

**CHAPTER 18**

**PO 390 – NAVIGATE A ROUTE USING A MAP AND COMPASS**





**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 1**

**EO M390.01 – IDENTIFY PARTS OF THE COMPASS**

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Total Time:	30 min
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**PREPARATION**

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**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.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TPs 1 and 2 to present background material and introduce the parts of a compass to the cadets.

Demonstration and performance was chosen for TP 3 as it allows the instructor to explain and demonstrate the skill the cadet is expected to acquire while providing an opportunity for the cadets to practice setting a predetermined declination under supervision.

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**INTRODUCTION**

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**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have identified the parts of the compass and set a predetermined declination.

**IMPORTANCE**

It is important for cadets to understand the principles on how a compass works, recognize the parts of the compass and be able to set the magnetic declination on the compass. This basic knowledge will aid the cadet in learning how to use the compass as a navigational tool.

**Teaching Point 1****Explain the Principles Behind the Workings of a Compass**

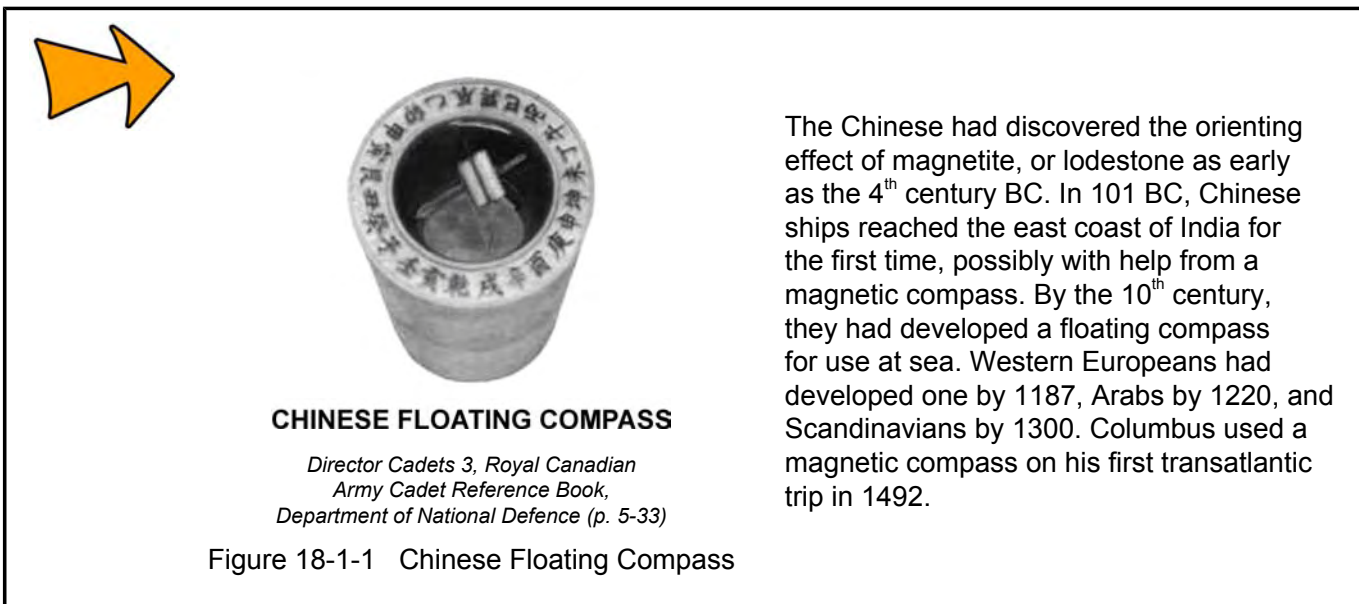
Time: 5 min

Method: Interactive Lecture

**INTRODUCTION**

The compass is an important tool used in wilderness navigation. It is not a replacement for good map-reading skills; however it is a trustworthy tool to complement and complete ground navigation. A compass user must take care to be precise in compass measurements. A small error in calculation or measurement can equal a significant error in the field.

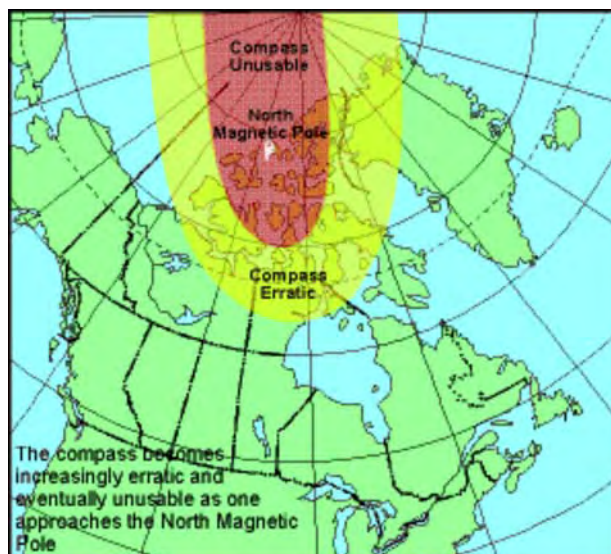
A magnetic compass remains viable as a navigational aid, even with the advent of Global Positioning System devices, because it does not require batteries and remains reliable year after year.

**HOW A COMPASS WORKS**

Regardless of intended purpose or complexity of construction, most compasses operate on the same basic principle. A small, elongated, permanently magnetized needle is placed on a pivot so that it may rotate freely on the horizontal plane. The earth's magnetic field, which is shaped approximately like the field around a simple bar magnet, exerts forces on the compass needle causing it to rotate until it comes to rest in the same horizontal direction as the magnetic field. Over much of the earth this direction is roughly running between north and south, which accounts for the compass's importance in navigation.

The earth has a north and south magnetic pole. These magnetic poles correspond roughly with the actual geographical poles. The north magnetic pole is located (2005 estimate) at approximately 82.7 degrees N latitude and 114.4 degrees W longitude, which lies over 800 km from the north geographic pole.

The horizontal force of the magnetic field, responsible for the direction in which a compass needle is oriented, decreases in strength as one approaches the north magnetic pole. This decrease is due to the lines of force changing direction towards the vertical as they bend back into the earth at the north magnetic pole towards the south magnetic pole. The compass starts to behave erratically, and eventually as the horizontal force decreases even more, the compass becomes unusable.



*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-33)*

Figure 18-1-2 Earth's Magnetic Field

The nature of the earth's magnetic field is such that the magnetic north pole shifts geographic position about 5–10 km per year. Natural phenomena, like earthquakes, may also shift the magnetic field.

### CONFIRMATION OF TEACHING POINT 1

#### QUESTIONS

- Q1. Why is the compass such an important navigational tool?
- Q2. Approximately how far can the north magnetic pole shift in a year?
- Q3. Why does a compass become less accurate the further north a person travels?

#### ANTICIPATED ANSWERS

- A1. Over much of the earth, a compass roughly indicates the direction of true north, which accounts for the compass's importance in navigation.
- A2. The magnetic north pole shifts geographic position about 5–10 km per year.
- A3. The horizontal force of the magnetic field, responsible for the direction in which a compass needle is oriented, decreases in strength as one approaches the north magnetic pole. This decrease is due to the lines of force changing direction towards the vertical as they bend back into the earth at the north magnetic pole towards the south magnetic pole. The compass starts to behave erratically, and eventually as the horizontal force decreases even more, the compass becomes unusable.

**Teaching Point 2****Identify and Describe the Parts of the Compass**

Time: 10 min

Method: Interactive Lecture



Divide the cadets into equal groups according to the number of compasses available. Starting with the compass opened, use Figures 8-1-3 and 8-1-4 to identify the parts of the compass.

**PARTS OF THE COMPASS**

**A – Sight.** Located at the top of the compass cover. Used to align on an objective when taking a bearing or to observe one along a given bearing.

**B – Compass Cover.** Protects the compass dial and houses the sighting mirror.

**C – Sighting Mirror.** Used to see the compass dial while taking a bearing.

**D – Sighting Line.** Used when aligning an objective or observing along a bearing.

**E – Luminous Index Point.** At the top of the compass dial and where a bearing is set or read from.

**F – Compass Dial.** Houses the magnetic needle, the orienting arrow, the meridian lines, the declination scale (on the inside) and the dial graduations (on the outside).

**G – Dial Graduations.** The compass dial is graduated in 2-degree divisions from 0 to 360 degrees. The dial is rotated by hand.

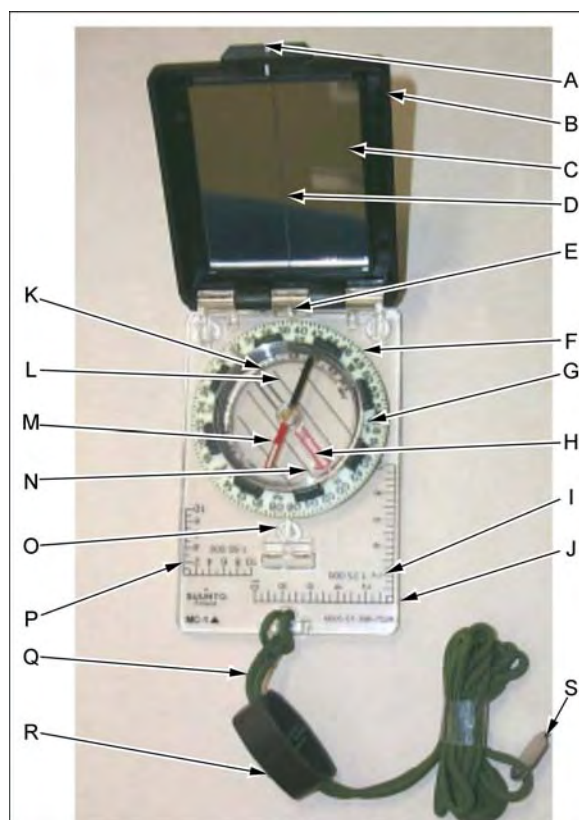
**H – Orienting Arrow.** The black and red orienting arrow is located inside the compass dial and is used to line up with the magnetic needle when taking a bearing on the ground. The orienting arrow is what is adjusted when the magnetic declination is set.

**I – Romer 1 : 25 000.** Used to measure six-figure grid references (GRs) on maps with a 1 : 25 000 scale.

**J – Compass Base Plate.** A clear piece of flat plastic to which the cover, dial and lanyard are attached.

**K – Declination Scale.** Used when adjusting the orienting arrow and while setting the magnetic declination for the map being used. It is graduated in 2-degree divisions.

**L – Compass Meridian Lines.** Black or red lines inside the compass dial. They are used to line up the compass dial with the grid lines (eastings) on a map.



*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-33)*

Figure 18-1-3 Compass

**M – Magnetic Needle.** Spins freely and points towards magnetic north. The south end of the compass needle is black and the north end, with a luminous patch, is red.



When the magnetic needle is lined up in the red end of the orienting arrow, the mnemonic device “Red in the Bed” is used to remember that the red end of the needle belongs in the red end of the arrow.

**N – Luminous Orienting Points.** There are two luminous orienting points located on either side of the red end of the orienting arrow.

**O – Luminous Index Point.** At the bottom of the compass dial; where a back bearing is read from.

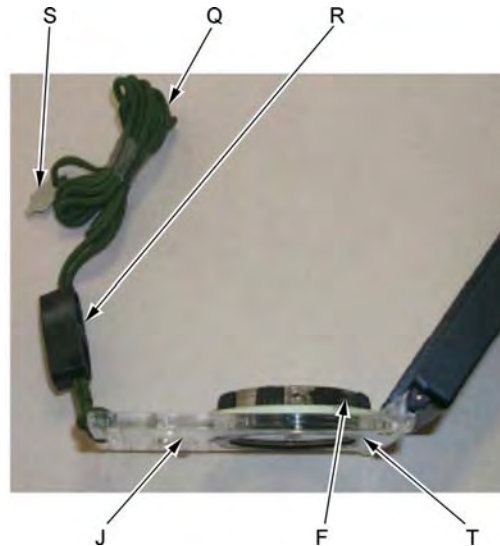
**P – Romer 1 : 50 000.** Used to measure six-figure GRs on maps with a 1 : 50 000 scale.

**Q – Safety Cord or Lanyard.** Used to fasten the compass to the wrist (never around the neck).

**R – Adjustable Wrist Lock.** Used to attach the compass to the wrist.

**S – Screwdriver.** Located at the end of the safety cord and is used to turn the screw to adjust the orienting arrow’s position on the declination scale.

**T – Declination Adjusting Screw.** Located on the back side of the compass dial and is used to adjust the orienting arrow’s position on the declination scale.



*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-34)*

Figure 18-1-4 Compass



After being exposed to a strong light source, the luminous parts of the compass will glow in the dark making operating the compass at night possible.

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## CONFIRMATION OF TEACHING POINT 2

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### QUESTIONS

- Q1. What is the purpose of the 1 : 25 000 and 1 : 50 000 romers?
- Q2. What colour is the north end of the magnetic needle?
- Q3. Where should the safety cord or lanyard of the compass never be placed?

### ANTICIPATED ANSWERS

- A1. The purpose of these romers is to measure six-figure GRs on maps with 1 : 25 000 and 1 : 50 000 scale respectively.
- A2. The north end of the magnetic needle is red.
- A3. The safety cord or lanyard of the compass should never be placed around a person's neck.



**Teaching Point 3****Explain, Demonstrate and Have Cadets Set a Predetermined Declination**

Time: 10 min

Method: Demonstration and Performance



Explain and demonstrate setting a predetermined declination as listed below, prior to the cadets' practicing. Calculating declination may be taught in EO C390.05 (Calculate Magnetic Declination, Section 10).

Do not go into too much detail about the three norths as this material will be covered in EO M390.05 (Determine Bearings on a Map and on the Ground, Section 5).

**DECLINATION**

Magnetic declination is the difference in bearing either between grid north and magnetic north or between true north and magnetic north. Declination will change for each topographical map and it also changes annually due to the shifting north magnetic pole.

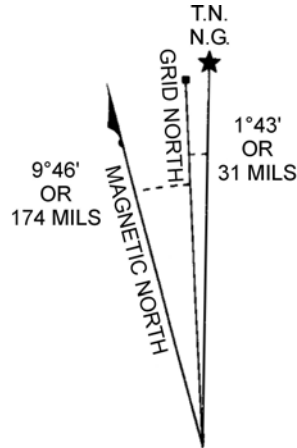


Cadets will almost always use the magnetic declination value between grid north and magnetic north (grid declination) when navigating using a map and compass. By setting the magnetic declination on the compass, magnetic bearings are converted to grid bearings which allow bearings taken from the map to be used on the ground and vice versa.

Declination is further described by stating whether the declination is east or west of magnetic north. The declination for the map being used is calculated using the information in the declination diagram (as illustrated in Figure 18-1-5) found in the marginal information of the map.



Declinations are stated in degrees and minutes. Each degree is subdivided into 60 minutes. This is important when setting the declination as the declination scale is graduated in 2-degree divisions.



USE DIAGRAM ONLY TO OBTAIN NUMERICAL VALUES  
 APPROXIMATE MEAN DECLINATION 1982  
 FOR CENTRE OF MAP  
 ANNUAL CHANGE (INCREASING) 4.4'


*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-39)*

Figure 18-1-5 Declination Diagram

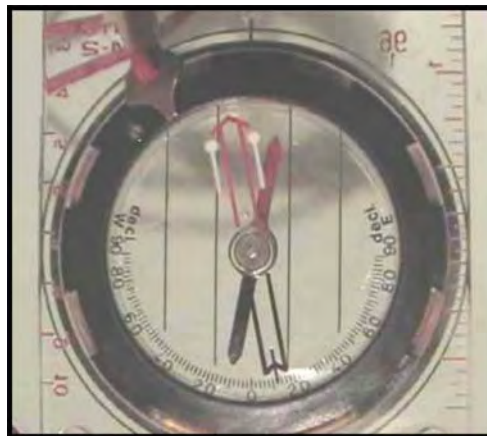
### ADJUSTING THE DECLINATION ON A COMPASS

The compass's declination scale must be set to compensate for the difference between grid north and magnetic north. To do this we must first have the amount of declination in degrees east or west. Then, turn the compass over and look at the back of the dial.

From the zero point, using the screwdriver, turn the declination adjusting screw to the right for west and to the left for east declination (as illustrated in Figure 18-1-6). Each small black line represents two degrees of declination.



When setting declination on a compass, it is easier to hold the screwdriver and turn the compass, especially in cold weather. The declination shall *never* be turned past the last number of the declination scale.



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-1-6 Declination Screw



If a person were to follow a compass bearing for one km without first adjusting for declination, for every one degree of declination, that person would be over 17 m to the left or right of their plotted bearing. This is how important declination is.

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## ACTIVITY

Time: 5 min

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### OBJECTIVE

The objective of this activity is to have cadets set magnetic declination on a compass.

### RESOURCES

- Compasses, and
- Predetermined declination.

### ACTIVITY LAYOUT

N/A.

### ACTIVITY INSTRUCTIONS

1. Divide the cadets into groups based on the number of compasses available.
2. Give the cadets a declination value.
3. Have the cadets turn the compass over (on its back with the declination adjusting screw facing up).
4. With the other hand have the cadet grasp the screwdriver that is attached to the safety cord/lanyard.
5. Using the screwdriver, have the cadet turn the declination adjusting screw to the right for west and to the left for east declination values.
6. Check the set declination.

### SAFETY

N/A.

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### CONFIRMATION OF TEACHING POINT 3

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

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### END OF LESSON CONFIRMATION

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### QUESTIONS

- Q1. A compass is a tool used to complement what other ground navigation skill?
- Q2. What must be done to the luminous marks of the compass to make them glow?
- Q3. In what direction would the declination adjusting screw be turned for an east declination value?

### **ANTICIPATED ANSWERS**

- A1. A compass is used to complement map-reading skills.
- A2. The luminous marks need to be exposed to a strong light source.
- A3. The declination adjusting screw would be turned to the left.

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### **CONCLUSION**

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### **HOMEWORK/READING/PRACTICE**

N/A.

### **METHOD OF EVALUATION**

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

### **CLOSING STATEMENT**

Map and compass skills are the core of the cadets' Proficiency Level Three survival training. Being familiar with the compass and how it works is one of the bases on which the rest of the lessons are anchored.

### **INSTRUCTOR NOTES/REMARKS**

TP 2 may need to be modified to reflect the type of compass used for the lesson.

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### **REFERENCES**

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- A2-036 A-CR-CCP-121/PT-001 Director Cadets 3. (2003). *Royal Canadian Army Cadet Reference Book*. Ottawa, ON: Department of National Defence.
- A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.



**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 2**

**EO M390.02 – IDENTIFY MARGINAL INFORMATION AND CONVENTIONAL SIGNS**

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Total Time: 60 min

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**PREPARATION**

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**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.

Distribute topographical maps before beginning the lesson.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TP 1 to introduce the details of marginal information to the cadet.

An in-class activity was chosen for TP 2 as it is an interactive way to introduce conventional signs to the cadet.

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**INTRODUCTION**

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**REVIEW**

The review for this lesson will be from EO M390.01 (Identify Parts of the Compass, Section 1).

**QUESTIONS**

- Q1. What is the purpose of the sighting mirror?
- Q2. What is the function of the meridian lines found inside the compass dial?
- Q3. The mnemonic device “Red in the Bed” is used to remember what?

**ANTICIPATED ANSWERS**

- A1. The sighting mirror is used to see the compass dial while taking a bearing.
- A2. Compass meridian lines are used to line up the compass dial with the grid lines (eastings) on a map.
- A3. The mnemonic device “Red in the Bed” is used to remember that the red end of magnetic needle is lined up within the red end of the orienting arrow.

## OBJECTIVES

By the end of this lesson the cadet shall have to identified marginal information and conventional signs found on a topographical map.

## IMPORTANCE

Cadets need to be able to identify features on the map as they relate to objects on the ground. The cadets will apply this knowledge during training where any type of map is used.

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### Teaching Point 1

### Identify and Describe Marginal Information on a Topographical Map

Time: 20 min

Method: Interactive Lecture

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## MARGINAL INFORMATION

The margins provide information important to the understanding and use of the map. Before using an unfamiliar map, it is important to have a good look at the information contained in its margins. The layout and contents of the marginal information is normally in the same place for all topographical maps, but will always be found within the margins. This information includes:



Have cadets point out each piece of marginal information on a topographical map as it is being described.

**Name of Map Sheet.** For ease of reference the name of the map is usually a major community or district located on the map (found at the bottom centre of the margin, as well as in the top or bottom right corner).

**Number of the Map and Index of Adjoining Maps.** A diagram showing the position of the map sheet in relation to adjoining sheets is shown near the lower right-hand margin. The diagram shows the sheet numbers of the adjoining sheets and accentuates the sheet in hand.

**Date of Map Data.** Helps to indicate the amount of change that may have occurred since the map was printed (found in the bottom left corner).

**Map Scale.** Indicates the scale of the map, most commonly 1 : 25 000 or 1 : 50 000. Scale is used to represent distances on the map in direct relation to the ground. On a 1 : 50 000 scale map 1 cm on the map represents 50 000 cm (500 m) on the ground.

**Scale Bars.** Used as a measuring aid for determining distance on the map (found bottom centre below the map name). The left end of the scale bars is divided into tenths for measuring distances more accurately.

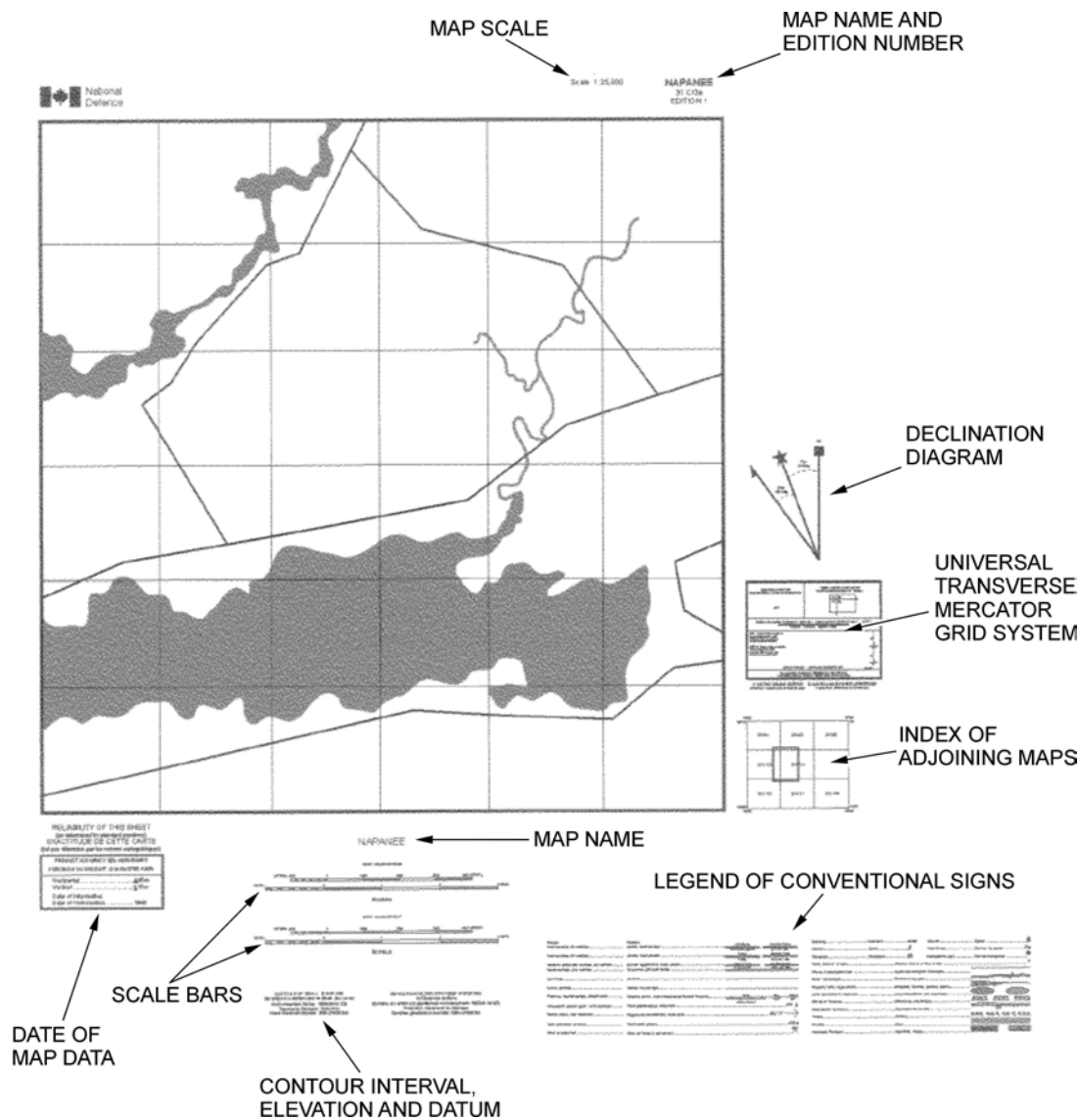
**Contour Interval.** Indicates the vertical (height) interval between contour lines and is given in metres or feet. The contour interval is found in the bottom margin.

**Legend of Conventional Signs.** A table showing the conventional signs used on the sheet in their correct colours with their descriptions is shown in the bottom or side margin, plus in a more complete list on the back of the map.

**Military Index Number.** The index is found in the top right corner of the map sheet and used for ordering additional maps.

**Declination Diagram.** Contains the information for the map on how true, grid, and magnetic north relate to each other. This information is given in the form of a diagram with explanatory notes. The diagram is in the right side margin.

**Universal Transverse Mercator Grid System (UTM).** The UTM grid system divides the earth's surface into zones, each covering six degrees of longitude and eight degrees of latitude. The 60 longitude bands are numbered and the 20 latitude bands are lettered. Each grid zone is one rectangle of the grid pattern, established by the bands and designated by the figures of the longitude band followed by the letter of latitude band.



*Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 11)*

Figure 18-2-1 Marginal Information

Military users, refer to this map as:	SERIES <b>A901</b> MCE 320 EDITION 1
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*Canadian Forces, Maps, Field Sketching, Compasses and the  
Global Positioning System, Department of National Defence (p. 12)*

Figure 18-2-2 Military Index Number

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### CONFIRMATION OF TEACHING POINT 1

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#### QUESTIONS

- Q1. Besides the margins, where else may the legend of conventional signs be found?
- Q2. How is a map usually named?
- Q3. What is the purpose of the declination diagram?

#### ANTICIPATED ANSWERS

- A1. The legend of conventional signs may also be found on the back of the map.
- A2. A map is usually named for a major community or district located on the map.
- A3. The declination diagram contains the information for the map on how true, grid, and magnetic north relate to each other.

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#### Teaching Point 2

#### Conduct an Activity Where the Cadets Identify Conventional Signs by Colour

Time: 30 min

Method: In-Class Activity



Discuss the information with the cadets prior to the commencement of the activity outlined below.

#### CONVENTIONAL SIGNS

A number of symbols are used to indicate an object or item of detail that cannot be shown either by outline or by a line symbol. Most have been established through long usage and standardization agreements. The meaning of most symbols is obvious. However, if there is doubt consult the table of conventional symbols located on every map. Located on the back of most maps you will find many additional conventional signs.

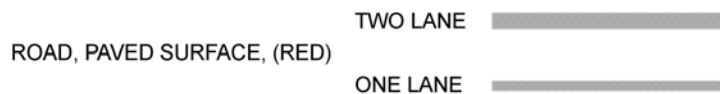
Map-reading not only involves the ability to interpret the symbols shown on the map and to understand the information given in pictorial or written form, but it also involves a true understanding of the ground portrayed and an appreciation of the reliability and value of the particular map being used.

Where the symbol may have more than one meaning, the sign or symbol will be accompanied by a descriptive word (eg, tank or tower).

The use of colour aids in distinguishing details.



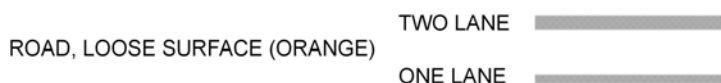
**Red.** Used to identify paved roads and highway numbers. Red is also used to shade in areas of urban development.



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-2-3 Red Conventional Signs

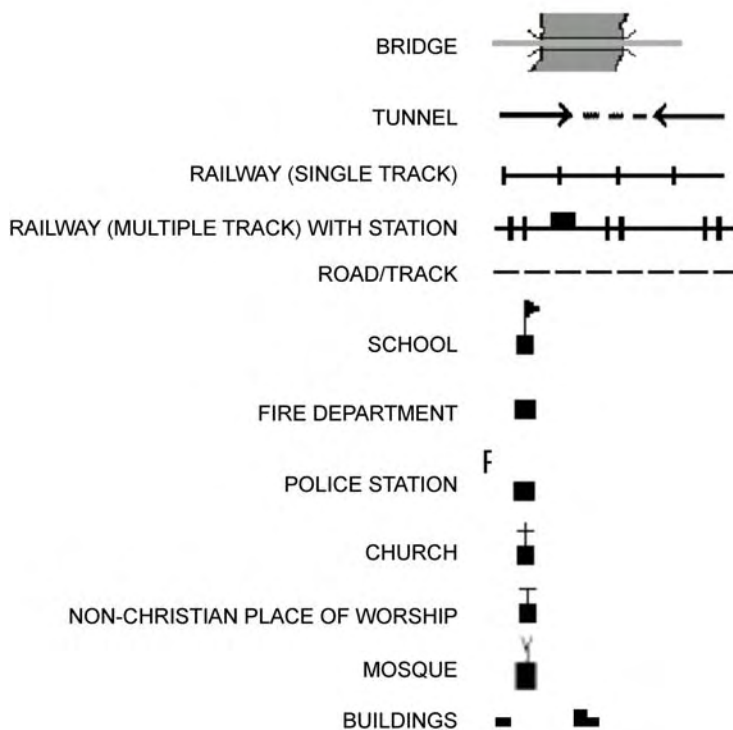
**Orange.** Used to represent unpaved roads.



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-2-4 Orange Conventional Signs

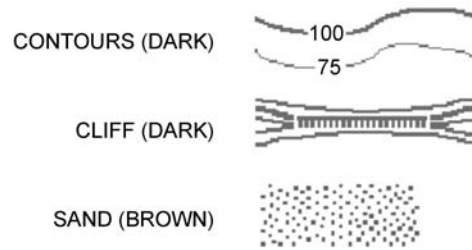
**Black.** Used for cultural features, toponyms (place names), some symbols and precise elevations.



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-2-5 Black Conventional Signs

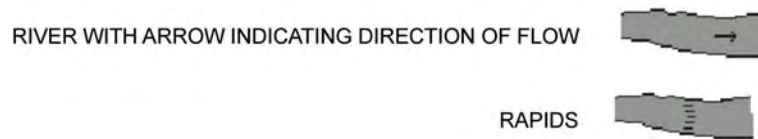
**Brown.** Used for contour lines, contour elevations, spot elevations, sand, cliffs, and other geographical features.



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-2-6 Brown Conventional Signs

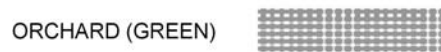
**Blue.** Used for water or permanent ice features (eg, rivers, lakes, swamps and ice fields), names of water features and the grid lines.



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-2-7 Blue Conventional Signs

**Green.** Used for vegetation features such as woods, orchards and vineyards.



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-2-8 Green Conventional Signs

**White.** Used to represent open fields.

**Grey.** Used for the legend of conventional signs on the back of the map.

**Purple.** Used for updates that are made over top of the original map information.

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## ACTIVITY

Time: 20 min

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### OBJECTIVE

The objective of this activity is to have the cadet identify conventional signs through the creation of a topographical map of Mapville.

### RESOURCES

- Flip chart/whiteboard,
- Markers/dry erase markers, and
- Topographical maps.

**ACTIVITY LAYOUT**

The cadets should be seated in front of a flip chart/whiteboard with topographical maps available.

**ACTIVITY INSTRUCTIONS**

1. Draw a large outline of a topographical map on the flip chart/whiteboard at the front of the room.
2. Have the cadets approach the front, one at a time, and draw a conventional sign on the developing map of Mapville.
3. Have the cadets explain what the sign is for and why they chose to put it where they did. No sign may be used more than once.
4. Have cadets continue to add conventional signs until the time is used up.



Based upon the number of cadets in the class, each cadet may have to add several different conventional signs to the map.

**SAFETY**

N/A.

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**CONFIRMATION OF TEACHING POINT 2**


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

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**END OF LESSON CONFIRMATION**


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The cadets' participation in the creation of the topographical map of Mapville will serve as confirmation of this lesson.

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**CONCLUSION**


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**HOMEWORK/READING/PRACTICE**

N/A.

**METHOD OF EVALUATION**

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

**CLOSING STATEMENT**

Map-reading not only involves the ability to interpret the symbols shown on the map and to understand the information given in pictorial or written form, but it also involves a true understanding of the ground portrayed and an appreciation of the reliability and value of the particular map being used. This information will aid the cadet during their map and compass practical assessment.

**INSTRUCTOR NOTES/REMARKS**

N/A.

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**REFERENCES**

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- A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.



**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 3**

**EO M390.03 – DETERMINE GRID REFERENCES (GRs)**

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Total Time: 60 min

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**PREPARATION**

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**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.

Topographical maps are the preferred training aid for TP 2, however, the worksheet located at Annex A may be used. If required, photocopy Annex A for each cadet.

Create a slide or photocopy the training aid located at Annex B for each cadet.

Photocopy the worksheet located at Annex C for each cadet.

Based on the topographical map being used, create a list of objects for the cadets to determine six-figure GRs for, and a list of six-figure GRs for the cadets to determine what objects they represent.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TPs 1 and 4 to introduce the grid system used to identify locations on a map.

