Fall Pre-View 2012 Astronomy Course
Mississippi Valley NightSky Conservation
The Sky Around Us

Program developed by
-Mississippi Valley Conservation Authority
-Royal Astronomical Society of Canada
-Ottawa Astronomy Friends

Instructors:
Pat Browne
Stephen Collie
Rick Scholes

Course Assistant
Amelia Booth

Software
-Earth Centered Universe courtesy David Lane
-Stellarium - GPL

Review - Points to Ponder

- Light Year (distance)

Why do we measure distances in light years?

Light Year (is a measure of a large distance – which we can use beyond our solar system)

D = V * T

The time for light (as a wave) to propagate from point A to point B in a Year

V = 300,000 km/sec

T = 1 Year

or (365days/hours x 24hours/day x 60min/hr x 60sec/min) secs

or (number of AUs in a light year is equivalent to number of inches to mile)

(93million Miles or … 160Mkms x 60,000 ~ 10 million million kms – 10 x 10^12, i.e trillion)

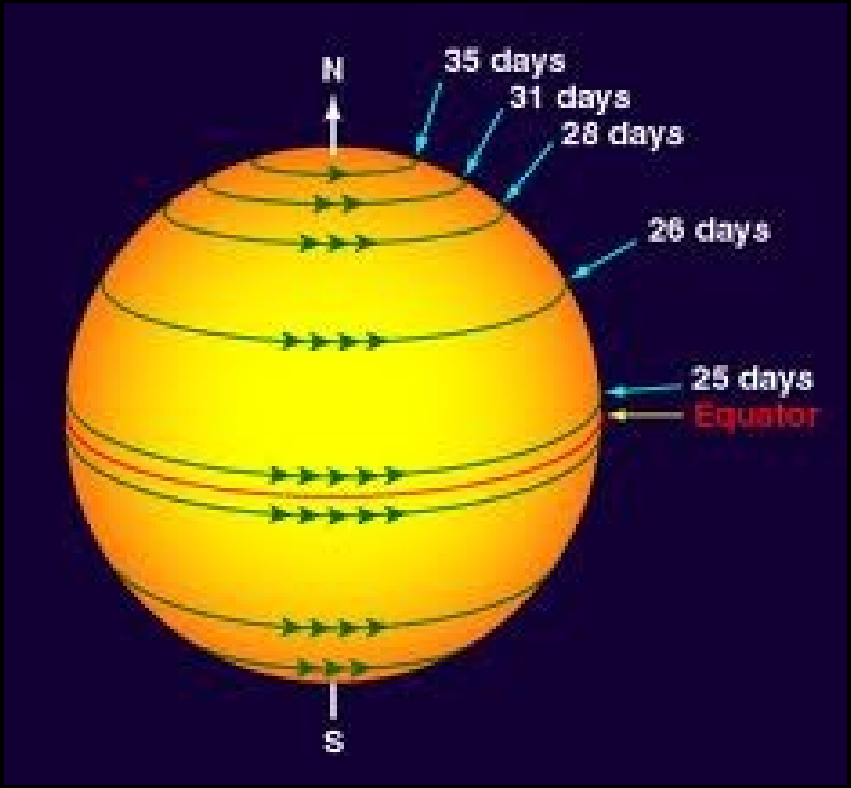
Solar System Orbit, Rotation and Tilt

The earth rotates on its own axis, what about the sun and the moon?

Sun

Solar rotation is able to vary with latitude because the Sun is composed of a gaseous plasma. The rate of rotation is observed to be fastest at the equator (latitude φ=0 deg), and to decrease as latitude increases.

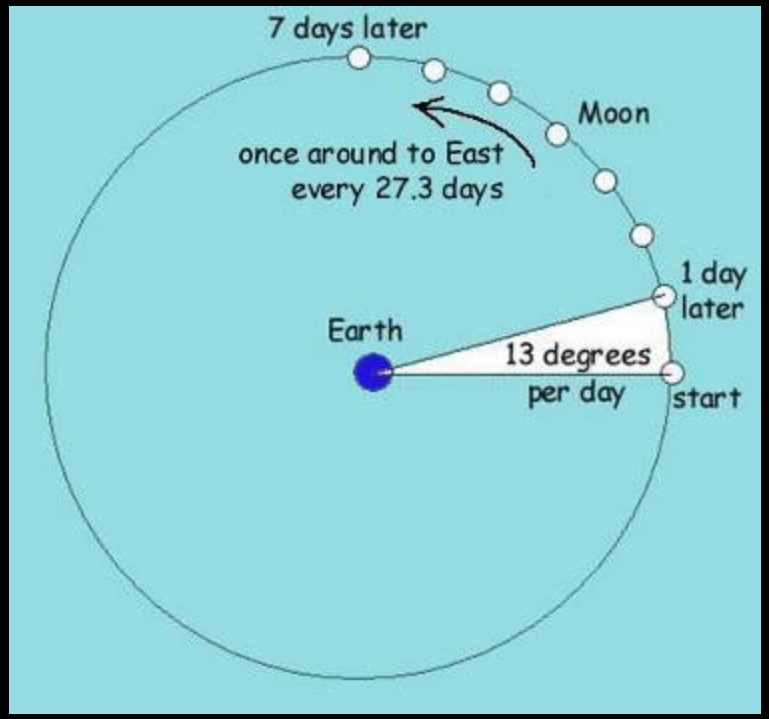
We use sunspots to measure rotation

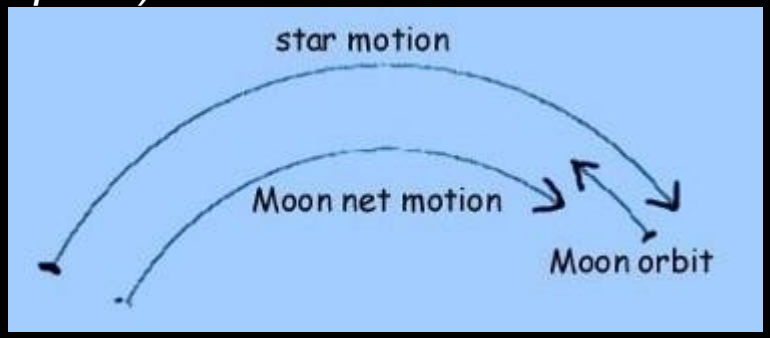


Look at your MoonGazer and you will see that the sun has sunspots!

Moon rotational period = Orbital period around the earth

Astronomers who have studied the moon for centuries felt frustrated that they could see only one side. The moon turns on its axis in exactly the period that it takes to go around the earth, 27 1/3 days, so it keeps the same side always toward the earth (but not toward the sun).Helen Sawyer Hogg The Stars Belong to Everyone p. 65)





Although the Moon is moving eastward around the Earth, the Earth is also turning to the east, and much faster, for it goes all the way around its axis of rotation in just under a day. So despite its eastward motion, it rises in the east, and sets in the west courtesy http://cseligman.com/text/sky/moonmotion.htm

Earths Orbit and Tilt

Tilt – Different seasons and incidence and duration of Sunlight

In summer the sun is high in the sky due to where it is on the ecliptic with respect to our celestial equator. That means for us to be able to see the planets, they are opposite the sun and their location is on the lower section of the ecliptic with respect to our celestial equator

