]</p>	Ss record Answers to questions in lab notebook
11 S/B	Reading weather maps	Show the class weather maps that show maps for several days in a row. (Try to use maps that show a weather system moving	Computer with LCD projector	Download satellite images and	

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19,15		<p>toward your local area and have the students try to predict the weather.) (10 min)</p> <p>Explain what the symbols mean. (10 min)</p> <p>Assign reading about weather maps (15 min)</p> <p>Ss color barometric pressure map low and high pressure areas and compare with radar image (15 min)</p> <p>Show class different satellite images (10 min)</p>		<p>weather maps from www.noaa.gov</p> <p>Make copies of barometric pressure maps</p>	
12 S/B 28	Storm Chasers Video	<p>Show various Storm Chaser videos pausing occasionally for class discussion. (45 min)</p> <p>Pose the question “The wind is very destructive but is there anything fun we could use the wind for. Ss will respond with “kite flying”. Discuss with the class the possibility of flying kites. (15 min)</p>	VCR/TV	Check out Storm Chasers video[7]	
13	Introduce kites/early flight	<p>Early flight video (30 min)</p> <p>Discuss history and uses of kites (15 min)</p> <p>Ss copy a diagram of how kites fly into their notebooks (15 min)</p>	VCR/TV Kite books[8],[9],[10]		Ss record kite diagram in notebooks.
14	Kite building	Hand out kite instructions and material. (5	Frustrationless Flyer	Make copies	Ss successfully

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		min) Go over instructions for building kite (10 min) Ss build kites (45 min)	Kite Kit™ One for each student.	of Kite instructions for each student.	build a kite
15	Kite flying	Allow Ss to finish kites (15 min) Explain safety rules and how to launch kites (5 min) Go outside to safe area and fly kites. (30 min) Return to class and put kites away (10 min)			Ss successfully launch and fly their kite.
16	Kite flying	Display and explain how to use different types of kites (10 min) Go outside to safe area and fly kites allowing student to use their own kite or commercially produced kites. (40 min) Return to class and put kites away (10 min)	Assortment of kites. Box kite, Large Delta kite, Dual line Delta kite, Dual line aerofoil kite, and any other interesting type of kite.	Make sure kites are ready for use.	Ss fly kites successfully.
17	Power kiting introduction	Show Kite surfing video (20 min) Show class kite surfing kites and explain how to use them (20 min) Show trainer kite instruction video (20 min)	TV/VCR Kite surfing video	Check out or purchase kite surfing video	
19	Field trip Power kiting, kite	Field trip to local Kite flying area. Ss fly kites and try the power kites. A local kite	Kites	Make field trip arrangements	

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	surfing demo	surfer demonstrates kite surfing in San Francisco Bay.			
20	Introduce sailing/video	<p>Ss share what they liked about the field trip (10 min)</p> <p>Ss write short paragraph about their experience with kites (25 min)</p> <p>Ask Ss what other fun activity could you do with the wind. When they respond with “sailing” show sailing video (20 min)</p> <p>Discuss upcoming sailing fieldtrip. (5 min)</p>	TV/VCR Sailboat racing video		Ss write about their kiting experience
21 S/B 4, 5, 6, 11	Why do boats float? Density Lab	<p>Introduce density and demonstrate how to calculate it (15 min)</p> <p>Ss use Hanging balance, graduated cylinders, rulers, and water to measure density of objects. Ss should determine the density of water and observe that objects that have a density higher than water sink. This will cause conflict when they are asked how a huge ship made of steel can float. Ss record data on their lab sheet (35 min)</p> <p>Ss answer questions on lab sheet and discuss “Why do boats float?” (10 min)</p>	Hanging balances, graduated cylinders, Density cubes of different materials.		Ss record data and answer questions on lab sheet

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22	Knot tying day	<p>Introduce the knot tying activity and give each student 2 ft long piece of rope and knot tying instructions. (5min)</p> <p>Demonstrate figure-8 knot while Ss try to tie the knot themselves. (15 min)</p> <p>Demonstrate bowline knot while Ss try to tie knot themselves (15 min)</p> <p>Assist Ss having trouble with knots and let those who have mastered those knots try more advanced knots. (15 min)</p> <p>Explain sailing orientation fieldtrip. (10 min)</p>	<p>Knot tying instructions</p> <p>Two foot sections of ¼” to ½” rope, one for each student</p> <p>List of what Ss should bring on upcoming field trip</p>	Practice tying knots	Ss demonstrate to teacher that they can successfully tie the knots.
23	Sailing orientation	Trip to local organization that teaches sailing to kids. Orientation covers sailing safety, terms, parts of a boat, how to sail.		Make field trip preparations	
24	Sailing field trip	Second field trip students sail boat as a team taking turns at each station on the boat.			
25	Writing assignment Begin	Students work on writing assignment that describes their Sailing experience (60 min)			Ss writing assignment
26	Sailing race.	Final sailing trip. Teams of Ss race each other around a sailing course.			