Demonstration and performance was chosen for TPs 2, 3, 5 and 6 as it allows the instructor to explain and demonstrate determining four- and six-figure GRs and the construction and use of romers while providing an opportunity for the cadet to practice these skills under supervision.

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**INTRODUCTION**

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**REVIEW**

The following questions are a review of EO M390.02 (Identify Marginal Information and Conventional Signs, Section 2).

**QUESTIONS**

Q1. What does the contour interval on a topographical map represent?

- Q2. What are conventional signs?  
Q3. What is the colour green used for on topographical maps?

### ANTICIPATED ANSWERS

- A1. Indicates the vertical (height) interval between contour lines and is given in metres or feet.  
A2. These are symbols used to indicate an object or item of detail that cannot be shown either by an outline or by a line symbol.  
A3. It is used for vegetation features such as woods, orchards and vineyards.

### OBJECTIVES

By the end of this lesson the cadet shall have determined four- and six-figure GRs.

### IMPORTANCE

It is important for cadets to accurately determine four- and six-figure GRs in order to convey their location to others, for others to convey their location, and to plot a route on a topographical map.

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### Teaching Point 1

### Explain the Use of Grid Lines and GR Accuracy

Time: 5 min

Method: Interactive Lecture

---

### USE OF GRID LINES

Grid lines are used to convey a person's location to others and to plot a route on a topographical map using GRs.

The grid system is a network of intersecting vertical and horizontal blue lines superimposed on a topographical map. Maps are normally printed so that north is at the top of the sheet. The lines of the grid system are drawn evenly spaced, one scale kilometre apart, so that one set of lines run north-south (vertically) and the second set of lines run east-west (horizontally). The lines are assigned a sequential number and count up from the bottom left corner. The numbers are written along the edges of the map and occasionally within it. The intersecting grid lines at the lower left corner designate a grid square.

**Eastings.** Similar to the X-axis in mathematical graphing, eastings are a series of vertical parallel lines plotted as an overlay to the map sheet, which are drawn from top to bottom and numbered, with two digits, sequentially from west to east. They run north-south, similar to lines of longitude.



It is important to note that while eastings run parallel to each other, lines of longitude do not. The spacing between lines of longitude is widest at the equator and come together at the north and south poles. It is because of this difference that a bearing taken from a topographical map is a grid bearing, not a true bearing.

**Northings.** Similar to the Y-axis in mathematical graphing, northings are a series of horizontal parallel lines plotted as an overlay to the map sheet, which are drawn from left to right and numbered, with two digits, sequentially from south to north. They run east-west, the same as lines of latitude.

### GR ACCURACY

A four-figure GR represents one grid square and is accurate within a 1 000 m square (1 km<sup>2</sup> or 1 000 000 m<sup>2</sup>).

A six-figure GR represents one one-hundredth of a grid square and is accurate within a 100 m square (0.01 km<sup>2</sup> or 10 000 m<sup>2</sup>).

---

## CONFIRMATION OF TEACHING POINT 1

---

### QUESTIONS

- Q1. What is the grid system of a topographical map?
- Q2. What is the spacing between lines of the grid system of a topographical map?
- Q3. What is a northing?

### ANTICIPATED ANSWERS

- A1. The grid system is a network of intersecting vertical and horizontal blue lines superimposed on a topographical map.
- A2. The lines of the grid system are drawn evenly spaced, 1 km apart.
- A3. Similar to the Y-axis in mathematical graphing, northings are a series of horizontal parallel lines plotted as an overlay to the map sheet, which are drawn from left to right and numbered, with two digits, sequentially from south to north. They run east-west, the same as lines of latitude.

---

### Teaching Point 2

### Explain, Demonstrate, and Have the Cadet Practice Determining a Four-Figure GR

Time: 10 min

Method: Demonstration and Performance

---



For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be used to monitor cadet performance.

Characteristics of a four-figure GR:

- Four-figure GRs will have four numerical digits derived from the numbers assigned to the eastings and northings on the map sheet.
- The numbers are listed by recording the two-digit easting followed by the two-digit northing.



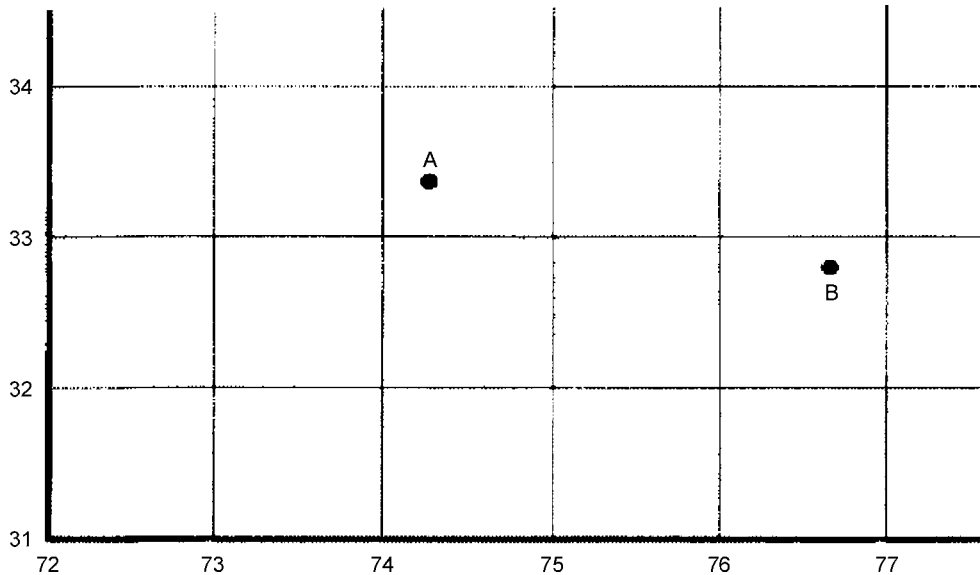
The grid lines that intersect in the bottom left corner of the grid square are used to identify that grid square.

Steps to determine a four-figure GR:

1. Confirm the correct grid square.
2. Place a finger at the bottom left corner of the map.
3. Move that finger along the bottom of the map (left to right) up to the grid line (easting) before the grid square.

4. Record the two-digit easting.
5. Place a finger at the bottom left corner of the map.
6. Move that finger along the left side of the map (bottom to top) up to the grid line (northing) before the grid square.
7. Record the two-digit northing after the two-digit easting to create the four-figure GR.
8. Confirm the four-figure GR.

In Figure 18-3-1 Building A is located at GR 7433 and Building B at GR 7632.



*Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 37)*

Figure 18-3-1 Four-Figure Grid References

Steps to determine a grid square using a four-figure GR:

1. Confirm the four-figure GR.
2. Place a right-hand finger at the bottom left corner of the map.
3. Move that finger along the bottom of the map (left to right) up to the grid line (easting) numbered the same as the first two digits of the four-figure GR.
4. Place a left-hand finger at the bottom left corner of the map.
5. Move that finger along the left side of the map (bottom to top) up to the grid line (northing) numbered the same as the last two digits of the four-figure GR.
6. Move the right-hand finger up the grid line and the left-hand finger right along the grid line.
7. Where the two grid lines intersect is the bottom left corner of the grid square.
8. Confirm the correct grid square.

In Figure 18-3-1, GR 7532 represents the grid square southeast of Building A and west of Building B.





Have the cadets practice the skill either on a topographical map or the worksheet located at Annex A.

If using Annex A, check the cadets' answers using the answer key located at Annex D.

---

## CONFIRMATION OF TEACHING POINT 2

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

---

### Teaching Point 3

### Explain, Demonstrate, and Have the Cadet Practice Estimating a Six-Figure GR

Time: 10 min

Method: Demonstration and Performance

---



Using either the overhead or the handout created from Annex B, explain and demonstrate how to determine a six-figure GR. Care must be taken to ensure that all cadets understand each step before proceeding to the next step.

For this skill lesson, it is recommended that instruction takes the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be used to monitor cadet performance.

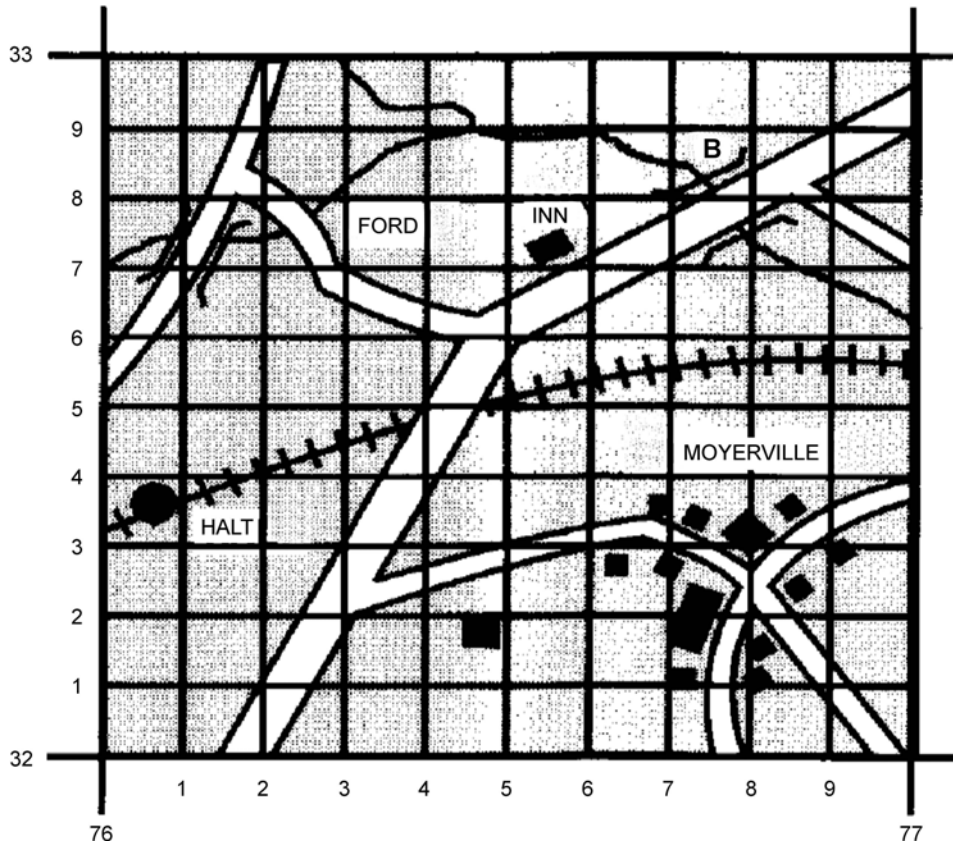
Estimate a six-figure GR by:

1. creating an imaginary grid system to divide a grid square into 100 equally sized smaller grid squares with 10 along the bottom edge and 10 along the left-side edge (as illustrated at Figure 18-3-2);
2. noting that six-figure GRs will have six numerical digits derived from the numbers assigned to the eastings and northings on the map sheet and their estimated tenths;
3. recognizing that the numbers are listed by recording the three-digit easting followed by the three-digit northing; and
4. remembering that the grid lines that intersect in the bottom left corner of the grid square are used to identify that imaginary grid square.

Steps to determine a six-figure GR:

1. Identify the object within the grid square. Note the four-figure GR.
2. Using the imaginary grid within the square, determine the three-digit easting by using the two digits of the easting combined with the number of tenths, measured from the left, to the line before the object.
3. Using the imaginary grid within the square, determine the three-digit northing by using the two digits of the northing combined with the number of tenths, measured from the bottom, to the line before the object.

- Combine the two sets of numbers to create the six-figure GR.



*Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 38)*

Figure 18-3-2 Six-Figure Grid References

**Example 1:** Determine the six-figure GR for the building west of the town of Moyerville.

- Building west of the town of Moyerville is within GR 7632.
- 76 combined with 4 tenths creates '764'.
- 32 combined with 1 tenth creates '321'.
- Building west of the town of Moyerville is located at GR 764321.

**Example 2:** Determine the six-figure GR for the Inn north-north-west of the town of Moyerville.

- The Inn at the north part of the grid square at GR 7632.
- 76 combined with 5 tenths creates '765'.
- 32 combined with 7 tenths creates '327'.
- The Inn at the north part of the grid square is located at GR 765327.



Have the cadets complete the worksheet located at Annex C.

### CONFIRMATION OF TEACHING POINT 3

The cadets' completion of the worksheet will serve as the confirmation of this TP.

#### Teaching Point 4

**Define a Romer as a Device Used for Measuring a Point Within a Grid Square and Identify the Types of Romers Available for Use and Where to Find Them**

Time: 5 min

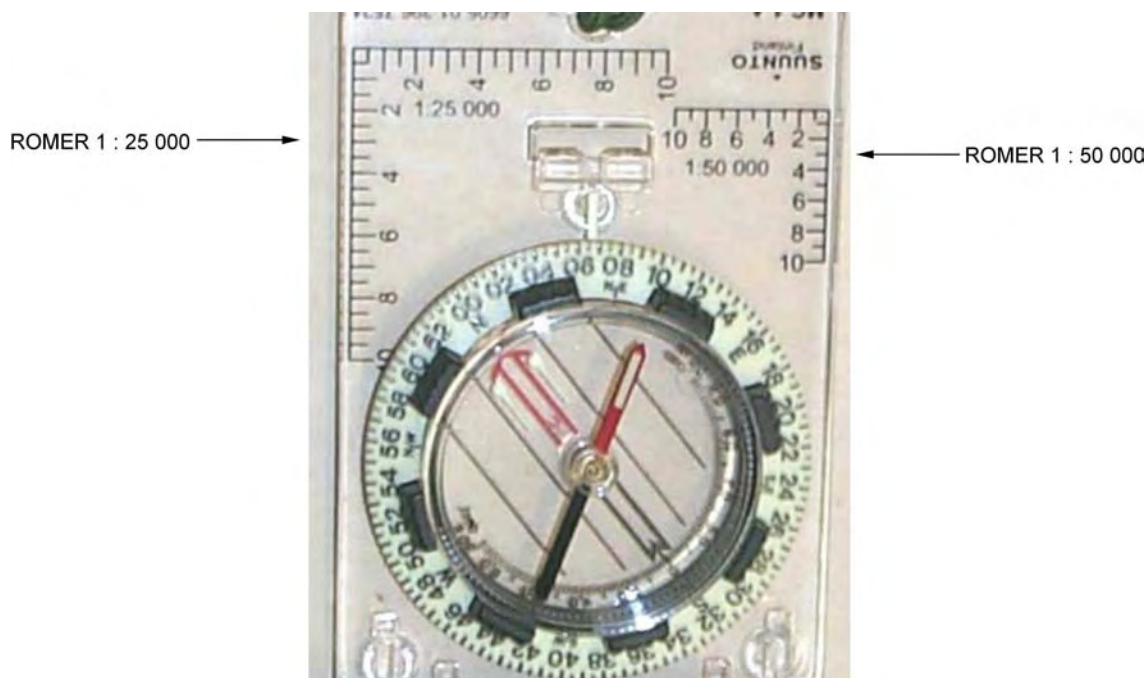
Method: Interactive Lecture

**Romer.** A device used for measuring a point within a grid square to determine its six-figure GR.

Romers may be purchased or created. Purchased romers include compasses and protractors. Constructed romers use a small piece of paper and the scale bars of a topographical map.

#### COMPASS

Many compasses include romers already printed on the compass base plate. There are commonly two romers, for use with 1 : 25 000 and 1 : 50 000 scale topographical maps.

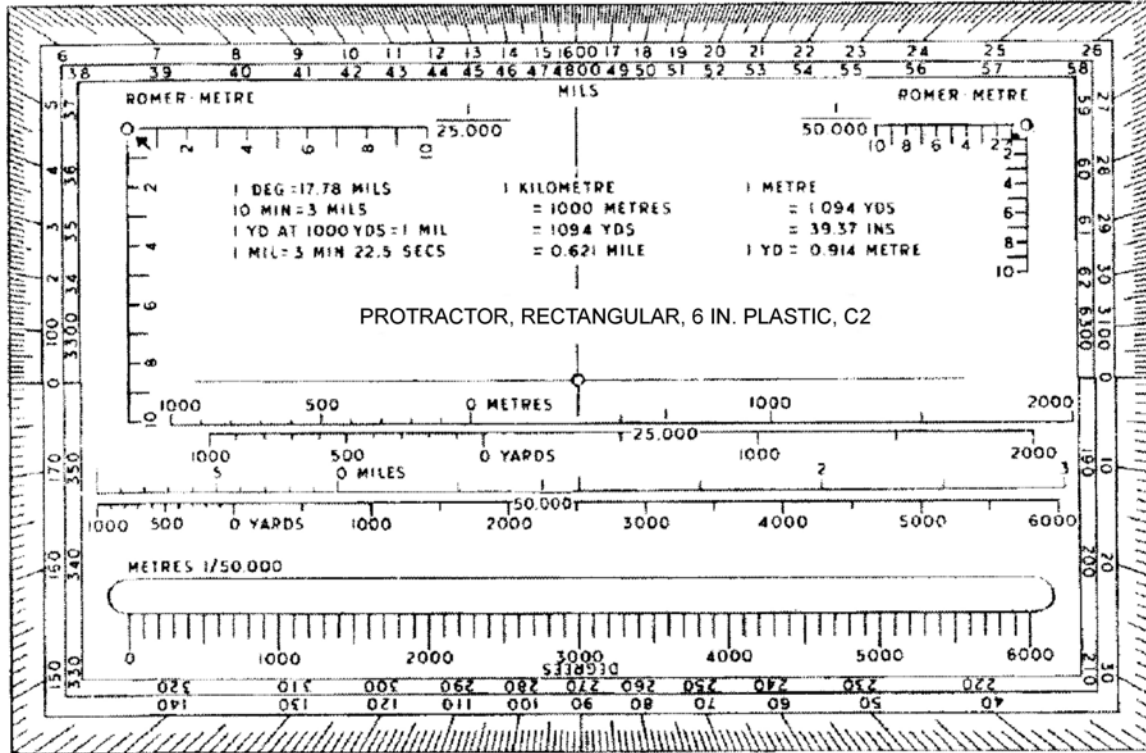


*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-3-3 Compass

**PROTRACTOR**

All protractors may be used to determine a bearing on a map, however, few have romers already printed on them. The Canadian Forces has created the C2 protractor (as illustrated in Figure 18-3-4) specifically designed for use on topographical maps.

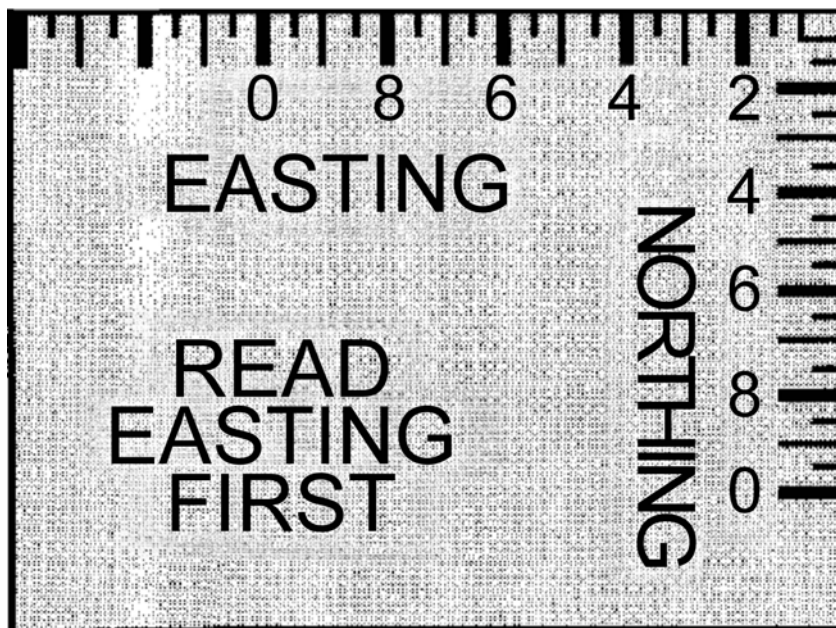


*Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 41)*

Figure 18-3-4 C2 Protractor

**CONSTRUCTED**

A constructed romer requires a piece of paper with at least one square corner and the scale bars of the topographical map. Using the scale bars of the topographical map, a romer can be constructed as illustrated in Figure 18-3-5.



*Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 41)*

Figure 18-3-5 Constructed Romer

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#### CONFIRMATION OF TEACHING POINT 4

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#### QUESTIONS

- Q1. What is a romer?
- Q2. Where are the romers on a compass found?
- Q3. What two things are required to construct a romer?

#### ANTICIPATED ANSWERS

- A1. A device used for measuring a point within a grid square to determine its six-figure GR.
- A2. The romers are printed on the compass base plate.
- A3. A constructed romer requires a piece of paper with at least one square corner and the scale bars of the topographical map.

**Teaching Point 5****Explain, Demonstrate, and Have the Cadet Construct a Romer for Use in Determining Six-Figure GRs**

Time: 10 min

Method: Demonstration and Performance



Accuracy must be stressed to the cadets when constructing a romer. Have the cadets ensure that their pencils are sharp or their pens are fine tipped.

For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be used to monitor cadet performance.

Construct a romer for determining six-figure GRs by:

1. obtaining a blank piece of paper with a square edge;
2. placing one side of the square edge along the 100-m scale bars;
3. marking off 100-m segments beginning at the corner of the paper and working outward;
4. numbering these markings from zero (at the corner of the paper) to ten; and
5. repeating Steps 2. to 4. on the adjacent edge (eg, completed romer as illustrated in Figure 18-3-5).



It is important to use the correct scale bar. The constructed romer's markings should match the grid lines of the topographical map; the side of a grid square must be equal to ten 100-m marks on each of the romer's two edges.

**CONFIRMATION OF TEACHING POINT 5**

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

**Teaching Point 6****Explain, Demonstrate, and Have Cadet Practice Determining a Six-Figure GR Using a Constructed Romer**

Time: 10 min

Method: Demonstration and Performance



This TP uses all the skills from the previous TPs and it is essential that this TP not be covered until problems from the previous TPs have been corrected.

Unlike TP 3, where the cadets used the very visible 'imaginary' grid (eg, Figure 18-3-2) to determine a six-figure GR, the cadets will now be using their constructed romer from TP 5 to determine a six-figure GR and to locate objects with a six-figure GR. Much greater care and attention to detail must be used by the cadets in order to ensure accuracy.

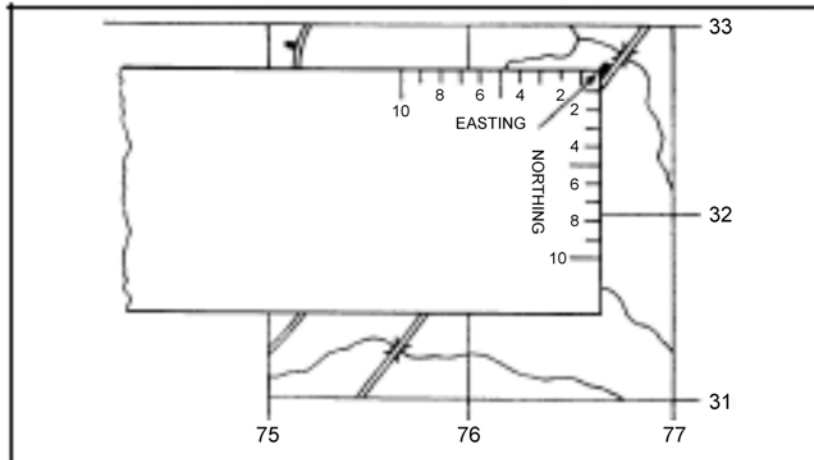
For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be used to monitor cadet performance.

Determine a six-figure GR using a constructed romer, by:

1. placing the corner of the constructed romer on the bottom left corner of the grid square, noting the four-figure GR;
2. moving the constructed romer to the right the number of tenths required to align the romer directly to or before (never past) the conventional sign or location for which the GR is being determined;
3. reading the value along the X-axis of the romer where it crosses the easting on the map sheet (the value at this intersection becomes the value for the third digit of the six-figure GR);
4. moving the constructed romer up the number of tenths required for the corner of the romer to be positioned on or before (never past) the conventional sign or location for which the GR is being determined;
5. reading the value along the Y-axis of the romer where it crosses the northing on the map sheet (the value at this intersection becomes the value for the sixth digit of the six-figure GR); and
6. combining the two sets of digits to create the six-figure GR.




*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-20)*

Figure 18-3-6 Using a Constructed Romer

Determine what a six-figure GR represents using a constructed romer, by:

1. determining the four-figure GR, by removing the third and sixth digits from the six-figure GR, to identify and locate the correct grid square;
2. placing the corner of the constructed romer on the bottom left corner of the grid square;
3. moving the constructed romer to the right the number of tenths, as identified by the third digit;
4. moving the constructed romer up the number of tenths, as identified by the sixth digit; and
5. determining the object (that is up and to the right from the tip of the romer).



Examples used will be from Annex C.

**Example 1:**

From Figure 18C-1, determine the six-figure GR for the Post Office.

1. Grid square GR 7632.
2. Four tenths to the right.
3. 76 combined with 4 tenths creates '764'.
4. Four tenths up.
5. 32 combined with 4 tenths creates '324'.
6. The Post Office is located at GR 764324.



**Example 2:**

From Figure 18C-1, determine the object located at GR 766323.

1. Four-figure GR is 7632.
2. Place romer at the bottom left corner of grid square 7632.
3. Move the romer to the right six tenths.
4. Move the romer up three tenths.
5. GR 766323 identifies the Train Station.



Have the cadets practice using the lists created before the lesson, of objects for the cadets to determine six-figure GRs for, and of six-figure GRs for the cadets to determine what objects they represent, on the appropriate topographical map.

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### CONFIRMATION OF TEACHING POINT 6

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

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### END OF LESSON CONFIRMATION

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The cadets' participation in determining six-figure GRs will serve as the confirmation of this lesson.

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### CONCLUSION

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### HOMework/READING/PRACTICE

N/A.

### METHOD OF EVALUATION

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

### CLOSING STATEMENT

It is important for cadets to accurately determine four- and six-figure GRs in order to convey their location to others, determine where others are, and to plot a route on a topographical map. This skill will be of great benefit whenever the cadets are using topographical maps.

### INSTRUCTOR NOTES/REMARKS

N/A.

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### REFERENCES

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- A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.

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**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 4**

**EO M390.04 – DETERMINE DISTANCE ON A MAP AND ON THE GROUND**

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Total Time: 90 min

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**PREPARATION**

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**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 five 'point-to-point' and five 'along a route between two points' distances for the topographical map being used. Four- and six-figure grid references (GRs) should be used to designate the start and end points.

Measure and mark three 100-m pace courses. One should be on a flat trail/road, another through light bush, and the last through heavier bush, with slopes if possible. Pace courses should be wide enough to allow several cadets to use them at the same time.

Calculate personal pace for 100 m.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

Demonstration and performance was chosen for TPs 1 and 2 as it allows the instructor to explain and demonstrate measuring distances on a map and determining personal pace, while providing an opportunity for the cadet to practice these skills under supervision.

An interactive lecture was chosen for TP 3 to introduce the factors that can affect the cadets' personal pace.

A practical activity was chosen for TP 4 as it is an interactive way for the cadet to experience pacing and the factors that affect it in a safe, controlled environment. This activity contributes to the development of pacing skills and knowledge in a fun and challenging setting.

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**INTRODUCTION**

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**REVIEW**

The following questions are a review of EO M390.03 (Determine Grid References [GRs], Section 3).

## QUESTIONS

- Q1. What are eastings?
- Q2. Which grid line intersection is used to represent a grid square?
- Q3. What is a romer?

## ANTICIPATED ANSWERS

- A1. Similar to the X-axis in mathematical graphing, eastings are a series of vertical parallel lines plotted as an overlay to the map sheet, which are drawn from top to bottom and numbered, with two digits, sequentially from west to east. They run north-south, similar to lines of longitude.
- A2. The grid lines that intersect in the bottom left corner of the grid square are used to identify that grid square.
- A3. A device used for measuring a point within a grid square to determine its six-figure GR.

## OBJECTIVES

By the end of this lesson the cadet shall have determined distance on the map and on the ground.

## IMPORTANCE

It is important for cadets to be able to accurately determine distance on the map and on the ground in order to effectively use a topographical map to plot a route that will be followed on the ground.

---

### Teaching Point 1

### Explain, Demonstrate and Have the Cadet Determine Distance on a Map

Time: 30 min

Method: Demonstration and Performance

---



For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

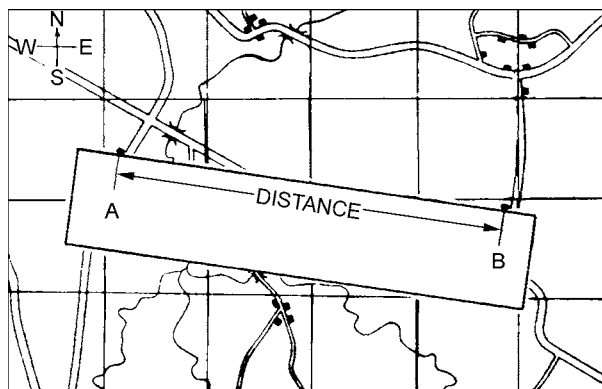
**Note:** Assistant instructors may be used to monitor cadet performance.

## DETERMINING DISTANCE ON A MAP

Cadets can use a map to measure the distance between two points (eg, points A and B as illustrated at Figure 18-4-1) on the ground. All maps are drawn to scale; therefore, a specified distance on a map equals a specified distance on the ground. The scale of a map is printed at the top and bottom of each map (eg, scale 1 : 50 000). This means that 1 cm on the map equals 50 000 cm (500 m) on the ground.

There are two ways to determine distance on a topographical map – point-to-point and along a route.

## Measuring Point-to-Point

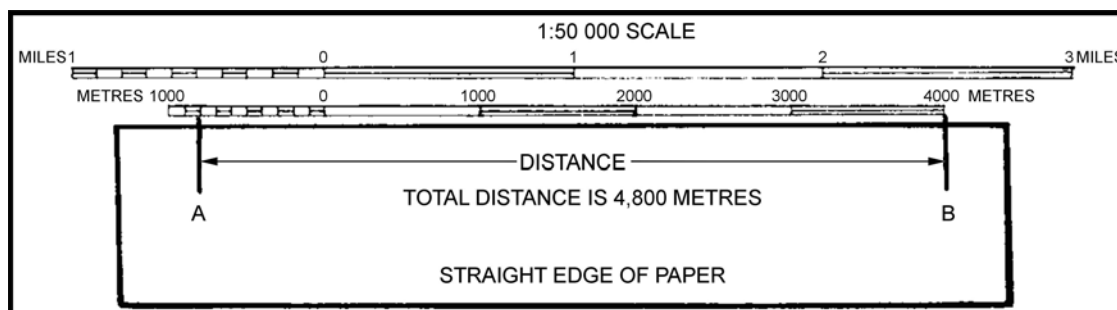


*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-24)*

Figure 18-4-1 Measure Distance Point-to-Point

To measure a distance point-to-point:

1. Lay the straight edge of a piece of paper against the two points.
2. With a sharp pencil, mark the paper at the A (start) and B (end) points.
3. Lay the paper just under the metres scale bar with the B mark at the right end of the scale. Move the paper to the left aligning the B mark with each thousand metre mark until the A mark falls within the subdivided thousands (hundreds) to the left of the zero.
4. To calculate the total distance, add the number of thousands where the B mark is, plus the number of subdivided thousands where the A mark is to the left of the zero.



*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-25)*

Figure 18-4-2 Calculate Distance



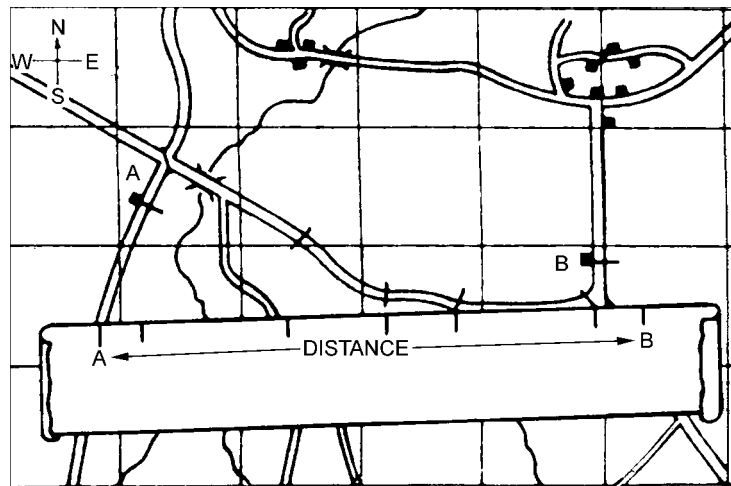
For a distance that is longer than 5 000 m, measure the first 5 000 m and mark the paper with a new line and label it '5 000 m'. Place the new mark at the zero or thousands mark until the A mark fits within the subdivided thousands (hundreds) bar. Add the total of that distance to the 5 000 m to create the total distance.

### Measuring Along a Route Between Two Points

Sometimes cadets need to find the distance between A and B around the curves in a road along a planned route.

To measure a distance along a route between two points:

1. Lay the straight edge of a piece of paper against point A.
2. With a sharp pencil, mark point A on the paper and the map.
3. Line up the paper with the edge of the road until a curve is reached and make another mark on the paper and on the map.
4. Pivot the paper so that it continues to follow the road edge. Repeat until you reach point B.
5. Mark the paper and the map at point B.
6. Lay the paper just under the metres scale bar with the B mark at the right end of the scale. Move the paper to the left aligning the B mark with each thousand metre mark until the A mark falls within the subdivided thousands (hundreds) to the left of the zero.
7. Add the number of thousands where the B mark is, plus the number of subdivided thousands (hundreds) where the A mark is to the left of the zero, to determine the total distance.