Orbit – Different Constellations throughout the year

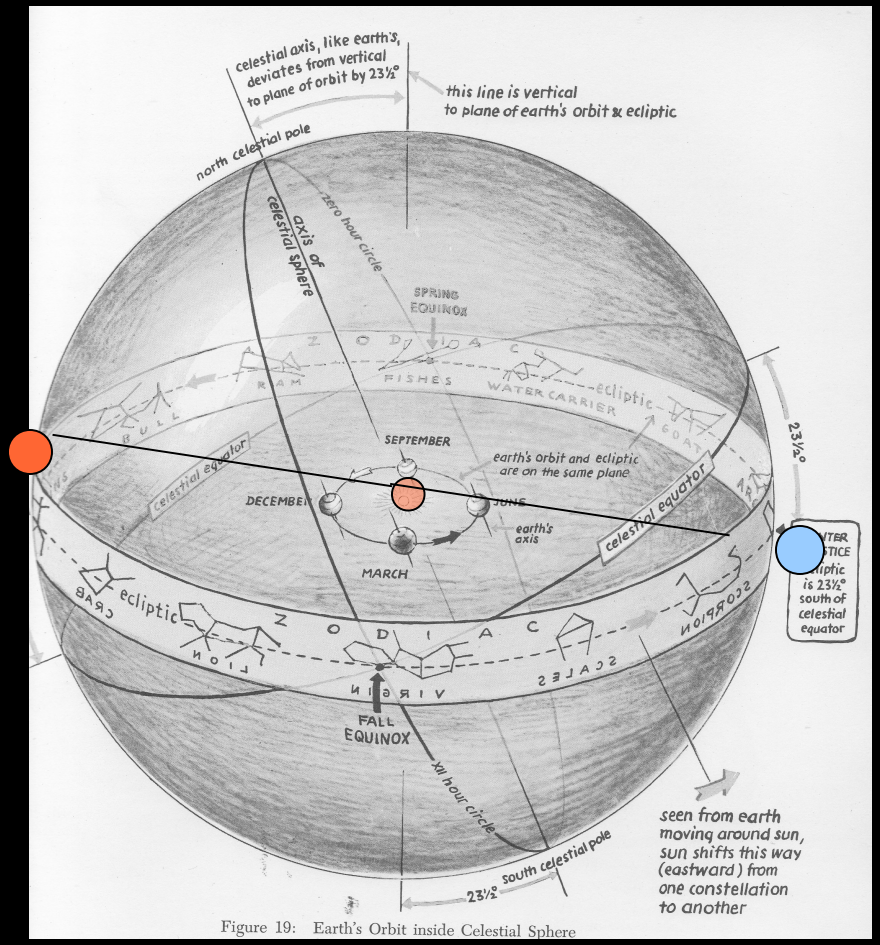
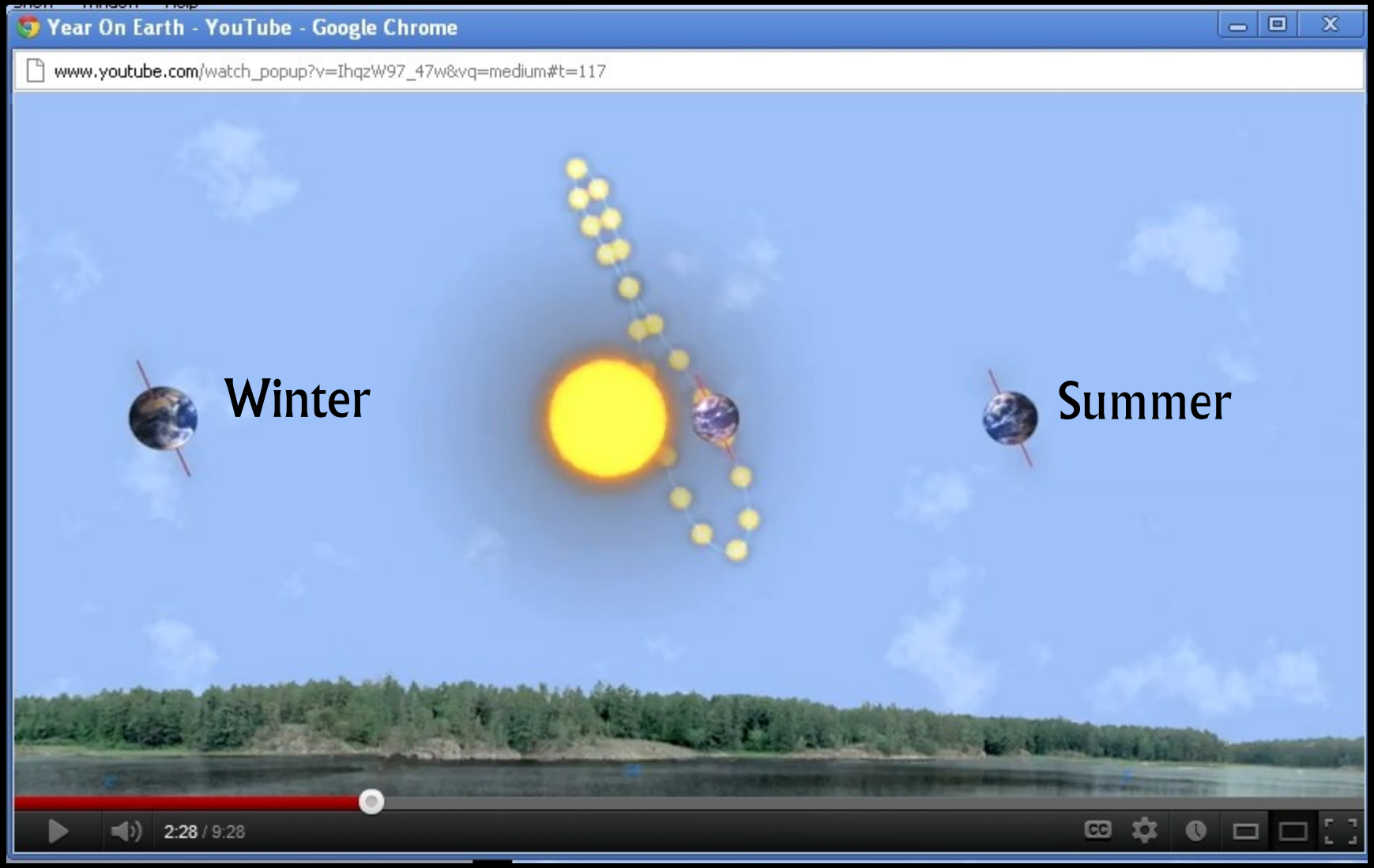


Figure 19: Earth's Orbit inside Celestial Sphere

Earth's TILT … ½ of the year tilted away from the sun (winter northern hemisphere) and the other ½ we are tilted towards the sun.
Analemma curve – yearly path of the sun in the sky (from A Year on Earth video)



Observations

Mizar – Double star

Arcturus – Red! - brightest star Northern Hemisphere

Observations (where were the planets?)

- Planets were behind trees... because planets lie on the same plane of the ecliptic as the sun.
- In order to be visible in the night sky, they need to be an angular distance away from the sun, and hence since the sun is high in the sky in the northern hemisphere in the summer time, the planets will be low in the sky.

Night Sky 1 Week Later

II Stars and Solar System Observing in our Milky Way Galaxy

WHERE
Locating stars on the
Celestial Sphere
Constellations
Constellations are convenient
(culturally determined) groups of
stars recognizable as a pattern
We locate stars, clusters, galaxies
within these patterns

WHEN:
Do they rise and set on
our local horizon
(our latitude of say 45deg)

WHAT: Observable Properties:
Spectra
(implies … ChemicalComposition)
Brightness
(Visual vs. Intrinsic helps calibrate
distance)

Calibrating our Observations – Evaluating Brightness of Celestial Objects

Brightness:

Magnitude Scale = Geometric

Greeks divided stars from Bright to Faint into 5 visual brightness levels.

Very Faint Objects are positive

Very Bright - are negative (i.e. moon)

Visual Magnitude Scale

Difference of 5 Magnitudes = 100

Magnitude 0 to Magnitude -1 means an increase of 100^ (1/5) = 2.5

Objects on our Celestial Sphere

What we see in the sky depends

DATE: Aug 24

TIME: Between 10 and 11

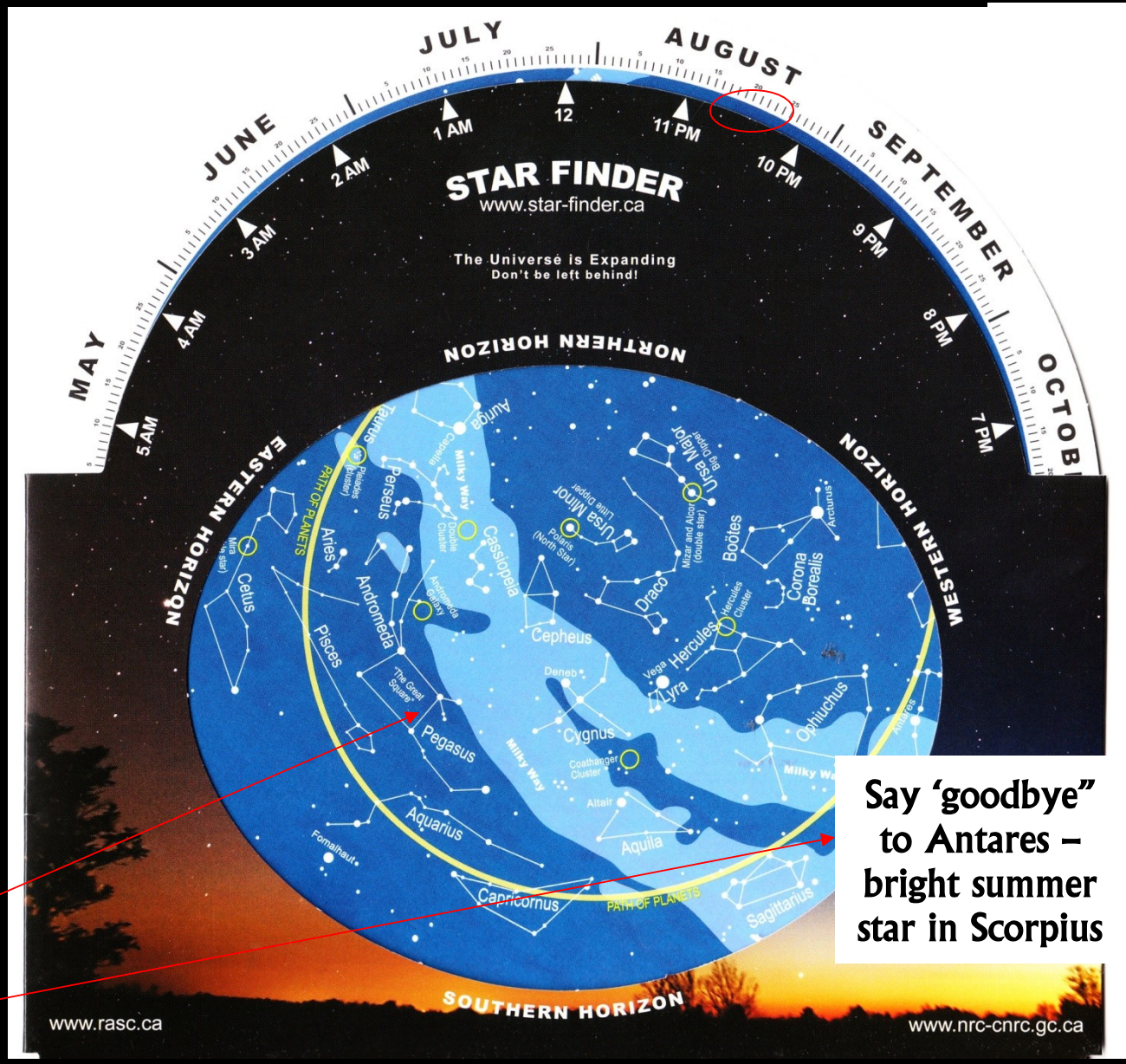
LATITUDE (45deg)