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Astronomy Unit Outline

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27	Introduction to astronomy	<p>Show slides of astronomical objects. Ss write down questions they have about each slide (20min)</p> <p>Ss share two most pressing questions with the class. (10 min)</p> <p>Hand out textbook to students and introduce them to astronomy chapters. Also let them look through classroom reference materials. Ss try to find the answer to the questions that they shared with the class. (20 min)</p> <p>Allow Ss to share answers with the class (10 min)</p>	Slide Projector, slides[11] Text (Earth Science)[12]	Select slides and set up projector	Student record questions and answers in notebooks
28 S/B 12, 13	Night and Day earths rotation	<p>Ask the class “What causes day and night?” and “How could we tell the time without a clock?” Ss record answers in their note books (5 min)</p> <p>Ss share their theories with the rest of the class. (5 min)</p> <p>Using a globe and a light source show what the earth looks like when the sun shines on</p>	Earth Globe Overhead Projector Time Zone transparency		Ss write ways to tell time without a clock in notebooks

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		<p>it. Ss will discuss how they would change their theories or if their theory matches the new info. Ask what “High Noon” might mean. Discuss what 24 hours in a day has to do with the earth’s rotation. (20 min)</p> <p>The discussion should lead the students to understand the earth rotates once every 24 hours, that it is “noon” when the sun is highest overhead (neglecting DST) and when it is noon where you are it is midnight directly across the globe. Make sure everyone in the class understands this before moving on. (5 min)</p> <p>Put a time zone map on overhead projector and handout a copy for each student. Have students count 24 time zones. Demonstrate how to determine what time it is in other parts of the world by counting over time zones. (15 min)</p> <p>Review main points of lesson. (5 min)</p>			
29 S/B 12, 13	Using time zone maps	<p>Write a time zone problem on the board for the Ss to solve. (5 min)</p> <p>Ss complete worksheet with progressively more difficult time zone problems. (25min)</p> <p>Introduce vocab “prime meridian” and</p>	Overhead Projector Time Zone transparency		Ss complete time zone worksheet

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		<p>“International Date Line” and explain how they work. Show how a student could travel across the date line and have their birthday twice or miss their birthday depending on which way they crossed the date line at midnight. (20 min)</p> <p>Discuss the question “Why is this important for astronomers?” and how universal time is important for astronomers. (10 min)</p>			
30 S/B 2, 3	The sun earth System	<p>Hold a basketball in front of the class. Tell Ss this will represent the sun. Ask, “How big would the earth be compared to this “sun”?” Ss respond with baseball, golf ball, etc. Show them a peppercorn represents the earth. (5 min)</p> <p>Show slides of the sun, point out features, and compare feature to size of the earth. (10 min)</p> <p>Ask question “How far would this earth (peppercorn) be from this sun (basketball). After discussing the problem have students measure distance in the hallway (approx 40 ft) and have students hold them in their locations. (15 min)</p> <p>Return to classroom and have students find picture illustration of the sun and earth in a book. Discuss whether the picture is</p>	Basketball Peppercorns Sun slides Slide Projector Tape Measure	Select appropriate slides of the sun	Ss record responses in notebooks

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		<p>realistic or misleading. Why? Is it possible to draw the sun and the earth to scale on the same piece of paper Why or Why not? Ask Ss if they think illustrations of the solar system are drawn to scale. Why or why not. Ss write responses in notebooks. (10 min)</p> <p>Short reading assignment about sun together as a class with pauses for discussion. (20 min)</p>			
31 S/B 3, 20, 1	Observing the sun	<p>Show class a pinhole sun viewer. Explain that they will be making their own. Hand out and go over instructions. (10 min) http://www.exploratorium.edu/eclipse/how.html</p> <p>Hand out materials, Ss build pinhole viewer. (30 min)</p> <p>Take students outside to use their viewer. INSTRUCT THEM NOT TO LOOK DIRECTLY AT SUN! (10 min)</p> <p>Return to class and put viewers away. (5 min)</p>	<p>Cardboard tubes Long skinny Cardboard boxes Aluminum foil Tape Scissors Pins</p>	Gather materials Photocopy instructions	Ss demonstrate that they successfully built and used their pinhole viewer
32 S/B 11, 20, 23	Observing the sun with a telescope.	<p>Introduce activity; show students telescope set up in classroom. Explain basic operation. (15 min)</p> <p>Ss help carry and set up equipment outside.</p>	Good quality Telescope	Prepare telescope by mounting cardboard in front of	