*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-25)*

Figure 18-4-3 Measure Distance Along a Route

---

### ACTIVITY

Time: 15 min

---

#### OBJECTIVE

The objective of this activity is to have the cadets measure distance on a map.

#### RESOURCES

- Topographical map,
- Paper, and

- Pencil.

### ACTIVITY LAYOUT

N/A.

### ACTIVITY INSTRUCTIONS

1. Divide the cadets into pairs.
2. Distribute a map to each pair.
3. Have the cadets determine the distance:
  - a. point-to-point, and
  - b. along a route.
4. Check answers.
5. Repeat Steps 3. to 4. until complete or the time is up.



All marks should be carefully erased from the map after each distance is determined.

### SAFETY

N/A.

---

### CONFIRMATION OF TEACHING POINT 1

---

The cadets' participation in determining distance on a map will serve as the confirmation of this TP.

---

### Teaching Point 2

### Explain, Demonstrate and Have the Cadet Pace

Time: 15 min

Method: Demonstration and Performance

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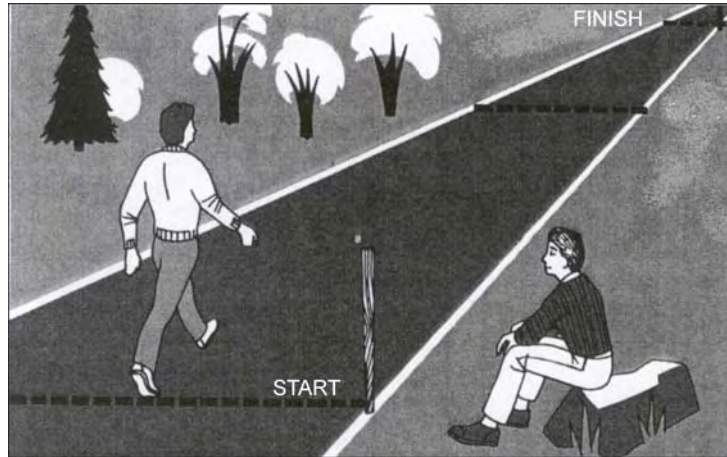
For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be used to monitor cadet performance.

### DETERMINING A PERSONAL PACE FOR 100 M

Being able to determine distance is a key skill for ground navigation. By learning how to determine distance using a personal pace, a cadet will have the skill to determine how far they have travelled, and how far they have to travel to reach their destination.



B. Kjellstrom, *Be Expert With Map & Compass*, Hungry Minds, Inc. (p. 53)

Figure 18-4-4 Determining Distance Using Pacing

**Personal Pace.** The number of paces a person walks over a distance of 100 m.

**COUNTING PACES**

There are two basic methods to count pace:

- count every pace (count every step); or
- count every other pace (count every left or every right step).

For example:

- count every pace: 140 paces = 100 m; or
- count every other pace: 70 paces = 100 m.

**CALCULATING DISTANCE**

In order to determine distance travelled, the total number of paces travelled is divided by the personal pace and multiplied by 100 m to calculate the number of metres travelled.

Formula:

$$\frac{\text{total number of paces}}{\text{personal pace}} \times 100 \text{ m} = \text{total distance travelled (m)}$$

Example:

$$\frac{140 \text{ paces}}{70} \times 100 \text{ m} = 200 \text{ m}$$

Common methods of keeping track of the number of paces travelled include:

- transferring pebbles from one pocket to another: one pebble for each 100 paces;
- using a length of cord with knots – the knotted cord is held with the hand gripping a knot and the hand is advanced one knot down the cord for every 100 paces; and



- combining the knotted cord and pebbles (eg, cord with 10 knots, pebbles transferred for each completed cord [10 knots x 100 paces each = 1000 paces/pebble]).

---

## ACTIVITY

Time: 10 min

---

### OBJECTIVE

The objective of this activity is to have the cadets determine their personal pace.

### RESOURCES

- Calculator (one per pair of cadets),
- Paper, and
- Pen/pencil.

### ACTIVITY LAYOUT

Measure a 100-m course and mark it with a clearly defined start and end point on a flat trail/road.

### ACTIVITY INSTRUCTIONS

1. Have the cadets walk the pace course, counting out loud, being careful to keep an accurate count.
2. Have the cadets walk the pace course three times, noting their pace count each time.
3. Have the cadets calculate their personal pace by averaging their three pace counts.
4. Have the cadets record their personal pace.



Do not walk with someone when determining a personal pace. When people walk together, they automatically adjust their pace length to match the other person's in order to stay together.

### SAFETY

Boundaries must be marked and supervised.

---

## CONFIRMATION OF TEACHING POINT 2

---

The cadets' participation in determining personal pace will serve as the confirmation of this TP.

**Teaching Point 3****Describe Factors That Affect Pacing**

Time: 5 min

Method: Interactive Lecture

**FACTORS THAT AFFECT PACING**

This teaching point should be presented by asking the cadets what they think could affect their personal pace. Ensure to cover any points that are not suggested by the cadets.

Factors that will affect personal pace include:

**Terrain.** The rougher the ground, the shorter the pace.

**Slopes.** Pace is shorter going uphill and longer going downhill.

**Fatigue.** Will shorten a person's pace.

**Equipment.** Footwear with poor traction will shorten a person's pace. Carrying a heavy load will also shorten a person's pace.

**Weather.** Snow and rain will shorten a person's pace. The wind will increase/decrease pace length if a person is travelling with/against the wind.

**Obstacles.** Going around small features (eg, trees, bushes) will affect pace count unless compensated for. Compensation methods include:

- **Sidestepping.** Stepping to the side (left/right) enough paces to bypass the obstacle, pacing forward past the obstacle and sidestepping back (right/left) to return to the original line of travel. This method maintains pace accuracy, but takes time.



The paces that the cadets sidestep are not added to their total pace count.

- **Alternating sides.** In this method, the cadet alternates which side (left/right) of the obstacle they pass (eg, last obstacle was passed on the left, next will be on the right). This method is less accurate, but faster.



If obstacles are always bypassed on the same side, the line of travel will veer off in that direction unless a distant steering point (eg, tall tree, hill top, building) is used as a guide.

**CONFIRMATION OF TEACHING POINT 3****QUESTIONS**

- Q1. How does slope affect pace?
- Q2. How will weather affect pace?
- Q3. What can happen if you always bypass obstacles on the same side?

## ANTICIPATED ANSWERS

- A1. Pace is shorter going uphill, and longer going downhill.
- A2. Snow and rain will shorten a person's pace, the wind will increase/decrease pace length if a person is travelling with/against the wind.
- A3. The line of travel will veer off in that direction unless a distant steering point (eg, tall tree, hill top, building) is used as a guide.

### Teaching Point 4

### Demonstrate and Have the Cadet Practice Determining Distance Using the Pace-Counting Method Over Varied Terrain

Time: 30 min

Method: Practical Activity



This activity combines the cadets' personal pace determined in TP 2 with the knowledge taught in TP 3. This allows the cadets to gain experience pacing and the effect varied terrain will have on their pace.

## ACTIVITY

### OBJECTIVE

The objective of this activity is to have the cadets determine their personal pace over varied terrain.

### RESOURCES

- Calculator (one per pair of cadets),
- Paper, and
- Pen/pencil.

### ACTIVITY LAYOUT

Measure two 100-m pace courses and mark each of them with clearly defined start and end points. One should be through light bush and the second through heavier bush, with slopes if possible.

### ACTIVITY INSTRUCTIONS

1. Inform the cadets that they will be using their personal pace on two courses to determine the effect of terrain on pace.
2. Divide the cadets into two groups. Assign one group to each course.
3. Have the cadets, individually, pace the course five times, and then determine the difference between this count and their personal pace.
4. After 15 minutes, have the cadets switch courses.
5. Have the cadets, individually, pace the course five times, and then determine the difference between this count and their personal pace.

6. Have the cadets record their findings.

### **SAFETY**

Boundaries must be marked and supervised.

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### **CONFIRMATION OF TEACHING POINT 4**

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

---

### **END OF LESSON CONFIRMATION**

---

The cadets' participation in determining distance on a map and determining their personal pace will serve as the confirmation of this lesson.

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### **CONCLUSION**

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### **HOMEWORK/READING/PRACTICE**

N/A.

### **METHOD OF EVALUATION**

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

### **CLOSING STATEMENT**

It is important for cadets to be able to accurately determine distance on the map and on the ground in order to effectively use a topographical map to plot a route that will be followed on the ground. The skill gives the map reader confidence in their ability to know where they are at all times.

### **INSTRUCTOR NOTES/REMARKS**

N/A.

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### **REFERENCES**

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- A2-041 (B-GL-382-005/PT-001) Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.
- C0-111 (ISBN 978-0-9740820-2-8) Tawrell, P. (2006). *Camping and Wilderness Survival: The Ultimate Outdoors Book* (2<sup>nd</sup> ed.). Lebanon, NH: Leonard Paul Tawrell.
- C2-041 (ISBN 0-07-136110-3) Seidman, D., & Cleveland, P. (1995). *The Essential Wilderness Navigator*. Camden, ME: Ragged Mountain Press.



**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 5**

**EO M390.05 – DETERMINE BEARINGS ON A MAP AND ON THE GROUND**

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Total Time: 60 min

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**PREPARATION**

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**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.

Ensure sufficient topographical maps of the exercise area are available.

Create a list of points (designated by description and by grid reference [GR]) from the topographical map of the exercise area for the cadets to determine in TP 5.

A reconnaissance (recce) of the exercise area should be made to determine a site with several distinctive features to be used as prominent objects for the cadets to take bearings.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TPs 1–4 to introduce the cadets to the compass, the degree system, the three norths, and bearings.

Demonstration and performance was chosen for TPs 5 and 6 as it allows the instructor to explain and demonstrate determining bearings on a map and on the ground while providing an opportunity for the cadets to practice these skills under supervision.

---

**INTRODUCTION**

---

**REVIEW**

The following questions are a review of EO M390.04 (Determine Distance on a Map and on the Ground, Section 4).

**QUESTIONS**

- Q1. After marking a map to assist in determining distance, what should be done with the marks?
- Q2. Define personal pace.

Q3. What effect does weather have on a person's pace?

**ANTICIPATED ANSWERS**

- A1. All marks should be carefully erased from the map after each distance is determined.
- A2. The number of paces a person walks over a distance of 100 m.
- A3. Snow and rain will shorten a person's pace while wind will increase/decrease the pace length if a person is travelling with/against the wind.

**OBJECTIVES**

By the end of this lesson the cadet shall have determined bearings on a map and on the ground.

**IMPORTANCE**

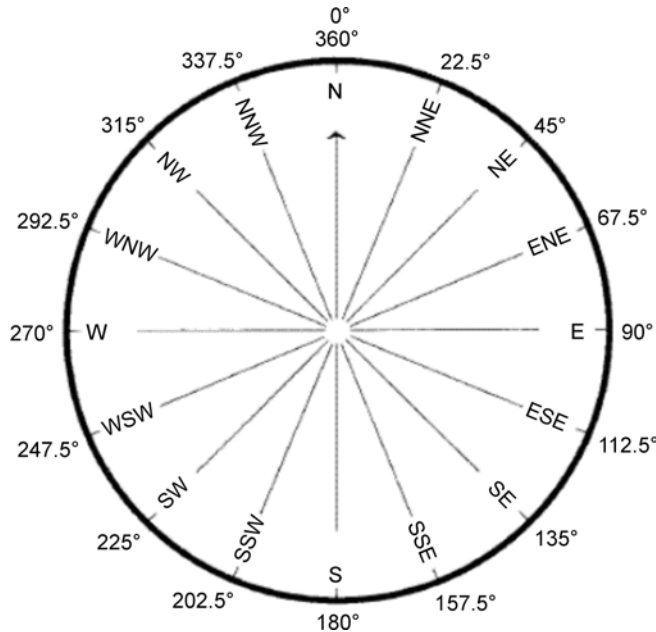
It is important for cadets to be able to determine bearings on a map and on the ground as this is one of the key skills required to navigate using a map and compass.

**Teaching Point 1**

**Identify and Explain the 16 Points of a Compass**

Time: 10 min

Method: Interactive Lecture



*Director Cadets 3, 2007, Ottawa, ON: Department of National Defence*

Figure 18-5-1 Compass Rose

**FOUR CARDINAL POINTS**

The four cardinal points of the compass, measured at right angles clockwise from north are:

- north (N) at 0 and 360 degrees,
- east (E) at 90 degrees,
- south (S) at 180 degrees, and

- west (W) at 270 degrees.

#### **FOUR INTER-CARDINAL POINTS**

The four inter-cardinal points are located halfway between each of the cardinal points. Measured clockwise from north, they are:

- northeast (NE) at 45 degrees,
- southeast (SE) at 135 degrees,
- southwest (SW) at 225 degrees, and
- northwest (NW) at 315 degrees.

#### **EIGHT INTERMEDIATE POINTS**

The eight intermediate points are located halfway between each cardinal point and inter-cardinal point. Measured clockwise from north, they are:

- north-northeast (NNE) at 22.5 degrees,
- east-northeast (ENE) at 67.5 degrees,
- east-southeast (ESE) at 112.5 degrees,
- south-southeast (SSE) at 157.5 degrees,
- south-southwest (SSW) at 202.5 degrees,
- west-southwest (WSW) at 247.5 degrees,
- west-northwest (WNW) at 292.5 degrees, and
- north-northwest (NNW) at 237.5 degrees.



As an aid to remember the different types of points:

- cardinal points are designated by one letter;
- inter-cardinal points are designated by two letters; and
- intermediate points are designated by three letters.

---

### **CONFIRMATION OF TEACHING POINT 1**

---

#### **QUESTIONS**

- Q1. Which two degree values may be used for north?
- Q2. How many inter-cardinal points are there?
- Q3. Name one of the intermediate points.

#### **ANTICIPATED ANSWERS**

- A1. 0 and 360 degrees.
- A2. Four.

A3. Either NNE, ENE, ESE, SSE, SSW, WSW, WNW, or NNW.

---

**Teaching Point 2****Explain the Degree System on a Compass**

Time: 5 min

Method: Interactive Lecture

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The cardinal, inter-cardinal, and intermediate points describe directions only to within one-sixteenth of a full circle. For a more precise indication of direction it is necessary to use the sub-divisions of the circle called degrees. This measurement starts and ends at north (top) and is measured in a clockwise rotation.

**Degrees.** The most common method of dividing a circle is by degrees. These degrees represent 360 equal angles in a complete circle and they are represented by the symbol “°” (eg, 222°).



It is important to emphasize that degrees should always be measured clockwise and always using north as the start point.

---

**CONFIRMATION OF TEACHING POINT 2**

---

**QUESTIONS**

- Q1. Degrees are measured in which direction?
- Q2. What is the most common method of dividing a circle?
- Q3. How many degrees are in a full circle?

**ANTICIPATED ANSWERS**

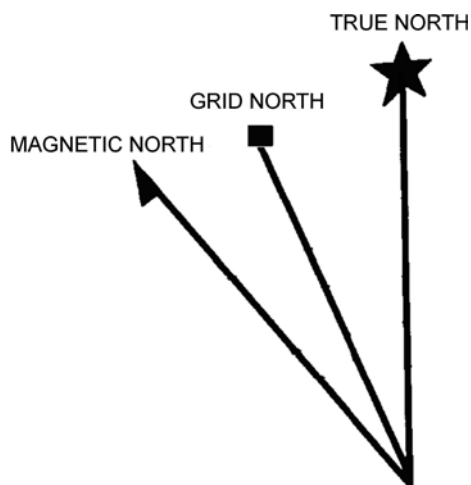
- A1. Degrees are measured clockwise from north.
- A2. Degrees.
- A3. 360 degrees.



**Teaching Point 3****Identify and Explain the Three Norths**

Time: 5 min

Method: Interactive Lecture



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-5-2 The Three Norths

**THE THREE NORTHS**

The relationship between the three norths, especially grid and magnetic, is key to using a compass on both a map and on the ground.

**True North.** True north is located at the top of the earth where the geographic North Pole is located, where all lines of longitude meet. In the declination diagram on the map, true north is represented by the symbol of a star, which represents the North Star, Polaris.

**Grid North.** Grid north is the north indicated by the grid lines (eastings) on a topographical map. The easting lines run parallel to each other and will never meet at the geographic North Pole; because of this, grid north points off slightly from true north. In the declination diagram on the map, grid north is represented by a square, which represents a map grid.

**Magnetic North.** Magnetic north is the location of the north magnetic pole, where the Earth's magnetic field bends back into the Earth toward the south magnetic pole. It is located in the Canadian arctic and is different from true north. It is the direction in which the compass needle points. In the declination diagram on the map, magnetic north is represented by a needle as on a compass.

The differences between the three norths affect navigation for the map and compass user, in the form of magnetic declination. Magnetic declination is the difference in bearing either between true north and magnetic north or between grid north and magnetic north.



Cadets will normally use the magnetic declination value between grid north and magnetic north when navigating using a map and compass. By setting the magnetic declination on the compass, magnetic bearings are converted to grid bearings which allow bearings taken from the map to be used on the ground and vice versa.

---

### CONFIRMATION OF TEACHING POINT 3

---

#### QUESTIONS

- Q1. Which north is represented by a star?
- Q2. Which north does a compass needle point towards?
- Q3. Which magnetic declination value is most important to topographical map users?

#### ANTICIPATED ANSWERS

- A1. True north.
- A2. Magnetic north.
- A3. The magnetic declination value between grid north and magnetic north.

---

#### Teaching Point 4

#### Explain Bearings

Time: 5 min

Method: Interactive Lecture

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#### DEFINITION OF A BEARING

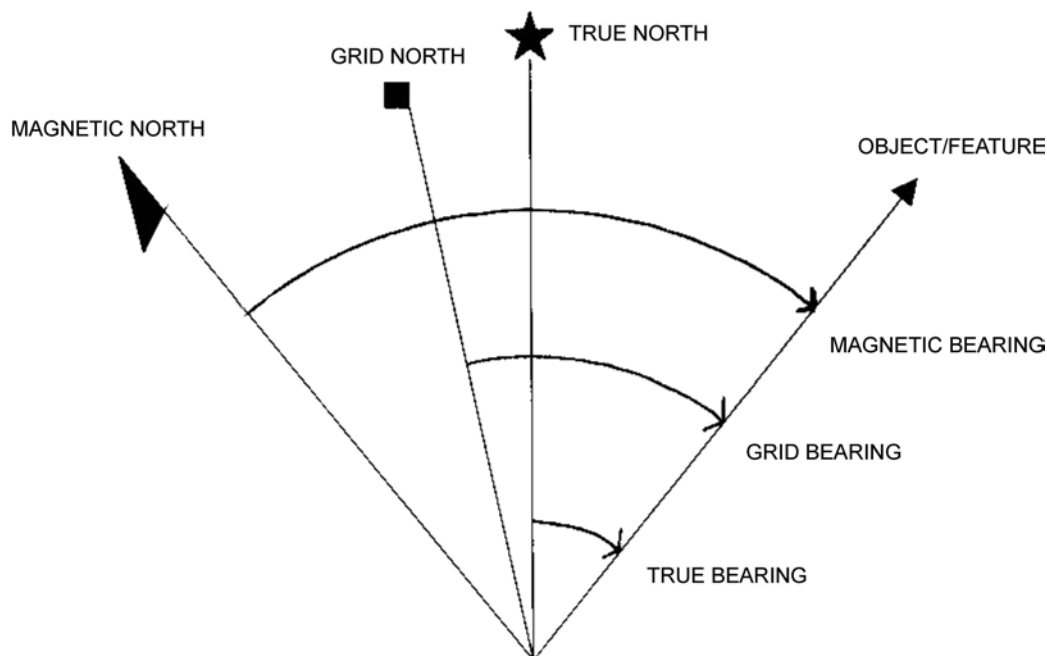
**Bearing.** A bearing is an angle that is measured clockwise, from north. It is measured in degrees and is relative to the observer.



In geometry, an angle is based on three points; a vertex, and two points, each of which designates a ray. For a bearing, the vertex is the point where the bearing is taken from, another point is north, and the last point is where the bearing is directed to. The north (either true, grid or magnetic) used identifies the type of bearing.

In ground navigation, one ray of the angle points north (usually grid north) and the other ray, known as a plotting ray, points to the object/direction.

## TYPES OF BEARINGS



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-5-3 Types of Bearings

**True Bearings.** A true bearing is a bearing measured from true north. While map users rarely use them, directions determined using the sun, moon and stars are true bearings. Global Positioning System (GPS) receivers also use true bearings.

**Grid Bearings.** A grid bearing is a bearing measured from grid north. The ability to determine a bearing from a map allows a map user to plan routes or activities before going into the field, and allows an easy method of communicating information about movement or location.

**Magnetic Bearings.** A magnetic bearing is measured from magnetic north and is measured using a compass, which either has no option of setting magnetic declination or has the magnetic declination set to zero. A magnetic bearing is a quick and efficient method of describing a route when a map is not being used.



If a compass has its declination set to zero, bearings to objects on the ground determined by that compass are magnetic bearings. Setting the magnetic declination on a compass converts the magnetic bearings determined by that compass into grid bearings for the map being used.

**Back Bearing.** A back bearing is a bearing that is in exactly the opposite direction of the bearing that has been measured. A back bearing can be useful for different reasons: to return to the start location after a hike, or to calculate the bearing from an object to one's current location. The steps to calculate a back bearing are:

- if the bearing is less than 180 degrees, add 180 degrees; and
- if the bearing is greater than 180 degrees, subtract 180 degrees.

---

## CONFIRMATION OF TEACHING POINT 4

---

### QUESTIONS

- Q1. A bearing is another name for what?
- Q2. Directions determined using the sun, moon and stars are what type of bearing?
- Q3. How is knowing a back bearing useful?

### ANTICIPATED ANSWERS

- A1. A bearing is another name for an angle.
- A2. True bearings.
- A3. A back bearing can be useful for different reasons: to return to the start location after a hike, or to calculate the bearing from an object to one's current location.

---

### Teaching Point 5

### Explain, Demonstrate and Have the Cadets Practice Determining a Bearing on a Map

Time: 15 min

Method: Demonstration and Performance

---

The ability to determine a bearing from a map allows cadets to plan routes or activities before going into the field, and allows an easy method of communicating information about movement or location. When a compass is adjusted to compensate for magnetic declination, it will allow bearings taken on the map to be used on the ground and vice versa.



For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be employed to monitor cadet performance.



*Director Cadets 3, 2007, Ottawa, ON: Department of National Defence*

Figure 18-5-4 Measuring a Bearing on a Map



A cadet will accidentally measure a back bearing if they determine the bearing in the wrong direction (eg, bearing from point B to point A instead of point A to point B).

Prior to measuring a bearing on a map it is good practice to first estimate the bearing by drawing a compass rose and looking at where the bearing would be on the compass rose. This serves as a good check to ensure the cadet has not accidentally measured the back bearing.

To measure a bearing on a map:

1. Set the predetermined declination on the compass.
2. Identify and mark the start (point A) and finish (point B) points on a map.
3. Draw a plotting ray from point A to point B.
4. Lay the fully opened compass with the edge of the compass base plate along the plotting ray, and the sighting arrow pointed in the direction of travel (point A to point B).
5. Hold the compass in place, rotate the compass dial so that the compass meridian lines align with the easting lines on the map, ensuring north on the dial indicates north on the map.
6. Read the number on the compass dial at the luminous index pointer.



If the bearing is taken from point B to point A, the compass will be pointing 180 degrees in exactly the opposite direction of travel wanted. This is called a back bearing.



Have the cadets practice determining bearings on a map from the list created (before the lesson) from the topographical map of the exercise area.

---

### CONFIRMATION OF TEACHING POINT 5

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The cadets' participation in determining bearings on a map will serve as the confirmation of this TP.

---

#### Teaching Point 6

#### Explain, Demonstrate, and Have Cadets Determine the Bearing of a Prominent Object

Time: 10 min

Method: Demonstration and Performance

---



For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while the cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor the cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be employed to monitor the cadets' performance.

A compass can be used to determine the bearing for a direction of travel and from one's current location to a prominent object. The ability to take a bearing of a prominent object also allows the cadet to look for a prominent object as a steering point when they need to follow a given bearing. A bearing is a quick and accurate method for describing the direction of travel.



A prominent object is something that is usually tall and easily recognizable (eg, church steeple, tall tree or hilltop).



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-5-5 Determining a Bearing



After the cadets have demonstrated the skill, have them practice determining the bearings of other prominent objects. This location should be predetermined by the recce IAW the pre-lesson instructions.

To determine the bearing of a prominent object:

1. Set the predetermined declination on the compass.
2. Hold the compass at eye level and at arm's length, and turn to face the prominent object (as illustrated in Figure 18-5-5).
3. Aim at the object using the compass sight, ensuring the sighting line is in line with the index pointer.
4. Adjust the compass cover so the compass dial is seen in the sighting mirror.
5. Look in the mirror and turn the compass dial until the magnetic needle is over the orienting arrow (put the red in the bed).
6. Read the number on the compass dial at the luminous index pointer.



Inform the cadets that when taking a bearing of a prominent object they will get different readings than other cadets unless they are all using the same line of sight to that prominent object (eg, standing in the same spot).

---

### CONFIRMATION OF TEACHING POINT 6

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The cadets' participation in determining bearings on the ground will serve as the confirmation of this TP.

---

**END OF LESSON CONFIRMATION**

---

The cadets' participation in determining bearings on a map and on the ground will serve as the confirmation of this lesson.

---

**CONCLUSION**

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**HOMEWORK/READING/PRACTICE**

N/A.

**METHOD OF EVALUATION**

This EO is assessed IAW A-CR-CCP-803/PG-001, Chapter 3, Annex B, Appendix 5 (390 PC).

**CLOSING STATEMENT**

It is important for cadets to be able to determine bearings on a map and on the ground as this is one of the key skills required to navigate using a map and compass. Experience in this skill will give the cadets confidence in their ability to navigate in the field.

**INSTRUCTOR NOTES/REMARKS**

To preserve and reuse the maps, the maps should be covered or coated to allow the use of wet-erase markers instead of pencils or pens.

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**REFERENCES**

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A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.





**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 6**

**EO C390.01 – IDENTIFY TYPES OF MAPS**

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Total Time:	30 min
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**PREPARATION**

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**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.

Photocopy the handout located at Annex E for each cadet.

The following maps are the minimum required to instruct this lesson: topographical, orienteering, street, and road. However, as many examples of different types of maps should be collected.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TPs 1–3 to orient the cadets to maps and present basic or background material on the purposes, types, and care of maps.

Demonstration and performance was chosen for TP 4 as it allows the instructor to explain and demonstrate folding a map while providing an opportunity for the cadets to practice folding a map under supervision.

---

**INTRODUCTION**

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**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have identified types of maps.

**IMPORTANCE**

It is important for cadets to understand the types of maps in order to choose the appropriate map to meet their needs.

---

**Teaching Point 1****Explain the Purpose of a Map**

Time: 5 min

Method: Interactive Lecture

---

**THE PURPOSE OF A MAP**

Maps are designed to give the user specific information based on its type. While there are many different types of maps, there is information that is common to most types.



The art and science of making maps is called cartography. The oldest known maps are preserved on Babylonian clay tablets from about 2300 B.C.

**A Map is a Scale Representation of the Ground**

A map is usually drawn to scale, that is, it is a proportionately smaller representation of the area depicted. However, many maps distort key features to highlight or emphasize them on the map. For example, roads are almost always depicted wider than they would be to scale. Scales may range from 1 : 5 000 (very high detail map) to 1 : 10 000 000 (a globe or a map of the world).

**A Map Uses Symbols to Represent Both Physical and Man-Made Features Found on the Ground**

Many features on a map are too small to see if depicted to scale. Cartographers (map-makers) use internationally accepted symbols to represent both natural and man-made features. These symbols are commonly known as conventional signs.

**Maps Identify Locations Such as Towns, Lakes, and Rivers, by Name**

Locations such as towns, lakes, and rivers are identified by name. Other important features such as mountains, highways, and political boundaries are also identified.

**Map Designs Reflect the Needs of the User**

Map designs reflect the individual needs of the user. Urban planners need a map that shows where water, sewer, and electrical lines are located. Travellers need to get to where they want to be, whether it is within a city or across the country. Education providers need maps that show the demographics (the statistical data of a population such as age, education, etc) of the region to know where their students may be coming from. Cadets need a map that will help them navigate, whether it is planning a flight or using a compass to trek to a survival site.

---

**CONFIRMATION OF TEACHING POINT 1**

---

**QUESTIONS**

- Q1. What is the purpose of a map?
- Q2. Internationally accepted symbols used to represent both natural and man-made features are known as what?
- Q3. Maps identify many types of locations by name. Identify three.

**ANTICIPATED ANSWERS**

- A1. Maps are designed to give the user specific information based on its type.

- A2. These symbols are commonly known as conventional signs.
- A3. Locations such as towns, lakes, and rivers are identified by name. Other important features such as mountains, highways, and political boundaries are also identified.

---

## Teaching Point 2

## Describe the Various Types of Maps

Time: 5 min

Method: Interactive Lecture

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### VARIOUS TYPES OF MAPS

Maps contain information based on their type.



If the type of map is available as a training aid, it should be displayed when it is being discussed.

#### Topographical

This type of map is commonly used by the military. The purpose of a topographical map is to present a picture of the ground as it really exists. Topographical maps show as much detail as the scale allows, generally 1 : 25 000, 1 : 50 000, or 1 : 250 000. This is the main type of map used by cadets for ground navigation.

#### Orienteering

Through the International Orienteering Federation (IOF), specific rules and standards have been set for the production of orienteering maps, including colour, symbols, and scales. They are more detailed than topographical maps, with reference to vegetation and landforms.

#### Political

Political maps show countries, provinces, counties and other political borders. Most globes show the political boundaries of the world.

#### Street

Street maps are designed to help commuters and tourists locate key sites such as roads and highways, police stations, fire halls, hospitals, schools, parks and more within a metropolitan area (eg, town, city).

#### Road

Road maps are designed to show the roads and highways over a large area like a province or territory. They show how to travel between cities, towns, parks, etc.

#### Statistical

Statistical maps show statistical information such as the production levels of crops or minerals across a country.

#### Relief

Relief maps are a three-dimensional representation, usually of terrain. The terrain elevation is usually exaggerated by a factor between five and ten. This helps to visually recognize the terrain features.

## Outline

Outline maps show large areas with only borders, and coastlines showing. They normally have a high map scale (eg, 1 : 10 000 000).

## Air Photo

Air photo maps are actual pictures used in reconnaissance or to create many of the maps listed. They are the most accurate in that they show the actual area. Satellites pictures now represent the next level of air photo maps with the ability to zoom in on almost any area in the world.

---

## CONFIRMATION OF TEACHING POINT 2

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### QUESTIONS

- Q1. What is the main type of map used by cadets for ground navigation?
- Q2. To travel from one city to another, what type of map is best?
- Q3. Most maps are flat (two dimensional). What type discussed is not?

### ANTICIPATED ANSWERS

- A1. Topographical maps.
- A2. A road map.
- A3. Relief maps.

---

### Teaching Point 3

### Describe How to Care for a Topographical Map

Time: 5 min

Method: Interactive Lecture

---

### HOW TO CARE FOR A TOPOGRAPHICAL MAP

Some maps produced are already waterproofed, however, most maps are not. Paper maps are expensive and may be easily damaged. Precautions must be taken to protect them from water, dirt and wind. Maps, when exposed to water, will become soggy, start to deteriorate and become very easy to tear.

#### Waterproofing the Map

Preparing a map for exposure to the elements is a vital step in prolonging the life of the map. Ways to prepare a map for waterproofing include:

- **Resealable Plastic Bag Method.** This method requires a large heavyweight resealable clear plastic bag and waterproof tape (eg, clear packing tape). Place the folded map into the bag with one edge at the sealed opening and an adjacent edge along one of the two sides of the bag. Cut enough tape to completely adhere to one edge of the bag from corner to corner. Stick one half of the tape along one edge of the bag that overhangs the map, from corner to corner. Flip the bag over (on to the side of the map that is not being used) and fold the tape down on itself and the other side of the bag. Fold the empty portion of the bag over the backside of the map and tape it down.
- **Contact Paper.** Sometimes called Map Tac, this is a clear plastic that has an adhesive on one side. Covering the map with contact paper will waterproof the map; however, it will become very stiff. A wet-erase marker or grease pencil will be required to write on the map. Use rubbing alcohol to remove permanent marker.

- **Chemical Coatings.** Chemical coatings are effective in waterproofing maps; however, they must be applied carefully in a well-ventilated area. They are sprayed or brushed onto the map. The coating must be allowed to fully dry before using the map.

### **Drying Technique**

If a map gets wet, carefully open it fully and let it dry completely on a flat clean surface. If it dries when it is folded, it may stick together, ruining the map.

### **Only Partially Opening in a Strong Wind**

A map should never be fully opened in a strong wind. It should be opened to the area being used, and refolded along the original fold lines.

### **Using Pencil and Erasing When Work is Complete**

Use only pencil to mark your maps and erase all markings gently. Maps that are protected by plastic can be marked using wet-erase markers or grease pencils.

### **Storing the Map**

Maps should be stored in a dry place, rolled, folded, or laid flat.

---

## **CONFIRMATION OF TEACHING POINT 3**

---

### **QUESTIONS**

- Q1. Name the three types of waterproofing techniques discussed.
- Q2. How should a map be handled in a strong wind?
- Q3. Where should maps be stored?

### **ANTICIPATED ANSWERS**

- A1. Resealable plastic bag method, contact paper, and chemical coatings.
- A2. It should be opened to the area being used, and refolded along the original fold lines.
- A3. Maps should be stored in a dry place.