Objects Above our Local Horizon

Star Rise and Set TIME

The stars rise and set 4 minutes earlier each day because the earth has also moved through its orbit as it has rotated around from night to day to Night

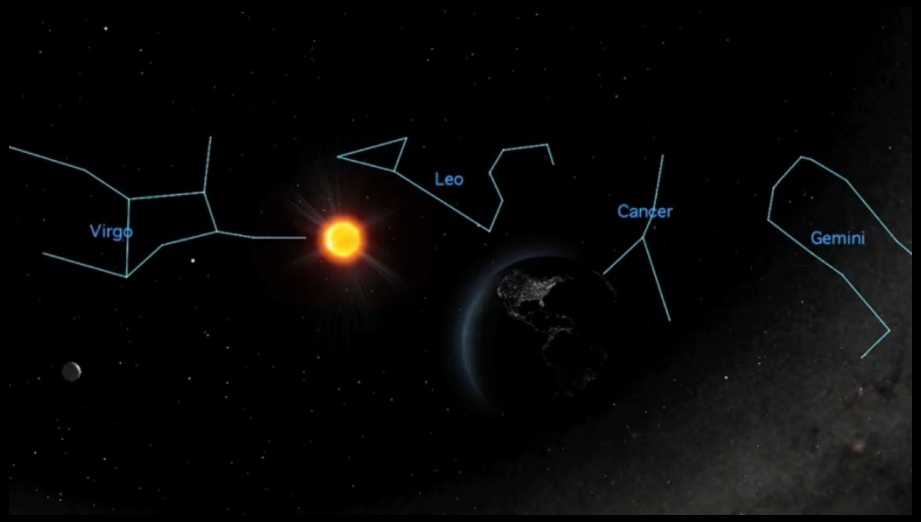
Andromeda Fall Constellation rises earlier (containing the Great Andromeda Galaxy)



Say 'goodbye" to Antares – bright summer star in Scorpius

Star Time – Sidereal Time
A year on earth in star time…

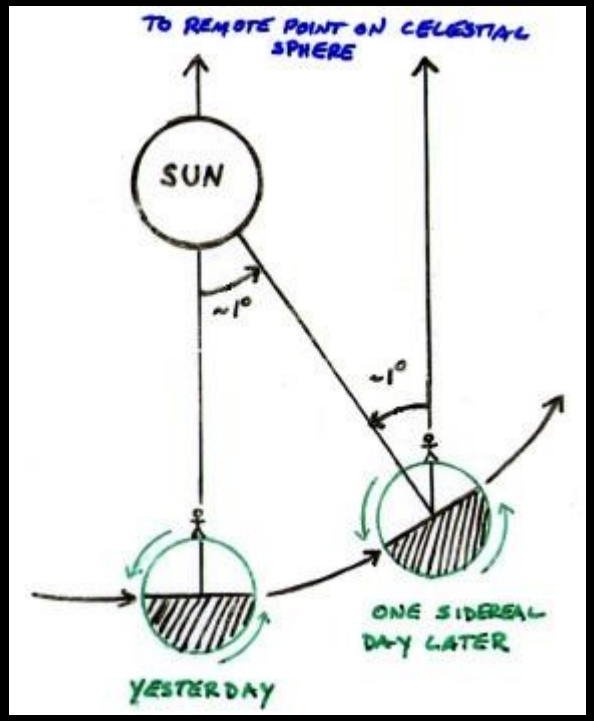
Sidereal Time = our time measurement with respect to the stars.



1 Day = 1/365th of a circle
~ about one degree around the Sun.
Earth rotates on its axis as well as rotates around the sun.

The time for a star to return to the same place in our sky the following evening is only 23 hours, 56 minutes and 4 seconds (not 24) This is called a sidereal day (1 revolution of the earth with respect to the stars)

Do the earth rotating dance around the sun then with respect to the stars infinitely far away…



Observations
Where (constellation) and Distance

Constellation	Object	Description	Distance	Magnitude
Bootes	Arcturus	Brightest Star Northern Horizon	40	0 .15 Bright!
Ursa Major	Mizar	Famous Double Star	78	2.0
Lyra	Epsilon Lyrae	Double Double (2 pairs of pairs)	160	4.7
Cygnus	Deneb	Alberio (optical pair)	390	3.1

http://stars.astro.illinois.edu/sow/sowlist.html - Very thorough treatment!!!

Observations Beyond nearby Stars into the realm of the star clusters … and galaxy (ies)

Distant Nebula, Globular Clusters and Galaxies

Constellation	Object	Description	D	m
Lyra	M57	"Planetary Nebula"	2300	8.8
Hercules	M13	Great Globular Cluster	25000	5.8
Ursa Major	M81	Spiral Galaxy	12,000,000	6.9
Ursa Major	M101	"Pinwheel" Galaxy	27,000,000	7.9
Sagittarius	M22	Globular Cluster	10400	5.1
Sagittarius	M28	Globular Cluster	18300	6.8

Open clusters in our Milky Way		Galaxy	1000 x 100000 ly	
Sagittarius	M8	Lagoon Nebula (protostars)	5200	6.0
Sagittarius	M17	Swan Nebula (gray patch)	5000	6.0
Sagittarius	M24	Great Star Cloud- MilkyWay	10000	4.6

http://messier.seds.org/ For complete description of what we saw (and more!)

Distances and Brightness of Star clusters

When we look at Open Star Clusters, we are looking into the Milky Way between 500 – 1000 light years distance. The Star Clouds in the constellation of Sagittarius are good examples

When we look at Globular Clusters we are looking 10x more deeply out of the disk of the galaxy in a halo around it – M13 is one example

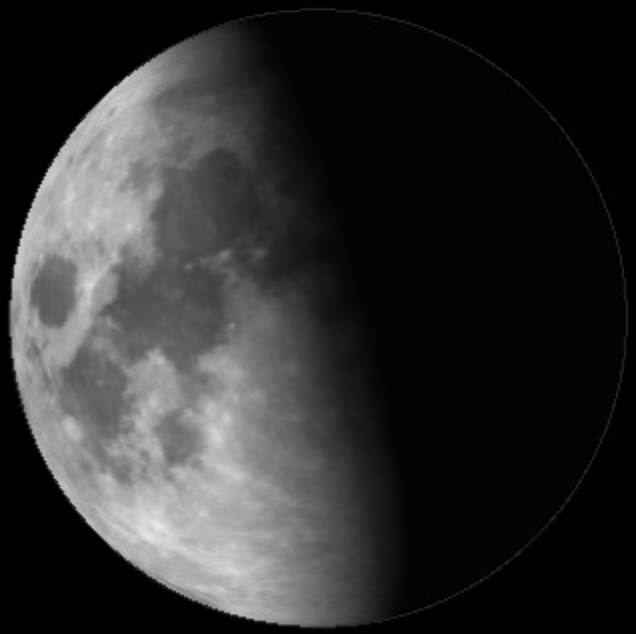
Finally when we look at Galaxies, we are looking outside of our own galaxy =~ 100,000,000 light years

What we can/cannot see when the Moon is Up (above the horizon)

Moon

Magnitude: **-11.26**
Absolute Magnitude: 33.35
RA/DE (J2000): 16h25m20.5s/-21°52'04.0"
RA/DE (of date): 16h26m6s/-21°53'45"
Hour angle/DE: 2h08m18s/-21°53'45" (geometric)
Hour angle/DE: 2h08m13s/-21°50'53" (apparent)
Az/Alt: +210°56'48"/+16°37'58" (geometric)
Az/Alt: +210°56'48"/+16°41'04" (apparent)
Ecliptic Geocentric (of date): +248°18'24.0"/-0°12'31.0"
Obliquity (of date): +23°26'16.0"
Distance: 0.00246160AU
Apparent diameter: +0°32'26.0"

First Quarter Moon in the West – Waxing Crescent courtesy stellarium



An illuminated moon makes it hard to see deep Sky Objects because they are awash in moonlight.

However, we can now turn our attention to the Moon at First Quarter… one of the best times to make observations as Stephen Collie will explain…

Ocular view [Ctrl+O]

Earth, Ottawa, 42m FOV 1.25° 11.8 FPS 2012-08-24 21:22:21

Lunar Observations - Guides

MoonGazer – handout (RASC)

Moon Maps

SkyNews (Canadian)

Isobel Willaimson Lunar Certificate
… (RASC)

Lunar Certificate from the RASC

Goals

Here is a summary of the goals for this certificate program:

1. Develop an appreciation for, and an understanding of, the lunar surface.
2. Develop an understanding of modern lunar geology and the forces that have shaped the Moon over its history.
3. Develop skills in observing detail.
4. Develop an understanding of how lunar phases and librations affect viewing of specific features

Lunar Familiarization
using binocs and small telescope

A – Lunar Phases and Orbital Motion — Check □

Recognizing and understanding the phases of the moon is fundamental to lunar observing and by understanding the Moon's various stages of illumination, the observer will know when to look for certain features. In addition, a clear understanding of our near neighbor's orbital motion will enable the observer to explain its unique movements across the sky as it revolves around Earth.

