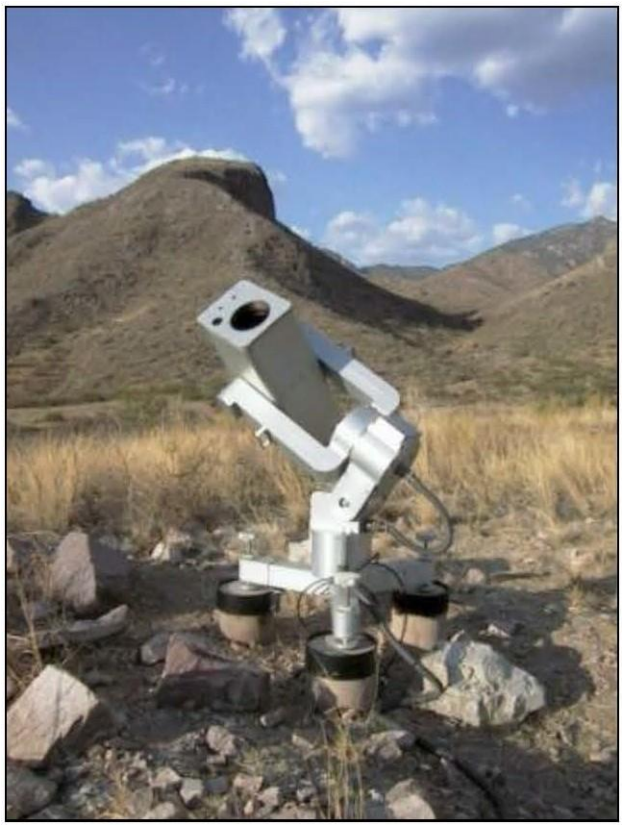
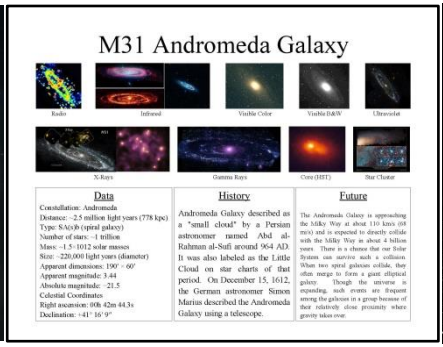
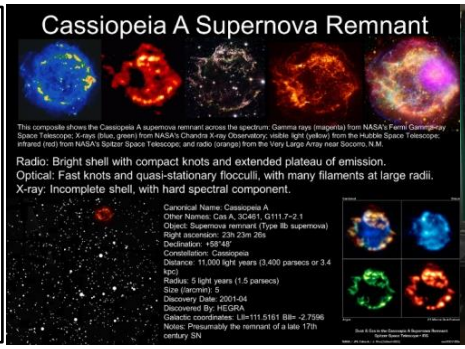
Cosmic Images Across the Spectrum



Using computers online, students will learn how to access robotic telescopes, take photographs of planets, galaxies, and nebulae and use image processing tools to bring out detail in these photos the same way that professional astronomers do. Each student will download the image processing software onto their computer's hard drive from the NASA web site and is assigned the task to request an image from the robotic telescopes as much in advance of the program as possible (to allow for cloudy nights and make sure they have clear images). Each student will need access to a computer during this activity.

Using a search engine, locate and download images of the selected object taken by detectors sensitive to various frequencies in radio, infrared, ultraviolet, X-rays and gamma rays, and assemble with the processed visible image. Then, information for each selected object, such as type of object, when discovered and by who, constellation found in with its celestial coordinates, apparent and true size, brightness, etc. will be compiled onto a page or "block" and submitted to be added to a “Cosmic Quilt.” Color poster-sized printouts of all blocks submitted can be assembled together for a physical Cosmic Quilt and put on display as an exhibit for all to see.





