

# LESSON 1: OBSERVING

## *Suggested Outline:*

- **Hand out** & discuss *Beginner's Observing Guide* and the Explore the Universe Certificate Program Guidelines (ETUC).
- **Hand out** *Preparing for an Observing Session* article.
- Discuss basic equipment: i.e. Red light, maps, clothing. (show observer's bag)
- **Hand out** *The Observing Logbook* article
- **Hand out** *RASC Visual Observing Log* sheet (from RASC national website.)
- Describe how to record observations using the sample observation form
- **Hand out** & discuss *Lunar Sketching for Fun* article.
- **DEMO:** have students observe file "[#1 - Observing Slides](#)" and fill out a *RASC Visual Observing Log* sheet.
- Offer the students an observing logbook made up of *RASC Visual Observing Logs* formatted into a 4.25" x 5.5" coil bound book for students to record their observations in.
- Show [Observing/Weather page](#) on club website
- **Hand out** and show students how to use a planisphere

## **Between Class Assignments:**

- Read *Beginner's Observing Guide* chapters 8 and 9
  - *Tips on Becoming a Better Observer*
  - *Recording Observations*
- Within a couple of days either way of either a first or third quarter moon (look on calendar for days) Hold a ball in the air in the direction of the moon in such a way that you are facing both. Observe the light and shadow of the sun on the ball. Record your observation.  
(*Skyways*: last paragraph on pg. 10)
- Observe the point of Sunrise and/ or Sunset each morning/ night. Record your observations.  
**Hand out** *Skyways*: Observing Sunrise & Sunset pg. 23, 24

## LESSON 2: MOTIONS OF THE SKY & SEASONS

### *Suggested Outline:*

- Watch the Celestial Sphere video (part on celestial sphere only. min 0 to min 8)
- Discuss material from the video and show diagrams.
  - Apparent motion of sky. (show “#2 - BOG Fig 1”)
  - **DEMO:** use a lamp and an Earth globe to show a day. Explain why things rise in east and set in west. Have students try for themselves by spinning.
  - Why we see different stars in different seasons. **Hand out** *Skyways* pg. 14. (show “#2 - BOG Fig 2”)
  - **DEMO:** *Skyways* "Modeling the changing Seasons" pg 15, 16
  - Show concept of Observer's Horizon. (show “#2 - BOG Fig 3”). Take a large piece of paper, cut a hole out of it, lay the paper over an earth globe to represent horizon.
- Show concept of Celestial Sphere. (show “#2 - BOG Fig 4”).
- Discuss the reasons for seasons. (**Hand out** *Skyways* pg 17, 18)
  - **DEMO:** *Skyways* "Globe and Grid" pg 19, 20
- Discuss Lesson 1’s assignment (Observe Point of Sunrise / Sunset). **DEMO:** Show sunrise/ sunset on planetarium software to demonstrate what was observed.
- **DEMO:** *Skyways* "3-D Season Model" pg. 27, 28

### **Between Class Assignments:**

- Read *Beginner’s Observing Guide* chapter 1
  - *Welcome to Astronomy and to the Night Sky*
- Observe from ETUC "Constellations and Bright Stars" section.

## LESSON 3: MAPS, NORTH, DISTANCE, POSITION AND BRIGHTNESS.

### *Suggested Outline:*

- Watch the Celestial Sphere video (part on constellations only. min 8 to min 30)
- Star Maps:
  - **Hand out** sample all-sky chart from *Skyways* pg. 50
  - Explain why we need star maps for different times and locations. (quick review of lesson 2)
  - Explain how to read the sky chart. (i.e. how to hold it so it reads correctly)
  - Explain terminology (i.e. zenith, cardinal points, ecliptic, different objects shown)
  - Explain what constellations are (groups of far away stars that the human brain sees as a pattern) and why we use constellations (to divide the sky). Show figures and boundaries with planetarium software.
- Finding North:
  - Discuss how to locate North using the Big Dipper as a guide. (show with planetarium software or sky map.)
  - Discuss how to find the other directions once North has been determined. (i.e. face North, hold out arms straight out to side, left hand is west, right hand is east, back is South)
- Measure Distance in the Sky:
  - Show how to describe distance using "Handy Sky Measures"
  - **Hand out** *Skyways*: Handy Sky Measures (pg. 49)
  - Practice by measuring angular distance between objects in the classroom.
- Location:
  - Discuss Altitude-Azimuth location system. (*Beginner's Observing Guide* pg. 18)
  - **Hand out** *The Horizon (Altitude – Azimuth) System* diagram
  - Azimuth: N=0, E=90, S=180, W=270 degrees.
  - Altitude: 0=horizon, 90 = zenith, 45 = halfway, 30= 1/3, 60- 2/3
  - Must state time with this system!
- **DEMO:** use [www.heavens-above.com](http://www.heavens-above.com) website to get real time data on satellites for the evening. Have student locate and observe using Alt-Az system to find the satellites. **Hand out** "Daily Predictions for all satellites brighter than magnitude: (brightest) 3.5" page.