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		<p>(10 min)</p> <p>Ss look through telescope at a far away sign or object. (15 min)</p> <p>Set up telescope for projecting image of sun on piece of white paper. Reduce aperture of telescope with opaque material. Ss observe projected image of sun. DO NOT LOOK DIRECTLY AT THE SUN THROUGH THE TELESCOPE! (10 min)</p> <p>Ss help put away telescope and return it to classroom. (10 min)</p>		<p>eyepiece for projection of sun image and opaque aperture reduction or solar filter.</p>	
<p>33</p> <p>S/B 27</p>	<p>Moon Phases</p>	<p>Ask, “Why does the moon appear different sometimes?” Ss discuss their theories on the moons phases. (10 min)</p> <p>To illustrate the motions of the sun, earth, and moon. Take student outside or to a large open area for them to move. Assign three students to be the earth, moon, and sun. Using rope or string to represent gravity between them have the “moon” revolve around the earth. Each time the “moon” makes one revolution have the “earth” take two steps around the “sun”. Explain how this is a model of how they move in space. (20 min)</p>	<p>Rope or heavy string</p> <p>Overhead projector</p> <p>Spheres for earth and moon</p>	<p>Photocopy blank diagrams of moon phases</p>	<p>Ss label diagrams of moon phases</p>

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		<p>Back in the classroom using a light source such as an overhead projector and spheres representing the earth and moon to show how light hits them during the different phases. (15 min)</p> <p>Ss label a diagram of the earth, sun, and moon system with the appropriate phase labels. (15 min)</p>			
34 S/B 3	Eclipses	<p>Ask Ss what they think causes eclipses, the difference between solar and lunar eclipses. How often they occur etc. (10 min)</p> <p>Allow students to use the light source and spheres to demonstrate how they think an eclipse occurs. (15 min)</p> <p>After Ss have come up with a good explanation show a computer simulation of an eclipse from Starry Night© software to fill in gaps in their understanding. (15 min)</p> <p>Short reading assignment from text about eclipses. (15 min)</p> <p>Tell students about any upcoming eclipses. (5 min)</p>	<p>Light source Spheres Starry Night Software Text[12]</p>		
35	Planets	<p>Ask Ss if they can name the planets starting from the sun and working outward and</p>	<p>1 Orange 9 surveying flags</p>		

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S/B 2, 3, 10, 25, 8		<p>write them on the board. (5 min)</p> <p>Have Ss recall the lesson where a basketball was the sun and a peppercorn was the earth. Discuss how big the solar system might be if the sun was a basketball. What if the sun was the size of an orange? Have students give distances of each planet from the sun in miles and write it on the board with the planet. Scale measurements to feet assuming the sun the size of an orange. Divide number of feet by 3 to get the number of paces one could walk to approximate the distance. Assign each student to a planet and give him or her a surveyor's flag to write the information their planet on. Take the students outside to a LARGE grassy area and put an orange on the end of a stick. Student pace the distances to their planet and use their flag to mark the spot. As you get farther from the orange have the students take note of how far away they have gotten from the orange and if they can still see it. After Ss have made it all the way to Pluto walk back to the orange collecting the flags as you go. Return to the classroom (40 min)</p> <p>Discuss how long it would take to travel to various locations in the solar system.</p>	Marker		

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		<p>Compare distances to the nearest star to the sun with distances between the planets. Discuss the size of the milky way galaxy and the Sun's location in it. (15 min)</p>			
<p>36 S/B 22</p>	<p>Constellations</p>	<p>Give students a couple constellations without lines connecting the stars. Ss try to connect the dots (stars) to represent something. (10 min)</p> <p>Discuss what a constellation is and reveal what the constellations you gave them are supposed to represent. (10 min)</p> <p>Give Ss two star maps, one with constellations labeled another unlabeled. Ss use the labeled one to label the unlabeled one. Explain how to use a star chart. (15 min)</p> <p>Ss will be wondering about their zodiac sign. Use this opportunity to discuss the difference between astrology and astronomy. Make clear the difference between mythology and the science of astronomy. Give students an opportunity to read mythology of some constellations. (15 min)</p>	<p>Star maps[13],[11] Constellation Mythology reading[11]</p>	<p>Make copies of Star charts, and blank constellations</p>	