**Teaching Point 4****Explain, Demonstrate, and Have Cadets Practice Folding a Map**

Time: 10 min

Method: Demonstration and Performance



For this skill lesson, it is recommended that the instruction take the following format:

1. Explain and demonstrate folding the map.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

The cadets will use Annex E as their map. This annex also shows the steps in pictorial format.

**Note:** Assistant instructors may be used to monitor the cadets' performance.

The steps to fold a map:

Lay map face up (north at the top), fold map in half by bringing the top of the map sheet down to the bottom of the map sheet.

Fold the top half of the map sheet up in half again, then turn the map over and fold the bottom half to match the top half.

Fold the ends of the map in half from left to right.

Fold each of the open ends back into half again so that the map name and index to adjacent map sheet appears on the outside.



If the map is folded correctly, it should now open like an accordion in the shape of an M with the map name visible on top.

---

**CONFIRMATION OF TEACHING POINT 4**


---

The cadets' participation in folding a map will serve as the confirmation of this TP.

---

**END OF LESSON CONFIRMATION**


---

**QUESTIONS**

- Q1. A map is usually drawn to scale. What does this mean?
- Q2. What type of map should be used to travel from the Same City Museum to the Same City Zoo?
- Q3. If the map is folded correctly, how should it now look?

**ANTICIPATED ANSWERS**

- A1. A map is a proportionately smaller representation of the area depicted.

A2. A street map.

A3. The map should now open like an accordion in the shape of an M with the map name visible on top.

---

## CONCLUSION

---

### HOMework/READING/PRACTICE

N/A.

### METHOD OF EVALUATION

N/A.

### CLOSING STATEMENT

It is important for cadets to understand the types of maps in order to choose the appropriate map.

### INSTRUCTOR NOTES/REMARKS

The following types of maps are the minimum required to instruct this lesson:

- topographical,
- orienteering,
- street, and
- road.

---

## REFERENCES

---

- A2-036 A-CR-CCP-121/PT-001 Director Cadets 3. (2003). *Royal Canadian Army Cadet Reference Book*. Ottawa, ON: Department of National Defence.
- A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.
- C0-007 (ISBN 0-02-029265-1) Kjellstrom, B. (1994). *Be Expert With Map and Compass: The Complete Orienteering Handbook*. New York, NY: Hungry Minds, Inc.
- C2-041 (ISBN 0-07-136110-3) Seidman, D., & Cleveland, P. (1995). *The Essential Wilderness Navigator*. Camden, ME: Ragged Mountain Press.

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**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 7**

**EO C390.02 – INTERPRET CONTOUR LINES**

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.

Photocopy the handouts located at Annexes F and H for each cadet.

Create slides of Annexes G and I.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TP 1 to illustrate to the cadets how to interpret contour lines.

A practical activity was chosen for TP 2 as it is an interactive way to introduce cadets to interpreting contour lines in a safe, controlled environment. This activity contributes to the development of ground navigation skills and knowledge in a fun and challenging setting.

**INTRODUCTION**

**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have interpreted contour lines.

**IMPORTANCE**

It is important for cadets to be able to interpret contour lines in order for them to navigate through or around different elevations.

---

**Teaching Point 1****Explain How Contour Lines Are Interpreted to Indicate the Shape of the Ground**

Time: 15 min

Method: Interactive Lecture

---

**HOW CONTOUR LINES ARE INTERPRETED TO INDICATE THE SHAPE OF THE GROUND**

Through learning how to interpret contour lines, cadets will be better able to understand the relationship between contour lines on the map to the features on the ground.

**Relief**

Relief, or elevation, is the shape of the ground on a vertical plane. Relief on a map is the representation of the height and shape of the ground in intervals of metres or feet.

There are two distinct elements in the representation of relief, including:

- **Representation of Height.** This is a fact-based representation of the height of the land and of landforms. Differences in appearance on the map (as compared to the ground) will arise from the type, density and accuracy of the information provided.
- **Representation of Shape.** This may be largely artistic, and the methods used will vary between maps.

**Contour Lines and Intervals**

A contour line joins points of equal elevation in relationship to sea level, and is the standard method of showing relief on topographical maps.

Contour lines are shown at a regular vertical interval. This difference in height between contours lines is called contour interval. The contour interval is always stated in the margin of the map, normally near the graphic scales.

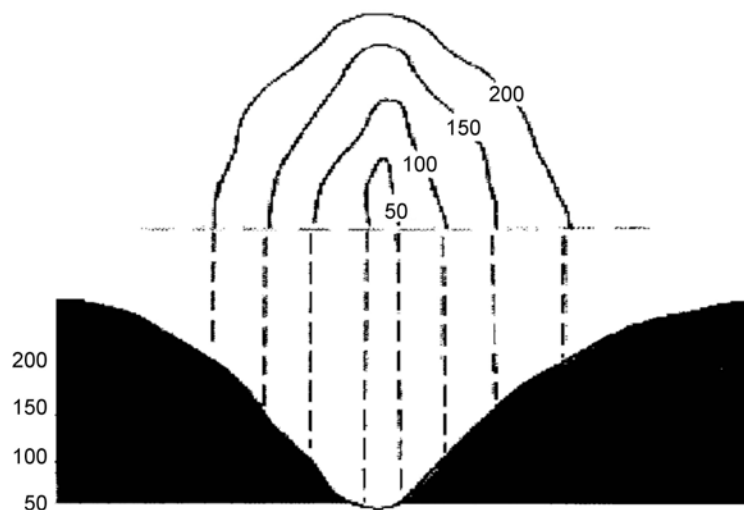
Contour lines are normally drawn as continuous brown lines. Every fourth or fifth contour line is called an “Index Contour” and is shown by a thicker brown line. This helps when reading and counting the contour lines to determine a height.

**The Shape of the Ground**

Interpreting contour lines provides a visualization of the shape of the ground, which is shown on the map by contour lines and contour intervals. Correct interpretation of the shape of the ground from interpreting contour lines requires practice. It is essential to study the various features, comparing the map to the ground in each case.

**Types of Slopes**

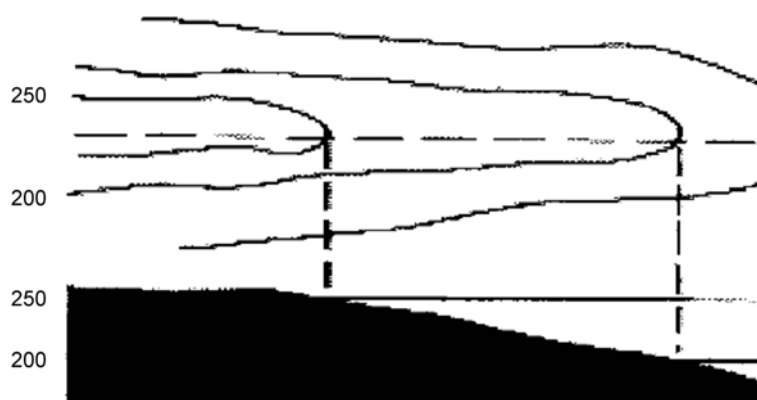
- **Steep.** Contour lines are close together. There is less distance to travel to gain or lose elevation.



*Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 32)*

Figure 18-7-1 Steep Slopes

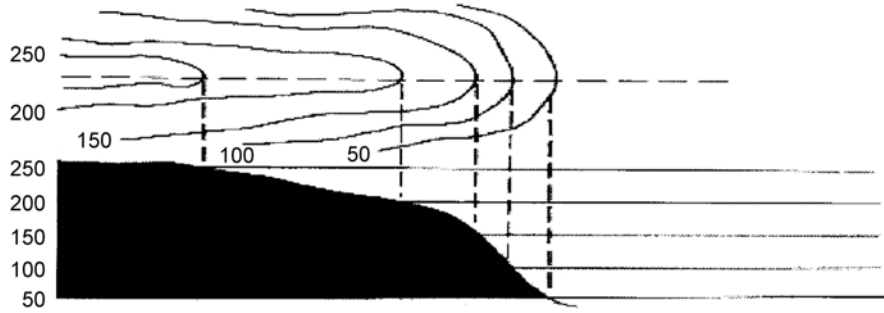
- **Gentle.** Contour lines are further apart. There is a greater distance to travel to gain or lose elevation.



*Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 32)*

Figure 18-7-2 Gentle Slope

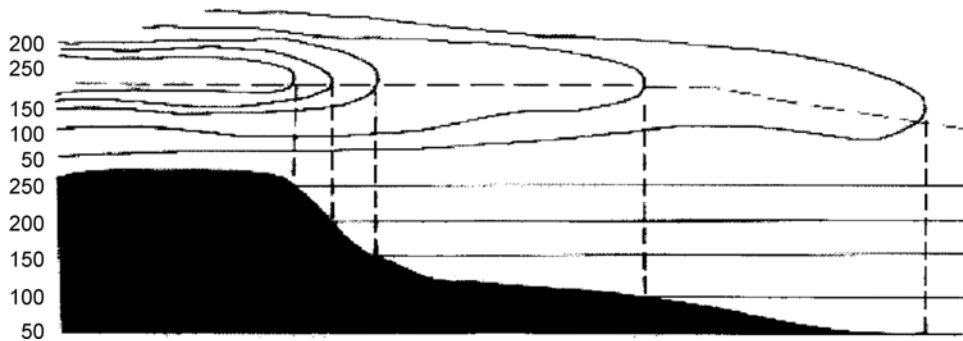
- **Uniform.** Contours are an equal distance apart. The slope remains constant in its rise/decline, whether the slope is steep or gentle.
- **Convex.** The spacing between contour lines moving down a slope decreases. The middle of the slope seems to bulge outward – appearing convex.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 32)

Figure 18-7-3 Convex Slope

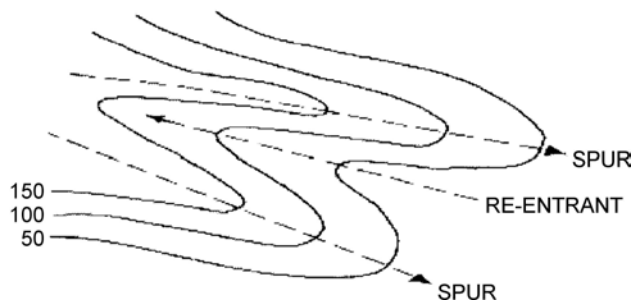
- **Concave.** The spacing of the contour lines increases towards the bottom of the slope. The middle of the slope seems to depress inward – appearing concave.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 32)

Figure 18-7-4 Concave Slope

- **Spurs.** A contour feature that extends out from a slope.
- **Re-Entrants.** A contour feature that cuts back into a slope.



Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 32)

Figure 18-7-5 Spurs and Re-Entrant



Distribute Annex F to each cadet and have them complete the worksheet. Correct the answers using the answer key located at Annex G.

---

### CONFIRMATION OF TEACHING POINT 1

---

The cadets' completion of the matching contour line worksheet will serve as the confirmation of this TP.

#### Teaching Point 2

#### Have the Cadets Interpret Contour Lines

Time: 10 min

Method: Practical Activity



Have cadets work independently (or in small groups if it suits the needs of the class).  
The cadets will choose the easiest route, based on slope as indicated by the contour lines.

---

### ACTIVITY

---

#### OBJECTIVE

The objective of this activity is to have the cadet interpret contour lines on a map.

#### RESOURCES

- Contour line worksheet located at Annex H, and
- Relief version of map located at Annex I.

#### ACTIVITY LAYOUT

N/A.

#### ACTIVITY INSTRUCTIONS

1. Hand out contour line worksheet.
2. Have cadets draw a route, based on the features (especially elevations), on their map.
3. Have cadets explain why they chose their route, emphasizing the contour lines that would be traversed.
4. When cadets have finished, display the slide of Annex I and discuss the terrain and its affects on possible routes.



Inform the cadets that there is no right answer. Routes chosen can be based on many factors, such as: differing hiking abilities, fitness levels, personal preferences, etc.

**SAFETY**

N/A.

---

**CONFIRMATION OF TEACHING POINT 2**

---

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

---

**END OF LESSON CONFIRMATION**

---

The cadets' completion of the two contour line worksheets will serve as the confirmation of this lesson.

---

**CONCLUSION**

---

**HOMEWORK/READING/PRACTICE**

N/A.

**METHOD OF EVALUATION**

N/A.

**CLOSING STATEMENT**

It is important for cadets to be able to interpret contour lines in order to navigate through or around differences of elevation. This skill will require practice.

**INSTRUCTOR NOTES/REMARKS**

N/A.

---

**REFERENCES**

---

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.



**ROYAL CANADIAN AIR CADETS**  
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**SECTION 8**

**EO C390.03 – ORIENT A MAP BY INSPECTION**

---

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.

Photocopy Annex J. Cut the first page along the dotted lines and post the three locations around the training area (eg, on walls, trees, etc). Ensure that the locations match the demonstration map.

Ensure sufficient topographical maps of the exercise area are available.

A recce of the exercise area should be made to determine a site where the topographical map of the exercise area may be oriented by inspection. The site chosen should have a minimum of three distinctive features to be used as prominent objects by the cadets in order to orient their maps.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TP 1 to give the cadets an overview of the purpose of orienting a map.

Demonstration and performance was chosen for TP 2 as it allows the instructor to explain and demonstrate orienting a map by inspection while providing an opportunity for the cadets to practice the skill under supervision.

---

**INTRODUCTION**

---

**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have oriented a map by inspection.

**IMPORTANCE**

It is important for cadets to be able to orient a map by inspection in order to match the symbols on the map with the terrain it represents. It also allows the cadet to confirm or discover their approximate location on the map.

**Teaching Point 1****Explain the Purpose of Orienting a Map**

Time: 5 min

Method: Interactive Lecture

**PURPOSE OF ORIENTING A MAP**

Orienting a map by inspection means to rotate the map so that the map directions and map detail correspond with those on the ground. This is a simple and quick way of orienting a map, if the person's approximate location is known. If the approximate location is unknown, orienting a map by inspection is much more difficult as similar features may confuse map readers and thereby they orient themselves incorrectly. If more unique features are visible and shown on the map, it will be easier to find one's approximate location.

Orienting the map does a number of things:

- it makes it easy to relate the map to the ground;
- it helps to confirm, or possibly find, a person's approximate location; and
- when moving over a complex route, or when travelling over long distances, it helps keep a hiker on the right track.

**CONFIRMATION OF TEACHING POINT 1****QUESTIONS**

- Q1. What is physically done to the map when it is being oriented?
- Q2. What key piece of information makes orienting a map by inspection simple and quick?
- Q3. Orienting the map does a number of things. Describe one.

**ANTICIPATED ANSWERS**

- A1. The map is rotated so that the map directions and map detail correspond with those on the ground.
- A2. The person's approximate location.
- A3. Three possible answers include:
- it makes it easy to relate the map to the ground;
  - it helps to confirm, or possibly find, a person's approximate location; and
  - when moving over a complex route, or when travelling over long distances, it helps keep a hiker on the right track.

**Teaching Point 2****Explain and Demonstrate How to Orient a Map**

Time: 20 min

Method: Demonstration and Performance



After explaining each step, demonstrate using the training aids.

After the demonstration, have the cadets orient a topographical map of the exercise area using the prominent objects they observe.



To orient a map, complete the following steps:

Identify the approximate location on the map (the 'You').

Select three prominent objects around your current location and find them on the map (house, church and bridge).

Rotate the map until all identified objects on the map line up with the objects located on the ground.

Ensure that all features line up with the positions on the map.



Show page 18J-2.

---

## ACTIVITY

Time: 15 min

### OBJECTIVE

The objective of this activity is to have the cadets orient a map by inspection.

### RESOURCES

- Topographical map of the exercise area, and
- The cadet's location on the map.

### ACTIVITY LAYOUT

N/A.

### ACTIVITY INSTRUCTIONS

1. Have cadets confirm their location on the map.
2. Have cadets select three prominent objects around their current location and find them on the map.
3. Have cadets rotate the map until all identified objects on the map line up with the objects located on the ground.
4. Ensure all features line up with the positions on the map.

### SAFETY

N/A.

---

## CONFIRMATION OF TEACHING POINT 2

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

---

**END OF LESSON CONFIRMATION**

---

The cadets' participation in orienting a map by inspection will serve as the confirmation of this lesson.

---

**CONCLUSION**

---

**HOMEWORK/READING/PRACTICE**

N/A.

**METHOD OF EVALUATION**

N/A.

**CLOSING STATEMENT**

It is important for cadets to be able to orient a map by inspection in order to match the symbols on the map with the terrain it represents. It also allows the cadet to confirm or discover their approximate location on the map.

**INSTRUCTOR NOTES/REMARKS**

N/A.

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**REFERENCES**

---

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.



**ROYAL CANADIAN AIR CADETS**  
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**SECTION 9**

**EO C390.04 – ORIENT A MAP USING A COMPASS**

---

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.

Ensure sufficient topographical maps of the exercise area are available.

Photocopy Annex K. Cut the first page along the dotted lines and post the three locations around the training area (eg, on walls, trees, etc). Ensure that the locations match the demonstration map. Ensure that the north of the demonstration map corresponds to the north of the training area, which will allow the map to be oriented with a compass.

Calculate the magnetic declination for the topographical map of the exercise area.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TP 1 to give the cadets an overview of the purpose of orienting a map.

Demonstration and performance was chosen for TP 2 as it allows the instructor to explain and demonstrate orienting a map using a compass while providing an opportunity for the cadets to practice the skill under supervision.

---

**INTRODUCTION**

---

**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have oriented a map using a compass.

## IMPORTANCE

It is important for cadets to orient a map using a compass in order to match the symbols on the map with the terrain it represents. It also allows the cadet to confirm or discover their approximate location on the map.

---

### Teaching Point 1

### Explain the Purpose of Orienting a Map

Time: 5 min

Method: Interactive Lecture

---

## PURPOSE OF ORIENTING A MAP

Orienting a map using a compass means to rotate the map so that the north of the map matches the north of the ground. This is confirmed, visually, with the map directions and map detail corresponding with those on the ground. This is a simple and quick way of orienting a map if the person's approximate location is known. If the approximate location is unknown, orienting a map using a compass can still be done, but this does not determine the map reader's location. Similar features may confuse map readers and thereby they orient themselves incorrectly. If more unique features are visible and are shown on the map it will be easier to find one's approximate location.

Orienting the map does a number of things:

- it makes it easy to relate the map to the ground;
- it helps to confirm, or possibly find, a person's approximate location; and
- when moving over a complex route, or when travelling over long distances, it helps keep a hiker on the right track.

---

## CONFIRMATION OF TEACHING POINT 1

---

## QUESTIONS

- Q1. What is physically done to the map when it is being oriented?
- Q2. Can a map be oriented using a compass if the person's location is unknown?
- Q3. Orienting the map does a number of things. Describe one.

## ANTICIPATED ANSWERS

- A1. The map is rotated so that the map directions and map detail correspond with those on the ground.
- A2. Yes. Also, the oriented map may assist map readers in discovering their location.
- A3. Three possible answers include:
- it makes it easy to relate the map to the ground;
  - it helps to confirm, or possibly find, a person's approximate location; and
  - when moving over a complex route, or when travelling over long distances, it helps keep a hiker on the right track.

**Teaching Point 2****Explain, Demonstrate and Have the Cadets Practice  
Orienting a Map Using a Compass**

Time: 20 min

Method: Demonstration and Performance



After explaining each step, demonstrate using the training aids.

After the demonstration, the cadets will orient the topographical map of the training area.

To orient a map using a compass, complete the following steps:

1. Identify the cadet's approximate location on the map (the 'You').
2. Set the magnetic declination.
3. Set the compass dial to north.
4. Lay the compass flat on the map with the cover open.
5. Point the mirror to north (top of the map).
6. Align the compass meridian lines with the map easting lines (use the arrow beside the 'You' on the demonstration map).
7. Turn the map until the magnetic needle lines up with the orienting arrow.
8. Ensure that all features (the house, church and bridge) line up with their positions on the map.



Show page 18K-2.

**ACTIVITY**

Time: 10 min

**OBJECTIVE**

The objective of this activity is to have the cadets orient a map using a compass.

**RESOURCES**

- Topographical map of the exercise area,
- Compass,
- Predetermined magnetic declination, and
- The cadet's location on the map.

**ACTIVITY LAYOUT**

N/A.

**ACTIVITY INSTRUCTIONS**

1. Have cadets confirm their location on the map.
2. Have cadets set the magnetic declination.
3. Have cadets set the compass dial to north.
4. Have cadets lay the compass flat on the map with the cover open.
5. Have cadets point the mirror to north (top of the map).
6. Have cadets align the compass meridian lines with the map easting lines.
7. Have cadets rotate the map until the magnetic needle lines up with the orienting arrow.
8. Have cadets ensure that all features line up with their positions on the map.

**SAFETY**

N/A.

---

**CONFIRMATION OF TEACHING POINT 2**

---

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

---

**END OF LESSON CONFIRMATION**

---

The cadets' participation in orienting a map using a compass will serve as the confirmation of this lesson.

---

**CONCLUSION**

---

**HOMEWORK/READING/PRACTICE**

N/A.

**METHOD OF EVALUATION**

N/A.

**CLOSING STATEMENT**

It is important for cadets to orient a map using a compass in order to match the symbols on the map with the terrain it represents. It also allows the cadet to confirm or discover their approximate location on the map.

**INSTRUCTOR NOTES/REMARKS**

N/A.

---

**REFERENCES**

---

A2-041 B-GL-382-005/PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.



**ROYAL CANADIAN AIR CADETS**  
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**SECTION 10**

**EO C390.05 – CALCULATE MAGNETIC DECLINATION**

Total Time:

60 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.

Photocopy the handouts located at Annexes L and N for each cadet.

Create slides of Annex M.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TP 1 to orient the cadet to calculating magnetic declination and present basic material.

Demonstration and performance was chosen for TP 2 as it allows the instructor to explain and demonstrate calculating magnetic declination while providing an opportunity for the cadets to practice calculating magnetic declination under supervision.

An in-class activity was chosen for TP 3 as it is an interactive way to reinforce calculating magnetic declination.

**INTRODUCTION**

**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have calculated magnetic declination.

**IMPORTANCE**

It is important for cadets to know how to calculate magnetic declination as it provides the cadet with confidence that they will arrive at their destination when navigating on a bearing. Not accounting for magnetic declination

may affect navigation, as the cadet may travel off the intended route. For every one degree of magnetic declination not accounted for, a person would be approximately 17 m off for each kilometre travelled.

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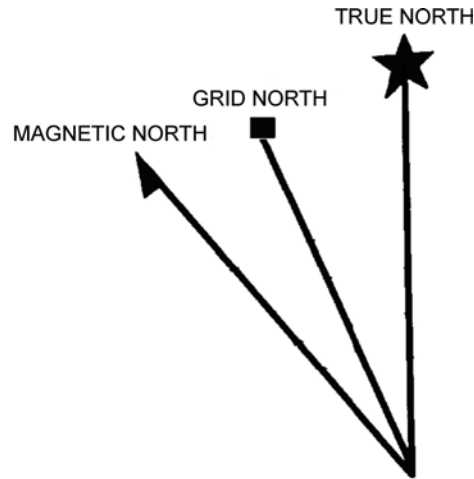
### Teaching Point 1

### Discuss the Three Norths and Magnetic Declination

Time: 5 min

Method: Interactive Lecture

---



*Director Cadets 3, 2008, Ottawa, ON: Department of National Defence*

Figure 18-10-1 The Three Norths

### THE THREE NORTHS

The relationship between the three norths, especially grid and magnetic, is key to using a compass on both a map and on the ground.

**True North.** True north is located at the top of the earth where the geographic North Pole is located and where all lines of longitude meet. In the declination diagram on the map, true north is represented by the symbol of a star, which represents the North Star, Polaris.

**Grid North.** Grid north is the north indicated by the grid lines (eastings) on a topographical map. The easting lines run parallel to each other and will never meet at the geographic North Pole; because of this, grid north points off slightly from true north. In the declination diagram on the map, grid north is represented by a square, which represents a map grid.

**Magnetic North.** Magnetic north is the location of the magnetic north pole, where the Earth's magnetic field bends back into the Earth toward the south magnetic pole. It is located in the Canadian arctic and is different from true north. It is the direction in which the compass needle points. In the declination diagram on the map, magnetic north is represented by a needle as on a compass.

### MAGNETIC DECLINATION

The differences between the three norths affect navigation for the map and compass user, in the form of magnetic declination. Magnetic declination is the difference in bearing either between true north and magnetic north or between grid north and magnetic north.



The line of zero declination, as of 2008, runs through Baker Lake, Nunavut, Churchill, Man., and Sioux Lookout, Ont.





Cadets will normally use the magnetic declination value between grid north and magnetic north when navigating using a map and compass. By setting the magnetic declination on the compass, magnetic bearings are converted to grid bearings which allow bearings taken from the map to be used on the ground and vice versa.

---

### CONFIRMATION OF TEACHING POINT 1

---

#### QUESTIONS

- Q1. Which north is represented by a star?  
 Q2. Which north does a compass needle point towards?  
 Q3. Which magnetic declination value is most important to topographical map users?

#### ANTICIPATED ANSWERS

- A1. True north.  
 A2. Magnetic north.  
 A3. The magnetic declination value between grid north and magnetic north.

---

#### Teaching Point 2

#### Explain, Demonstrate and Have Cadets Calculate Magnetic Declination

Time: 15 min

Method: Demonstration and Performance

---



Distribute Fact Sheet located at Annex L. When using the slides from Annex M, cover the right section (the equations) and reveal each step as required. Example 1 should be used as the demonstration and Example 2 to be performed step-by-step by the cadets. If more examples are required, use the questions from the worksheet. However, Question 9 should not be used as an example, only as a question for the cadets to calculate as it involves an east/west declination switch.

For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be employed to monitor cadet performance.

#### LOCATING DECLINATION DIAGRAM

Calculating current declination uses the information provided by the declination diagram on a map and the information printed directly underneath. This diagram is most often found on the right side of the map in the marginal information.

## IDENTIFYING THE FORMULA USED TO CALCULATE MAGNETIC DECLINATION

Several mathematical principles are used in the formula to calculate magnetic declination. Understanding of the mathematical order of operations is essential.

**Formula:** Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination

**Grid Magnetic Angle.** The angle between grid north and magnetic north, found on the declination diagram. Written in degrees and minutes.



1 degree (°) = 60 minutes ('), similar to calculating time (eg, 1 hour = 60 minutes).

This ratio is very important to remember when adjusting the grid magnetic angle to the current declination. This is where many errors occur.

**Current Year.** The current calendar year.

**Year of Declination Information.** Found below the declination diagram.

**Annual Change.** Found below the declination diagram and is written in minutes.



It is important that the annual change be inserted into the formula correctly:

- If annual change is **increasing**, insert into formula as a **positive** number.
- If annual change is **decreasing**, insert into formula as a **negative** number.

**Current Declination.** This is the result of the formula. It is the magnetic declination to be set on the compass.

**West Declination.** When magnetic north is west (to the left) of grid north on the declination diagram.

**East Declination.** When magnetic north is east (to the right) of grid north on the declination diagram.



If the current declination calculates to a negative number, an east declination changes to a west declination and vice versa.

## CALCULATING MAGNETIC DECLINATION

Steps to calculate magnetic declination:

1. Identify grid magnetic angle.
2. Identify current year.
3. Identify year of declination information.
4. Identify annual change.
5. Determine whether the annual change is positive or negative.
6. Input the information into the formula.
7. Solve for current declination.
8. Determine whether the magnetic declination is east or west.



Show slide of Example 1 of Calculating Magnetic Declination located at Annex M.

Example 1:



USE DIAGRAM ONLY TO OBTAIN NUMERICAL VALUES  
APPROXIMATE MEAN DECLINATION 1975  
FOR CENTRE OF MAP  
ANNUAL CHANGE DECREASING 1.4'

ONE THOUSAND METRE  
UNIVERSAL TRANSVERSE MERCATOR GRID  
ZONE 20


*Natural Resources Canada, 2008, Topo Declination Diagram. Retrieved April 11, 2008, from [http://gsc.nrcan.gc.ca/geomag/field/magdec\\_e.php?p=1](http://gsc.nrcan.gc.ca/geomag/field/magdec_e.php?p=1)*

Figure 18-10-2 Declination Diagram


From Figure 18-10-2:

1. Grid Magnetic Angle: 18° 18'
2. Current Year: 2008 (used for this example)
3. Year of Declination Information: 1975
4. Annual Change: decreasing 1.4'
5. Decreasing means 1.4' becomes -1.4'
6. Input the information into the formula:  

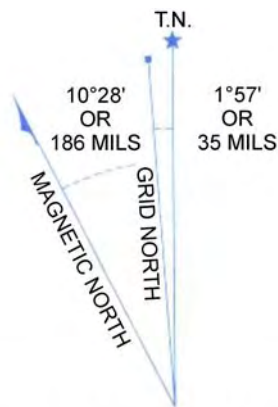
$$18^{\circ} 18' + [(2008 - 1975) \times (-1.4')] = \text{Current Declination}$$
7. Solve for current declination.
  - a.  $18^{\circ} 18' + [(33) \times (-1.4')] = \text{Current Declination}$
  - b.  $18^{\circ} 18' + [-46.2'] = \text{Current Declination}$
  - c.  $18^{\circ} 18' - 46.2' = \text{Current Declination}$

 Since 46.2' cannot be easily subtracted from 18° 18', 1° is converted into 60' (similar to time calculations), which converts 18° 18' to 17° 78'.

- d.  $17^{\circ} 78' - 46.2' = \text{Current Declination}$
  - e.  $17^{\circ} 31.8' = \text{Current Declination}$
8. Since magnetic north is west of grid north and the result is positive, the magnetic declination for the topographical map in 2008 is 17° 31.8' west declination.

 Show slide of Example 2 of Calculating Magnetic Declination located at Annex M.

Example 2:



USE DIAGRAM ONLY TO OBTAIN NUMERICAL VALUES  
 APPROXIMATE MEAN DECLINATION 1996  
 FOR CENTRE OF MAP  
 ANNUAL CHANGE INCREASING 2.7'

ONE THOUSAND METRE  
 UNIVERSAL TRANSVERSE MERCATOR GRID  
 ZONE 18

Canada Centre for Mapping, Bancroft 31 F/4, Natural Resources Canada

Figure 18-10-3 Declination Diagram

From Figure 18-10-3:

1. Grid Magnetic Angle: 10° 28'
2. Current Year: 2008 (used for this example)
3. Year of Declination Information: 1996
4. Annual Change: increasing 2.7'
5. Increasing means 2.7' becomes +2.7'

6. Input the information into the formula:  
 $10^{\circ} 28' + [(2008 - 1996) \times (+2.7')] = \text{Current Declination}$
7. Solve for current declination.
- $10^{\circ} 28' + [(12) \times (+2.7')] = \text{Current Declination}$
  - $10^{\circ} 28' + [+32.4'] = \text{Current Declination}$
  - $10^{\circ} 28' + 32.4' = \text{Current Declination}$
  - $10^{\circ} 60.4' = \text{Current Declination}$



Since 60.4' is greater than 1°, 60' is converted into 1° (similar to time calculations), which converts 10° 60.4' to 11° 0.4'.

- $11^{\circ} 0.4' = \text{Current Declination}$
8. Since magnetic north is west of grid north and the result is positive, the magnetic declination for the topographical map in 2008 is 11° 0.4' west declination.

### CONFIRMATION OF TEACHING POINT 2

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

#### Teaching Point 3

#### Have Cadets Calculate Magnetic Declination

Time: 30 min

Method: In-Class Activity

### ACTIVITY

#### OBJECTIVE

The objective of this activity is to have the cadets calculate magnetic declination.

#### RESOURCES

- Magnetic declination worksheet located at Annex N, and
- Pen/pencil.

#### ACTIVITY LAYOUT

N/A.

#### ACTIVITY INSTRUCTIONS

1. Distribute a worksheet to each cadet.
2. Have the cadets individually complete as many problems on the worksheet as possible in 20 minutes.
3. Correct the worksheet with the cadets using the answer key located at Annex O.
4. Answer any questions the cadets may have on calculating magnetic declination.

**SAFETY**

N/A.

---

**CONFIRMATION OF TEACHING POINT 3**

---

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

---

**END OF LESSON CONFIRMATION**

---

The cadets' calculation of magnetic declination will serve as the confirmation of this lesson.

---

**CONCLUSION**

---

**HOMEWORK/READING/PRACTICE**

N/A.

**METHOD OF EVALUATION**

N/A.

**CLOSING STATEMENT**

Knowing how to calculate magnetic declination provides the cadet with confidence that they will arrive at their destination when navigating on a bearing.

**INSTRUCTOR NOTES/REMARKS**

Cadets may use a calculator if they wish.

---

**REFERENCES**

---

A2-041 B-GL-382-005-PT-001 Canadian Forces. (2006). *Maps, Field Sketching, Compasses and the Global Positioning System*. Ottawa, ON: Department of National Defence.



**ROYAL CANADIAN AIR CADETS**  
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**SECTION 11**

**EO C390.06 – DETERMINE DIRECTION USING THE SUN**

---

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.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

Demonstration and performance was chosen for this lesson as it allows the instructor to explain and demonstrate determining direction using the sun while providing an opportunity for the cadets to practice the skill under supervision.

---

**INTRODUCTION**

---

**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have determined direction using the sun.

**IMPORTANCE**

It is important for the cadets to be able to determine direction using the sun so in a survival situation they can navigate to and from their survival site without the aid of a compass or map.