- Brightness:
  - Discuss magnitudes system.
    - Visual system
    - Created by Hipparchos before telescope
    - 1 being brightest, 6 being dimmest (originally)
    - System needed more values so we went into negative numbers for brighter objects.
    - The larger the number the fainter the object.
    - Show chart BOG pg 20.
- Go outside and put it into practice – observe!

**Between Class Assignments:**

- Read *Beginner's Observing Guide* chapters 2, 3, 4, 6
  - *Reading the Star Maps and Seeing the Constellations*
  - *Finding North in the Night Sky*
  - *Distance, Position, and Brightness in the Sky*
  - *The Six Star Maps*
- Determine the 4 cardinal points from your home (N, S, E, W)
- Answer "Practice Your Skills" questions from *Beginner's Observing Guide* Chapter 4. (pg 17, 19 & 21)
- Answer the Practical Skills questions from the *Beginner's Observing Guide* maps for the appropriate season. (chapter 6)
- Do "Measuring the Sky" activity. (*Skyways* pg. 51)
- Observe from ETUC "Constellations and Bright Stars" section.

# LESSON 4: TELESCOPE TYPES AND USING THEM

## *Suggested Outline:*

- Show & discuss different telescope designs, mounts and accessories.
  - <http://www.starizona.com/acb/basics/index.aspx>
- Watch Video – *The Infinity Series 2*. Second part. “How to use your telescope”. Video discusses aligning your finderscope, polar alignment, importance of dark site, letting your scope cool down, sky charts and accessories.
- **Hand out** and discuss *Quick Reference Guide of Telescope Information*
- Star Hopping
  - **DEMO:** star hopping techniques using planetarium software
- Show how to use a planetarium program. Focus on generating a map. I use Cartes du Ciel because it is free so all students can have access to it.
- **Hand out** RASC Calgary Centre’s brochures
  - Choosing & Using Binoculars
  - Choosing & Using a Telescope
- More information on telescopes and using them  
<http://www.telescope.com/articles/com/9.uts>
- Astronomy terms:
  - *Beginner’s Observing Guide* pages 178 to 187
  - **Hand out** Astronomical Dictionary

## **Between Class Assignments:**

- Read *Beginner’s Observing Guide* chapters 10, 11
  - *The Importance of Binoculars*
  - *When to Buy a Telescope*
- Observe from ETUC "Constellations and Bright Stars" section.

## LESSON 5: STAR DESIGNATIONS, RIGHT ASCENSION / DECLINATION & DEEP SKY OBJECTS

### *Suggested Outline:*

- Discuss star common star designations - Bayer, Flamsteed. (*Beginner's Observing Guide* pg. 23)
  - Use planetarium software to show designations in use.
  - Point out Greek alphabet at back of *Beginner's Observing Guide* (pg 192)
- Discuss RA / DEC location system.
  - Use Celestial Sphere globe (or planetarium program) to illustrate RA/DEC system. Concentrate on explaining that the coordinates are locked into place on the celestial sphere, each star has its own "address". It is more important for the students to understand this than it is to understand exactly how the system works. Demo on planetarium software how this makes finding objects easier than the alt-az system from different locations around the globe.
  - **Hand out** *Equatorial Coordinates Systems* article.
- Watch the *Celestial Sphere* video (part on deep sky only. min 30 to min 40)
- Discuss different types of deep sky objects.
  - Show file "#5 – Deep Sky Objects definitions" on a data projector (or use overheads provided) and discuss.
  - **Hand out** *The Deep Sky Objects* article.
  - **Hand out** *Skyways* pgs 76 through 80.
  - You can visit SEDS Messier website. <http://messier.seds.org> to view more types of objects.
- Show unlabeled slides (1 – 12) of deep sky objects in file "#5 – Object Identification". These have been drawn to try and approximate what would be seen through a telescope. **Hand out** notes pages of unlabeled slides. Have students write down beside each image what type of object they are. Then go over the next set of slides (14 – 25) with the answers on them. The Belmont Society created the drawings.
- Discuss how to read the charts from the Mag-7 Star Atlas Project.

### **Between Class Assignments:**

- Read *Beginner's Observing Guide* chapters 5 and 6
  - *Names of Stars*
- Observe from ETUC Deep Sky Objects section

## LESSON 6: THE MOON & ECLIPSES

### *Suggested Outline:*

- Discuss moon phases
  - **Hand out** *Skyways* pg 29, 30
  - Show “Phases of the Moon” figure from the *Beginner’s Observing Guide*. Use the file “#6 – Moon Phase figure” on a data projector.
  - **DEMO:** *Skyways* pg. 31, 33 – Modeling Moon Phases activity
  - **DEMO:** *Skyways* pg. 34 – Rotating Moon activity
  - **DEMO:** "Observing the Waxing Crescent Moon" activity. (*Skyways* pg. 35-37) Use planetarium software to do the activity in the classroom.
- Discuss why lunar & solar eclipses occur
  - **Hand out** the articles from “Mr Eclipse.com” on Lunar and Solar Eclipses.
  - **DEMO** eclipse shadows on a globe. Use a lamp and a Styrofoam ball on pencil. Have students try it by themselves.
- Discuss the tides.
  - **Hand out** *Skyways* pg 39, 40
  - Use applet to demo tides:

### **Between Class Assignments:**

- Read *Beginner’s Observing Guide* chapters 13 and 15
  - *Observing the Moon*
  - *Observing Eclipses*
- Do "Observing the Waxing Crescent Moon" activity. (*Skyways* pg. 37)
- Observe from ETUC Moon section

## LESSON 7: THE SOLAR SYSTEM

### *Suggested Outline:*

- **Hand out** *Skyways* pg 41, 56, 57, 59 – 61
- Discuss solar system formation. (*Skyways* pg. 57) Watch the video “*Voyage to the Planets*” (part on solar system formation only.)
- Size of the Solar System
  - **DEMO** the distance between the Earth and Moon. Separate the 12” Earth globe and 4” ball by about 39 feet (12m).
  - Continue to discuss the size of the Solar System by converting it into meters so the students can get a feel for how large it is. See *Skyways* pg. 45 for a scale in meters.
  - Point out “if the Earth could be placed at the center of the Sun, the Moon would orbit the Earth about halfway to the Sun’s surface.” (*Skyways* pg .46)
- Discuss observing the planets
  - Five planets are easily seen “naked eye” Venus, Jupiter, Mars, Saturn, and Mercury.
  - Can usually tell the difference between planets and stars because planets do not twinkle.
  - Mercury and Venus are “inferior planets” (orbit within the orbit of Earth) they are only seen close to the sun. So may only be seen at sunrise or sunset.
  - They exhibit phases like the moon when viewed in telescopes.
  - Mars, Jupiter, Saturn, Uranus, Neptune and Pluto are “superior planets” orbit outside the orbit of Earth.
  - Superior planets do not exhibit phases.
  - Superior planets exhibit “retrograde motion” at “opposition” (see BOG pg 120 for definition). Show figure on Beginner’s Observing Guide pg. 122

### **Between Class Assignments:**

- Read *Beginner’s Observing Guide* chapters 14, 17, 18, 19, 20, 21
  - *Observing the Planets*
  - *Observing Meteors and Meteor Showers*
  - *Observing the Aurora*
  - *Observing Comets*
  - *Observing the Zodiacal Light*
  - *Observing the Sun Safely*
- Observe from ETUC Solar System section.

## LESSON 8: STARS

### *Suggested Outline:*

- **Hand out** *Skyways* pg 61, 62
- Work through Module 2 - #1 through 10.
- When discussing #3 “Types of Stars”
  - Discuss the different types of variable stars
    - Intrinsic: Pulsating, Eruptive
    - Extrinsic: Eclipsing Binary, Rotating
  - For more detailed variable star info and information on how to start observing them the students should go to the AAVSO website.  
<http://www.aavso.org/>
- When discussing #4 “Temperature and Colours of Stars”
  - Have students do *Skyways* HR Diagram activity (pg 72, 73)
  - Discuss stellar classifications (Oh, Be, A, Fine, Gal/ Guy, Kiss, Me)
    - Show file “#6 – OBAFGKM chart” or use overhead provided.
  - **Hand out** *Skyways* pg 74, 75
- When discussing #6 “The Life Cycle of a Star”
  - use the “Balloon Stars” demo from *Skyways* pg. 63 to help illustrate a star in equilibrium
- Watch *The Infinity Series Part 2: Deep Space - The dance of Gravity* video (First part only, about 40 min). The video discusses stellar evolution, quasars, pulsars, galaxies and a bit of cosmology.

### **Between Class Assignments:**

- Read *Beginner’s Observing Guide* chapter 7 and 16
  - *Information about the Brightest Stars*
  - *Observing Variable Stars*
- Observe from ETUC Double & Multiple Stars and Variable Stars sections.

# LESSON 9: OBSERVATORY AND EQUIPMENT OPERATION & CLASS WINDUP

## *Suggested Outline:*

- Go over operation of observatory equipment and rules.
  - The operating procedures for observatory equipment are located in the yellow duo-tang on the table by the Log In binder by the main door and on the club website. <http://pgrasc.org/members/members-area/observatory-operating-procedures/>
  - Explain how a key to the observatory may be obtained. Be a member in good standing for a minimum of three months. Volunteer at open houses, tours and other Centre events.
  - Explain that a gate key to get access to the grounds may be obtained without necessarily having an observatory key. (basic right of membership in the Centre)
  
- *Explore the Universe Certificate*
  - Explain that the students do not have to stop working on the certificate once the course is over. They should keep working on it until complete.
  - Point out when the students are finished their *Explore the Universe Certificate* they need to fill out and hand in their Application form, Observation Report form and log book to be examined prior to awarding the certificate.
  - Point out that upon successful completion of the certificate the students name will be added to the National website as having completed the Certificate. <http://www.rasc.ca/explore-universe>
  
- **Hand out** a *NOVA Program Certificate of Completion* to each student.

## **Between Class Assignments:**

- Continue *Explore the Universe Certificate* observations as necessary to finish certificate program.