® During the course of this program observe and identify each of the following lunar phases: Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Last Quarter, and Waning Crescent. If this exercise has already been accomplished while doing the Explore the Universe Certificate program, a simple review is all that is required. For others a record of the date and time of each lunar phase seen is required. For more details about lunar phases check the RASC's Beginner's Observing Guide which has excellent information about phases.

® Observe Earthshine on a waxing or waning crescent Moon. Earthshine is a faint but noticeable glow on the unlit portion of the lunar disc that is caused by sunlight reflecting off the surface of Earth back to the Moon. The glow is most prominent during the early or late crescent phases, when from the lunar surface a nearly "Full Earth" is in view that reflects a significant amount of sunlight back to the Moon.

® Observe the Moon's orbital motion by noting its position against the background stars or in relation to a terrestrial object, such as a nearby tree. On subsequent nights, repeat the observation at exactly the same time of day and note its change of position across the sky. You should notice a significant eastward movement that is caused by orbital motion.

B – Major Basins (Maria) & Pickering Unaided Eye Scale — Check □

The first thing an observer will notice when viewing the lunar surface is the large, dark regions that cover significant amounts of its surface area. They are called lunar basins or maria and they stand out visually, but are easier to identify using binoculars or a telescope at low power. These large dark areas are excellent markers for navigating the lunar surface and it is important to become familiar with them first. A Full or nearly Full Moon is the best time to observe the lunar basins or maria, although they can be seen at other times.

® Using unaided eyes and binoculars (or a telescope at low power) identify the majors basins on the Moon including Mare Crisium, Mare Fecunditatis, Mare Tranquillitatis, Mare Nectaris, Mare Serenitatis Mare Imbrium, Mare Nubium, Mare Humorum, and Oceanus Procellarum.

© Using binoculars, or a telescope at low power, identify these other notable dark lunar features: Mare Frigoris, Mare Vaporum, Sinus Medii, Sinus Aestuum, Mare Insularum, Sinus Iridum, Mare Cognitum, and Sinus Roris.

© To better understand the challenges faced by observers before the age of telescopes, test your visual acuity by determining your Pickering Number – how deep can you go with unaided eyes on the Moon? A template for this very challenging list is on page 46.

C – Ray System Extent — Check □

Ray systems represent the ejecta deposits from recent impacts that have not been darkened by solar radiation. Overlapping ray systems help determine the relative ages of features.

® Under a Full or nearly Full Moon, observe the extent of the ray systems for Tycho, Copernicus, Kepler and other young craters across the lunar surface.

© Using the template provided on page 47 sketch the extent of the rays systems for Tycho, Copernicus and Kepler at or near Full Moon.

D – Crescent Moon Less Than 24 Hours From New — Check □

The Crescent Moon is an important part of some religious observances today and was for many cultures of antiquity. The theoretical limit of a visible crescent is approximately 12- 14 hours under perfect conditions, before or after New Moon. A waxing crescent is seen at dusk in the western sky, while a waning crescent is seen at dawn in the Eastern sky – how close can you come?

® During the course of your Williamson Certificate Program identify and note the waxing or waning crescent Moon and document your best sighting with the unaided eye. To calculate the age of the Moon, use the RASC Observer's Handbook, Month by Month section for times of New Moon or the RASC Observer's Calendar.

WARNING: While binoculars can help to spot a slim Crescent Moon, it is very dangerous to use them near the Sun. Binoculars are **not** recommended if the Sun is above the horizon.

Date	Age in Hours	Location
_____	_____	_____
_____	_____	_____
_____	_____	_____

E – Binocular & Unaided Eye Libration — Check □

Libration is the apparent "swiveling" or "wobbling" of the Moon as seen from Earth caused by the Moon's elliptical orbit which allows us to "peek" around the edge of the Moon and see up to 59% of its surface.

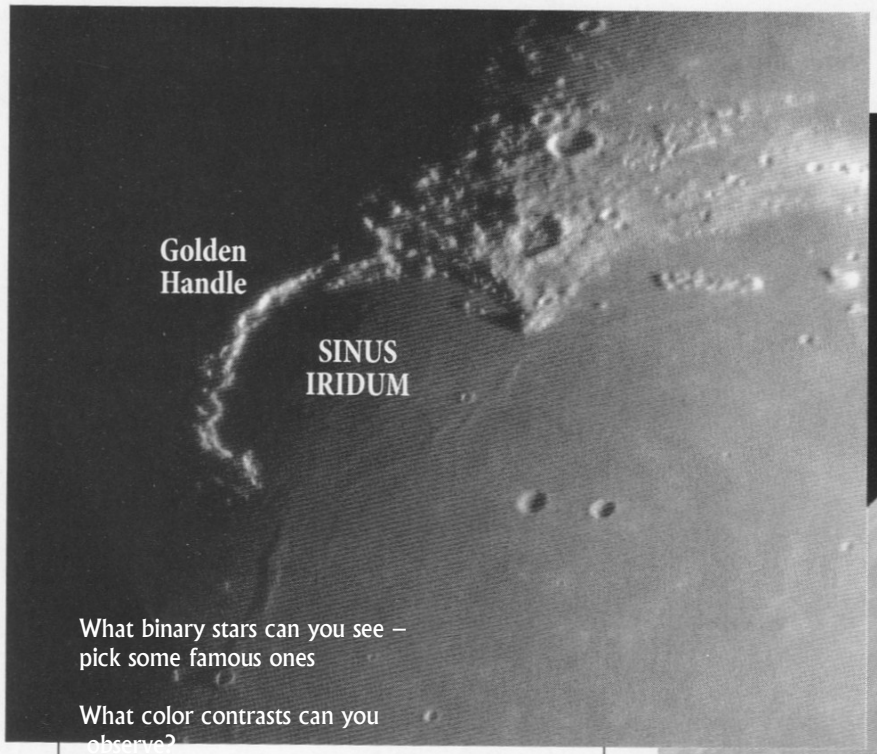
® Using binoculars note the relative location of Mare Crisium from one part of a lunation to another. Other dark features near the limbs of the Moon can be used for this activity as well, such as Mare Frigoris to the North, Grimaldi to the West, Mare Australe to the Southeast and Mare Humboldtianum to the Northeast.

Important Note: East and West directions on the Moon are opposite to our view from Earth. If you can imagine yourself on the Moon looking back at the Earth you should understand this anomaly.

© Without using binoculars, detect and sketch the libration of the Moon from one lunation to another using the template provided on page 48.

even more eye-catching is the Alpine Valley, a nar-

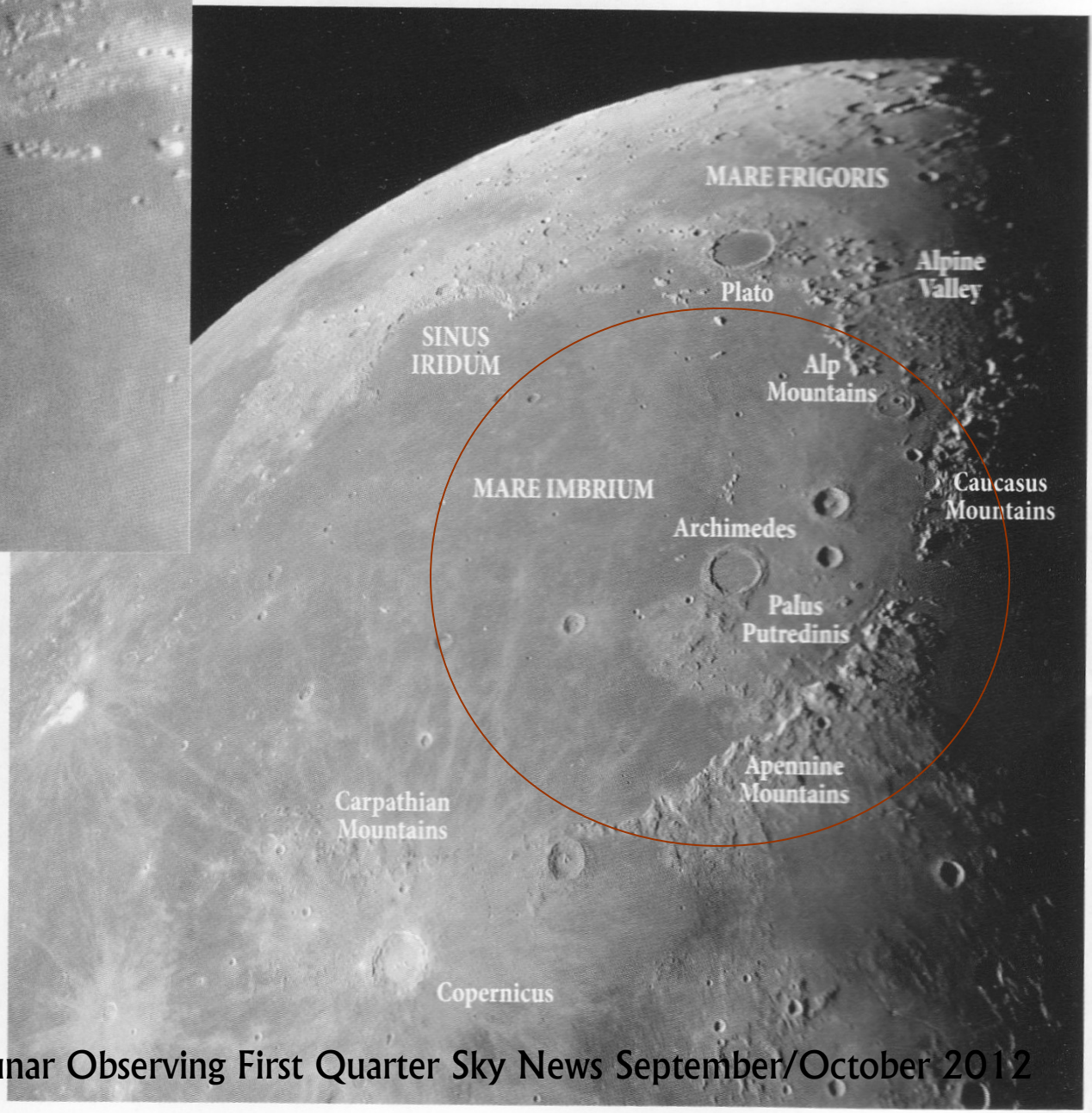
main basin rim, the curving arc of the Apennines really does look like a segment



What binary stars can you see – pick some famous ones

What color contrasts can you observe?