Daily Observation Log

Observer: _____ **Date:** _____

Time: _____ am / pm **Duration:** _____ min

Sky: 0 1 2 3 4 5 (circle one) **Seeing:** 0 1 2 3 4 5 (circle one)

Constellation(s): _____

_____

_____

_____

Star(s): _____

_____

_____

Planet(s): _____

Object(s): _____

Phenomena: _____

Observational Method: unaided eye paper tube binoculars telescope (circle one)

Drawing:

Instructions for Completing Daily Observation Log

Observer: Please print your full name

Date: Record current month/day/year (i.e. 01/08/2009)

Time: Record the time you began the observation and circle AM or PM

Duration: Record the total number of minutes you actually made your observation

Sky: Circle one number that best represents the sky from clear to completely overcast. 0 = clear; 1 = a few small clouds; 2 = partly cloudy; 3 = sky 50% cloud-covered; 4 = few breaks in clouds; 5 = completely overcast

Seeing: Circle one number that best represents the seeing conditions from excellent to poor. "Seeing" is a term used by astronomers to describe the steadiness of the atmosphere. One method of determining how steady or unsteady the atmosphere is, due to air currents and temperature changes, is by studying the brighter stars. Bright stars that appear to "twinkle" indicate turbulence in the layers of air in the atmosphere. Rate the seeing conditions on a scale of 0 for perfectly steady to 5 for stars that appear to "dance" in the sky.

Constellation(s): List any constellation you are able to identify in the night sky.

Star(s): Write the name of each brightest star you are able to identify by consulting a star chart or atlas.

Planet(s): Write the name of any planet you identify by referring to current data available giving its location.

Object(s): Record the number and types of objects seen in the sky. Examples include meteors ("falling or shooting stars"), satellites, comets, asteroids, etc.

Phenomena: Any form of sky glow, such as aurora or the Milky Way, may be recorded

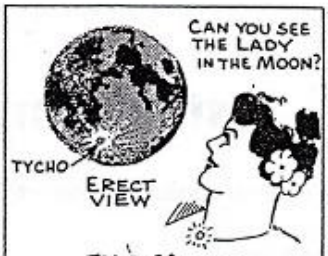
Observational Method: Circle the method of observation used. More than one per observation period can be utilized.

Drawing: Draw the moon phase (amount of sunlit portion) if visible. Also draw in anything recorded for that day's observation. You should draw in boundary lines separating different parts of the sky and include the direction abbreviated (i.e. SW) for each segment.

The SKY Show

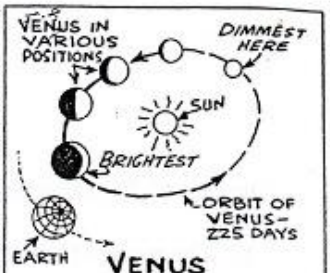
THE SUN

... INTERESTING TELESCOPE OBJECT AT 40× TO 70× BUT YOU MUST USE A SUN FILTER TO AVOID SERIOUS INJURY TO YOUR EYE. THE SUN SPOTS ARE EASY TO SEE



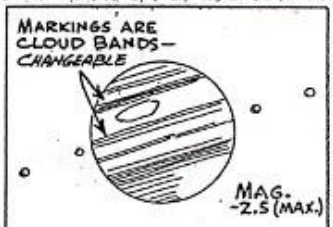
THE MOON

MAGNITUDE -12 WHEN FULL IS 190,000 TIMES BRIGHTER THAN FIRST MAGNITUDE STAR. CRATER TYCHO *(TIE-CO)* IS ON SOUTH SIDE - MOST PHOTOS ARE SHOWN INVERTED



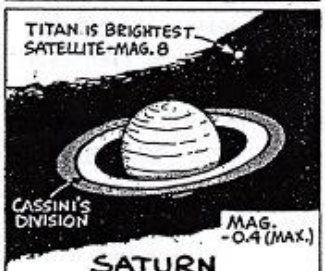
VENUS

LIKE ALL OF THE PLANETS, VENUS ORBITS AROUND THE SUN AND IS LIGHTED BY THE SUN. ON HER NEAR APPROACHES TO THE EARTH SHE IS BRILLIANT AT -4 MAGNITUDE



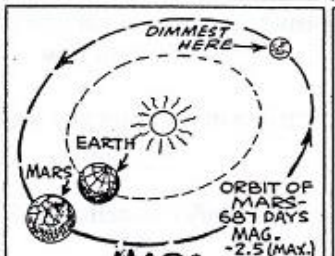
JUPITER

BIG JUPE IS THE EASIEST PLANET TO SEE -- ALWAYS BRIGHTER THAN -1½ MAG. HIS FOUR BRIGHTEST MOONS OF MAG. 6 SHUTTLE BACK AND FORTH, CHANGING NIGHTLY



