Laboratory 1:
Using skycharts & planetarium software

Experiments are to be completed on the provided laboratory sheets below; any supporting material (eg. graphs) should be attached. Make sure your name and your partners name(s) are clearly indicated on the front page of your lab. **Neatness and clarity count!** Use complete sentences in answering all questions, explain your answers when asked clearly, and if you use an equation to do a calculation, *write the equation down* first, then put in numbers and solve. **Show all your work!**

Labs are due on VIULearn a week after the lab as a single, reasonably sized PDF file.

APPARATUS

Skychart, ruler, calculator, *Starry Night* or *SkySafari* or other equivalent planetarium software.

OBJECTIVE

1. To learn to use a *skychart*.

2. To learn to use *planetarium software*.

3. To learn to locate specific objects in the sky.

4. To observe and differentiate between deep-sky objects.

THEORY

1). Skycharts (such as those available via the ASTR 112 website) are a *projection* of the three-dimensional sky onto paper, showing the position of stars, planets, and other objects on the sky. The skychart is arranged so that the center of the chart (marked with a '+') is the *zenith*, the point directly overhead on the sky, while the edges represent the horizon. The cardinal directions (N, S, etc.) are indicated along the horizon. Brighter or more major stars are indicated by larger dots.

(Example) *What would we see in the SE sky? Turn the skychart so that SE appears "rightside up". Near the horizon is Sirius (the 'Dog Star') and the constellation of Canis Major. About half way up is the constellation Orion and near the zenith (the small '+') is the variable star Algol.*

2). *Angular measurement* is common when working with skycharts. The *zenith* (point directly overhead) is exactly 90° from the horizon. An imaginary line running from horizon to horizon through the *zenith* spans 180°, e.g. tracing out the line from north to south through the zenith.

(Example) *The star Sirius is about 15° above the horizon; the Hyades star cluster is roughly 2/3 of the way to the zenith or 66° above the horizon; and Algol is nearly at the zenith.*

3). *Starry Night* and *SkySafari* are two examples of computer programs that simulate the night sky and as a result are sometimes referred to as 'planetarium' software. *Starry Night* is bundled with some versions of the class textbook and is also installed on the computers in the lab located in B315-113 while *SkySafari* is available for purchase online for phones, tablets and Mac computers. A basic PDF tutorial and video on using these programs is available on the ASTR 112 website under the 'Info & Handouts' page. **You should work through these short tutorials PRIOR to attempting this lab. NOTE: a VIU computer account is required to log onto the computers in the lab; see** http://www.viu.ca/technology/ **for further details**. Other planetarium programs such as *Stellarium* may also be used but please note that they are not supported with supplementary material in ASTR 112.

*(**Example**)* *You should know how to do the following tasks in a planetarium program: set your location, adjust date & time, search for objects, zoom in/out, obtain astronomical information about a selected object, adjust the portion of the sky being viewed, display constellation names and boundaries, display a field-of-view indcator, display a grid/zenith/nadir/ecliptic, etc.*

Laboratory 1: Using Skycharts & planetarium software

1. **Print off the lab & January skychart for the Northern Hemisphere** from the website.

2. Start up the *planetarium* software (see the appropriate tutorials available on the website). **Set the date & time to Thurs, Jan 18, 2024 at 9pm PST in Nanaimo** for observations for this lab. **Press the time 'stop' button (■) or the equivalent in other programs to keep the time set to 9pm**.

3. For *Starry Night*, **turn on Stick figures (Astronomical) & Labels** under Constellations under the Options (sub)menu. For *SkySafari* do the same using **Settings → Constellations** (use As Traditional Lines; you may also wish to Show Asterisms and Show Names as necessary.)

4. For *Starry Night* use the Options submenu **display the Zenith/Nadir (Poles)** under Alt-Az Guides & **display the Ecliptic** under Celestial Guides. For *SkySafari* do the same using **Settings → Grid & Reference**.

5. [*2 marks*] On the skychart the *ecliptic* is shown as a dashed line that runs through the southern sky; planetarium programs show it as a coloured line (when displayed). Using the textbook, class notes or other source **define the ecliptic**. In the planetarium software **display both constellation boundaries and names/labels**. **Record the names of constellations (partly or wholly above the horizon) through which the ecliptic passes. These constellations belong to a group collectively known as. . . ?**

6. [*2 marks*] Use the skychart or *planetarium software* to **locate the constellation of *Orion* and describe its position in the sky (use compass direction & approximate height). Sketch the full asterism used to identify Orion, labelling its brightest stars, and locate, label & name the DSO's (deep-sky objects) M42, IC 434, and NGC 2024** within it.