Blue and yellow??



HISTORY LESSON Although the wonders of the Imbrium Basin, right, can be enjoyed in a single night, the best approach is to view it over several evenings, as the terminator advances across its impressive expanse. One of the most captivating features along the Imbrium rim is Sinus Iridum, the Bay of Rainbows. Because of its appearance when the terminator cuts across its middle, above, it's also known as the Golden Handle.

BOTH PHOTOS BY GARY SERONIK

When we observe…

Clothing:
Prepare to dress warmly as if it were still winter. Standing around can get chilly because you are not moving, and because the air is moist as water precipitates out of the air due to cooler temperatures.

Optical Aids – Looking through Oculars:
Allow your eyes to adapt to what you are seeing. Use your peripheral vision – the rods and cones that pick up faint fuzzies.
Learn not to stare into the eyepiece but let your eye relax and allow the peripheral vision to see things too.

Daylight: Never point binoculars or telescopes close to the SUN

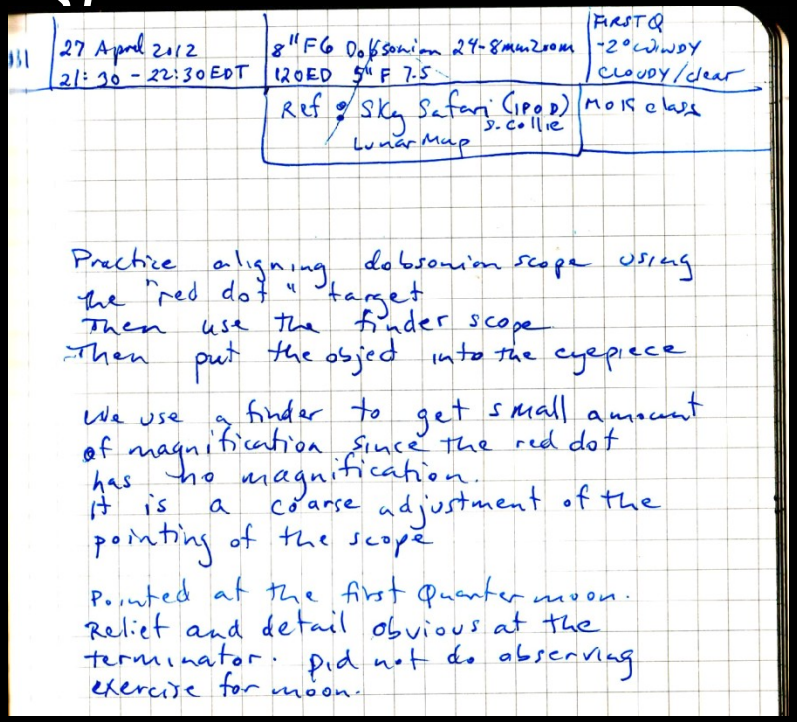
Flashlight: Use a red flashlight to consult charts if you are trying to hunt something down.

LOGBOOK:
Keep an observing Log! Record observations even if you're tired.

"If you don't keep a logbook you'll always be a beginner."

Learn and Record what you see in constellations

Obse
using the red dot,
the finder and the
eyepiec
magnification
es)

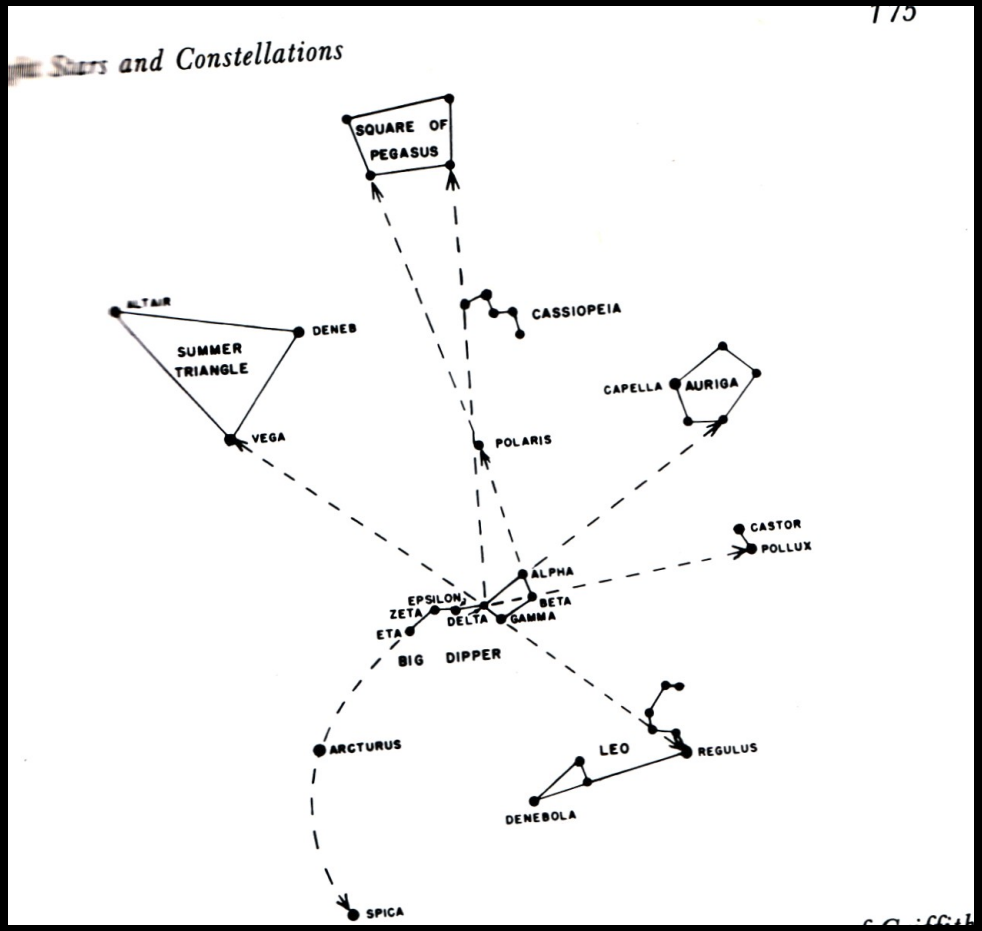


27 April 2012 21:30 - 22:30 EDT	8" F6 Dobsonian 24-8mm zoom 120ED 5" F 7.5	FIRST Q -2° WINDY CLOUDY/clear
	Ref: Sky Safari (iPod) S. Collie Lunar Map	MOIS class

Practice aligning dobsonian scope using the "red dot" target
Then use the finder scope
Then put the object into the eyepiece

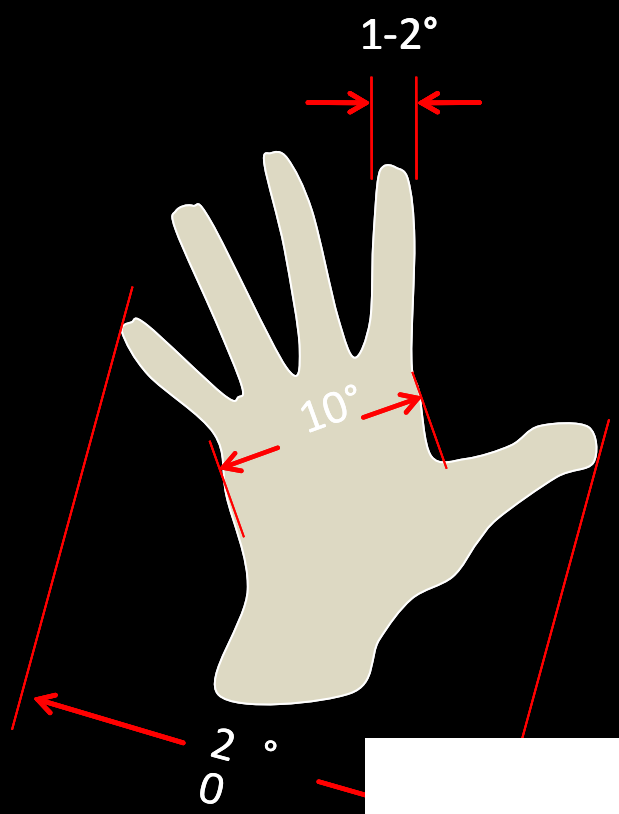
We use a finder to get small amount of magnification since the red dot has no magnification.
It is a coarse adjustment of the pointing of the scope

Pointed at the first Quarter moon.
Relief and detail obvious at the terminator. Did not do observing exercise for moon.