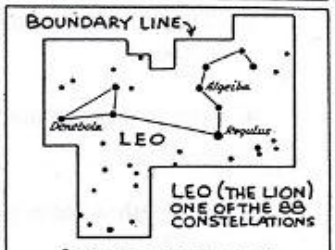
SATURN

SATURN IS THE PRETTIEST PLANET. THE RINGS ARE SEEN PLAINLY AT 40× ALTHOUGH INVISIBLE WITH 7× BINOCULAR. WITH HIGHER POWER YOU MAY BE ABLE TO SEE CASSINI'S DIVISION



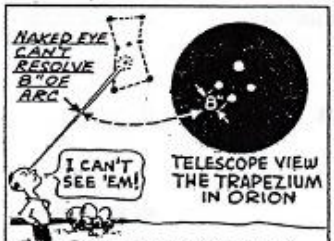
MARS

RED MARS MAKES A NEAR APPROACH TO THE EARTH EVERY OTHER YEAR, AND AT SUCH TIMES SOME SURFACE DETAIL CAN BE SEEN WITH TELESCOPES AT 200-300×



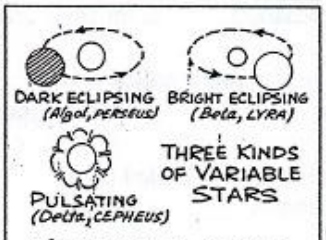
CONSTELLATIONS

A CONSTELLATION IS A GROUP OF STARS, USUALLY FORMING SOME KIND OF PATTERN OR "PICTURE." PROPERLY, A CONSTELLATION IS A SPECIFIC AREA OF THE SKY



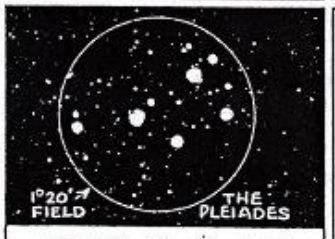
DOUBLE STARS

ONE OUT OF 15 STARS IS A DOUBLE OR MULTIPLE STAR AND ABOUT 500 OF THESE FROM 2 SECONDS TO 1 MINUTE OF ARC SEPARATION CAN BE "SPLIT" WITH SMALL TELESCOPES



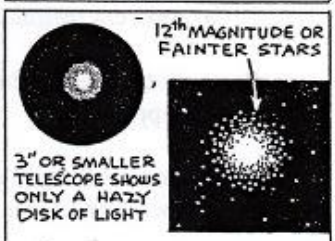
VARIABLE STARS

A VARIABLE STAR VARIES IN BRIGHTNESS. THE CHANGE TAKES 2 DAYS *(AVERAGE)*, MAKING THE V.S. A POOR "SHOW" OBJECT ALTHOUGH IDEAL FOR SYSTEMATIC STUDY



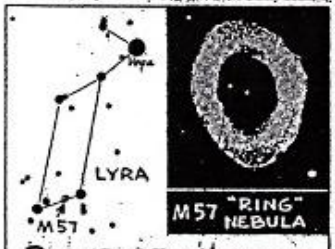
OPEN CLUSTERS

OPEN CLUSTERS OF STARS ARE A FAVORITE TARGET FOR THE TELESCOPE. 40 TO 60× IS ENOUGH FOR MOST GROUPS. POPULAR PLEIADES CLUSTER IS A FINE BINOCULAR OBJECT



GLOBULAR CLUSTERS

A GLOBULAR CLUSTER IS A BALL OF STARS. INDIVIDUAL STARS ARE FAINT AND NEED 6" OR MORE APERTURE FOR RESOLUTION. M13 AND M22 ARE TWO BRIGHTEST

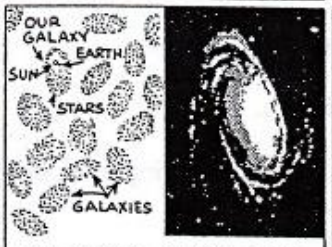


PLANETARY NEBULAE

PLANETARY NEBULAE ARE SO NAMED ONLY BECAUSE THEY ARE ROUND LIKE PLANETS. THEY ARE LUMINOUS GAS CLOUDS AND ARE A PART OF OUR GALAXY