**Teaching Point 1****Explain, Demonstrate and Have Cadets Determine Direction Using a Shadow Stick**

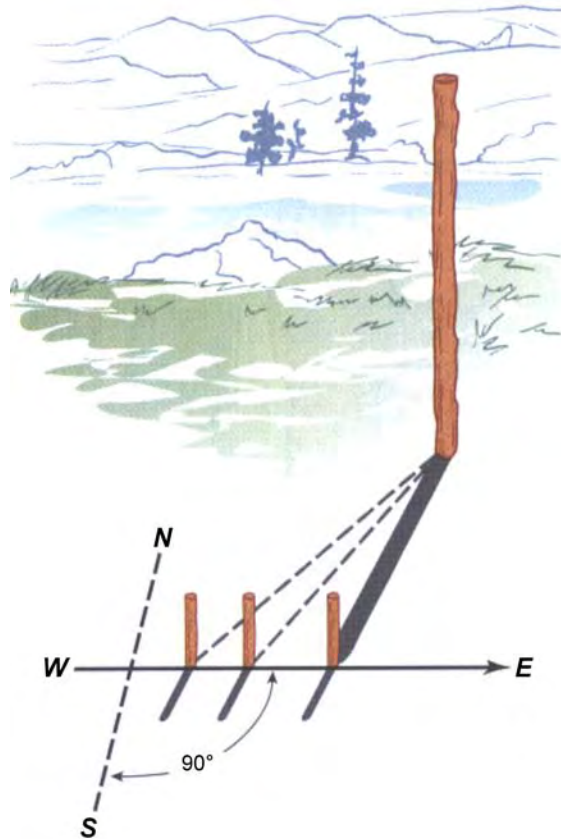
Time: 15 min

Method: Demonstration and Performance

**DETERMINE DIRECTION USING A SHADOW STICK**

In a survival situation, one may not have a map of the area, a compass or the use of a watch. On this occasion, it may be necessary to use natural guides, such as the sun to determine direction. The sun can be used to find north using a branch or stick to cast a shadow on the ground.

A shadow stick works because the sun always travels east to west, even though it may not rise at exactly 90 degrees or set at exactly 270 degrees. The tip of the shadow stick's shadow moves in the opposite direction, so the first shadow tip is always west of the second, anywhere on earth. Improvised methods are only general indicators of direction. The shadow stick is more accurate and easier to read when the stick is narrow.



*National Association of Search and Rescue, Fundamentals of Search and Rescue, Jones and Bartlett Publishers, Inc. (p. 76)*

Figure 18-11-1 Shadow Stick



---

## ACTIVITY

Time: 10 min

---

### OBJECTIVE

The objective of this activity is to have the cadets construct a shadow stick and determine direction using the sun.

### RESOURCES

Stick.

### ACTIVITY LAYOUT

N/A.

### ACTIVITY INSTRUCTIONS

1. Divide the cadets into groups of three or four.
2. Have the cadets find a 45–60 cm straight stick.
3. Find a level vegetation-free spot. Push the 45–60 cm straight stick into the ground about 10 cm so it will remain upright, inclining it by 5–10 degrees to create a longer, bigger shadow.
4. Mark the tip of the shadow with a stone. Wait until the shadow tip moves several centimetres (10–15 minutes with a 45 cm stick).



Use the time interval required for Step 4. to instruct TP 2.

5. Mark the position of the new shadow tip.
6. Draw a straight line from the first mark through the second mark and continue about 30 cm past it (as illustrated in Figure 18-11-1).
7. Have the instructor or a supervisor verify the bearings with a compass.



The line drawn indicates the east–west line. The first mark made is west and the last mark made is east. A line perpendicular to the east–west line is a north–south line.

### 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****Explain, Demonstrate and Have Cadets Determine Direction Using an Analog Watch**

Time: 10 min

Method: Demonstration and Performance



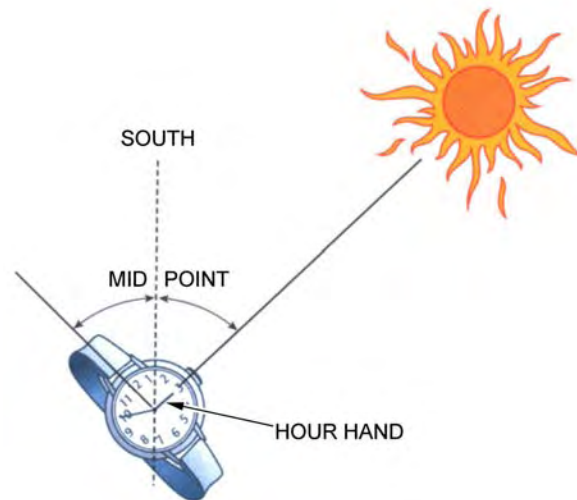
Use an analog wall clock for demonstration purposes instead of an analog watch. Ask the cadets if any of them have an analog watch. Since digital watches are more common than analog watches, the cadets should understand that without one, they cannot use this method.

**DETERMINE DIRECTION USING AN ANALOG WATCH**

An analog watch can help establish direction using either standard or daylight savings time. The analog watch method is based on the principle that at noon (or 1 pm for daylight savings time) the sun is approximately due south in the northern hemisphere and approximately due north in the southern hemisphere. Using this principle, an analog watch's (with the correct time) hour hand, at noon, pointed at the sun, also points approximately due south/north. At times other than noon, bisecting the angle between the hour hand (pointing at the sun) and the 12 (or the 1 for daylight savings time) on the watch face, creates an imaginary line that points approximately due south/north.



This method becomes less accurate the closer a person is to the equator.



*National Association of Search and Rescue, Fundamentals of Search and Rescue, Jones and Bartlett Publishers, Inc. (p. 76)*

Figure 18-11-2 Analog Watch

---

**ACTIVITY**

---

Time: 5 min

---

**OBJECTIVE**

The objective of this activity is to have the cadets determine direction using an analog watch.

**RESOURCES**

Analog watch (with the correct time).

**ACTIVITY LAYOUT**

N/A.

**ACTIVITY INSTRUCTIONS**

1. Point the hour hand towards the sun.
2. Determine the halfway point between the hour hand and noon (or 1 pm for daylight savings time).
3. Create an imaginary line between the centre of the watch face and the halfway point (as illustrated in Figure 18-11-2).



The imaginary line is a north–south line (points to the south in the northern hemisphere and to the north in the southern hemisphere).

**SAFETY**

N/A.

---

**CONFIRMATION OF TEACHING POINT 2**

---

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

---

**END OF LESSON CONFIRMATION**

---

The cadets' participation in constructing a shadow stick and determining direction using an analog watch will serve as the confirmation of this lesson.

---

**CONCLUSION**

---

**HOMEWORK/READING/PRACTICE**

N/A.

**METHOD OF EVALUATION**

N/A.

**CLOSING STATEMENT**

It is important for the cadets to be able to determine direction using the sun so in a survival situation they can navigate to and from their survival site without the aid of a compass or map.

**INSTRUCTOR NOTES/REMARKS**

Sticks are to be collected by the cadets in the field.

---

**REFERENCES**

---

C3-002 (ISBN 0-00-653140-7) Wiseman, J. (1999). *The SAS Survival Handbook*. Hammersmith, London: HarperCollins Publishers.



**ROYAL CANADIAN AIR CADETS**  
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**SECTION 12**

**EO C390.07 – DETERMINE DIRECTION AT NIGHT**

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.

Choose a suitable night to perform this activity by checking both a moon calendar and local weather conditions.

A sky map should be created for the date and location where the lesson will be taught. Annex P is an example created for reference of what a sky map looks like and how it is used to locate constellations. Photocopy the created sky map for each cadet.

Photocopy the handout located at Annex Q for each cadet.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

Demonstration and performance was chosen for this lesson as it allows the instructor to demonstrate determining direction at night while providing an opportunity for the cadet to practice the skill under supervision.

**INTRODUCTION**

**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have determined direction at night.

**IMPORTANCE**

It is important for the cadets to be able to navigate at night so they will have the skills to find their way in the dark. In a survival situation, being able to determine direction in the dark is a skill that can assist in being rescued.

**Teaching Point 1****Explain, Demonstrate and Have Cadets Determine Direction Using the Moon**

Time: 10 min

Method: Demonstration and Performance



This TP must be conducted during a clear night when the moon is in one of its crescent phases. Determine the phases of the moon on a moon calendar or through the internet.

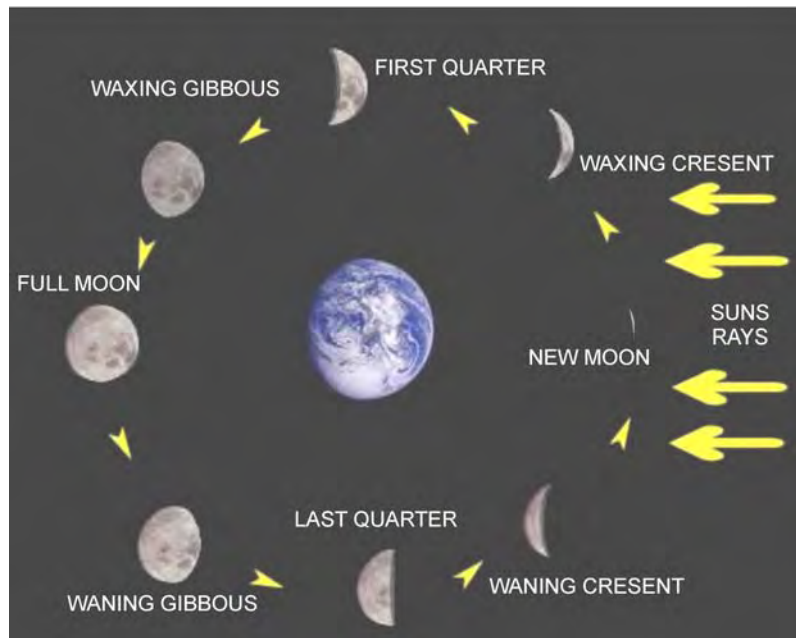
**IDENTIFYING THE PHASES OF THE MOON**

The phases of the moon are caused by the relative positions of the earth, sun, and moon. The moon rotates around the earth, on average, once every 27 days, 7 hours and 43 minutes.

The sun always illuminates the half of the moon facing the sun (except during lunar eclipses). When the sun and moon are on opposite sides of the earth, the moon appears “full” like a bright, round disk. When the moon is between the earth and the sun, it appears dark, a “new” moon. In between these phases, the moon’s illuminated surface appears to grow (waxing) to full, and then shrink (waning) to the next new moon.



The moon’s familiar crescent shape is formed by the shadow of the earth on the moon’s surface and always points relatively north and south in the sky.

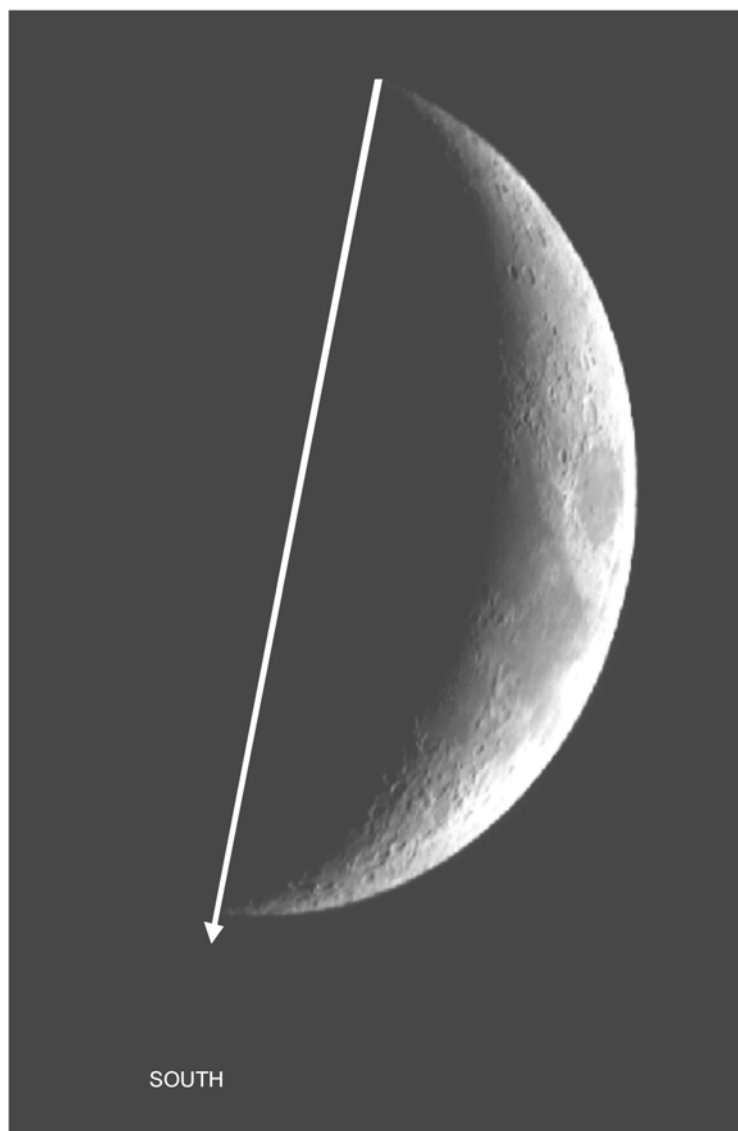


*Afreshhorizon.co.uk, Copyright 2008 by A Fresh Horizon. Retrieved November 14, 2007, from [http://www.afreshhorizon.co.uk/images/moon\\_phases.jpg](http://www.afreshhorizon.co.uk/images/moon_phases.jpg)*

Figure 18-12-1 Moon Phases

## DETERMINING SOUTH

Drop a line along the points of the crescent moon and project it to the horizon. This point on the horizon is in the general direction of south.



*The Calvin College Observatory, 2001, The Crescent Moon, Copyright 2001 by The Calvin College Observatory.  
Retrieved November 14, 2007, from <http://www.calvin.edu/academic/phys/observatory/images/moon/>*

Figure 18-12-2 Determining South by the Moon



This method will give a general direction of north and south.

---

## ACTIVITY

Time: 5 min

---

### OBJECTIVE

The objective of this activity is to have the cadets determine direction using the moon.

### RESOURCES

N/A.

### ACTIVITY LAYOUT

N/A.

### ACTIVITY INSTRUCTIONS

Explain, demonstrate and have the cadets drop an imaginary line along the points of the crescent moon and project that line to the horizon (as illustrated in Figure 18-12-2). This point on the horizon is in the general direction of south.

### SAFETY

N/A.

---

## CONFIRMATION OF TEACHING POINT 1

---

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

---

### Teaching Point 2

### Explain, Demonstrate and Have Cadets Identify the Major Constellations Required to Find Polaris

Time: 10 min

Method: Demonstration and Performance

---



The best watching time for stars is between the moon's last quarter and the first, and three hours after sunset so the sky is dark enough to see the low intensity stars.

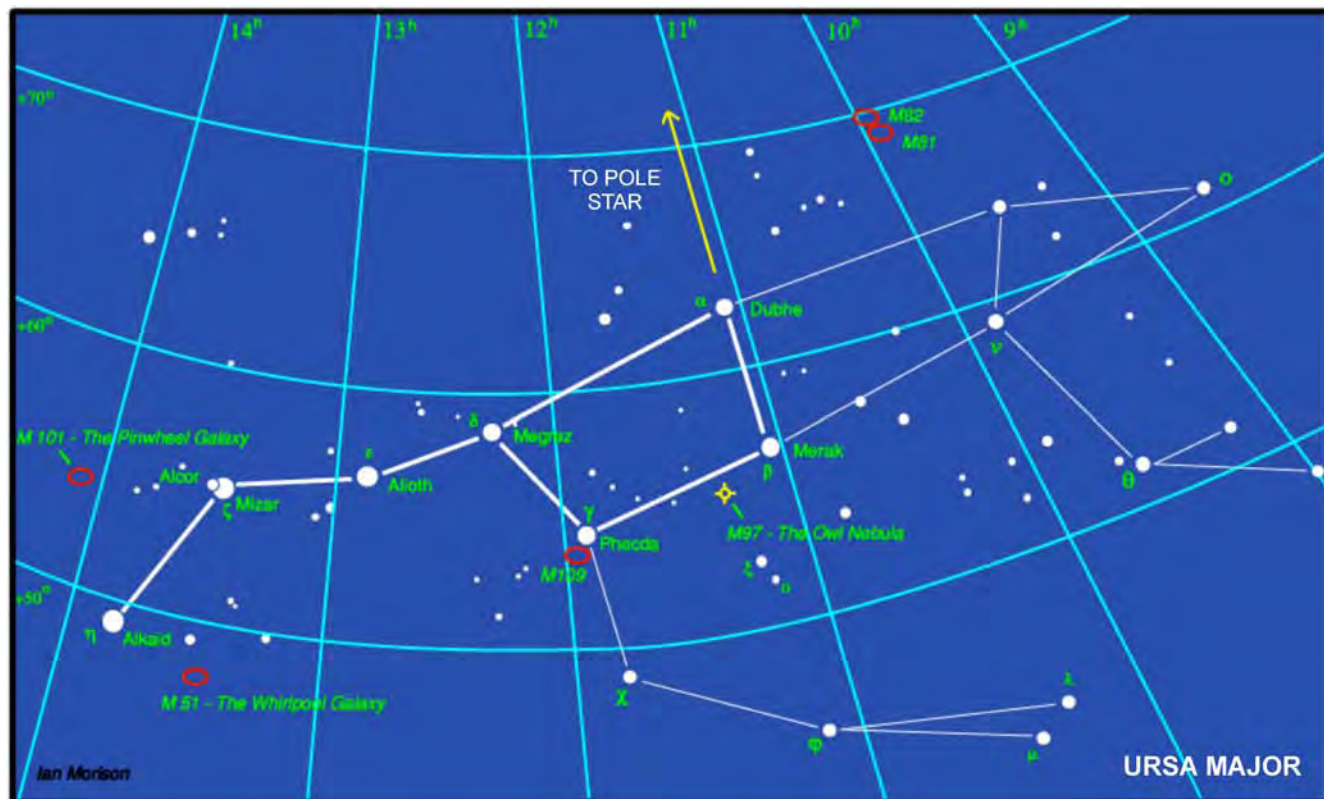
### CONSTELLATIONS

Constellations are groupings of stars that have been given legendary or historical significance. These groups have been joined together with lines, outlining a figure or symbol, so that they may be found in the sky.

#### Ursa Major (Big Dipper)

Ursa Major is visible throughout most of the year in the northern hemisphere and is known as the "Great Bear" in Latin. The seven brightest stars are located in the bear's hindquarters and tail and form the well known asterism Big Dipper as it appears to form the shape of a ladle, or dipper shape. The stars Dubhe and Merak, located on the outside edge of the dipper, are also known as "The Pointer" since they point in the direction of Polaris.





Jobrell Bank Observatory, 2006, Ursa Major, Copyright 2006 by The University of Manchester. Retrieved November 14, 2007, from <http://www.jb.man.ac.uk/public/Ursamajor.jpg>

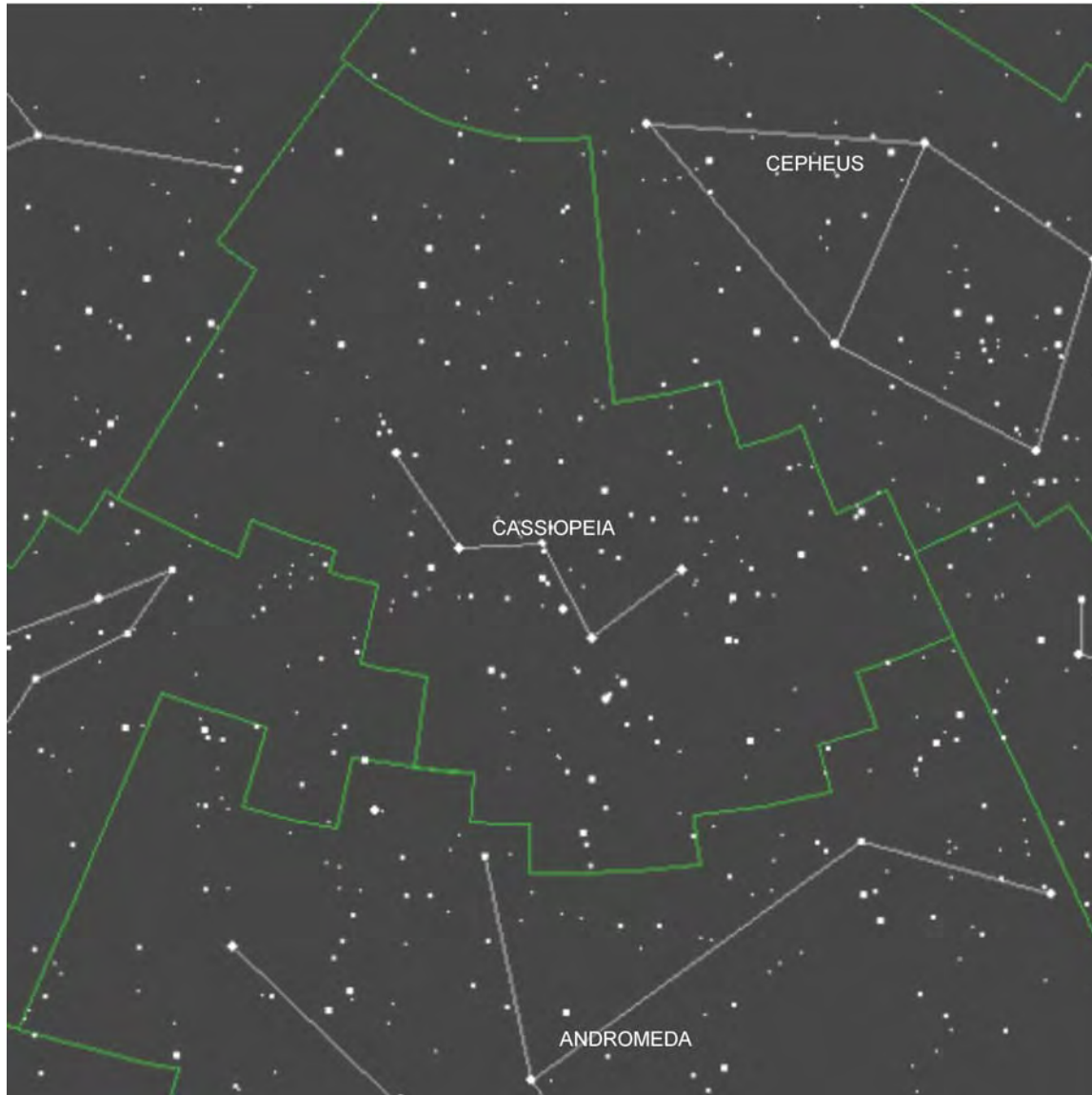
Figure 18-12-3 Ursa Major



The Big Dipper is not a constellation. It is part of Ursa Major, the Great Bear. The Big Dipper is an asterism – a recognized, but not official, grouping of stars. Some asterisms fall within a single constellation, others span across constellations.

### Cassiopeia

Cassiopeia is a northern constellation which in Greek mythology represents a vain queen who boasted about her unrivalled beauty. It is made up of five stars that resemble a lopsided “M” or “W” depending on its position in the sky. Viewing the constellation as an “M”, connect the three bottom stars with an imaginary line. From the right-most star create an imaginary line straight down to find Polaris.



*About.com, 2007, Cassiopeia, Copyright 2007 by About Inc. Retrieved November 14, 2007, from <http://space.about.com/od/starsplanetsgalaxies/ig/Constellations-Pictures/cassiopeia.htm>*

Figure 18-12-4 Cassiopeia

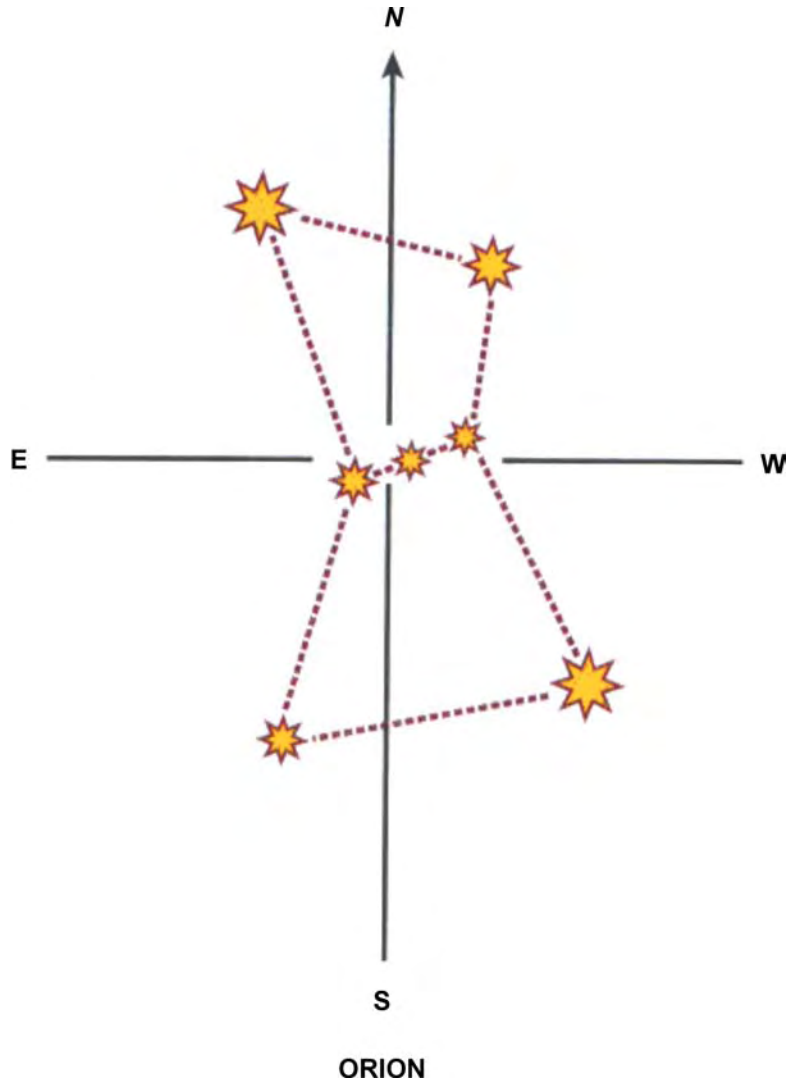
## Orion

Orion is a constellation often referred to as The Hunter. It is one of the largest and most visible constellations in the sky. Its brilliant stars are found on the celestial equator and are visible throughout the world. From mid-northern latitudes, Orion is visible in the evening from November to early May and in the morning from late July to November. The constellation of Orion consists of seven stars. The three stars that are close together are the belt of the constellation. The Orion constellation, rises on the horizon due east and sets due west. At the equator it will pass directly overhead, and in the northern hemisphere it will pass south directly overhead. The top of Orion points in the direction of the Pole Star.



*About.com, 2007, Orion, Copyright 2007 by About Inc. Retrieved November 14, 2007, from <http://space.about.com/od/starsplanetgalaxies/ig/Constellations-Pictures/orion.htm>*

Figure 18-12-5 Orion

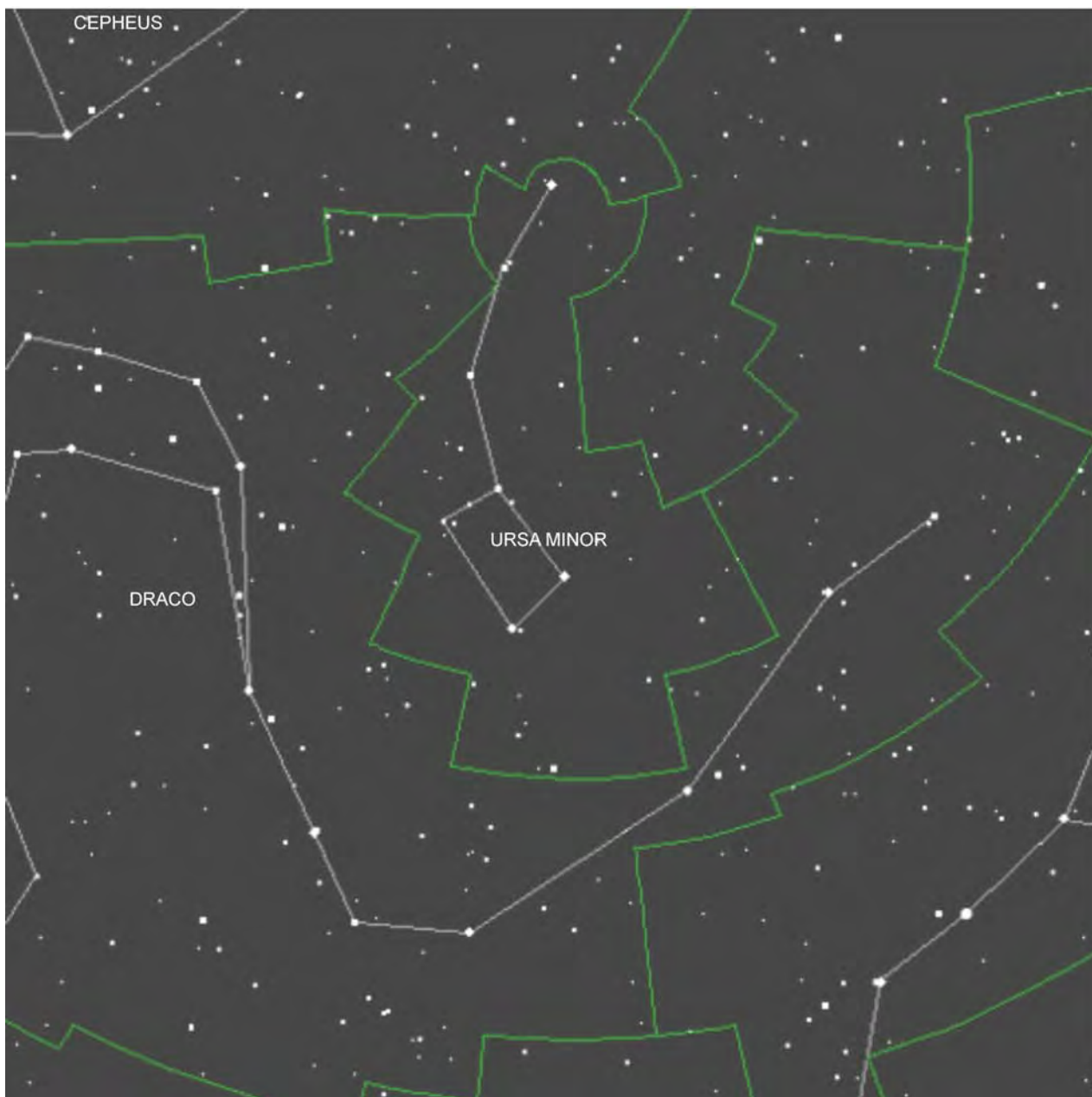


*National Association of Search and Rescue, Fundamentals of Search and Rescue, Jones and Bartlett Publishers, Inc. (p. 78)*

Figure 18-12-6 Orion and North

### **Ursa Minor (Little Dipper)**

Ursa Major is a constellation in the northern hemisphere. Its name means “Little Bear” in Latin. Ursa Minor is known as Little Dipper because its seven brightest stars appear to form a ladle, or dipper shape. The star at the end of the dipper’s handle is Polaris, the North or Pole Star.



*About.com, 2007, Ursa Minor, Copyright 2007 by About Inc. Retrieved November 14, 2007, from <http://z.about.com/d/space/1/7/f/P/ursaminor.gif>*

Figure 18-12-7 Ursa Minor

---

### ACTIVITY

Time: 5 min

---

### OBJECTIVE

The objective of this activity is to have cadets locate various constellations.

## RESOURCES

- Sky map, and
- Red-filtered flashlight.

## ACTIVITY LAYOUT

N/A.

## ACTIVITY INSTRUCTIONS

1. Indicate north to the cadets (use compass if necessary).
2. Hold the sky map upside-down (allowing the cadet to look at it) and overhead with the “N” on the map pointing north.



The east and west printed on the sky map are on the opposite side of the east and west of an earth map. The reason is that when the map is held above the head, the east and west markings will then be the same as on the ground. To better read a sky map in the dark, use a flashlight with a red filter so night vision is not affected.

3. With the aid of a local sky map, have the cadets locate:
  - a. Ursa Major,
  - b. Cassiopeia,
  - c. Orion, and
  - d. Ursa Minor.

## SAFETY

N/A.

---

### CONFIRMATION OF TEACHING POINT 2

---

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

---

### Teaching Point 3

### Explain, Demonstrate and Have Cadets Locate Polaris Using the Major Constellations Identified in TP2

Time: 5 min

Method: Demonstration and Performance

---

## POLARIS

Polaris is more commonly known as the North Star. It is the brightest star in the constellation Ursa Minor. It is very close to the celestial pole (0.7 degrees away from the pole rotation), making it the current Pole Star. The star lies in a direct axis above the North Pole and appears to stand almost motionless in the sky and the other stars seem to rotate around it. Polaris has been close to the actual position of north for the past 1000 years and during the course of the 21<sup>st</sup> century it will continue to close in on being in line with True North and will be closest on March 24, 2100 (almost 0.45 degrees away). After that date it will start to pull away and eventually another star will become the new Pole Star.

## Locating the North Star

Polaris is located in the constellation Ursa Minor, which contains the group of stars that make up the Little Dipper (as illustrated in Figure 18-12-7). Polaris is the star in the end of the Little Dipper's handle. Often the Little Dipper is not very bright and can be challenging to find.



*Lunar and Planetary Institute, 2007, Polaris, Copyright 2007 by Lunar and Planetary Institute. Retrieved November 14, 2007, from <http://www.lpi.usra.edu/education/skytellers/polaris/about.shtml>*

Figure 18-12-8 Polaris

## ACTIVITY

Time: 5 min

### OBJECTIVE

The objective of this activity is to have the cadets locate Polaris.