7. [*1 mark*] The *Milky Way* passes through several constellations, including *Cygnus* and *Cassiopeia*. In the planetarium software display the Milky Way and turn its brightness all the way up. **Using compass directions, describe the horizon-to-horizon orientation of the Milky Way on the skychart. How does the skychart indicate the Milky Way?**

8. [*2 marks*] **Using the skychart, describe the location (use compass direction & approximate height above horizon) of the (centers of the) following constellations: Ursa Major, Gemini and Canis Minor. What common name(s) is each known by? What object or figure is each supposed to represent?**

9. [*2 marks*] In the planetarium software, turn to face north and zoom out until the field-of-view (FOV) is sufficiently large that you are able to see the northern horizon, Polaris, and the zenith. Access the time controls and continuously 'step' ahead one minute at a time until roughly an hour has passed (*NOTE: reset the time to 9pm when you are done*). **Do the stars appear to rotate *clockwise* or *counterclockwise* over time? From which overall compass direction do stars appear to rise? To set? *Why* do the stars appear to move like this?**

10. [*2 marks*] Orient yourself as in the previous question. Display constellation names and boundaries. Select & center the star Polaris. Follow tutorial instructions in order to display a custom field-of-view (FOV) of 98°, centered on Polaris. Zoom out enough so that you can see the entire FOV indicator and the region just outside of it. Adjust the time *back* in one hour increments until sunset, and then advance the time *forward* in increments of one hour until dawn, paying attention to the difference in behaviour of stars that fall *within* the FOV indicator vs. those *outside* of the FOV indicator, especially when they are below Polaris. **What fundamental difference in behaviour did you notice? What name do we give collectively to constellations whose stars behave this way? What do you notice about Polaris' behaviour during this time?**

11. [*3 marks*] On the January skychart use a ruler to measure the (radial) distance between the horizon and zenith: _____ cm; this 'length' corresponds to an angle of 90°. **Using these two values, calculate the (radial) scale (horizon-to-zenith) of the skychart in degrees-per-cm**. Show your work!

From the January skychart estimate the compass direction & height (in degrees) of *M31* in the constellation of Andromeda: _____ . **Then use a ruler to measure the distance between the horizon & *M31*:** _____ cm (measure along the radial line that connects the horizon, M31 and the zenith). **Use this measured distance and your (radial) scale (above) to *convert* from cm to the height of *M31* (in degrees) above the horizon. Comment on the agreement with your *estimate* for the height of M31.**

12. [*2 marks*] **Using *planetarium software*, describe the location (compass direction & approx height above the horizon) of Messier's 33rd AND 101st objects (M33 & M101):**