DIFFUSE NEBULAE

A LARGE DIFFUSE GAS CLOUD LIGHTED BY THE STARS IN ITS VICINITY IS KNOWN AS A BRIGHT DIFFUSE NEBULA. M42 IN ORION IS IMPRESSIVE, EASILY SEEN WITH ANY TELESCOPE



EXTERNAL GALAXIES

GALAXIES ARE COMPLETE STAR SYSTEMS LIKE OUR OWN GALAXY. ALL ARE VERY DISTANT. M81 SHOWN IS ABOUT AS BRIGHT AS A STAR OF 9th MAGNITUDE

NO.	TYPE	CONS.	M.
M44	OPEN CL.	CANCER	3.7
M41	OPEN CL.	CANIS MAJ.	4.6
M24	OPEN CL.	SAGR.	4.6
M31	GALAXY	ANDR.	4.8
M35	OPEN CL.	GEMINI	5.3
M13	GLOBULAR	HERCULES	5.7
M22	GLOBULAR	SAGR.	5.9
M8	DIFFUSE NEB.	SAGR.	—
M42	DIFFUSE NEB.	ORION	—
M57	PLANETARY	LYRA	9.3

MESSIER OBJECTS

FRENCH ASTRONOMER, CHARLES MESSIER, MADE UP THE FIRST LIST OF SKY OBJECTS OTHER THAN STARS (1784). ALL OF THE 103 M-OBJECTS CAN BE SEEN WITH SMALL TELESCOPES

Getting Started - Observe with MicroObservatory!

You'll use the "Observing With NASA" online interface to control the telescopes, which is linked at this url: http://mo-www.harvard.edu/OWN/

1. Request an image (or many!) from the MicroObservatory telescopes

- Click on the link “Control Telescope” on the upper left of the screen
- An array of thumbnail images of objects appear under 3 categories of Solar System, Stars & Nebulae, and Galaxies & Beyond
- Some objects appear faded and states “Not up tonight,” meaning the object is not available to be photographed
- Many of the objects appear clear and have a button called “Observe”
- Prior to selecting your target, you can click on the thumbnail to see a detailed view
- When ready, click on the “Observe” button and you will be taken to a page called “Adjust Your Telescope Settings”
- When only one option is offered for a setting, it is the best default for that object and the radio button should be clicked
- When more than one option is available, such as Exposure Time, select a setting you believe will work and click the radio button
    - If a red flag appears saying something like “Image may be under or overexposed,” choose another setting until you get a green flag, indicating the setting is optimal
    - When multiple filters is an option, choose it and you will receive 3 images in the RGB colors
- When done with the settings, click on the button “Continue” in the lower right corner
- Enter your contact information and click “Submit”
- Any image requested today will be taken tonight and emailed to you tomorrow, so hope for clear skies

  You might also want to read the "About MicroObservatory" section of that website to get background on how the telescope system works.

2. Visit the MicroObservatory directory of recently taken images to explore what the images taken by others look like and to find one you like, at this url:
http://mo-www.harvard.edu/jsp/servlet/MO.ID.ImageDirectory

When you go to this link be sure to open up the browser window wide so you see the long list of images taken over the last 2 weeks.