Lesson #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
		<p>Ask Ss if they have ever heard of the North Star or the Big Dipper. Tell the students that the next class they will be using a planetarium to study the constellations and learn how to find the North Star. Explain what a planetarium is and how it works. (10 min)</p>			
<p>37 S/B 22</p>	<p>Planetarium study of the constellations</p>	<p>Explain rules and procedures for using the Starlab™ (5 min)</p> <p>Assign Starlab set up tasks to students and begin set up. (15 min)</p> <p>Ss enter Starlab. Ss will be excited and curious about the acoustics, nervous about the dark, and have lots of questions. Let them settle down before turning out the lights. Hand out clipboards, worksheets and red-lensed flashlights. Dim lights and show star with lines connecting stars to show the constellations. Once stars are up explain apparent movement of the stars. Show them the star that does not appear to move. Ask them what star they think it is. Why does it not move? Can they find the Big Dipper? Explain the steps for finding the Big Dipper, North Star (Polaris), and Little Dipper. Ss</p>	<p>Starlab[11] Clipboards Red lensed flashlights</p>	<p>Photocopy worksheets Check batteries in flashlights</p>	<p>Ss record steps on worksheet</p>

Lesson #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
		record the steps on their worksheets. If time allows point out a couple more constellations. (25 min) Ss help take down and put away Starlab (15 min)			
38 S/B 22	Planetarium study of the constellations	Assign Starlab set up tasks to students and begin set up. (15 min) Show Ss stars with constellation pictures. Point out zodiac signs. Explain why they are all in a line and why they are called the Zodiacs. Show other prominent easy to find constellations such as Draco, Orion, Canis Major etc. (15 min) Switch to display of only stars. Have student volunteer demonstrate how to find the Big Dipper, North Star and Little Dipper. Demonstrate how to pick out constellations you showed earlier. (15 min) Put away Starlab (15 min)	Starlab[11]		
39 S/B 11	Star Finder	Show Ss a Star Finder. Show how it works and how to use it. (5 min) Hand out materials for making Star Finder. Explain the steps for making it. (5 min) Ss make star finders (20 min)	Star finder kits[11] Tape Scissors	Photocopy Star finder template onto cardstock Photocopy worksheets	Ss answer questions on worksheet

Lesson #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
		<p>Ss use Star Finder to answer questions on worksheet. (20 min)</p> <p>Tell students about upcoming camping trip. Explain how bright the stars appear away from city lights. Get the students interested in going on the trip. (10 min)</p>			
40 S/B 21	Planetarium study of the constellations	<p>Assign Starlab set up tasks to students and begin set up. (15 min)</p> <p>Project stars including planets and moon in their current position. Review constellations and finding Polaris. Ss will notice the planets and wonder what they are. Explain how the planets appear to “move” in the sky. Note that planets are found in the zodiac (20 min) constellations.</p> <p>Let students practice with Star Finders. Challenge them to find constellations that we have not studied. (10 min)</p> <p>Put away Starlab (15 min)</p>	<p>Starlab[11]</p> <p>Star finders[11]</p>		Ss will have to identify constellations in a quiz
41	Camping trip Planning	<p>Ask Ss “What should we bring on our camping trip?” Discuss their responses. (10 min)</p> <p>Put a chart on board or overhead projector.</p>	Overhead projectors		Ss complete observing plan

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		<p>As a class decide what to bring for meals, make a schedule of who cooks when, a list of what equipment we need to bring etc. (20 min)</p> <p>Make an observing plan. Assign groups of students a constellation to research and determine what objects we could see with our telescope or binoculars. When groups are finished they share what they think we should observe. As a class arrange the objects in the order that we should observe them. (20 min)</p> <p>Give students a list of what they should bring on the camping trip. Discuss logistics of the trip. (10 min)</p>			
<p>42</p> <p>S/B 8, 9, 11, 20, 21, 22, 23, 25</p>	<p>Camping trip</p>	<p>As dusk approaches point out the first few stars or planets that become visible. Start gathering the students to help set up equipment. Have students try to find constellations that they have studied. Ss should try to locate Polaris so the telescope can be polar aligned. Proceed through the object that the students choose when planning. Plan may have to be modified due to sky conditions. Students take turns looking through the telescope. Students waiting to look through the telescope should be encouraged to use the binoculars, lie</p>	<p>Camping gear Telescope Binoculars</p>	<p>Make field trip preparations.</p>	

Lesson #	Content Outline	Teaching Sequence	Equipment and Materials	Preparation	Assessment
		<p>down and scan the sky for meteors, satellites, International Space Station, constellations, etc.</p> <p>After a couple hours when student interest starts to wane have a S'more break. Those that are interested can continue to observe with you but as it gets late others may want to sleep or hang out around the campfire.</p> <p>Have students help take down and put away equipment.</p>			
43 S/B 22	Final quiz	Students enter Starlab individually. Using nothing but their star finder they are required to demonstrate without assistance how to find the Big Dipper, North Star, Little Dipper, and two other constellations of their choice.	Starlab[11]		Ss demonstrate to the teacher their ability to identify constellations.