Follow the Arc to Arcturu
and Speed on to Spic …
(diagram courtesy Helen
Sawyer Hogg).

Observing: Angular scale in the Sky



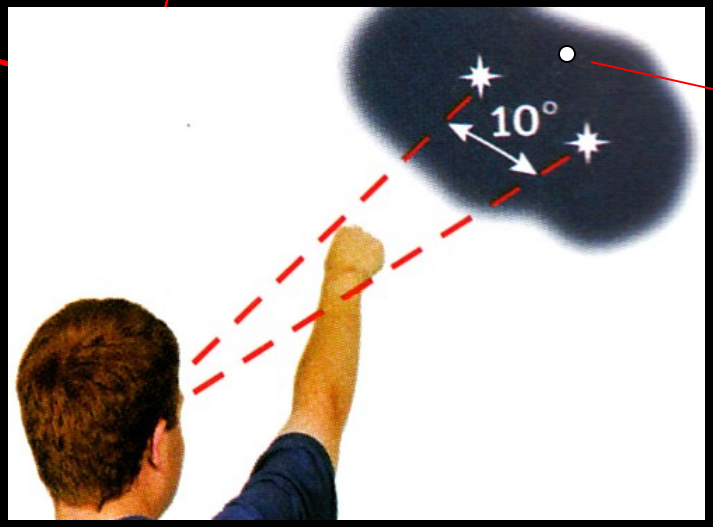
Use your hand as a scale

Finger: between 1 and 2 degrees

Fist: about 10 degrees

Spread fingers: ~ 20

Works for any hand since the bigger the hand, the longer the arm, and the angles are about the same



The moon is around ½ degree

Planning your Observations

- Get a book from the library or a magazine that features a particular selection of objects visible from your location at the current date
- You can use ipod type devices but plan what you are doing beforehand so that you don't just stare at the ipod
- Better to plan indoors first . Use a planetarium program like ECU. We can do a lab showing how to set the time, place, information detail, catalogues…
- Make sure you are comfortable at the eyepiece
- You can sit down when you get tired.

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Course Assistant
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Software
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- Light Year (distance)

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(93million Miles or … 160Mkms x 60,000 ~ 10 million million kms – 10 x 10^12, i.e trillion)

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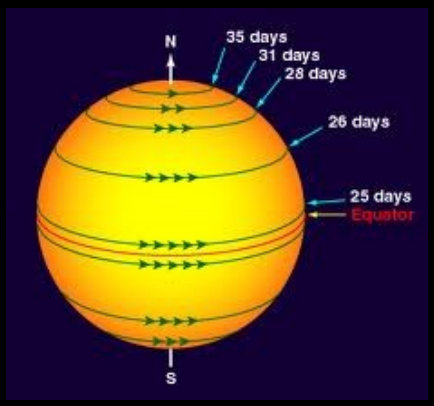

Look at your MoonGazer and you will see that the sun has sunspots!

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Moon rotational period = Orbital period around the earth

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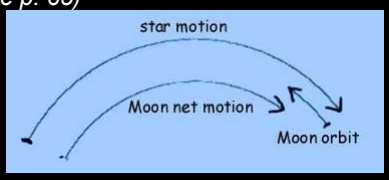

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Earths Orbit and Tilt

Tilt – Different seasons and incidence and duration of Sunlight

In summer the sun is high in the sky due to where it is on the ecliptic with respect to our celestial equator. That means for us to be able to see the planets, they are opposite the sun and their location is on the lower section of the ecliptic with respect to our celestial equator

Orbit – Different Constellations throughout the year

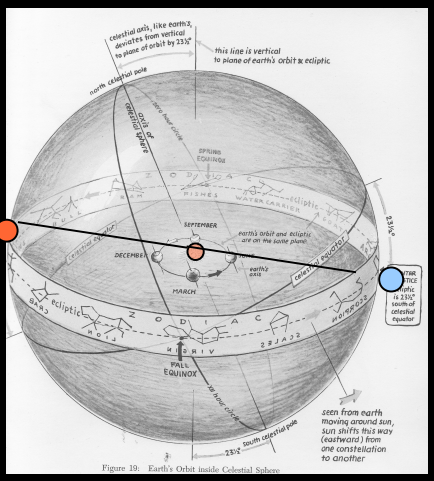

Figure 19. Earth's Orbit inside Celestial Sphere


Observations
Mizar – Double star
Arcturus – Red! - brightest star Northern Hemisphere
Serpens
Alphekka
Alkaid
Mizar
Alioth
Unukalhai
Izar
Bootes
Dubhe
Phad
Merak
Ursa Major
Arcturus
Canes Venatici
Muphrid
Zubeneschamali
Coma Berenices
Libra
Leo Minor
Virgo
Saturn
Mars
Spica

Observations (where were the planets?)

- Planets were behind trees... because planets lie on the same plane of the ecliptic as the sun.
- In order to be visible in the night sky, they need to be an angular distance away from the sun, and hence since the sun is high in the sky in the northern hemisphere in the summer time, the planets will be low in the sky.

Night Sky 1 Week Later

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WHERE
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Celestial Sphere
Constellations
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We locate stars, clusters, galaxies
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Do they rise and set on
our local horizon
(our latitude of say 45deg)

WHAT: Observable Properties:
Spectra
(implies ... ChemicalComposition)
Brightness
(Visual vs. Intrinsic helps calibrate
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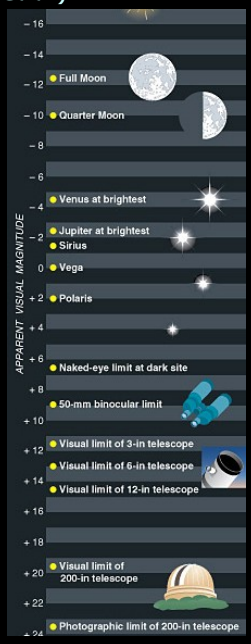

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Brightness:

Magnitude Scale = Geometric

Greeks divided stars from Bright to Faint into 5 visual brightness levels.

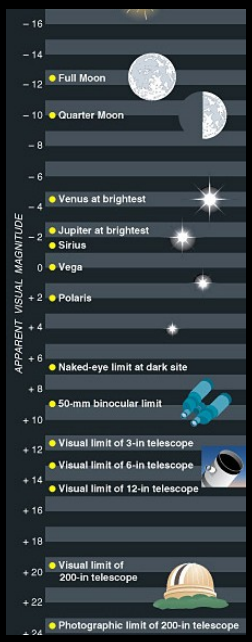
Very Faint Objects are positive

Very Bright - are negative (i.e. moon)

Visual Magnitude Scale

Difference of 5 Magnitudes = 100

Magnitude 0 to Magnitude -1 means an increase of 100^ (1/5) = 2.5



Objects on our Celestial Sphere

What we see in the sky depends

DATE: Aug 24

TIME: Between 10 and 11

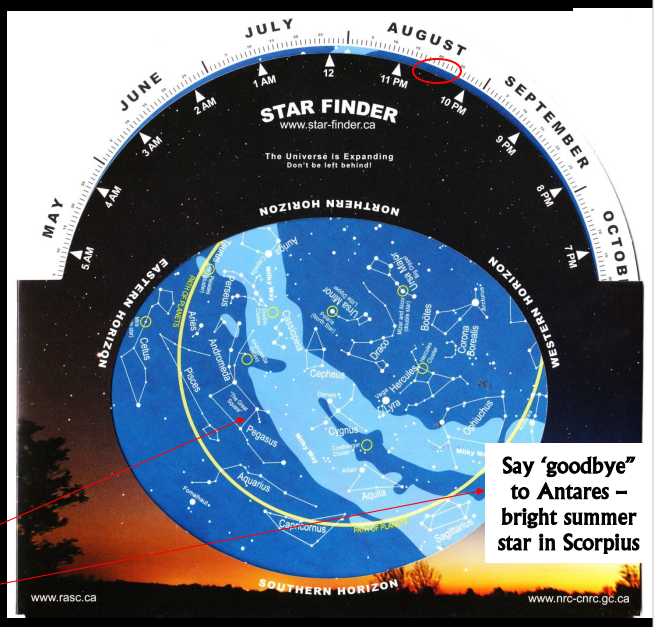
LATITUDE (45deg)

Objects Above our Local Horizon

Star Rise and Set TIME

The stars rise and set 4 minutes earlier each day because the earth has also moved through its orbit as it has rotated around from night to day to Night

Andromeda Fall Constellation rises earlier (containing the Great Andromeda Galaxy)

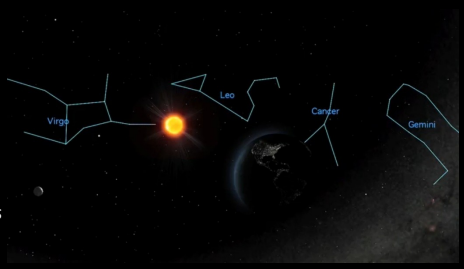


Say 'goodbye" to Antares – bright summer star in Scorpius

Star Time – Sidereal Time
A year on earth in star time…

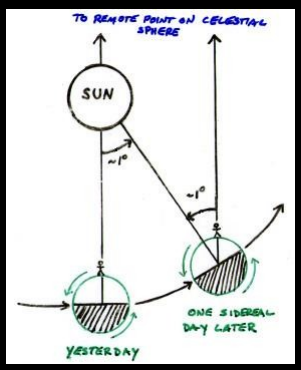
Sidereal Time = our time measurement with respect to the stars

1 Day = 1/365 of a circle
~ about a degree around the Sun.
Earth rotates on its axis as well as rotates around the sun.



The time for a star to return to the same place in our sky the following evening is only 23 hours, 56 minutes and 4 seconds (not 24) This is called a sidereal day (1 revolution of the earth with respect to the stars)

Do the earth rotating dance around the sun then with respect to the stars infinitely far away…



Observations
Where (constellation) and Distance

Constellation	Object	Description	Distance	Magnitude
Bootes	Arcturus	Brightest Star Northern Horizon	40	0 .15 Bright!
Ursa Major	Mizar	Famous Double Star	78	2.0
Lyra	Epsilon Lyrae	Double Double (2 pairs of pairs)	160	4.7
Cygnus	Deneb	Alberio (optical pair)	390	3.1

http://stars.astro.illinois.edu/sow/sowlist.html - Very thorough treatment!!!