### RESOURCES

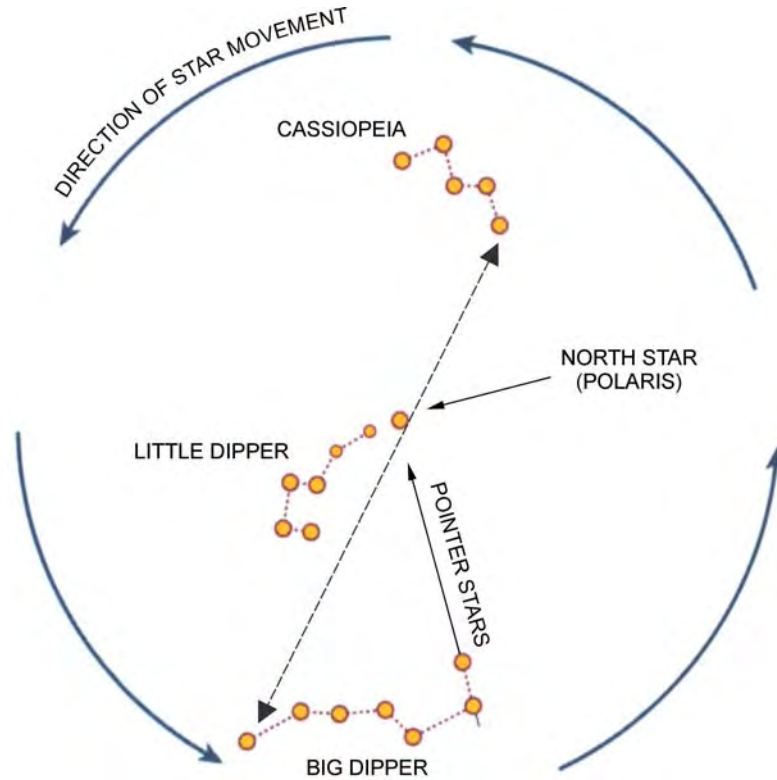
Handout located at Annex Q.

### ACTIVITY LAYOUT

N/A.

### ACTIVITY INSTRUCTIONS

1. Hand out copies of Annex Q to each cadet.
2. Have the cadets find the constellation Ursa Major (Big Dipper).
3. Have the cadets draw an imaginary line between the two stars (the pointers Merak and Dubhe) at the end of the big dipper's bowl as they will point toward the Pole Star. The distance to the Pole Star is about five times the distance between the pointers.



*National Association of Search and Rescue, Fundamentals of Search and Rescue, Jones and Bartlett Publishers, Inc. (p. 76)*

Figure 18-12-9 Finding Polaris

4. Have the cadets locate the constellation Cassiopeia, which is directly across from Ursa Major.
5. Have the cadets draw an imaginary line between the star at the end of Cassiopeia and the last star in the handle of Ursa Major (as illustrated in Figure 18-12-9). Polaris is almost equidistant between Ursa Major and Cassiopeia.

**SAFETY**

N/A.

---

**CONFIRMATION OF TEACHING POINT 3**

---

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

---

**END OF LESSON CONFIRMATION**

---

The cadets' participation in determining south by the phases of the moon, locating the various constellations and locating Polaris will serve as the confirmation of this lesson.

---

**CONCLUSION**

---

**HOMEWORK/READING/PRACTICE**

N/A.



**METHOD OF EVALUATION**

N/A.

**CLOSING STATEMENT**

It is important for the cadets to be able to navigate at night so they can find their way in the dark. In a survival situation being able to determine direction in the dark is a skill that can assist in being rescued.

**INSTRUCTOR NOTES/REMARKS**

N/A.

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**REFERENCES**

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- C0-111 (ISBN 978-0-9740820-2-8) Tawrell, P. (2006). *Camping and Wilderness Survival: The Ultimate Outdoors Book* (2<sup>nd</sup> ed.). Lebanon, NH: Leonard Paul Tawrell.
- C3-002 (ISBN 0-00-653140-7) Wiseman, J. (1999). *The SAS Survival Handbook*. Hammersmith, London: HarperCollins Publishers.

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**ROYAL CANADIAN AIR CADETS**  
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**SECTION 13**

**EO C390.08 – USE BLAZING TECHNIQUES**

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Total Time: 30 min

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**PREPARATION**

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**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.

Blaze a route using grass and rocks for the demonstration in TP 2.

Prepare a route that is 100 m long for the cadets to use during the activity in TP 3.

Photocopy the handout located at Annex R for each cadet.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TP 1 to present basic material on blazing.

Demonstration was chosen for TP 2 as it allows the instructor to explain and demonstrate blazing techniques.

Performance was chosen for TP 3 as it provides an opportunity for the cadet to practice blazing techniques under supervision.

---

**INTRODUCTION**

---

**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have used blazing techniques.

**IMPORTANCE**

It is important for the cadets to know how to use blazing techniques in a survival situation. Blazing techniques can be used when a cadet leaves a site to find water or build a signal fire and needs to find their way back. Blazing techniques may also help searchers find a survival site.

---

**Teaching Point 1****Explain the Reasons for Blazing**

Time: 5 min

Method: Interactive Lecture

---

**REASONS FOR BLAZING****Leaving and Returning to the Site**

When searching for water or finding higher ground to build a signal fire, the survivor may have to walk for a kilometre or more. Blazing will help to establish the route. If one loses their sense of direction they can follow it back to the survival site.



Most trails are spotted (marked) coming and going so that they can be seen from both directions of travel.

**Acting as a Guide to a Ground Search and Rescue (SAR) Party**

Signs in the area will act as a clue to any presence or past presence and the direction markers will help rescuers follow someone's trail.

---

**CONFIRMATION OF TEACHING POINT 1**

---

**QUESTIONS**

- Q1. Why are trails spotted (marked) in two directions?
- Q2. What does blazing help to establish?
- Q3. What do signs in the area act as a clue to?

**ANTICIPATED ANSWERS**

- A1. Most trails are spotted (marked) coming and going so that they can be seen from both directions of travel.
- A2. Blazing will help to establish the route. If one loses their sense of direction they can follow it back to the survival site.
- A3. Signs in the area will act as a clue to any presence or past presence and the direction markers will help rescuers follow someone's trail.

---

**Teaching Point 2****Explain and Demonstrate Blazing Techniques**

Time: 10 min

Method: Demonstration

---

**BLAZING TECHNIQUES**

**Blazing.** Signals left behind if leaving the scene of a crash or moving to and from, or abandoning a survival site. These may include any of the following:

- A large arrow shape made to indicate the direction in which one is travelling. It will be visible from the air and other direction markers which can be interpreted at ground level. Direction markers could include:
  - rocks or debris placed in an arrow shape,

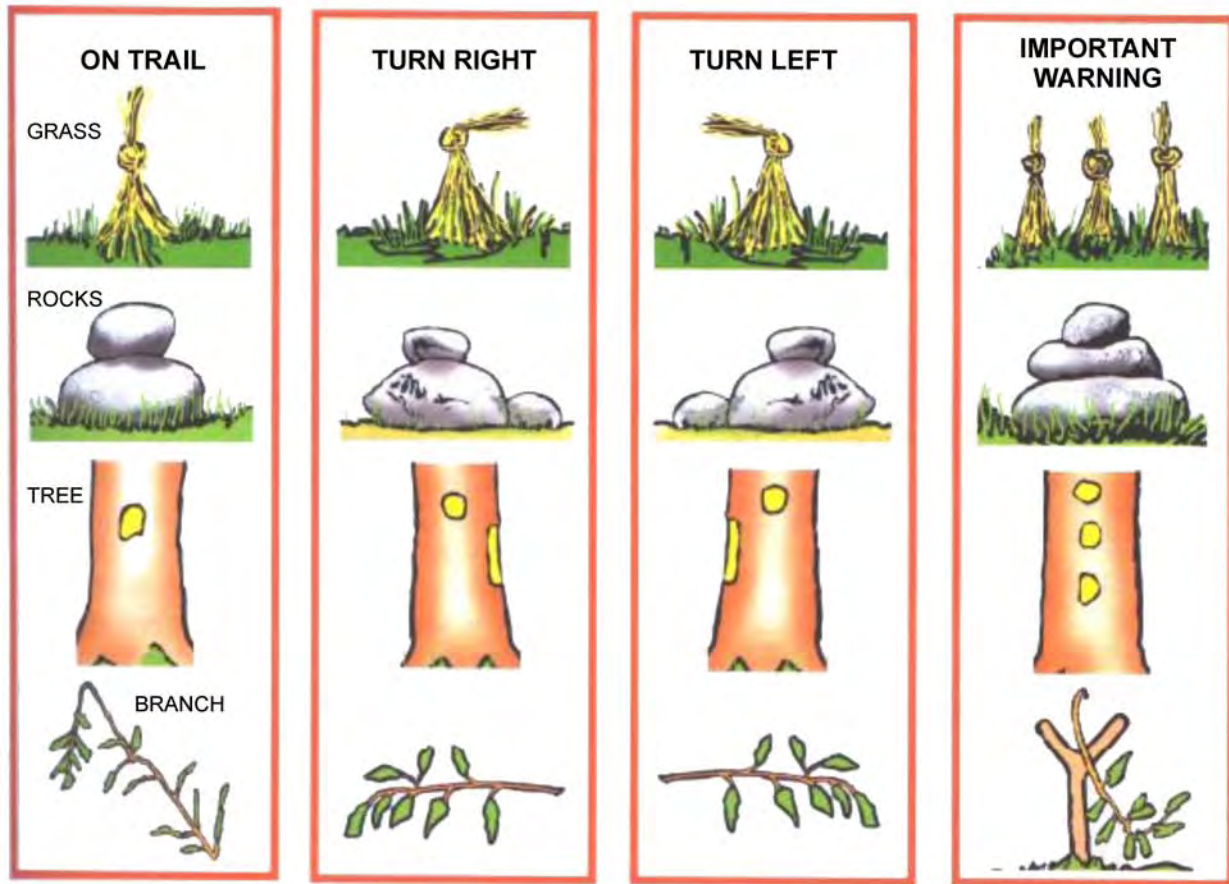
- a stick left in a crooked support, with the top pointing in the direction taken,
  - grass tied in an overhand knot with the end hanging in the direction followed,
  - forked branches laid with the fork pointing in the direction followed,
  - arrowhead-shaped notches cut out of tree trunks indicating a turn,
  - small rocks set upon larger rocks, with small rocks beside, and
  - a cross of sticks or stones meaning “not this way”.
- Trail-blazing signals, not only for people to follow but to establish a route to retrace and guide someone if they lose their sense of direction.
  - In case rescuers find the survival site while the lost person is away, written messages left in containers with details of planned movements. Hang them from tripods or trees and draw attention to them with markers.



Show the cadets the previously blazed trail with grass and rocks.

Allow the cadets to ask questions.

## EXAMPLES OF BLAZING



*P. Tawrell, Camping and Wilderness Survival: The Ultimate Outdoors Book, Paul Tawrell (p. 547)*

Figure 18-13-1 Blazing Techniques

### STEPS TO BLAZE A TRAIL

To blaze a trail with branches:

1. Find a route to follow for 100 m.
2. Gather branches which are already on the ground (deadfall or debris).
3. Create blazes by placing the branches along the route for 100 m.
4. At each created blaze, examine it from the point of view of returning along that trail. If necessary, create another blaze that will direct the person back along the trail.
5. Return the branches to the environment, when finished.



Demonstrate blazing with branches as the cadets observe.

---

## CONFIRMATION OF TEACHING POINT 2

---

**QUESTIONS**

- Q1. What can direction markers include?
- Q2. What is blazing?
- Q3. What should be left at the survival site?

**ANTICIPATED ANSWERS**

- A1. Direction markers may include:
- rocks or debris placed in an arrow shape,
  - a stick left in a crooked support, with the top pointing in the direction taken,
  - grass tied in an overhand knot with the end hanging in the direction followed,
  - forked branches laid with the fork pointing in the direction followed,
  - arrowhead-shaped notches cut out of tree trunks indicating a turn,
  - small rocks set upon larger rocks, with small rocks beside, and
  - a cross of sticks or stones meaning “not this way”.
- A2. Signals left behind if you leave the scene of a crash or abandon a survival site.
- A3. In case rescuers find the survival site while the lost person is away, written messages should be left in containers with details of planned movements.

**Teaching Point 3****Have Cadets Blaze a Trail**

Time: 10 min

Method: Performance



Have cadets blaze a trail using branches.

---

## ACTIVITY

---

**OBJECTIVE**

The objective of this activity is to have the cadets blaze a trail using branches.

**RESOURCES**

Handout of blazing techniques located at Annex R.

**ACTIVITY LAYOUT**

A route that is 100 m long.

## ACTIVITY INSTRUCTIONS

1. Distribute the handout located at Annex R to each cadet.
2. Have the cadets:
  - a. gather branches which are already on the ground (deadfall or debris);
  - b. place the branches along the route for 100 m;
  - c. turn the branches around when returning to the starting point; and
  - d. return the branches to the environment when the activity is complete.

## SAFETY

Ensure the cadets stay in the designated area during this TP.

---

### CONFIRMATION OF TEACHING POINT 3

---

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

---

### END OF LESSON CONFIRMATION

---

The cadets' participation in blazing a trail will serve as the confirmation of this lesson.

---

### CONCLUSION

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## HOMEWORK/READING/PRACTICE

N/A.

## METHOD OF EVALUATION

N/A.

## CLOSING STATEMENT

It is important for the cadets to know how to use blazing techniques in a survival situation. Blazing techniques can be used when the survivor leaves their site to find water or build a signal fire and needs to find their way back. Blazing techniques also help searchers find a survival site.

## INSTRUCTOR NOTES/REMARKS

N/A.

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### REFERENCES

---

- A3-016 B-GG-217-001/PT-001 Director Air Operations and Training. (1983). *Down But Not Out*. Ottawa, ON: Department of National Defence.
- C0-111 (ISBN 978-0-9740820-2-8) Tawrell, P. (2006). *Camping and Wilderness Survival: The Ultimate Outdoors Book* (2<sup>nd</sup> ed.). Lebanon, NH: Leonard Paul Tawrell.





**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 14**

**EO C390.09 – IDENTIFY ELEMENTS OF THE NIGHT SKY**

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Total Time:	120 min
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**PREPARATION**

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**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.

If there are insufficient quantities of planispheres and red-filtered flashlights, divide the cadets into groups based on the quantities available.

Planispheres may be created from Figures 15U-4 and 15U-5.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TP 1 in order to orient the cadets to the conditions required to observe the elements of the night sky.

Demonstration and performance was chosen for TP 2 as it allows the instructor to explain and demonstrate how to use a planisphere star chart while providing an opportunity for the cadets to practice the skill under supervision.

A practical activity was chosen for TP 3 as it is an interactive way to introduce the cadets to elements of the night sky. This activity contributes to the development of astronomy skills and knowledge in a fun and challenging setting.

---

**INTRODUCTION**

---

**REVIEW**

N/A.

**OBJECTIVES**

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

## IMPORTANCE

It is important for cadets to be able to identify the elements of the night sky so they can apply the knowledge acquired in a practical setting. Observing the night sky will allow the cadets to observe the moon, planets, stars and constellations. This may also assist in overcoming the sixth and seventh enemies of survival: boredom and loneliness.

---

### Teaching Point 1

### Describe Conditions Required to View the Elements of the Night Sky

Time: 5 min

Method: Interactive Lecture

---

## CLOUDS

The presence of clouds will inhibit observations of the elements of the night sky. Even partial cloud cover will make it more difficult to identify specific constellations by hiding parts of the constellation or obscuring elements used to find the constellation. It is best to observe the night sky on a cloudless night.

## MOON

The moon is the brightest object in the night sky. The moon itself does not shine, it reflects sunlight. When the moon is full, its light overpowers the light of the dim stars near it. For example, looking at a small flashlight that is next to a million candlepower flashlight, the light of the smaller flashlight is not any less, but its light is overpowered by the brighter flashlight.



The best time to look for stars is between the moon's last quarter and the first quarter, three hours after sunset so the sky is dark enough to see the low intensity stars.

The moon is second only to the sun as the largest source of natural light pollution.

## LIGHT POLLUTION



*T. Dickinson, NightWatch: A Practical Guide to Viewing the Universe, Firefly Books Ltd. (p. 48)*

Figure 18-14-1 Light Pollution's Effects

The sun and moon are the main sources of light pollution. However, artificial light pollution exists near built-up areas and makes the sky appear yellowish-gray as opposed to black. This happens because outdoor lighting illuminates the air as well as the ground. To clearly see stars at night, find a location that is free from lights. This includes individual lights, like street lights, as well as the glow that appears from built-up areas (eg, towns and cities). Figure 18-14-1 illustrates the effect of light pollution by contrasting the same section of sky with and without light pollution.

---

### CONFIRMATION OF TEACHING POINT 1

---

#### QUESTIONS

- Q1. Which natural phenomenon may inhibit the view of part or all of the night sky?
- Q2. What is the second brightest object that may be seen from Earth?
- Q3. What are examples of artificial light pollution?

#### ANTICIPATED ANSWERS

- A1. Clouds.
- A2. The moon.
- A3. This includes individual lights, like street lights, as well as the glow that appears from built-up areas (eg, towns and cities).

---

#### Teaching Point 2

**Explain, Demonstrate and Have the Cadets Use a Planisphere Star Chart**

Time: 10 min

Method: Demonstration and Performance

---



Instruct the cadets on the use of the specific planisphere star chart according to directions provided with the planisphere.

**Note:** Directions, for the *Firefly Planisphere: Latitude 42 deg N*, are included and may serve as an example of directions for the type of planisphere used.

Distribute one each, planisphere and red-filtered flashlight, per group of cadets and have the cadets orient their planisphere.

For this skill lesson, it is recommended that instruction take the following format:

1. Explain and demonstrate the complete skill while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be employed to monitor cadet performance.

Elements of the night sky can be identified with the naked eye, star charts, a planisphere star chart, binoculars or a telescope.

**Planisphere Star Chart.** An analog computer for calculating the position of stars. It has this name because the celestial sphere is represented on a flat plane, such as paper. Since the Earth is constantly in motion, the time

of day, time of year and location influence the appearance of the sky. An individual star chart cannot accurately represent all of these combinations. This would take many different star charts. A preferable method is to use a planisphere star chart which allows the user to twist a dial to show the true position of the stars.


Steps to use the *Firefly Planisphere: Latitude 42 deg N*:

1. Find the date around the outer edge of the disk, and the time of night on the inner, movable wheel. (As illustrated in Figure 18-14-2, the planisphere is set for 10 p.m. (22h) on the evening of January 23.)



R. Scagell, *Firefly Planisphere: Latitude 42 deg N*, Firefly Books Ltd.

Figure 18-14-2 Step 1

 Remember to allow for Daylight Savings Time (mid-spring to mid-fall) if it is in effect. This means subtracting one hour from the current time.

2. Hold the planisphere over your head. The oval map shows the entire sky, with the horizon around the edges of the map and the overhead point in the middle (as illustrated in Figure 18-14-3). Rotate the planisphere so that the eastern horizon, western horizon and the 'N' by the Midnight marker correspond with the ground.



*R. Scagell, Firefly Planisphere: Latitude 42 deg N, Firefly Books Ltd.*

Figure 18-14-3 Step 2

3. Pick out a major constellation by its shape. Remember that the map shows the whole sky, so what looks like a small pattern on the map may cover a large area of the sky. Once one constellation is found, it is used as a guide to locate other constellations. (as illustrated in Figure 18-14-4, the three central stars of Orion, known as Orion's Belt, will be used as a pointer to Sirius in Canis Major. Figure 18-14-5 illustrates a section of the planisphere and a section of night sky with Orion marked and Sirius circled.)



*R. Scagell, Firefly Planisphere: Latitude 42 deg N, Firefly Books Ltd.*

Figure 18-14-4 Step 3 Locating Sirius Using Orion's Belt



R. Scagell, *Firefly Planisphere: Latitude 42 deg N*, Firefly Books Ltd.

Figure 18-14-5 Step 3 Sirius Located



The above example used Orion as a guide; however, Orion is visible in Canada only from approximately November to April. If Orion is not visible, choose another constellation.

---

### CONFIRMATION OF TEACHING POINT 2

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The cadets' participation in using a planisphere will serve as the confirmation of this TP.

**Teaching Point 3****Describe and Have the Cadets Identify Elements of the Night Sky**

Time: 95 min

Method: Practical Activity



Depending on viewing opportunities, handouts may be created for the moon and Venus located at Annexes S and T.

**MOON**

The moon is the brightest object in the night sky. If the moon dominates the night sky making observing other elements of the night sky difficult, the opportunity should be used to observe the moon itself. While it may be a source of light pollution, when the Moon is at least half full, many features may be observed on its surface (see Annex S).

**VENUS**

The planet Venus and the Moon are the only natural objects that can be seen while the Sun is in the sky. Venus is normally seen either around dawn or dusk depending on where it is relative to Earth in its orbit (see Annex T).

**POLARIS**

Polaris is more commonly known as the North Star. It is the brightest star in the constellation Ursa Minor. It is very close to the celestial pole (0.7 degrees away from the pole rotation), making it the current North Star. The star lies in a direct axis above the North Pole and appears to stand almost motionless in the sky. Other stars seem to rotate around it. Polaris has been close to the actual position of north for the past 1000 years and during the course of the 21<sup>st</sup> century it will continue to close in on being in line with True North and will be closest on March 24, 2100 (approximately 0.45 degrees away). After that date it will start to pull away and eventually another star will become the new North Star.

**CONSTELLATIONS**

Throughout history humanity has gazed upon the stars and created patterns called constellations. These celestial groups are steeped in mythology and, in the case of the signs of the zodiac, embellished with the symbolism of astrology. One of the best known (in Canada) group of stars is known as the Big Dipper, however, it is not a constellation.



The Big Dipper is not a constellation. It is part of Ursa Major, the Great Bear. The Big Dipper is an asterism, a recognized, but not official, grouping of stars. Some asterisms fall within a single constellation; others cross constellations.

**Ursa Major**

Ursa Major means “Great Bear” in Latin. The seven brightest stars are located in the bear’s hindquarters and tail and form the well known asterism, the Big Dipper, as it appears to form the shape of a ladle, or dipper shape. The stars Dubhe and Merak, located on the outside edge of the dipper, are also known as “The Pointer” since they point in the direction of Polaris. Most of Ursa Major is visible year-round in Canada.

## Ursa Minor

Ursa Minor means “Little Bear” in Latin. Ursa Minor is known as Little Dipper because its seven brightest stars appear to form a ladle, or dipper shape. The star at the end of the dipper’s handle is Polaris, the North or Pole Star. Ursa Minor is visible year-round in Canada.

## Cassiopeia

Cassiopeia is a northern constellation which in Greek mythology represented a vain queen who boasted about her unrivalled beauty. It is made up of five stars that resemble a lopsided “M” or “W” depending on its position in the sky. It is visible year-round in Canada.

## Orion

Orion is a constellation often referred to as The Hunter. It is one of the largest and most visible constellations in the sky. The constellation consists of seven stars. The three stars that are close together at the centre of the constellation are known as Orion’s Belt. Orion is visible in Canada from approximately November to April.

## The Signs of the Zodiac

All of the signs of the zodiac will not be visible at the same time. This is due to the location of the signs around the celestial sphere, which means that several signs will be below the horizon at any one time.

The twelve signs of the zodiac are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, and Pisces.



See Annex U for more details of the 16 constellations. Use this information to answer questions the cadets may have about these constellations.

---

## ACTIVITY

Time: 85 min

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### OBJECTIVE

The objective of this activity is to have the cadets identify elements of the night sky.

### RESOURCES

- Planisphere star chart, and
- Red-filtered flashlight.

### ACTIVITY LAYOUT

N/A.

### ACTIVITY INSTRUCTIONS

1. Have the cadets locate the Moon (if visible).
2. Have the cadets locate Venus (if visible, see Annex T).
3. Have the cadets locate Polaris (always visible).



4. Have the cadets locate Ursa Major (always visible).
5. Have the cadets locate Ursa Minor (always visible).
6. Have the cadets locate Orion (if visible).
7. Have the cadets locate Cassiopeia (always visible).
8. Have the cadets, using a planisphere, locate signs of the zodiac.

### **SAFETY**

The site chosen for observing the night sky should be flat as the cadets will be concentrating on the sky and not where they are stepping.

---

### **CONFIRMATION OF TEACHING POINT 3**

---

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

---

### **END OF LESSON CONFIRMATION**

---

The cadets' identification of elements of the night sky will serve as the confirmation of this lesson.

---

### **CONCLUSION**

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### **HOMEWORK/READING/PRACTICE**

N/A.

### **METHOD OF EVALUATION**

N/A.

### **CLOSING STATEMENT**

Observing the night sky will allow the cadets to observe the moon, planet, star and constellations. This may assist in overcoming the sixth and seventh enemies of survival: boredom and loneliness.

### **INSTRUCTOR NOTES/REMARKS**

It is recommended this lesson be conducted after EO C340.04 (Describe Elements of the Night Sky, Chapter 15, Section 6).

---

### **REFERENCES**

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- C3-179 (ISBN 1-55209-302-6) Dickenson, T. (2006). *Night Watch: A Practical Guide to Viewing the Universe*. Richmond Hill, ON: Firefly Books Ltd.
- C3-180 (ISBN 1-55297-853-2) Scagell, R. (2004). *Firefly Planisphere: Latitude 42 Deg N*. Toronto, ON: Firefly Books Ltd.
- 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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**ROYAL CANADIAN AIR CADETS**  
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**SECTION 15**

**EO C390.10 – IDENTIFY METHODS OF PREPARING AND COOKING A SMALL ANIMAL OR FISH**

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Total Time: 60 min

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**PREPARATION**

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**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 practice skinning a small animal or preparing a fish and cooking a small animal or fish with the equipment provided prior to delivering the lesson.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

Demonstration was chosen for this lesson as it allows the instructor to explain and demonstrate skinning a small animal, preparing a fish and cooking a small animal or fish.

---

**INTRODUCTION**

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**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have identified methods of preparing and cooking a small animal or fish.

**IMPORTANCE**

It is important for the cadets to identify the methods of preparing and cooking a small animal or fish that can be used in a survival situation. While food is the last component of the survival pattern (a person can live for weeks without eating), if it is readily available, the efforts made in catching, preparing and cooking a small animal or a fish are worthwhile. Proper preparation and cooking minimizes the chances of getting sick and helps to preserve the food.

**Teaching Point 1****Explain and Demonstrate Skinning a Small Animal**

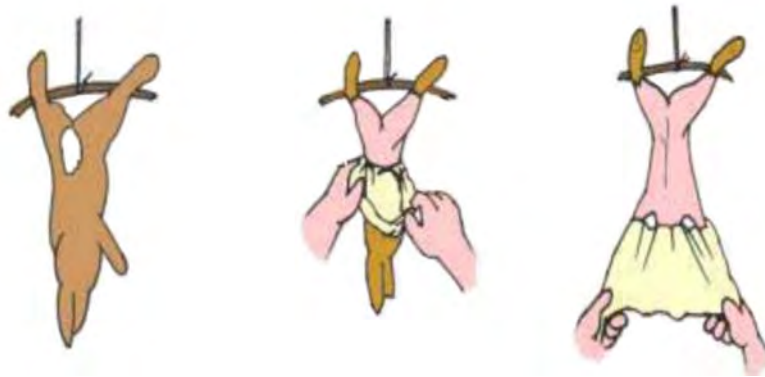
Time: 15 min

Method: Demonstration

**SKINNING A SMALL ANIMAL**

For best results, the steps for skinning a small animal should be done in the sequence outlined below.

1. Remove urine by holding the animal's forelegs and gradually squeeze down on the body from the chest to the bowels.
2. Cut a hole in the belly area.
3. Pull the skin apart at the hole exposing the guts. Remove the guts.
4. Cut the skin around the front and hind paws and between the hind legs.
5. Hang the small animal and pull off the skin by pulling it down and over the head.
6. Cut the head off the small animal.



Note. From "Dressing", Simple Survival. Retrieved March 15, 2007, from <http://www.simplesurvival.net/dressing.htm>

Figure 18-15-1 Skinning a Small Animal



The guts (innards or entrails) can be used as bait or buried as the odour will attract insects and scavengers.

**CONFIRMATION OF TEACHING POINT 1****QUESTIONS**

- Q1. How do you remove urine from the animal's body?
- Q2. What area of the animal's body is first cut?
- Q3. What is the last step in skinning an animal?

## ANTICIPATED ANSWERS

- A1. Remove the urine by holding the animal's forelegs and gradually squeeze down on the body from the chest to the bowels.
- A2. The first cut is made in the belly area.
- A3. Cutting the head off the small animal.

### Teaching Point 2

### Explain and Demonstrate Preparing a Fish

Time: 15 min

Method: Demonstration

## PREPARING A FISH

To prevent spoilage, prepare the fish as soon as possible. The innards (guts or entrails) can be used as bait or buried as the odour will attract insects and scavengers. Keep the fish cool and cook as soon as possible.

- Bleeding.** As soon as a fish is caught, cut its throat and allow it to bleed. Wipe the slime off the fish to make it less slippery. Do not let any slime get into your eyes as it may cause Fisherman's Conjunctivitis (pink eye). Cut out the gills (these are the flaps on both sides and just behind the fish's head) as they will quickly spoil.
- Gutting.** Make an incision from the anal orifice to where the throat was cut. Remove the entrails – you can use them for bait. Keep the roe, which runs down the side of the fish. It is hard in females and soft in males; it is very nutritious.



The roe of a fish are within the sexual organs (hard roe are eggs, soft roe is sperm). It is recommended that this is not explained to the cadets.

- Scaling.** Scaling is not necessary and fish can be cooked with scales on, but if there is time, scrape them off. Remove scales by holding the tail and pushing a dull knife across the skin at a forty-five degree angle. Draw the knife from tail to head.



Catfish have skin, not scales and should be skinned like a small animal.

- Filleting.** Pass the knife along the top side of the backbone. Cut behind the fin down to the backbone. Push the knife through and cut the fillet free from the tail. Cut the flesh away from the bones. Remove the fillet by cutting the skin at the stomach area.



*P. Tawrell, Camping and Wilderness Survival, Paul Tawrell (p. 144)*

Figure 18-15-2 Filleting a Fish

---

**CONFIRMATION OF TEACHING POINT 2**

---

**QUESTIONS**

- Q1. What is done as soon as a fish is caught?
- Q2. What should you do with the entrails?
- Q3. What is the process for filleting?

**ANTICIPATED ANSWERS**

- A1. As soon as a fish is caught, its throat is cut and allowed to bleed.
- A2. Remove the entrails – you can use them for bait.
- A3. Filleting:
  - 1. Pass the knife along the top side of the backbone.
  - 2. Cut behind the fin down to the backbone.

3. Push the knife through and cut the fillet free from the tail.
4. Cut the flesh away from the bones.
5. Remove the fillet by cutting the skin at the stomach area.

---

**Teaching Point 3**
**Explain Methods of Cooking a Small Animal or Fish and Demonstrate One of the Methods**

Time: 20 min

Method: Demonstration



While only one method will be demonstrated, all three are explained.

**COOKING A SMALL ANIMAL OR FISH**

In addition to killing parasites and bacteria, cooking food can make it more palatable. The methods chosen for cooking a small animal or fish are based on the items one may have in a survival situation.



Practice cooking a small animal or fish before demonstrating one of the following procedures to the cadets. Prepare all materials before the start of the class. The small animals and fish prepared during the instructor's practice should be cooked using all three methods and used as examples of the finished (fully cooked) products.

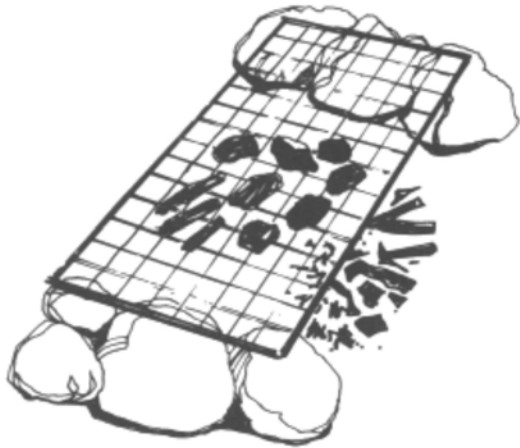
**GRILLING**

The following are some considerations for grilling food:

- Grilling is a quick way of cooking large amounts of food but it requires a support – such as wire mesh or a grid of green sticks – rested on rocks over the embers of the fire.
- It should only be used when food is plentiful since it wastes most of the fat from the meat.
- Hot rocks beside the fire can be used as grilling surfaces.

**Grilling:**

1. Place the large rocks on either side of the fire for the wire mesh/green sticks to rest on.
2. Place the wire mesh/green sticks (in grid formation) on the rocks above the fire.
3. Place food on the wire mesh/green sticks and cook until the meat is no longer pink. Fresh water fish are normally germ free and may be eaten raw, however it is more palatable when cooked.



IF NO WIRE MESH IS AVAILABLE, MAKE A GRID OF VERY GREEN STICKS OR REST A LONG STICK ON A FORKED SUPPORT SO THAT IT CAN HOLD FOOD OVER THE FIRE. WRAP FOOD AROUND THE STICK. YOU CAN ALSO BARBECUE MEAT AND VEGETABLES ON A STICK SUPPORTED ACROSS GLOWING EMBERS BY A FORKED STICK ON EACH SIDE.