3. Open the image processing software and run it on your computer

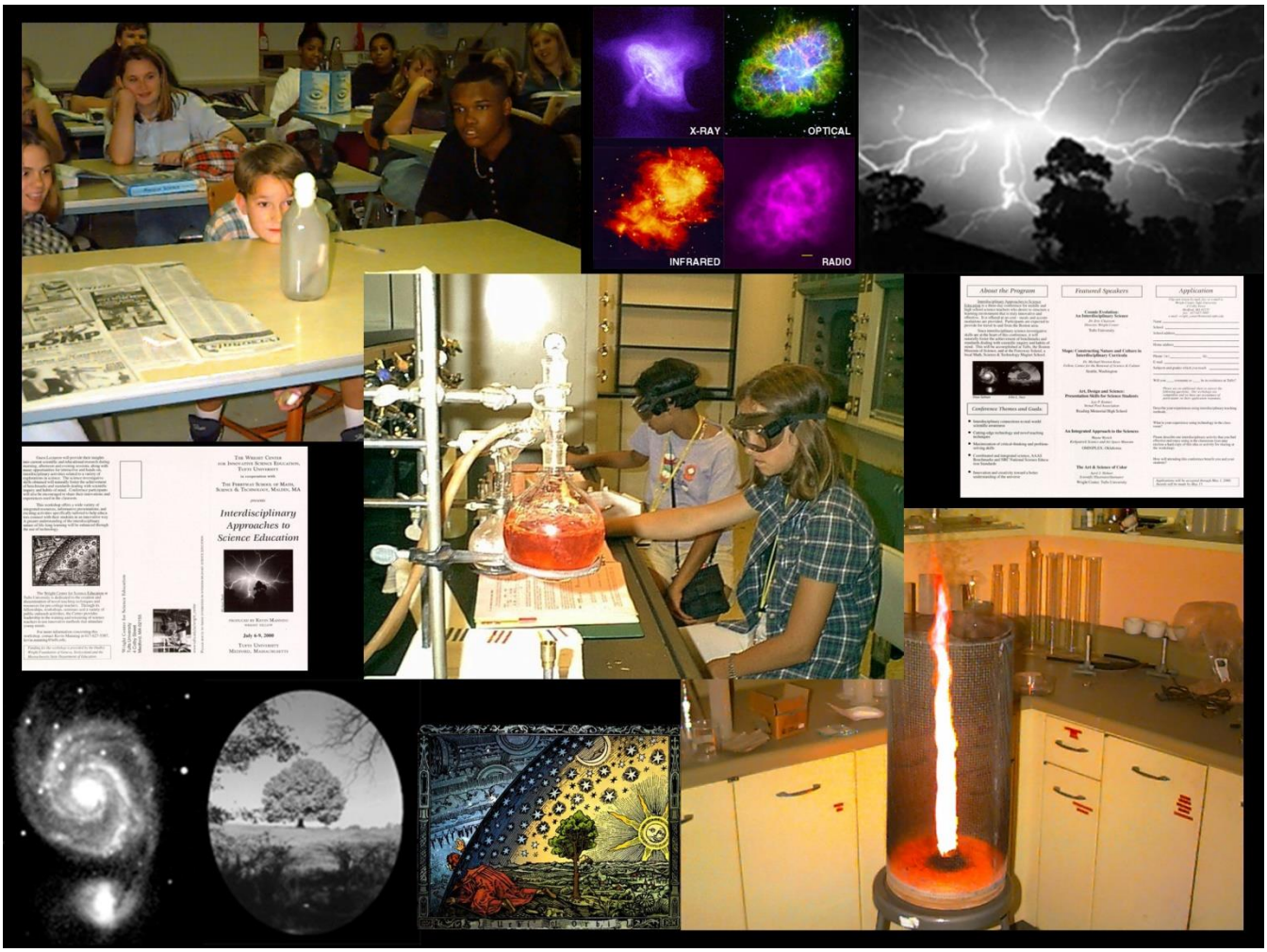
- Download the software from the web site's link at the top called “Download Software,” then double click the Windows version if you have a PC or the one for Mac
- Double-click on the folder named *MicroObservatoryImageWindows2.0* on the desktop
- Double-click on the file "run MS-DOS Batch File 1KB"
- Under the link “Tools & Training,” you can download the PDF file called MicroObservatory Image 2.0 Manual
- Begin following the index of command functions

4. Use your finished images in a variety of ways

- For information on what you can do with your MicroObservatory images once you've taken, downloaded and processed them, click on "Projects & Activities" for some great ideas
- Other options, along with general information on astronomy and astronomical events, are available under the link "News & Views"

Interdisciplinary/Cross-Curricular Learning

In our daily experience of life we often observe that the things we learn are not artificially compartmentalized, but touch on a wide variety of perspectives for a complete understanding. For example, the subject of pollution may appear differently when examined by different disciplines like biology, chemistry, ecology, economics, geography, and politics. Cause-and-effect relationships exist in literature, science, and social studies. While students are learning the basic information in core subject areas, they are not learning to apply their knowledge effectively in thinking and reasoning, and to apply, integrate, and transfer knowledge.



Using interdisciplinary/cross-curricular teaching methods has been shown to increase motivation for learning and level of engagement. In contrast to learning skills in isolation, when one participates in interdisciplinary experiences they see the value of what they are learning and become more actively engaged. It provides the conditions under which effective learning occurs. Cosmic Images across the Spectrum is a project involving the use of computers online to learn how to access robotic telescopes, take photographs of galaxies, nebulae, and star clusters and use image processing tools to bring out detail in these photos the same way that professional astronomers do.