Observations Beyond nearby Stars into the realm of the star clusters … and galaxy (ies)

Distant Nebula, Globular Clusters and Galaxies

Constellation	Object	Description	D	m
Lyra	M57	"Planetary Nebula"	2300	8.8
Hercules	M13	Great Globular Cluster	25000	5.8
Ursa Major	M81	Spiral Galaxy	12,000,000	6.9
Ursa Major	M101	"Pinwheel" Galaxy	27,000,000	7.9
Sagittarius	M22	Globular Cluster	10400	5.1
Sagittarius	M28	Globular Cluster	18300	6.8
Open clusters in our Milky Way		Galaxy	1000 x 100000 ly	
Sagittarius	M8	Lagoon Nebula (protostars)	5200	6.0
Sagittarius	M17	Swan Nebula (gray patch)	5000	6.0
Sagittarius	M24	Great Star Cloud- MilkyWay	10000	4.6

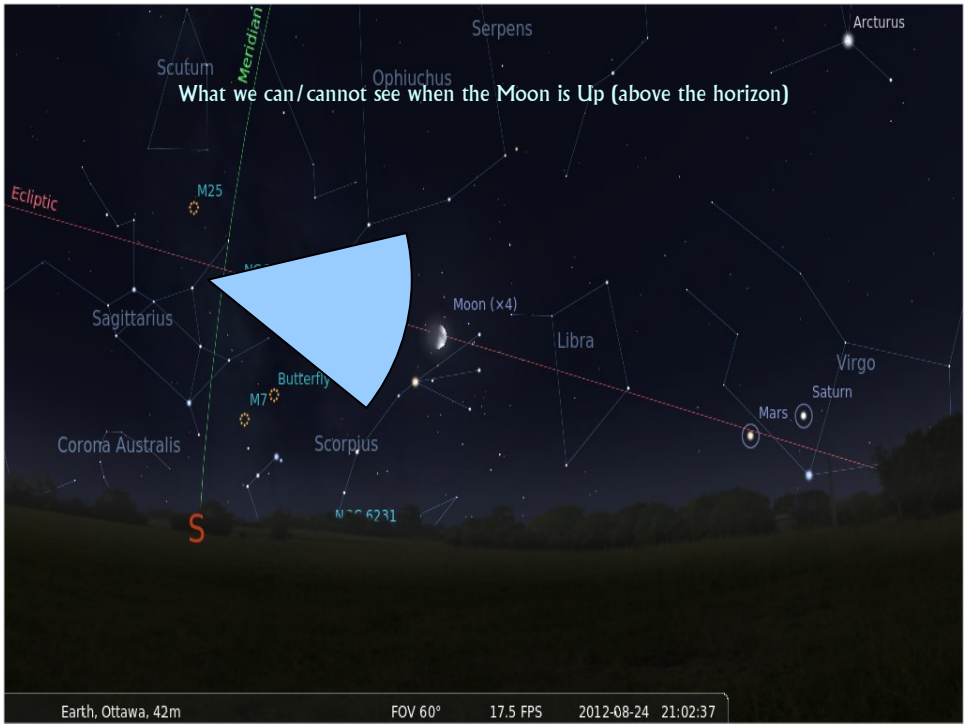
http://messier.seds.org/ For complete description of what we saw (and more!)

Distances and Brightness of Star clusters

When we look at Open Star Clusters, we are looking into the Milky Way between 500 – 1000 light years distance. The Star Clouds in the constellation of Sagittarius are good examples

When we look at Globular Clusters we are looking 10x more deeply out of the disk of the galaxy in a halo around it – M13 is one example

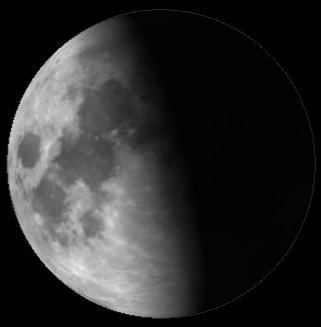
Finally when we look at Galaxies, we are looking outside of our own galaxy =~ 100,000,000 light years


What we can/cannot see when the Moon is Up (above the horizon)
Meridian
Serpens
Arcturus
Scutum
Ophiuchus
Ecliptic
M25
Sagittarius
Moon (×4)
Libra
Virgo
Butterfly
M7
Saturn
Mars
Corona Australis
Scorpius
S
Earth, Ottawa, 42m
FOV 60°
17.5 FPS
2012-08-24 21:02:37

Moon

Magnitude: **-11.26**
Absolute Magnitude: 33.35
RA/DE (J2000): 16h25m20.5s/-21°52'04.0"
RA/DE (of date): 16h26m6s/-21°53'45"
Hour angle/DE: 2h08m18s/-21°53'45" (geometric)
Hour angle/DE: 2h08m13s/-21°50'53" (apparent)
Az/Alt: +210°56'48"/+16°37'58" (geometric)
Az/Alt: +210°56'48"/+16°41'04" (apparent)
Ecliptic Geocentric (of date): +248°18'24.0"/-0°12'31.0"
Obliquity (of date): +23°26'16.0"
Distance: 0.00246160AU
Apparent diameter: +0°32'26.0"

First Quarter Moon in the West – Waxing Crescent courtesy stellarium



An illuminated moon makes it hard to see deep Sky Objects because they are awash in moonlight.

However, we can now turn our attention to the Moon at First Quarter… one of the best times to make observations as Stephen Collie will explain…

Ocular view [Ctrl+O]

Earth, Ottawa, 42m FOV 1.25° 11.8 FPS 2012-08-24 21:22:21

Lunar Observations - Guides

MoonGazer – handout (RASC)
Moon Maps

SkyNews (Canadian)

Isobel Willaimson Lunar Certificate
… (RASC)

Lunar Certificate from the RASC

Goals

Here is a summary of the goals for this certificate program:

1. Develop an appreciation for, and an understanding of, the lunar surface.
2. Develop an understanding of modern lunar geology and the forces that have shaped the Moon over its history.
3. Develop skills in observing detail.
4. Develop an understanding of how lunar phases and librations affect viewing of specific features

Lunar Familiarization
using binocs and small telescope

A – Lunar Phases and Orbital Motion

Check ☐

Recognizing and understanding the phases of the moon is fundamental to lunar observing and by understanding the Moon's various stages of illumination, the observer will know when to look for certain features. In addition, a clear understanding of our near neighbor's orbital motion will enable the observer to explain its unique movements across the sky as it revolves around Earth.

Ⓐ During the course of this program observe and identify each of the following lunar phases: Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Last Quarter, and Waning Crescent. If this exercise has already been accomplished while doing the Explore the Universe Certificate program, a simple review is all that is required. For others a record of the date and time of each lunar phase seen is required. For more details about lunar phases check the RASC's Beginner's Observing Guide which has excellent information about phases.

Ⓑ Observe Earthshine on a waxing or waning crescent Moon. Earthshine is a faint but noticeable glow on the unlit portion of the lunar disc that is caused by sunlight reflecting off the surface of Earth back to the Moon. The glow is most prominent during the early or late crescent phases, when from the lunar surface a nearly "Full Earth" is in view that reflects a significant amount of sunlight back to the Moon.

Ⓒ Observe the Moon's orbital motion by noting its position against the background stars or in relation to a terrestrial object, such as a nearby tree. On subsequent nights, repeat the observation at exactly the same time of day and note its change of position across the sky. You should notice a significant eastward movement that is caused by orbital motion.

B – Major Basins (Maria) & Pickering Unaided Eye Scale

Check ☐

The first thing an observer will notice when viewing the lunar surface is the large, dark regions that cover significant amounts of its surface area. They are called lunar basins or maria and they stand out visually, but are easier to identify using binoculars or a telescope at low power. These large dark areas are excellent markers for navigating the lunar surface and it is important to become familiar with them first. A Full or nearly Full Moon is the best time to observe the lunar basins or maria, although they can be seen at other times.

Ⓐ Using unaided eyes and binoculars (or a telescope at low power) identify the majors basins on the Moon including Mare Crisium, Mare Fecunditatis, Mare Tranquillitatis, Mare Nectaris, Mare Serenitatis Mare Imbrium, Mare Nubium, Mare Humorum, and Oceanus Procellarum.