*J. Wiseman, The SAS Survival Handbook, HarperCollins Publishers (p. 284)*

Figure 18-15-3 Grilling

## ROASTING

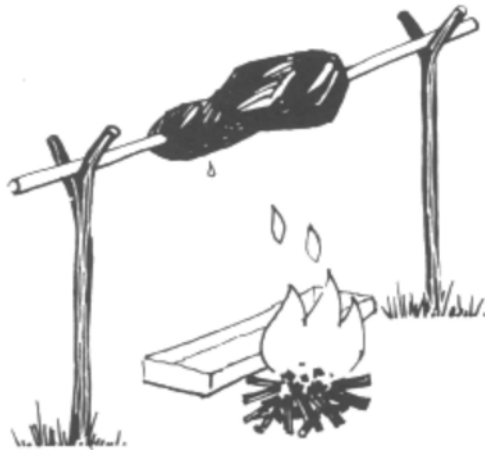
The following are some considerations for roasting food:

- Roasted meat cooks in its own fat.
- Continually turning the meat keeps the fat moving over the surface.
- The easiest method is to skewer the meat on a spit and turn it over the hot embers of a fire or beside a blazing fire where it is hot enough to cook.
- Roasting makes a very tasty dish but has two disadvantages:
  - Valuable fat is lost unless a drip tray is placed beneath the spit. Regularly baste the meat with fat from the tray.
  - Roasting by a fierce fire can cook and seal the outside, leaving the inner meat uncooked and harmful bacteria alive. A slow roast is preferable, and the inner meat can continue cooking after the outer meat has been cut off.

### Roasting:

1. Build a spit with two Y shaped sticks and a green stick as the centrepiece.
2. Place the spit over the fire.
3. Skewer the meat and place it on the spit. Turn it over the hot embers of the fire or place the spit beside a blazing fire where it is hot enough to cook. If possible, place a drip pan under the meat to catch the fat.
4. Continue turning the meat so the fat moves over the surface.





THE FIRE SHOULD BE SLIGHTLY TO ONE SIDE OF FOOD TO ALLOW FOR A DRIP TRAY TO CATCH VALUABLE FAT.

*J. Wiseman, The SAS Survival Handbook, HarperCollins Publishers (p. 284)*

Figure 18-15-4 Roasting

## FRYING

The following are some considerations for frying:

- Frying is an excellent way of adding variety to your diet if fat is available and you have a container in which to fry food.
- Any sheet of metal that you can fashion into a curve or give a slight lip can serve as a pan.
- In some areas, you may find a large leaf which contains enough oil that will not dry out before the cooking is done. Before you risk valuable food on them, try the leaves first. See if the leaves burn when placed over the embers. If you use a large leaf, fry only over embers, not over flames.

## Frying

1. Place a flat rock, large leaf, or sheet of metal on or next to the fire. (Avoid rocks with high moisture content, they may explode when heated).
2. Let the rock or metal heat up and cook on it as you would a frying pan.

---

## CONFIRMATION OF TEACHING POINT 3

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## QUESTIONS

- Q1. What are three types of cooking methods?
- Q2. Which type of cooking should only be used when food is plentiful?
- Q3. What material can serve as a pan?

## ANTICIPATED ANSWERS

- A1. Grilling, roasting and frying.
- A2. Grilling should only be used when food is plentiful since it wastes most of the fat from the meat.
- A3. Any sheet of metal that you can fashion into a curve or give a slight lip can serve as a pan.

---

### END OF LESSON CONFIRMATION

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The cadets' participation in identifying methods of preparing and cooking a small animal or fish will serve as the confirmation of this lesson.

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### CONCLUSION

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#### HOMEWORK/READING/PRACTICE

N/A.

#### METHOD OF EVALUATION

N/A.

#### CLOSING STATEMENT

It is important for the cadets to identify the methods of preparing and cooking a small animal or fish in a survival situation because before you can eat what you have caught you have to prepare and cook it. Proper preparation and cooking minimizes the chances of getting sick and helps to preserve the food.

#### INSTRUCTOR NOTES/REMARKS

Cadets who feel uncomfortable with skinning a small animal do not have to participate in that portion of the class but should be present for the TP on preparing a small animal or fish.

If a rabbit or squirrel cannot be caught in a snare, it may be bought at a farmers' market or a similar venue.

If a fish cannot be caught, it may be bought at a farmers' market or a similar venue.

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### REFERENCES

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- C0-111 (ISBN 978-0-9740820-2-8) Tawrell, P. (2006). *Camping and Wilderness Survival: The Ultimate Outdoors Book* (2<sup>nd</sup> ed.). Lebanon, NH: Leonard Paul Tawrell.
- C3-002 (ISBN 0-00-653140-7) Wiseman, J. (1999). *The SAS Survival Handbook*. Hammersmith, London: HarperCollins Publishers.
- C3-003 (ISBN 1-896713-00-9) Tawrell, P. (1996). *Camping and Wilderness Survival: The Ultimate Outdoors Book*. Green Valley, ON: Paul Tawrell.



**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 16**

**EO C390.11 – CONSTRUCT CAMP CRAFTS**

Total Time:

120 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.

Prepare three camp crafts for demonstration purposes.

Photocopy the diagrams detailing camp craft construction for the selected camp crafts located at Annexes V to AJ for each pair of cadets.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

A practical activity was chosen for this lesson as it is an interactive way to allow the cadets to practice constructing camp crafts in a safe, controlled environment.

**INTRODUCTION**

**REVIEW**

EO C190.03 (Tie Knots and Lashings, A-CR-CCP-801/PF-001, Chapter 15, Section 9) may serve as the review for this lesson.

**OBJECTIVES**

By the end of this lesson the cadet shall have constructed two camp crafts.

**IMPORTANCE**

It is important for the cadets to be able to construct camp crafts in a survival situation so they will be able to combat both the elements and psychological factors (eg, boredom and loneliness). It is important to construct camp crafts that serve a purpose in a survival situation (eg, a fishing pole does not have a purpose if there is no water present). The amount of energy put into constructing a camp craft should be relative to its usefulness.

**Teaching Point 1****Have the Cadets, in Pairs, Construct Two Camp Crafts**

Time: 110 min

Method: Practical Activity



For this skill lesson, it is recommended that the instruction take the following format:

1. Explain how the camp crafts that were prepared prior to the lesson were constructed.
2. Divide the cadets into pairs and distribute the handouts.
3. Have groups choose two camp crafts to construct.
4. Supervise the cadets as they construct camp crafts.

Cadets will choose the camp crafts they want to construct. If time allows, have each group construct a third camp craft.

**CAMP CRAFTS**

Two camp crafts will be chosen from the following:

- a ladder bed,
- a pack frame,
- a shower,
- a washstand,
- a drying rack,
- a tool rack,
- a camp craft for cooking, including:
  - a pot rod,
  - a swinging pot holder, or
  - a Chippewa kitchen;
- a wheelbarrow,
- a coat hanger,
- a simple bench,
- a bench with back rest,
- a camp table, or
- a friction-lock table.

---

**ACTIVITY**

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Time: 100 min

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**OBJECTIVE**

The objective of this activity is to have the cadets, in pairs, construct two camp crafts.

**RESOURCES**

- Knife,
- Cord,
- Axe,
- Bow saw,
- Other resources based on camp craft chosen, and
- Diagrams detailing camp craft construction (located at Annexes V to AJ).

**ACTIVITY LAYOUT**

N/A.

**ACTIVITY INSTRUCTIONS**

1. Divide the cadets into pairs and hand out diagrams detailing camp craft construction.
2. Have the cadets construct two camp crafts.
3. When camp crafts are completed, have the groups view all of the constructed crafts.
4. Do not leave camp crafts behind. Have the cadets redistribute all natural material used into the bush at the end of the lesson or exercise.

**SAFETY**

Tools shall be handled in a safe manner.

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**CONFIRMATION OF TEACHING POINT 1**

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

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**END OF LESSON CONFIRMATION**

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The cadets' participation in constructing camp crafts will serve as the confirmation of this lesson.

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**CONCLUSION**

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**HOMEWORK/READING/PRACTICE**

N/A.

## **METHOD OF EVALUATION**

N/A.

## **CLOSING STATEMENT**

It is important for the cadets to be able to construct camp crafts in a survival situation so they will be able to combat both the elements and psychological factors (eg, boredom and loneliness). It is important to construct camp crafts that serve a purpose for each survival situation (eg, a fishing pole does not have a purpose if there is no water present). The amount of energy put into constructing a camp craft should be relative to its usefulness.

## **INSTRUCTOR NOTES/REMARKS**

Natural resources found in the field, such as fallen or dead wood, are to be used for construction.

The directives found in CATO 11-08, *Environmental Protection and Stewardship*, are to be followed during this lesson.

The more difficult camp crafts should be constructed in advance for demonstration purposes.

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## **REFERENCES**

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- A0-039 CATO 11-08 Director Cadets 3. (1997). *Environmental Protection and Stewardship*. Ottawa, ON: Department of National Defence.
- C2-046 PioneeringProjects.org. (2004). *PioneeringProjects.org*. Retrieved February 20, 2007, from <http://www.pioneeringprojects.org/projects/index.htm>.
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**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 17**

**EO C390.12 – PERFORM MINOR FIRST AID IN A FIELD SETTING**

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Total Time:	120 min
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**PREPARATION**

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**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.

There is no requirement for a qualified first aid instructor to teach the material contained in this lesson, as the cadets are not required to qualify in first aid; however, the instructor should be a qualified first-aider.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

Demonstration and performance was chosen for TPs 1–3 and 5 as it allows the instructor to explain and demonstrate minor first aid while providing an opportunity for the cadet to practice and develop these skills under supervision.

An interactive lecture was chosen for TP 4 to introduce the cadets to the treatment of minor wounds and burns.

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**INTRODUCTION**

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**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet shall have performed minor first aid in a field setting.

**IMPORTANCE**

It is important for the cadets to be able to perform the selected minor first aid skills as injuries are a common occurrence in field settings. Having a basic understanding of minor first aid will allow the cadets to take action in an emergency situation.

**Teaching Point 1****Demonstrate and Have the Cadets Perform Minor First Aid**

Time: 25 min

Method: Demonstration and Performance

When performing first aid in the field there are certain considerations regardless of what the injury or illness is. The following are the first to be addressed:

- breathing problems,
- exposure,
- shock, and
- dehydration.

**BREATHING PROBLEMS**

Many people have died in the wilderness because they were left on their back while someone went to seek assistance. In most cases the person became unconscious and their relaxed tongue fell to the back of their throat blocking the air passage. In some cases the wounded individual vomited and it entered the lungs. In other cases blood from the nose or mouth collected in the airway and caused asphyxiation.

Placing a casualty in the recovery position is one of the basics of first aid. The recovery position protects an unconscious or injured casualty against fluid entering the lungs. If the casualty is on the snow or damp ground, a blanket or pad should be placed underneath to protect the face and reduce heat loss.



Have two assistants demonstrate each step as it is described.

**The Recovery Position**

The recovery position is adopted as follows:

1. Cross the casualty's legs at the ankles, with the leg further from you on top.
2. Place the arm that is closer to you along their side and the arm further from you across their chest (as illustrated in Figure 18-17-1).



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 3)*

Figure 18-17-1 Preparing the Roll



3. Support their head with one hand and grip their clothing at the waist on the far side.
4. Roll the person gently toward you, protecting their head and neck, and rest them against your knees (as illustrated in Figure 18-17-2).



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 3)*

Figure 18-17-2 Making the Roll

5. Bend their upper knee toward you to form a support (as illustrated in Figure 18-17-3).



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 3)*

Figure 18-17-3 Leg Position

6. Position their head with the chin slightly extended to keep their airway open.
7. Place the upper arm above the head to keep the casualty from rolling onto their face (as illustrated in Figure 18-17-4).
8. Place the lower arm along their back so they cannot roll onto their back.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 3)*

Figure 18-17-4 Final Position

If the individual is conscious and having breathing problems it is best to place them in a seated position. Casualties have died because they cannot get enough air into their lungs. A person lying down cannot breathe as well as someone who is sitting up.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 4)*

Figure 18-17-5 Semi-Sitting Position

## EXPOSURE

Exposure is a common hazard in a survival situation. It occurs when a person is exposed to the elements (eg, rain, snow, wind, immersed in water) and the body starts losing heat faster than it produces it. Hypothermia occurs when the body's core temperature falls below 33.7 degrees Celsius. If a person is wet, even in a mild wind, hypothermia may occur in temperatures as high as 15 degrees Celsius.

Anyone who is sick or injured is in more danger from exposure than a healthy person. They may get hypothermia or frostbite, because their bodies are unable to produce sufficient heat. A first-aider must protect a casualty from exposure even in a warm environment.

Protecting a casualty from exposure is as simple as covering them with a sleeping bag, blanket or extra clothing. It is also necessary to place something underneath the casualty as body heat is easily lost into the ground. Keep the casualty warm and dry as an injured person is extremely sensitive to changes in temperature.

## SHOCK

Shock may be present with many injuries or illnesses and is usually present in serious injuries. Shock occurs when there is inadequate organ perfusion (decreased blood flow through the organs).

### The Circulatory System

The heart is a pump. The arteries and veins work like flexible hoses: carrying blood to and from every part of the body, bringing oxygen and food, and removing carbon dioxide and waste products. The food and oxygen are “burned”, keeping the body healthy and producing heat. When organs are not getting enough oxygen to work properly the signs of shock will begin to show.

### Causes of Shock

Shock is caused by a drop in blood pressure. This pressure is provided by the heart and maintained by a system of veins and arteries. Several things may cause this pressure to drop; medications, prolonged rest, a variety of illnesses, and if there is a “leak” in the system from a bad cut or injury. With such a “leak”, blood flows out of the system and the pressure drops.

### Signs and Symptoms of Shock

Signs and symptoms of shock include:

- pale, cool clammy skin,
- rapid pulse rate,
- rapid breathing,
- thirst,
- gasping for air,
- anxiety,
- nervousness,
- confusion, and
- decreased amounts of urine.

### Shock Prevention and Treatment



Fainting is not the same as shock. It is caused by a shortage of blood flow to the brain.

Once shock begins, it may be difficult to stop. Always expect shock in any severe injury or illness and prevent/treat it by:

- ensuring a good airway;
- controlling bleeding;
- lying the casualty down on their back, with their feet raised 20–30 cm (8–12 inches) (do not tilt the entire body if there is difficulty breathing);
- keeping the casualty warm and comfortable;

- avoiding rough handling;
- reducing pain as much as possible (eg, by splinting fractures); and
- reassuring the casualty.

## DEHYDRATION



Dehydration is not usually a factor in urban first aid. In the wilderness, however, it often affects a person more than is realized.

Dehydration occurs when the body loses more water than it takes in. Dehydration is usually caused by:

- not drinking enough water;
- losing too much water through the skin by perspiration;
- losing too much water through the lungs by evaporation;
- losing water through vomiting or diarrhea; and
- frequently urinating.

A person who is working hard outdoors in a survival situation for several days with little opportunity to drink may become severely dehydrated and may show signs similar to shock. With the cold, very dry air in more northern regions, dehydration occurs more rapidly.

### Signs and Symptoms of Dehydration

Signs and symptoms of dehydration include:

- thirst,
- dry tongue,
- discomfort,
- tiredness,
- nausea,
- sleepiness,
- pale, cool and clammy skin,
- faster pulse,
- pinched skin on back of hand is slow to flatten out, and
- little urine, dark in colour.

A person who drinks an adequate amount of fluids and is healthy will produce at least 1 000 ml of urine per day.

### Prevention of Dehydration

Drink more water during outdoor activities. Try to drink even if there is no feeling of thirst. Remember that drinks containing caffeine are diuretics and will make one urinate more often. Although one can reduce thirst for a short time by nibbling on snow, remember that melting any amount of snow in the mouth takes an enormous

amount of heat from the body and produces little water. Any water one can get, no matter how cold, will use up less body heat than eating snow.



There are stories of people who have survived for long periods of time by drinking their own urine, but it is more likely that they survived in spite of drinking urine since urine and sea water contain large amounts of salt which draw water away from the tissues, having an overall negative effect on hydration.

---

## ACTIVITY

Time: 10 min

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### OBJECTIVE

The objective of this activity is to have the cadets practice putting a casualty in the recovery position.

### RESOURCES

N/A.

### ACTIVITY LAYOUT

N/A.

### ACTIVITY INSTRUCTIONS

1. Divide the cadets in groups of three or four.
2. Have one cadet act as the casualty, one act as the first-aider and one or two observe and assist.
3. The first-aider will put the casualty in the recovery position by:
  - a. crossing the casualty's legs at the ankles, with the leg furthest from the first-aider on top;
  - b. placing the arm closest to the first-aider along their side, the arm furthest from the first-aider across their chest;
  - c. supporting their head with one hand and grip their clothing at the waist on the far side with the other hand;
  - d. rolling the person gently toward the first-aider, protecting their head and neck, and resting them against the first-aider's knees;
  - e. bending their upper knee toward the first-aider to form a support;
  - f. positioning their head with the chin slightly extended to keep their airway open;
  - g. placing their upper arm to keep the casualty from rolling onto their face; and
  - h. placing the lower arm along their back so they cannot roll onto their back.
4. Have the cadets rotate through positions.

### SAFETY

N/A.

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## CONFIRMATION OF TEACHING POINT 1

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The cadets' participation in putting a casualty into the recovery position will serve as the confirmation of this TP.

---

### Teaching Point 2

### Demonstrate and Have the Cadets Practice Actions to be Taken at an Emergency Scene

Time: 30 min

Method: Demonstration and Performance

---



For this skill lesson, it is recommended that the instructor take the following format:

1. Explain and demonstrate the steps in the Priority Action Approach while cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be used to monitor the cadets' performance.

### ENSURE PERSONAL SAFETY

With serious injuries it is often difficult to know how to assist. Most people react well to less serious problems. When a person gets a cut or scrape or breaks an arm, it is easy to see and understand what is wrong and handle it without emotion or confusion.

In every first aid situation, before doing anything else, a person must make sure there is no further hazard threatening oneself or the casualty. Take care of the hazard first or get the casualty away from it.

Rescuer panic usually happens when the casualty is unconscious or dazed, when there is a lot of blood or disfigurement, or when we do not know what is exactly wrong with the casualty but suspect it is quite serious. Rescuers who are panicked need to regain control of themselves before performing first aid.

### FOLLOW THE STEPS IN A PRIORITY ACTION APPROACH

First aid employs the Priority Action Approach to identify and treat the most life threatening items first. Then the less critical areas are taken care of next. If the exact cause of the injury is known, either directly witnessed or the casualty is conscious and can describe the accident, there is no need to go through all the steps of the Priority Action Approach. However, if the cause is unknown it is necessary to follow a checklist of tasks.

The most common approach uses the first four letters of the alphabet as clues:

A = Airway and cervical spine

B = Breathing

C = Circulation

D = Deadly bleeds

Also, include "S" for shock, because it may be present in any serious injury or illness.



Check the level of consciousness (LOC), by talking to the casualty in a loud voice. If the casualty is unresponsive, immediately begin the Priority Action Approach.

**(A) Airway and Cervical Spine.** Check the airway. Is it open? Is there anything blocking the airway (eg, packed snow or blood)? Clear it. Is the tongue falling back blocking the airway? To open the airway, move the lower jaw upward without moving the neck.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 15)*

Figure 18-17-6 Chin Lift



If there is a possibility of neck injury, immobilize the neck with a cervical or improvised collar. Ensure airway is open.

**(B) Breathing.** Be sure the casualty is breathing. Remember, they can only live for minutes without air. Press an ear next to their lips. Listen for breathing, feel for their breath on the ear or cheek and watch for the chest to rise and fall. If the casualty is not breathing, start rescue breathing immediately.



### Rescue Breathing

With the chin lifted, as illustrated in Figure 18-17-6, place the mouth over the casualty's mouth and establish a seal. Close the nostrils and breathe into the casualty's mouth. Then lift the mouth away, permitting the casualty to exhale. The rescuer breathes 12 times each minute (15 times for a child and 20 for an infant) into the casualty's mouth.




Rescue breathing and cardiopulmonary resuscitation (CPR) are very different in purpose. Rescue breathing only addresses the casualty's breathing problems. CPR addresses both breathing and circulatory problems. CPR requires extensive practice and will not be covered in this lesson.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 15)*

Figure 18-17-7 Breathing

**(C) Circulation.** Check the circulation. Is there a pulse? The pulse in the neck (carotid pulse) is the easiest to check, because it is strongest. Fingers can be slipped onto the neck without removing clothing and risking frostbite. If there is no pulse and the first-aiders has CPR training, start CPR.

 Breathing and circulation go hand in hand and a casualty cannot survive without either. If there is no pulse, chances are unlikely that the casualty will be breathing. They can still have a heartbeat and not be breathing if the injuries are recent. Start rescue breathing in this situation.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 16)*

Figure 18-17-8 Pulse

**(D) Deadly Bleeds.** Make sure that the casualty is not bleeding severely from somewhere unseen. While wearing latex or surgical gloves, slide a hand gently beneath the casualty then remove and look for blood on the gloves. If the casualty is bleeding severely, try to stop it. Next, feel carefully underneath the casualty for any obvious bumps, irregularities or tenderness in the spine indicating damage.





*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 16)*

Figure 18-17-9 Bleeding

**(S) Shock.** Shock is a life-threatening disability. If the casualty shows or is likely to show the signs of shock, begin treatment immediately.



Shock is covered in TP 1.

Completing the Priority Action Approach should only take a couple of minutes.



First-aiders should wear latex gloves whenever they may be exposed to bodily fluids because of the increasing danger of HIV (the AIDS virus), hepatitis (A, B, C, D, and E) and other diseases. Every first aid kit should include one or more pairs of gloves. They can be obtained at a drug store, nursing station or hospital. After use, the contaminated gloves should be carefully removed and burned. Any blood that accidentally spatters onto skin must be washed off immediately with soap and water.

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### CONFIRMATION OF TEACHING POINT 2

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The cadets' participation in completing the Priority Action Approach will serve as the confirmation of this TP.

**Teaching Point 3****Demonstrate and Have the Cadets Move a Casualty to Shelter**

Time: 30 min

Method: Demonstration and Performance



For this skill lesson, it is recommended that the instructor take the following format:

1. Explain and demonstrate each carry while the cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor the cadets as they imitate each step in groups of two or three.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be used to assist with carries and monitor the cadets' performance.

**MOVING AND CARRYING OVER SHORT DISTANCES**

Many wilderness emergencies require moving or carrying a casualty a short distance, with usually only one or two rescuers. It is difficult to carry an adult for any distance and it is easy to injure them further while carrying.

**Drags**

A casualty should be dragged only if they must be moved quickly out of danger, severe cold, strong winds, blowing snow or water. It is important to assess the casualty before attempting a drag because some injuries, if not yet stabilized, may be aggravated by premature movement. If there is only one rescuer, dragging may be the only means of moving a casualty.

When dragging a casualty, observe the following rules:

- Drag a casualty headfirst. This allows the head and neck to be supported and keeps the body straight.
- Keep the body in-line. The casualty's body must not twist or bend. Avoid major bumps.
- The neck should not bend sharply, nor should the head fall forward or to the side.

Steps to drag a person:

1. If possible, secure the casualty's hands before beginning the drag.
2. Reach under the casualty's body and grip their clothing just below their shoulder on either side while supporting the head and neck using the forearms.
3. Crouch or kneel and walk backwards (as illustrated in Figure 18-17-10).
4. Stop when the casualty is out of danger.



This drag is hard on the rescuer's back, so be careful.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 21)*

Figure 18-17-10 Drag

5. If the casualty's clothing pulls up too much or tears, place a shirt or jacket over their chest and bring the sleeves under their back to provide a firm grip (as illustrated in Figure 18-17-11).



The first-aider can use cuff buttons or Velcro, mitten ties or a piece of cord to assist in this drag.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 21)*

Figure 18-17-11 Modified Drag

### Tarp Drag Method



Rarely should lifts or carries be done on snow because of the possibility of the rescuer slipping; it is safer and easier to drag a casualty on a tarp or sled.

The tarp drag method works well on snow. A rescuer may make a ramp of snow and slide a casualty onto a sled. This drag is also a good way to move a casualty onto insulating material to protect them from the cold ground or snow.

One may wish to leave the tarp under the casualty to aid in another lift. Always put the casualty into a basket stretcher with a backboard, blanket or tarp under them, as it is otherwise difficult to remove them without excessive movement.



Be careful when using the tarp drag method on sloping snow as control may be lost on a downhill slope.

Dragging a casualty on a tarp, blanket, sail, tent or large hide can be accomplished by following these steps:

1. Place the tarp next to the casualty.
2. Fold the tarp into accordion folds of about 1 m (3 feet) wide.
3. Log-roll the casualty toward the first-aider and brace them there with your knees while the first-aider use one hand to slide the folds close against their back.
4. Roll the casualty gently back onto the accordion folds.
5. Reach under the casualty and pull the folds out straight.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 21)*

Figure 18-17-12 Rolling Onto a Tarp

6. Grip the tarp and hold the casualty's head and shoulders off the ground and drag carefully.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 21)*

Figure 18-17-13 Tarp Drag

### **Single-Rescue Carries**

Most single-rescue carries are for short distances and cannot be used to transport a casualty with major injuries. All are extremely strenuous. They are often used to transport casualties with injuries of the lower extremities but care must be taken as it is easy to cause further injuries.

### **Packstrap Carry**

This is a quick, easy carry for very short distances. The casualty must be able to stand to get into position with their arms across the shoulders like packstraps. Bring the casualty's arms across the shoulders, crossing their wrists in front. Hold their wrists while bending forward and lift the casualty's feet off the ground. Be sure their arms are bent at the elbow.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 23)*

Figure 18-17-14 Packstrap Carry

### **Pickaback Carry**

This familiar carry is good for short-distance transport of conscious casualties with minor injuries and may be used to carry children for long distances.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 23)*

Figure 18-17-15 Pickaback Carry

### **Carrying Seat**

A quick and easy backpack seat to assist the pickaback system may be made with a simple loop of wide strap. It may be necessary to adjust the length once or twice for maximum comfort. This seat is best used if the casualty is lighter than the rescuer, otherwise it may put pressure on the rescuer's neck and shoulders.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 23)*

Figure 18-17-16 Carrying Seat With Wide Strap

### **CARRYING OVER LONG DISTANCES USING TWO-PERSON CARRIES**

Lifting is half as strenuous if there are two rescuers; however carrying for any distance is usually not easier because two carriers must compensate for each other's movements to keep balanced. The chance of error is multiplied with each added person in a lifting team and injury to the casualty often occurs if lifts are poor. Whenever more than one person lifts, observe the following rules:

- One person must be clearly designated as the leader and be responsible for giving all of the commands.
- The partner(s) must be told exactly what is to be done and what the commands will be.
- The lift should first be practiced without the casualty or on an uninjured person.
- Rescuers should maintain eye contact while lifting.

### **The Fore-and-Aft Lift and Carry**

This should be used only if the casualty has minor injuries. On uneven terrain, it may be the easiest method of lifting a casualty onto a stretcher or another means of transport. As it produces some pressure against the chest, it will restrict the casualty's air flow. Follow these steps:

1. If the casualty is conscious, help them sit up. If the casualty is unconscious, have a partner take the casualty's hands and pull them into the sitting position.
2. Cross the casualty's arms on their chest.
3. Crouch behind them, reach under their arms and grasp the opposite wrists.
4. Have your partner crouch between the casualty's knees, facing the casualty's feet and take a leg under each arm.
5. At the leader's signal, rise, keeping your back straight.





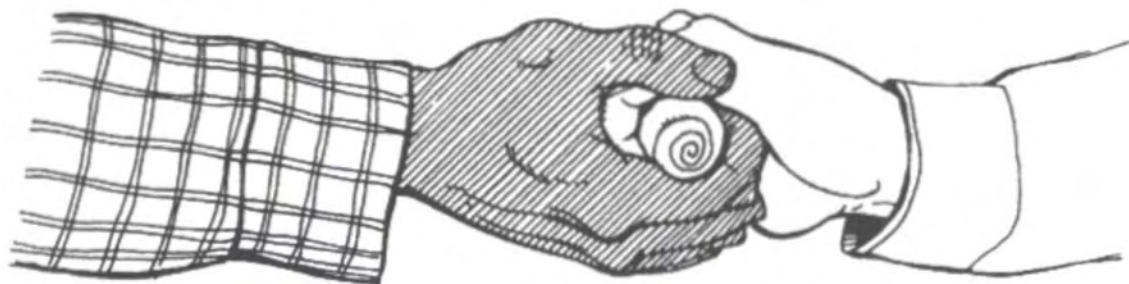
*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 26)*

Figure 18-17-17 Fore-and-Aft Lift and Carry

### Two-Hand Seat

This two-person lift and carry is good for casualties who cannot hold onto the rescuer's shoulders for support, or who are not fully alert.

1. Rescuers crouch on either side of the casualty.
2. Each rescuer will slide one hand under the casualty's thighs and lock fingers over a pad or while wearing mittens or gloves so that fingernails do not dig into each other (as illustrated in Figure 18-17-18).



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 26)*

Figure 18-17-18 Hand Grip

3. Reach across the casualty's back and grip their belt and pants at the opposite hip; the rescuers' arms are crossed (as illustrated in Figure 18-17-19).
4. Rise on command and step off with the inside foot. This supports the casualty's back; however, the fingers of the gripping hands will tire quickly.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 26)*

Figure 18-17-19 Two-Person Lift

For longer carries, try gripping your partner's wrists rather than their fingers. If wearing mittens, gripping the wrist will be more secure than gripping the hand. If the casualty is unconscious, they may be lifted easily to a sitting position. One rescuer pulls on the casualty's hands while the other lifts and supports their head; then the rescuers move into position while supporting the casualty's head and back.



*W. Merry, St. John Ambulance: The Official First Aid Guide, McClelland & Stewart Inc. (p. 26)*

Figure 18-17-20 Two-Person Carry

---

**CONFIRMATION OF TEACHING POINT 3**

---

The cadets' participation in completing all the carries will serve as the confirmation of this TP.

---

**Teaching Point 4****Have the Cadets Identify Minor Wounds and Types of Burns**

Time: 10 min

Method: Interactive Lecture

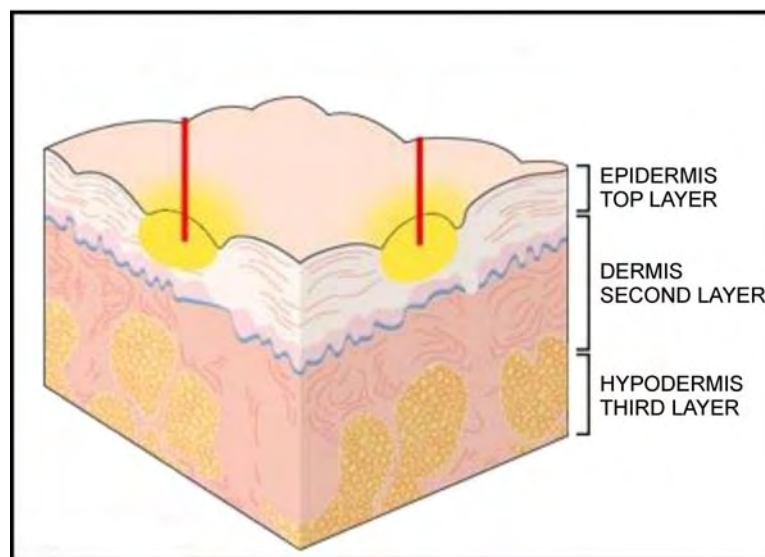
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**MINOR WOUNDS**

Minor wounds are those that do not have severe bleeding; bleeding wounds can be internal (inside the body) or external (outside the body). Common external bleeding wounds are:

- abrasions and scrapes, and
- nicks and cuts.

There is always a risk of infection when the skin's top layer is broken. Knowing how to identify and treat minor wounds can reduce the risk of infection or aggravation.



*Irishhealth.com, Copyright 2007 by Irishhealth.com. Retrieved March 17, 2007, from <http://irishhealth.com/index.html?level=4&con=467>*

Figure 18-17-21 Layers of Skin

**Abrasions and Scrapes.** These occur on the top layer of the skin, when the skin is scraped or rubbed away. They are often painful and may bleed in small amounts.