Mark the positions of M33 & M101 on the January skychart below. Why are they NOT in exactly the same location in the sky as given by your *planetarium software*?
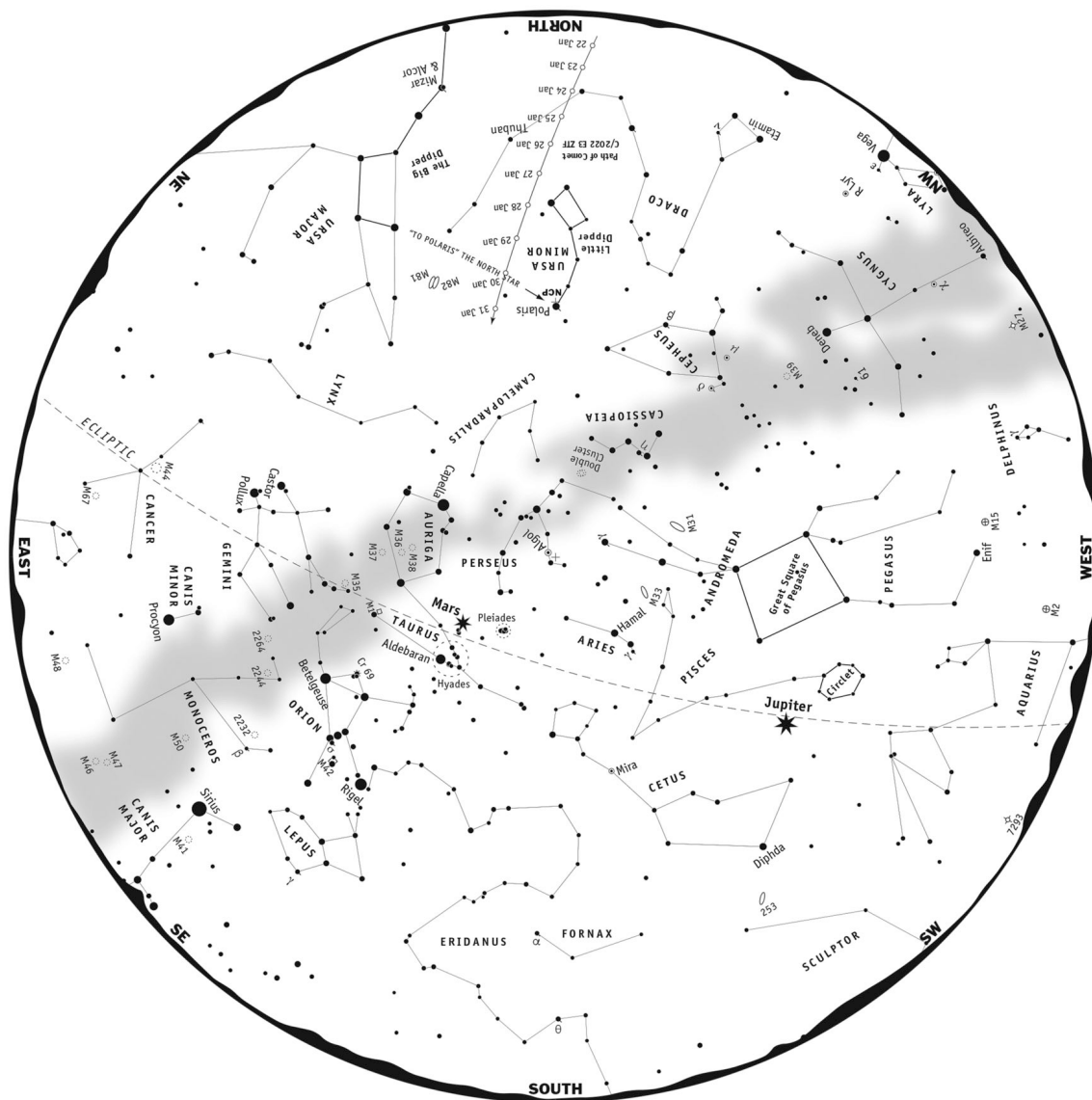
13. [*4 marks*] **Find & center the object M33 in your planetarium program**. In *Starry Night* use the FOV Indicators submenu item to display a red, circular 1° field-of-view on the sky; in *SkySafari* use **Observe → Scope Display** and enable both the 1° Custom Field of View and Show Even if Not Connected to Telescope settings. Zoom in so the 1° field-of-view circle fills the screen. Observe and draw M33 (see instructions below); you may find it useful to read the planetarium program's information on M33. **Repeat the above for the object M101**.

<div style="text-align:center">◯   ◯</div>
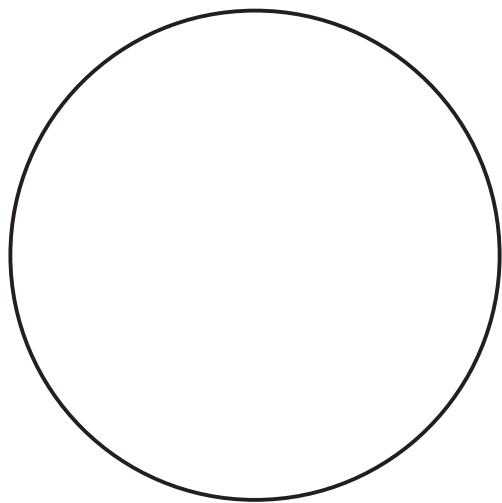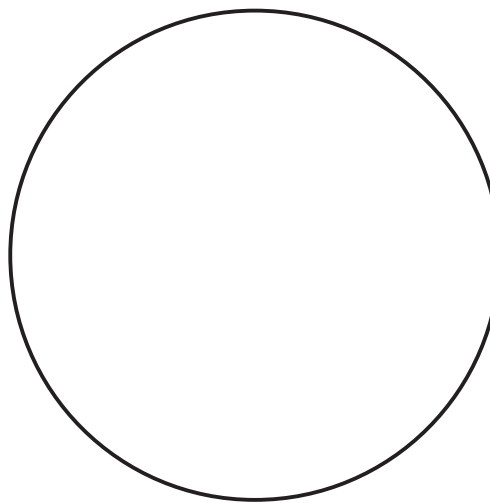
<div style="text-align:center">M33   M101</div>

In the left circular FOV above draw (by hand) a properly scaled, detailed COLOUR view of the object M33. Repeat on the right for M101. What type of objects are M33 and M101? How are they similar? How do they differ? Be SPECIFIC in your answers and make sure to include comments on characteristics such as colour, shape, size, symmetry, etc.