Ⓑ Using binoculars, or a telescope at low power, identify these other notable dark lunar features: Mare Frigoris, Mare Vaporum, Sinus Medii, Sinus Aestuum, Mare Insularum, Sinus Iridum, Mare Cognitum, and Sinus Roris.

Ⓒ To better understand the challenges faced by observers before the age of telescopes, test your visual acuity by determining your Pickering Number – how deep can you go with unaided eyes on the Moon? A template for this very challenging list is on page 46.

C – Ray System Extent

Check ☐

Ray systems represent the ejecta deposits from recent impacts that have not been darkened by solar radiation. Overlapping ray systems help determine the relative ages of features.

Ⓐ Under a Full or nearly Full Moon, observe the extent of the ray systems for Tycho, Copernicus, Kepler and other young craters across the lunar surface.

Ⓑ Using the template provided on page 47 sketch the extent of the rays systems for Tycho, Copernicus and Kepler at or near Full Moon.

D – Crescent Moon Less Than 24 Hours From New

Check ☐

The Crescent Moon is an important part of some religious observances today and was for many cultures of antiquity. The theoretical limit of a visible crescent is approximately 12- 14 hours under perfect conditions, before or after New Moon. A waxing crescent is seen at dusk in the western sky, while a waning crescent is seen at dawn in the Eastern sky – how close can you come?

Ⓐ During the course of your Williamson Certificate Program identify and note the waxing or waning crescent Moon and document your best sighting with the unaided eye. To calculate the age of the Moon, use the RASC Observer's Handbook, Month by Month section for times of New Moon or the RASC Observer's Calendar.

WARNING: While binoculars can help to spot a slim Crescent Moon, it is very dangerous to use them near the Sun. Binoculars are **not** recommended if the Sun is above the horizon.

Date	Age in Hours	Location
_____	_____	_____
_____	_____	_____
_____	_____	_____

E – Binocular & Unaided Eye Libration

Check ☐

Libration is the apparent "swiveling" or "wobbling" of the Moon as seen from Earth caused by the Moon's elliptical orbit which allows us to "peek" around the edge of the Moon and see up to 59% of its surface.

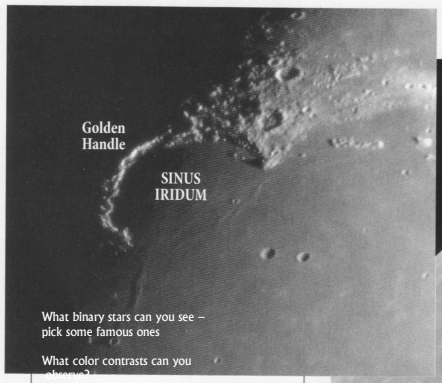
Ⓐ Using binoculars note the relative location of Mare Crisium from one part of a lunation to another. Other dark features near the limbs of the Moon can be used for this activity as well, such as Mare Frigoris to the North, Grimaldi to the West, Mare Australe to the Southeast and Mare Humboldtianum to the Northeast.

Important Note: East and West directions on the Moon are opposite to our view from Earth. If you can imagine yourself on the Moon looking back at the Earth you should understand this anomaly.

Ⓑ Without using binoculars, detect and sketch the libration of the Moon from one lunation to another using the template provided on page 48.

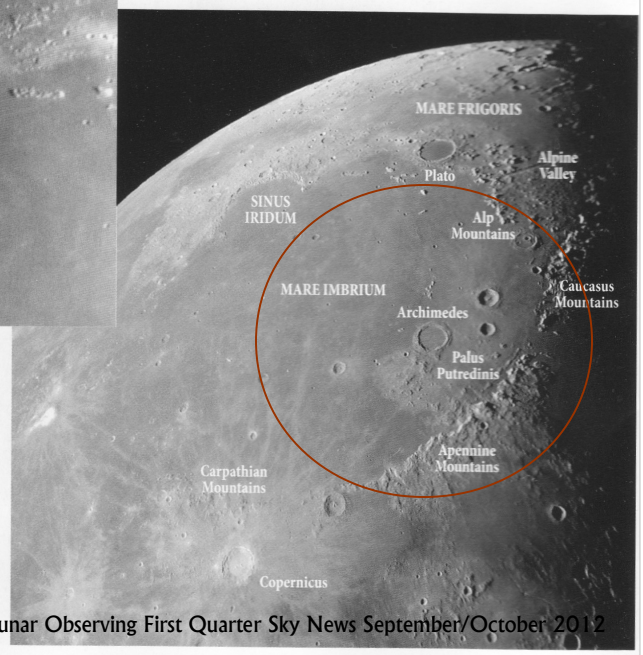
even more eye-catching is the Alpine Valley, a nar-

main basin rim, the curving arc of the Apennines really does look like a segment



What binary stars can you see – pick some famous ones

What color contrasts can you observe?



HISTORY LESSON Although the wonders of the Imbrium Basin, right, can be enjoyed in a single night, the best approach is to view it over several evenings, as the terminator advances across its impressive expanse. One of the most captivating features along the Imbrium rim is Sinus Iridum, the Bay of Rainbows. Because of its appearance when the terminator cuts across its middle, above, it's also known as the Golden Handle.

BOTH PHOTOS BY GARY SERONIK

Lunar Observing First Quarter Sky News September/October 2012

When we observe…

Clothing:
Prepare to dress warmly as if it were still winter. Standing around can get chilly because you are not moving, and because the air is moist as water precipitates out of the air due to cooler temperatures.

Optical Aids – Looking through Oculars:
Allow your eyes to adapt to what you are seeing. Use your peripheral vision – the rods and cones that pick up faint fuzzies.
Learn not to stare into the eyepiece but let your eye relax and allow the peripheral vision to see things too.

Daylight: Never point binoculars or telescopes close to the SUN

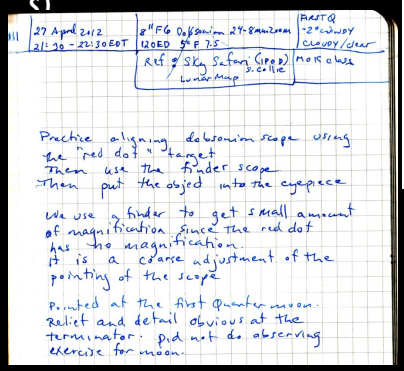
Flashlight: Use a red flashlight to consult charts if you are trying to hunt something down.

LOGBOOK:
Keep an observing Log! Record observations even if you're tired.

"If you don't keep a logbook you'll always be a beginner."

Learn and Record what you see in constellations

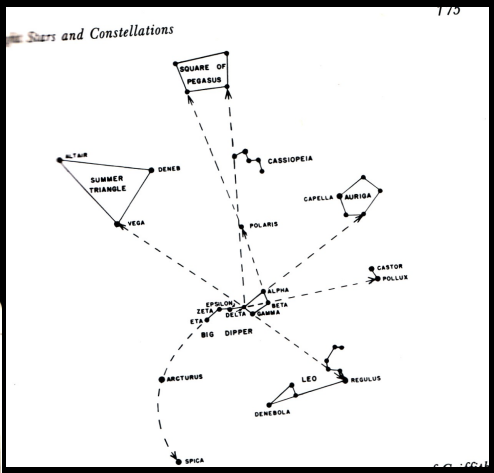
Obse
using the red dot,
the finder and the
eyepiece
magnification
s)


27 April 2012
21:30 - 22:30 EDT
8" F6 Dobsonian 24-8mm zoom
120ED 5" F 7.5
FIRST Q
-2° cloudy
CLOUDY/clear
Ref: Sky Safari (iPad) Lunar Map
moralwa

Practice aligning dobsonian scope using the "red dot" target
Then use the finder scope
Then put the object into the eyepiece

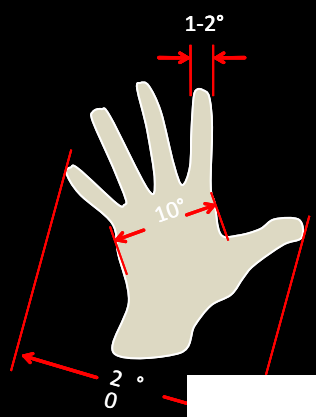
We use a finder to get small amount of magnification since the red dot has no magnification.
It is a coarse adjustment of the pointing of the scope

Pointed at the first quarter moon.
Relief and detail obvious at the terminator. did not do observing exercise for moon.



Follow the Arc to Arcturu
and Speed on to Spic …
(diagram courtesy Helen
Sawyer Hogg).

Observing: Angular scale in the Sky



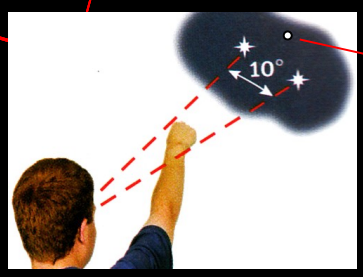
Use your hand as a scale

Finger: between 1 and 2 degrees

Fist: about 10 degrees

Spread fingers: ~ 20

Works for any hand since the bigger the hand, the longer the arm, and the angles are about the same



The moon is around ½ degree

Planning your Observations

- Get a book from the library or a magazine that features a particular selection of objects visible from your location at the current date
- You can use ipod type devices but plan what you are doing beforehand so that you don't just stare at the ipod
- Better to plan indoors first . Use a planetarium program like ECU. We can do a lab showing how to set the time, place, information detail, catalogues…
- Make sure you are comfortable at the eyepiece
- You can sit down when you get tired.