ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL THREE

INSTRUCTIONAL GUIDE

SECTION 6

EO C340.04 – DESCRIBE ELEMENTS OF THE NIGHT SKY

Total Time: 30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-803/PG-001, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Create slides of Figures 15U-1 to 15U-4.

Visit the National Research Council (NRC) website (Reference C3-221) and retrieve a planisphere star chart, make one copy for each cadet. Prepare one planisphere for use in TP1.

Photocopy Annex V for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for this lesson to orient the cadets to elements of the night sky, to generate interest and emphasize the teaching points.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall have described elements of the night sky.

IMPORTANCE

It is important for cadets to be able to describe the elements of the night sky so they may apply the knowledge acquired while viewing the night sky or during online stargazing. These activities may generate interest in astronomy.

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Teaching point 1 **Describe Fixed Elements of the Night Sky**

Time: 15 min Method: Interactive Lecture

VISIBLE STARS

Stars are large spherical bodies, many times the size of Earth, composed of hydrogen and heavy elements that are compressed and heated by the pressure of gravitation. This heat and pressure causes nuclear reactions, which make the star visible. A star's gravity then compresses the ongoing nuclear explosion, which prevents the star from disintegrating.

Although the smallest stars are many times larger than Earth, they are so far from Earth that, except for the Sun, they appear as mere luminous points. Their great distance also makes them appear fixed in the sky even though each star is actually moving in a vast orbit around the centre of the galaxy.



Star brightness is called magnitude. The lower the magnitude, the brighter the object. The brightest star visible in the night sky is Sirius, classified as a magnitude of −1.

Presently, the scale of visibility ranges from a faint magnitude 30, which are objects that can be detected by the Hubble Space Telescope, to a bright magnitude -27 which corresponds with the Sun. On this scale, the Sun is 16 trillion times brighter than a magnitude 6 star.

Ancient peoples imagined patterns using individual stars. One of the most useful and easily identifiable patterns uses seven bright stars: Alkaid, Mizar, Alioth, Megrez, Phekda, Merak and Dubhe. Together these stars form the Big Dipper, which is part of the constellation Ursa Major.



Show the cadets Figure 15U-1.

In the mid-northern hemisphere, the Big Dipper can be seen at any time of the year and at any time of night from everywhere in Canada. The Big Dipper is the most prominent stellar configuration in the night sky. It can easily be identified by untrained observers, making it the ideal reference point for finding other elements of the night sky.

The Big Dipper swings around the sky as the Earth rotates through day and night, so it appears in different orientations. Every 24 hours it circles the North Star (Polaris).



Show the cadets Figure 15U-2.



Show the cadets Figure 15U-3.

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CONSTELLATIONS



Constellations are patterns of stars partitioned and named long ago by our ancestors.

Of the 88 constellations recognized by the International Astronomical Union approximately one quarter of these are in the southern sky and not visible from mid-northern latitudes. About half of the remaining constellations are faint and hard to distinguish.



Hand out Annex U to each cadet.

Many of the visible and well-known constellations are shown in this handout. All constellations, including Ursa Major (the Big Dipper), circle the sky every 24 hours, with Polaris – the North Star – at the centre of the circle.

A planisphere may be used to locate constellations by holding it so the time of year is at the top. This represents the orientation of the constellations as seen at midnight. Remember that the constellations swing around Polaris once every 24 hours and also once every 12 months. A planisphere is only correct at midnight. At midnight, the stars at the top of the planisphere will be in front of an observer facing north and the stars at the bottom of the planisphere will be in front of an observer facing south.



Distribute the two parts of a planisphere retrieved from the NRC website http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf to each cadet. Demonstrate how to assemble a planisphere using a prepared copy.

ACTIVITY

Time: 5 min

OBJECTIVE

The objective of this activity is to have the cadets use the Big Dipper to locate other elements of the night sky.

RESOURCES

Handout of Figure 15U-4 showing the seasonal locations of the constellations in the night sky.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Have the cadets rotate their handout so that today's date is located at the top (midnight tonight).
2. Have the cadets find the Big Dipper in Ursa Major.
3. When all cadets have found Ursa Major, have them find Polaris (at centre).

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4. When all cadets have found Polaris, have them find the star Sirius in the constellation Canis Major (about July 5 position near the rim).

5. Have the cadets locate their own sign of the Zodiac (hint: midnight on their birthday).

SAFETY

N/A.

CONFIRMATION OF TEACHING POINT 1

The cadets' participation in this activity will serve as the confirmation of this TP.

Teaching point 2 **Describe Moving Objects of the Night Sky**

Time: 10 min Method: Interactive Lecture

SATELLITES

There are many moving lights in the sky, including aircraft and satellites. A satellite is any celestial body orbiting the earth, but most satellites that are large enough to be seen from the surface of the Earth are man-made. Aircraft have a flashing white light to identify their position as well as red and green wing tip lights, while man-made satellites orbiting the Earth are star-like and do not twinkle. They appear to shine with a steady white glow due to sunlight reflecting off the metal surfaces. Satellites are more prominent during the spring and summer when the Earth's shadow is lower in the sky. Sightings are greater just after dark and drop off close to midnight. Satellites move in a linear fashion at a regular pace, though most observers tend to view their motion as wavy or jerky. Some of these orbiting objects are inhabited by people.



To find the International Space Station (ISS) or any space shuttle, go to NASA's website http://spaceflight.nasa.gov/realdata/sightings/. Select your location from the menu and find out where to look in the sky.



Show the cadets Figure 15V-1.

The times that the spacecraft will be visible are listed. The NASA website uses the following format:

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THE FOLLOWING ISS SIGHTINGS ARE POSSIBLE FROM FRI FEB 08 TO WED FEB 20

SATELLITE	LOCAL DATE/TIME	DURATION (MIN)	MAX ELEV (DEG)	APPROACH (DEG-DIR)	DEPARTURE (DEG-DIR)
ISS	Fri Feb 08/07:04 PM	2	51	20 above WNW	51 above N

HUMANSPACEFLIGHT: Sighting opportunities by NASA, 2003. Retrieved February 8, 2008, from http://spaceflight.nasa.gov/realdata/sightings/

Figure 1 Building the ISS

The first column lists the spacecraft; the second column gives the date and time of the viewing. The third column shows how long the viewing will be possible. The fourth column shows the maximum height above the horizon that the spacecraft will be seen. The fifth column shows the direction in which the spacecraft will first appear and the final column shows the direction in which it will be last visible.



Hand out Annex V to each cadet.

PLANETS

The easiest way to observe planets is to know when and where to expect them. This information is readily available on astronomical calendars, observer handbooks and most astronomy resource books or can be easily found on the internet.

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Planet	Magnitude	Description
Mercury	0	Mercury is only visible for a few weeks each year because of its orbit. It is yellow and can be seen just after sunset or just before sunrise.
Venus	−4	Venus is visible in the early evening or the early morning for several months each year. It cannot be seen more than four hours after sunset or before sunrise. Venus appears white and is very bright.
Mars	−3 to 1	Because the distance from Earth varies, so does the apparent brightness of Mars. It appears to be a rusty colour due to the light reflecting off the red planet. Mars travels across half the sky in one year, making it interesting to track.
Jupiter	−2 to −3	Jupiter is brighter than most stars but is still not as bright as Venus. Jupiter appears creamy white and can occasionally be seen all night long.
Saturn	0	Saturn is often mistaken for a star since its brightness matches that of some of the brighter stars. Saturn appears as a pale yellow orb.
Uranus	6	Uranus has a distinct blue-green hue.
Neptune	8	Neptune appears to be approximately the same size of Uranus, though it has a deeper blue hue. They can be differentiated by their position in the sky.

Five planets are visible to the naked eye: Mercury, Venus, Mars, Jupiter and Saturn. Uranus and Neptune must be viewed through binoculars or a telescope.



Planets, like satellites, do not twinkle. Remember, the higher the brightness magnitude, the dimmer the planet – just like stars.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS

Q1. What is a satellite?

Q2. When is the planet Venus visible?

Q3. How many planets are visible to the naked eye?

ANTICIPATED ANSWERS

A1. A satellite is any celestial body orbiting the earth.

A2. Venus is visible in the early-evening or the early-morning.

A3. Five.

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END OF LESSON CONFIRMATION

QUESTIONS

Q1. What makes stars visible?

Q2. What are constellations?

Q3. What is the easiest way to observe planets?

ANTICIPATED ANSWERS

A1. Sustained nuclear reactions caused by the pressure and heat of gravity.

A2. Constellations are patterns of stars partitioned and named long ago by our ancestors.

A3. The easiest way to observe planets is to know when and where to expect them.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Knowledge about elements of the night sky is useful when viewing the night sky or during online stargazing. Recognizing these elements will enhance the enjoyment of amateur astronomy.

INSTRUCTOR NOTES/REMARKS

This EO may be conducted with EO C390.09 (Identify Elements of the Night Sky, Chapter 18, Section 14).

REFERENCES

C3-179 (ISBN 1-55209-302-6) Dickenson, T. (2001). *Night Watch: A Practical Guide to Viewing the Universe*. Willowdale, ON: Firefly Books.

C3-180 (ISBN 1-55297-853-2) Scagell, R. (2004). *Firefly Planisphere: Latitude 42 Deg N*. Willowdale, ON: Firefly Books.

C3-221 National Research Council of Canada. (2007). *Explore the Night Sky*. Retrieved December 3, 2007, from http://www.nrc-cnrc.gc.ca/eng/education/astronomy/constellations/html.html.

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