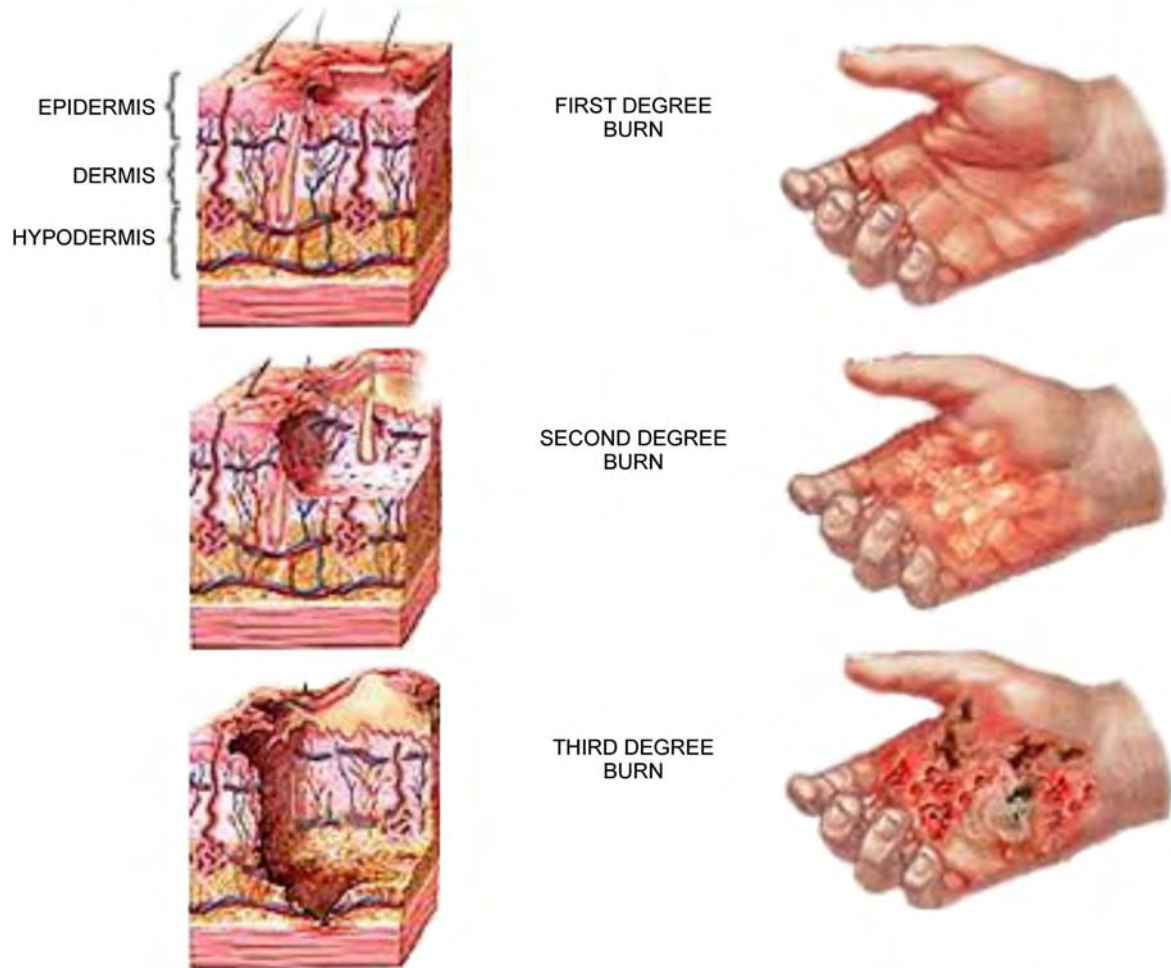
**Nicks and Cuts.** Cuts are breaks in the top or second layer of the skin; there is often minor bleeding involved.



*TheFatManWalking.com, Copyright 2006 by FatManWalking.com. Retrieved March 6, 2007, from <http://www.thefatmanwalking.com/page/65492/?jsessionid=mni5xlvdm9>*

Figure 18-17-22 Leg Scrape

## TYPES OF BURNS



*Medline Plus, Medical Encyclopedia, Copyright 2007 by US National Library of Medicine. Retrieved March 19, 2007, from [http://www.nlm.nih.gov/medecineplus/ency/presentations/100208\\_4.htm](http://www.nlm.nih.gov/medecineplus/ency/presentations/100208_4.htm)*

Figure 18-17-23 Types of Burns

**First-Degree Burns.** Called superficial burns and only affect the top layer of skin. Hot liquids, heat, and the sun are the main causes of these burns.

Signs and symptoms of a first-degree burn include:

- pinkish-reddish skin,
- slight swelling of the area,
- mild to moderate pain in the area, and
- sore, dry skin.



VisualDxHealth, 2006-2008. Sunburn, Copyright 2007 by Logical Images, Inc. Retrieved March 17, 2008, from [http://www.visualdxhealth.com/images/dx/webChild/sunburn\\_43305\\_lg.jpg](http://www.visualdxhealth.com/images/dx/webChild/sunburn_43305_lg.jpg)

Figure 18-17-24 First-Degree Burn



Sunburns are first-degree burns.

**Second-Degree Burns.** Affect the second layer of skin. Hot liquids, the sun, chemicals, and fire are the main causes of these burns.

Signs and symptoms of a second-degree burn include:

- raw-looking, moist skin,
- skin colouring that may range from white to cherry red,
- blisters containing clear fluid, and
- extreme pain in the area.



*Sickkids.ca. Copyright 1999 by The Hospital for Sick Children. Retrieved March 6, 2007, from <http://www.sickkids.ca/plasticsurgery/section.asp?s=Burns&s ID=4489&ss=About+Burns&ssID=4496>*

Figure 18-17-25 Second-Degree Burn

**Third-Degree Burns.** Affect the third layer of skin and can extend into the muscle. Contact with extreme heat sources (eg, hot liquids and solids, direct flame, chemicals) and electricity are the main causes of these burns.

Signs and symptoms of a third-degree burn include:

- dry, leathery skin,
- pearly white, tan, grey, or charred black skin,
- blood vessels or bone may be visible,
- little or no pain (nerves are destroyed),
- breathing problems, and
- shock.



*Sickkids.ca. Copyright 1999 by The Hospital for Sick Children. Retrieved March 6, 2007, from <http://www.sickkids.ca/plasticsurgery/section.asp?s=Burns&s ID=4489&ss=About+Burns&ssID=4496>*

Figure 18-17-26 Third-Degree Burn

---

#### CONFIRMATION OF TEACHING POINT 4

---

#### QUESTIONS

- Q1. Where do abrasions and scrapes occur?
- Q2. What layer of the skin does first-degree burn affect and what are the main causes?
- Q3. What are the main causes of third-degree burns?

#### ANTICIPATED ANSWERS

- A1. They occur on the top layer of the skin, when the skin is scraped or rubbed away. They are often painful and may bleed in small amounts.
- A2. Called superficial burns and only affect the top layer of skin. Hot liquids, heat and the sun are the main causes of these burns.
- A3. Contact with extreme heat sources (eg, hot liquids and solids, direct flame, chemicals) and electricity are the main causes of these burns.



**Teaching Point 5****Demonstrate and Have the Cadets Treat Minor Wounds and First-Degree Burns**

Time: 150 min

Method: Demonstration and Performance



For this skill lesson, it is recommended that the instructor take the following format:

1. Explain and demonstrate treating minor wounds and first-degree burns while the cadets observe.
2. Explain and demonstrate each step required to complete the skill. Monitor the cadets as they imitate each step.
3. Monitor the cadets' performance as they practice the complete skill.

**Note:** Assistant instructors may be used to assist with carries and to monitor the cadets' performance.

**TREATMENT FOR MINOR WOUNDS**

There are three basic objectives when treating abrasions, scrapes, nicks and cuts:

- to control bleeding;
- to prevent further injury; and
- to reduce the risk of infection.



Have cadets, in pairs, practice the principles of cleaning and treating a wound, using the following resources:

- gauze,
- gloves,
- scissors,
- sterile dressing, and
- tape.

Principles of cleaning and treating a minor wound to avoid infection:

1. Wash hands with soap and water and put gloves on. Do not cough or breathe directly over the wound.
2. Fully expose the wound, without touching it.
3. Gently wash loose material from the surface of the wound. Wash and dry the surrounding skin with clean dressings, cleaning the wound with clean gauze wiping from the centre of the wound to the edge of the wound (an antibiotic cream can be used on surface wounds and abrasions).
4. Cover the wound promptly with a sterile dressing.



*Medline Plus, Medical Encyclopedia, Copyright 2007 by US National Library of Medicine. Retrieved March 19, 2007, from [http://www.nlm.nih.gov/medecineplus/ency/presentations/100208\\_4.htm](http://www.nlm.nih.gov/medecineplus/ency/presentations/100208_4.htm)*

Figure 18-17-27 Washing the Wound

5. Tape the dressing in place.
6. Remove and dispose of the gloves and wash your hands and any other skin area that may have been in contact with the casualty's blood.



*Medline Plus, Medical Encyclopedia, Copyright 2007 by US National Library of Medicine. Retrieved March 19, 2007, from [http://www.nlm.nih.gov/medecineplus/ency/presentations/100208\\_4.htm](http://www.nlm.nih.gov/medecineplus/ency/presentations/100208_4.htm)*

Figure 18-17-28 Dressing and Taping the Wound

## TREATMENT FOR FIRST-DEGREE BURNS



Have cadets, in pairs, practice the principles of cleaning and treating heat and radiation burns, using the following resources:

- gauze,
- gloves,
- scissors,
- sterile dressing, and
- tape.

**Heat Burns.** The most common types of burns; caused by sources of heat such as flames from stoves, lanterns, and fires. A scald is a heat burn caused by hot liquid or steam.

To treat a heat burn:

1. Immerse the burn in cool water until the pain is reduced. If it is not possible to immerse the burn in cool water, flush the burn with cool water and cover it with a clean, wet cloth.



*Medline Plus, Medical Encyclopedia, Copyright 2007 by US National Library of Medicine. Retrieved March 19, 2007, from [http://www.nlm.nih.gov/medecineplus/ency/presentations/100213\\_1.htm](http://www.nlm.nih.gov/medecineplus/ency/presentations/100213_1.htm)*

Figure 18-17-29 Cooling the Burn

2. Cover the burn with a clean, lint-free dressing.
3. Seek further medical attention, if necessary.



*Medline Plus, Medical Encyclopedia, Copyright 2007 by US National Library of Medicine. Retrieved March 19, 2007, from [http://www.nlm.nih.gov/medecineplus/ency/presentations/100213\\_1.htm](http://www.nlm.nih.gov/medecineplus/ency/presentations/100213_1.htm)*

Figure 18-17-30 Dressing the Burn

**Radiation Burns (Sunburns).** These are caused by over-exposure to sunlight and can be prevented by wearing sunscreen of a high sun protection factor (SPF), long sleeves, and wide-brimmed hats. Sunburns range from mild to serious.



SPF indicates the time a person using sunscreen can be exposed to sunlight before getting sunburn. For example, a person who would normally burn after 12 minutes in the sun would expect to burn after 120 minutes if protected by a sunscreen with SPF 10. The higher the SPF, the more protection sunscreen offers against ultraviolet radiation (UV).

To treat radiation burns:

1. Seek shade.
2. Gently sponge the area with cool water.
3. Cover the area with a cool wet towel.
4. Repeat as needed to relieve pain.
5. Pat the skin dry.
6. Apply medicated sunburn lotion (ointment).
7. Seek medical attention, if necessary.



Blisters caused by sunburns should not be broken. Fevers and vomiting indicate a serious sunburn and medical attention should be sought immediately.

---

**CONFIRMATION OF TEACHING POINT 5**

---

The cadets' participation in treating minor wounds and first-degree burns will serve as the confirmation of this TP.

---

**END OF LESSON CONFIRMATION**

---

The cadets' participation in placing a casualty in the recovery position, practicing the Priority Action Approach, moving a casualty to shelter and treating minor wounds and first-degree burns will serve as the confirmation of this lesson.

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**CONCLUSION**

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**HOMEWORK/READING/PRACTICE**

N/A.

**METHOD OF EVALUATION**

N/A.

**CLOSING STATEMENT**

It is important for the cadets to be able to perform the selected minor first aid skills as injuries are a common occurrence in field settings. Having a basic understanding of minor first aid will allow the cadets to take action in an emergency situation.

**INSTRUCTOR NOTES/REMARKS**

There is no requirement for a qualified first aid instructor to teach the material contained in this lesson, as the cadets are not required to qualify in first aid; however, the instructor should be a qualified first-aider.

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**REFERENCES**

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**ROYAL CANADIAN AIR CADETS**  
**PROFICIENCY LEVEL THREE**  
**INSTRUCTIONAL GUIDE**



**SECTION 18**

**EO C390.13 – ACT AS A MEMBER OF A GROUND SEARCH AND RESCUE (SAR) PARTY**

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Total Time:	120 min
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**PREPARATION**

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**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.

Examples of confinement methods and clues are to be created prior to the lesson.

The lost person's survival site is to be created prior to the lesson.

The briefing to be presented in TP 4 should be created based on the details of the lost person that will be found at the scenario's survival site. A sample briefing is located at Annex AK.

Additional staff will be required during TP 4 for supervision and assistance in the search.

**PRE-LESSON ASSIGNMENT**

N/A.

**APPROACH**

An interactive lecture was chosen for TP 1 to present the categories of lost persons and other general information to the cadets.

Demonstration was chosen for TPs 2 and 3 as it allows the instructor to explain and demonstrate limiting the search area and clue orientation which the cadet is expected to learn.

A practical activity was chosen for TP 4 as it is an interactive way to experience being a member of a search and rescue party. This activity contributes to the development of search and rescue skills and knowledge in a fun and challenging setting.

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**INTRODUCTION**

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**REVIEW**

N/A.

**OBJECTIVES**

By the end of this lesson the cadet, in pairs, shall have acted as a member of a ground SAR party.

## IMPORTANCE

It is important for the cadets to know how a ground SAR party operates so they know what to look for when searching for a lost person. It is easier for them to plan their rescue in a survival situation.

---

### Teaching Point 1

### Explain Lost Person Behaviour and General Information

Time: 10 min

Method: Interactive Lecture

---

## LOST PERSON BEHAVIOUR

**Profiling.** Recording and analyzing a person's psychological and behavioural characteristics, to assess or predict their capabilities or to assist in identifying a particular subgroup of people.

People that become lost exhibit specific traits that have been profiled from SAR statistics. These traits, if known to the SAR party, will greatly help in the search effort. While there will always be exceptions, lost persons will generally react to their situation based on these specific traits.

### Children (1–3 Years)

Children will rarely be far from the point they were last seen, unless some mode of transportation is available (eg, a river, boat, vehicle). In general, children in this age group exhibit the following traits:

- unaware of the concept of being lost;
- navigation skills and sense of direction are practically non-existent;
- tend to wander aimlessly with no specific objective; and
- will seek out the most convenient location to lie down and go to sleep, for example:
  - inside a hollow log,
  - under a thick bush,
  - under an overhanging rock, or
  - under a picnic table.

### Children (3–6 Years)

Children will rarely be far from the point they were last seen, unless some mode of transportation is available (eg, a river, boat, vehicle, bicycle). In general, children in this age group exhibit the following traits:

- more mobile and capable of walking further than children aged 1–3 years;
- have a concept of being lost and will generally try to return home or go back to a place they are familiar with;
- have definite interests and may be drawn away by animals, older children or just exploring;
- when tired, generally try to find a spot to sleep; and
- some have been instructed to stay away from strangers and as a result will not answer or talk to searchers when called by name.



### **Children (6–12 Years)**

This group is much more complex than the previous groups in that they may intentionally be running away. They may also seek out some mode of transportation (eg, boat, vehicle, bicycle). In general, members of this group exhibit the following traits:

- navigational and directional skills are much more developed;
- generally oriented to their normal, familiar surroundings and become confused in a strange environment;
- may intentionally run away to avoid punishment, gain attention, or sulk;
- often will not answer when called;
- darkness usually brings on a willingness to accept help and be found;
- suffer from the same fears and problems an adult would, but with a greater sense of helplessness; and
- the circumstances of becoming lost often reflect they are being taken to an unknown environment or surroundings by parents or other adults they know.

### **Older Persons**

Older persons have a wide variety of capabilities, but the many physical and mental conditions of this group define their behavioural characteristics. In general, members of this group exhibit the following traits:

- may be suffering from senility or Alzheimer's disease;
- may be easily attracted by something that catches their attention;
- their orientation may be to previously known environments rather than the present;
- some may have conditions that require the same type of supervision that children do;
- more lucid older persons may be more likely to over-extend and exhaust themselves rapidly, which can result in a heart attack or other fatal complications; and
- they may be hard-of-hearing or deaf which presents problems with detection.

### **People With Intellectual Disabilities (All Ages)**

This group is very difficult to categorize due to the wide variety of disabilities; however some general behavioural characteristics are:

- they act and react in much the same way as children from the age of 6–12;
- they generally will not respond to their spoken name;
- they most often will be hidden from view as a result of fright or seeking shelter from the elements;
- many times they will stay in one place for days; and
- they usually have no physical impairments but may do nothing to help themselves.

### **Hikers**

Hikers are one of the groups more likely to become lost and their behavioural characteristics include:

- they usually rely on trails with a set destination in mind;

- problems or complications may arise with navigation when trail conditions change or become obscure, for example:
  - a slide over the trail,
  - the trail is not maintained,
  - the trail is covered intermittently with snow in the spring, or
  - poorly defined trail junctions;
- often hiking party members may be mismatched in abilities and one person falls behind, becomes disoriented and ultimately lost;
- cutting switchbacks (a type of road/trail used to ascend/descend a slope by using almost 180 degree turns to follow the slope at a gentler angle for ease of driving/walking) will many times lead to disorientation or going down the wrong hill or drainage; and
- they may be dependent on travel aids and trails for navigation.

## **GENERAL INFORMATION**

Most adults and older youth do not have specific traits that may be used to predict their behaviour. The most important clue to predicting their behaviour is the reason (eg, hiking) they were in the wilderness in the first place. The following general information is relevant (to all groups) and may be used when trying to predict the behaviour of a lost person, their movements and whereabouts.

### **Category and Circumstances**

Can a lost person be categorized? Children are different from hikers, who are different from the elderly, etc. By categorizing a lost person, the search effort may be orientated to the most likely area. The circumstances surrounding the person before they become lost contribute greatly to predicting their behaviour. Effort must be made to discover these circumstances.

### **Terrain**

The terrain affects travel. The area should be examined for barriers, escape routes, drainages, ridges, etc. Flat terrain generally yields different travel distances (farther) than mountainous.

### **Weather**

Weather may restrict the lost person's movement. It is also a principle contributor to hypothermia, which may affect movement and decision making. Poor weather increases the importance of the length of time a person has been lost (eg, increased risk of hypothermia) and may require increased SAR efforts.

### **Personality**

It has a substantial effect on the lost person's ability to survive. Consider the aggressive personality versus the ponderer or pessimist.

### **Physical Conditions**

Are the lost person's physical capabilities limited in any way? A poor physical condition means an increased susceptibility to hypothermia. It also has a direct bearing on the distance a lost person will travel.

### **Medical Problems**

Is there any condition that could possibly precipitate abnormal behaviour? This could have a direct bearing on the distance a lost person will travel. Examples of medical problems that may affect a person's behaviour:

- weak heart,
- diabetes,
- allergies, and
- not having taken medication when needed (they do not have their prescription with them).



Through determining if the lost person is affected by any of the discussed conditions, logical assumptions may be made on their possible behaviour in order to determine the most likely area to focus the search effort.

---

## CONFIRMATION OF TEACHING POINT 1

---

### QUESTIONS

- Q1. Where are the most likely places to find a lost child between the ages of 1–3?
- Q2. Where would a hiker most likely be found?
- Q3. How does weather affect the behaviour of a lost person and the need to find them?

### ANTICIPATED ANSWERS

- A1. Lying down/asleep inside a hollow log, under a thick bush, under an overhanging rock, or under a picnic table.
- A2. On or near a trail.
- A3. Weather restricts the lost person's movement and is a principle contributor to hypothermia. Poor weather increases the importance of the length of time a person has been lost (eg, increased risk of hypothermia) and may require increased SAR efforts.

---

### Teaching Point 2

### Explain and Demonstrate Limiting the Search Area

Time: 20 min

Method: Demonstration

---



Demonstrate examples of limiting techniques, based on the types (eg, road block, track trap, string line) created (based on terrain) for the lesson, when it is being discussed.

### LIMITING THE SEARCH AREA

#### Why Limit the Search Area?

The search area should be limited as the smaller the area, the less time that will be required to effectively cover it. In addition, fewer searchers are required, or smaller spacing can exist between party members.

**Confinement.** An effort made to establish a search perimeter which encompasses the lost person and beyond which the person is unlikely to pass without being detected.

## Confinement Methods

Confinement methods are used to establish a perimeter around the area being searched and to detect a lost person that may wander out of the search area. Types of confinement methods include:

- **Road Block/Trail Block/Patrols.** Blocks and patrols are designed to cover the parts of the perimeter made up of roads and trails. Blocks serve to confine the search area and also inform through traffic of a search in progress. Patrols serve to cover stretches of roads and trails between the blocks.
- **Lookouts.** While aerial search has replaced the need for most fixed lookout towers, stationing lookouts on high ground is also a viable method of establishing a perimeter.
- **Track Traps.** Sections of trail or a road edge that has been brushed clear of all traces of use. Patrols would, on a regular basis, examine track traps for footprints for an indication that the lost person may have left the confinement area.
- **String Lines.** A method of confinement where a large spool of string is mounted in a backpack. As a SAR member walks through an area, the string unrolls, which is then tied by another SAR member approximately one metre (three feet) above the ground leaving a very visible perimeter. Arrows could also be placed on the string directing the lost person that comes across the string line to the closest SAR group, usually located at a road or trail block.

---

## CONFIRMATION OF TEACHING POINT 2

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### QUESTIONS

- Q1. Why limit the search area?
- Q2. Define confinement.
- Q3. What is a string line?

### ANTICIPATED ANSWERS

- A1. The search area should be limited as the smaller the area, the less time that will be required to effectively cover it. In addition, fewer searchers are required, or smaller spacing can exist between party members.
- A2. Confinement is an effort made to establish a search perimeter which encompasses the lost person and beyond which the person is unlikely to pass without being detected.
- A3. A string line is a method of confinement where a string is tied approximately one metre (three feet) above the ground leaving a very visible perimeter for the lost person.

---

### Teaching Point 3

### Explain and Demonstrate Clue Orientation

Time: 10 min

Method: Demonstration

---



Demonstrate examples of clues, based on the types (eg, footprint, food wrapper, trip plan, an eyewitness account, light flashing in the distance) created for the lesson, when it is being discussed.

## CLUE ORIENTATION

Searching for clues helps discover the characteristics and possible behaviour of the lost person that are key to limiting the search area.

### General Principles

The general principles of clue orientation are as follows:

- Clue seeking is a learned skill and must be practiced to develop a sense of what is the minimum information needed to decide on how to categorize a lost person. Clues found and deciphered allow the SAR leader to orientate the search effort to the most likely area.
- Avoid forming opinions and then gathering information to support that opinion. It may limit the searcher to only accepting clues that support their opinion.
- A SAR leader gathers information from everyone, as no one person can know all the facts.
- Assemble a complete profile of the missing person and their situation and let it offer direction.

### Searching for Clues

Types of clues that SAR leaders search for:

- **Physical.** Examples include footprints, food wrappers and dropped/lost items.
- **Recorded.** Examples include a trail register, summit logs and a trip plan.
- **People.** These are eyewitness accounts, the point last seen, family and friends.
- **Event.** Examples include a flashing light, a campfire or a ground-to-air signal.



The cadets should evaluate any physical clues they find for relevance. For example, a fresh candy wrapper possibly dropped by the lost person versus one that has been there for some time (dirty and weathered).

---

## CONFIRMATION OF TEACHING POINT 3

---

### QUESTIONS

- Q1. Why is searching for clues important?
- Q2. Why should a searcher avoid making an opinion and then search for clues?
- Q3. Name the four types of clues.

### ANTICIPATED ANSWERS

- A1. Searching for clues helps discover the characteristics and possible behaviour of the lost person that are key to limiting the search area.
- A2. It may limit the searcher to only accepting clues that support their opinion.
- A3. The four types are: physical, recorded, people and an event.

---

**Teaching Point 4****Cadets, in Pairs, Will Participate in a Ground SAR Exercise**

Time: 70 min

Method: Practical Activity

---



Planning and preparation are key to the running of this activity. Ensure the lost person is in position before beginning the search.

---

**ACTIVITY**

---

**OBJECTIVE**

The objective of this activity is to have the cadets, in pairs, act as a member of a SAR party.

**RESOURCES**

- Prepared briefing,
- Compasses (one per pair),
- Two first aid kits (to be given to the anchor [end] pairs),
- Hand-held radios (one per pair),
- Spare batteries, and
- Whistle (one per cadet).

**ACTIVITY LAYOUT**

A large confined outdoor area.

**ACTIVITY INSTRUCTIONS**

1. Issue equipment, to include:
  - a. compass,
  - b. first aid kit,
  - c. hand-held radio,
  - d. spare batteries, and
  - e. whistle.
2. Give a briefing, to include:
  - a. situation,
  - b. details of the confinement area,
  - c. formation: creeping line (as when cadets do a garbage sweep),
  - d. distance between pairs: 10–20 m (30–60 ft) based on the terrain,

- e. call signs and radio frequency to be used,
  - f. magnetic bearing (search direction),
  - g. safety bearing (if lost or disoriented), and
  - h. actions to take if the cadets discover a clue/lost person: radio in, wait for instructions.
3. Have the cadets deploy to the search start line.
  4. Have the cadets respond to a radio check.
  5. Begin the search.
  6. Have the cadets radio in if they find a clue.
  7. Have the cadets radio in if they find the lost person.
  8. Have first-aid trained cadets perform first aid on simulated minor injuries of the lost person (only if designed into the scenario).
  9. Have the cadets examine the (mock) survival site.
  10. Have the SAR leader conduct a debriefing of the activity.
  11. Have the cadets return equipment.

#### **SAFETY**

- A safety bearing shall be given to the cadets.
- Staff should be placed in the centre and at the ends of the search formation.

---

#### **CONFIRMATION OF TEACHING POINT 4**

---

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

---

#### **END OF LESSON CONFIRMATION**

---

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

---

#### **CONCLUSION**

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#### **HOMEWORK/READING/PRACTICE**

N/A.

#### **METHOD OF EVALUATION**

N/A.

#### **CLOSING STATEMENT**

Understanding how a SAR party operates, a person in a survival situation will have a better idea of knowing what is being looked for and where. If you know how to search, you should know how to be found. This information should allow the cadets to better plan for being rescued through selecting their site location, signal placement and clues known and also found.

## **INSTRUCTOR NOTES/REMARKS**

A briefing will be conducted before the practical activity, to include the scenario (eg, downed pilot, lost hiker), the confinement area, search bearing, and call signs.

The scenario's survival site should be set up prior to the activity.

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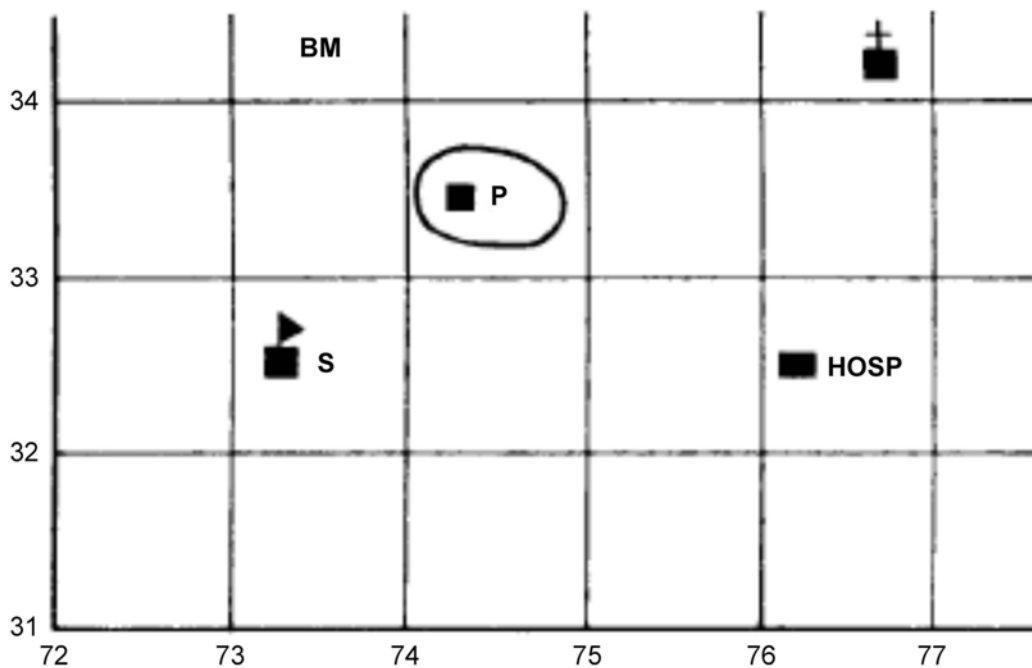
## **REFERENCES**

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- A3-052 (ISBN 0-913724-30-0) LaValla, P. (1999). *Search is an Emergency*. Olympia, WA: ERI International Inc.
- C3-208 (ISBN 0-7637-4807-2) National Association for Search and Rescue. (2005). *Fundamentals of Search and Rescue*. Mississauga, ON: Jones and Bartlett Publishers Canada.



### WORKSHEET FOR FOUR-FIGURE GRID REFERENCES



Determine the four-figure grid references for the following:

Post Office: \_\_\_\_\_

Hospital: \_\_\_\_\_

Christian Church: \_\_\_\_\_

Bench Mark: \_\_\_\_\_

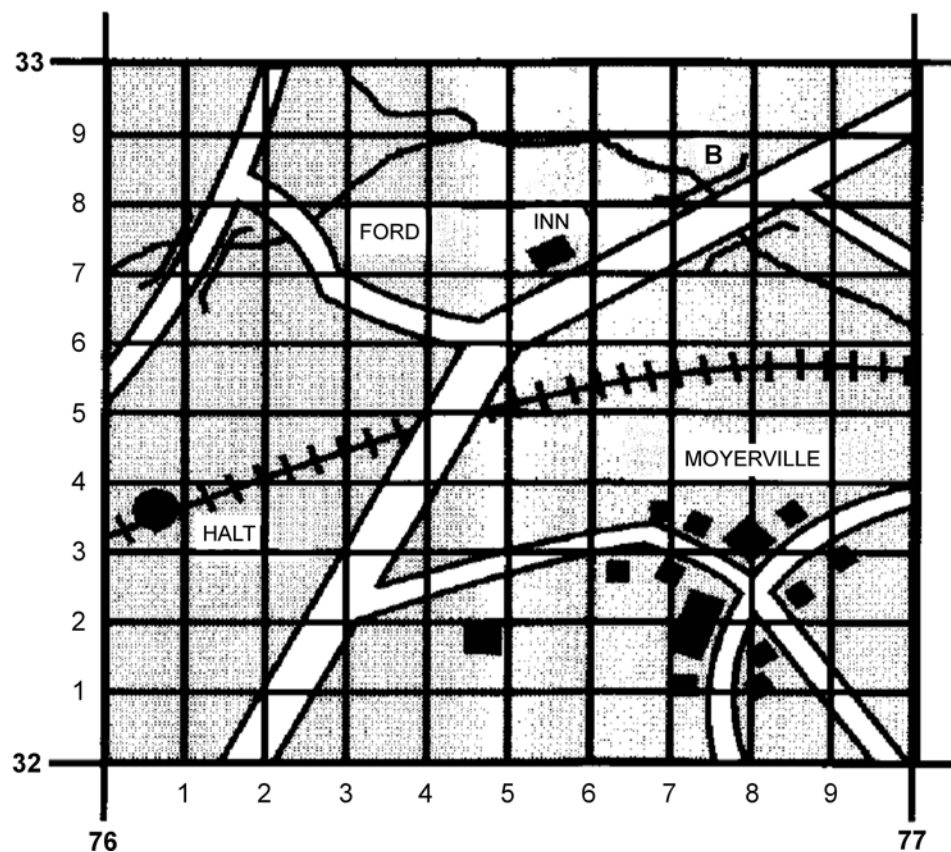
School: \_\_\_\_\_

*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-18)*

Figure 18A-1 Four-Figure Grid Reference Worksheet

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### SIX-FIGURE GRID REFERENCES



*Canadian Forces, Maps, Field Sketching, Compasses and the  
Global Positioning System, Department of National Defence (p. 38)*

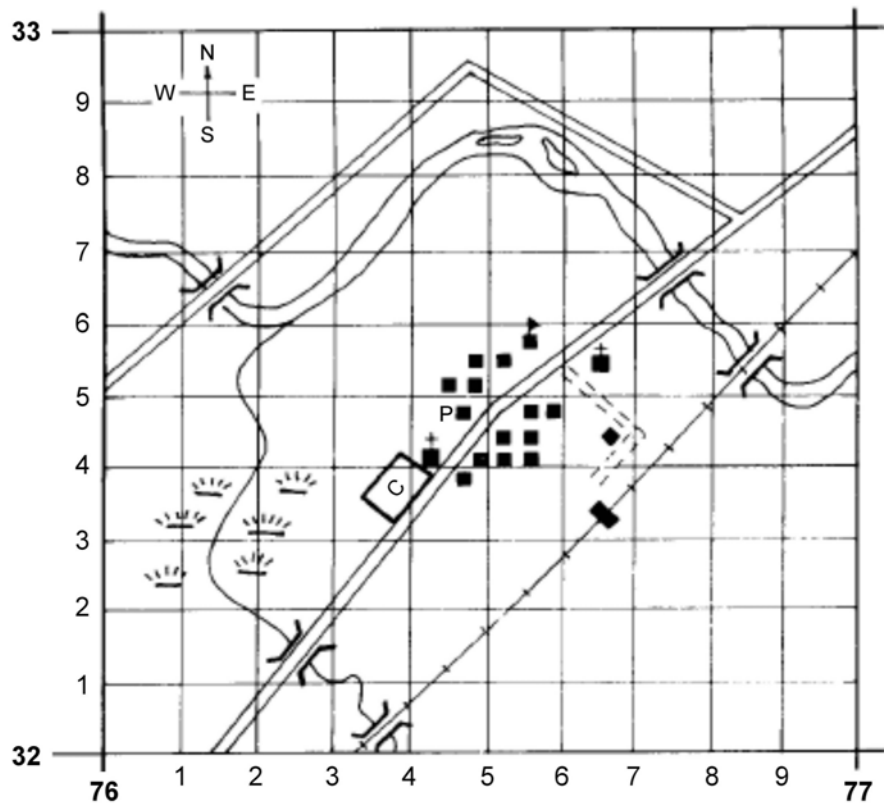
Figure 18B-1 Six-Figure Grid References

#### Steps to Determine a Six-Figure GR:

1. Identify the object within the grid square. Note the four-figure GR.
2. Using the imaginary grid within the square, determine the three-digit easting by using the two digits of the easting combined with the number of tenths, measured from the left, to the line before the object.
3. Using the imaginary grid within the square, determine the three-digit northing by using the two digits of the northing combined with the number of tenths, measured from the bottom, to the line before the object.
4. Combine the two sets of numbers to create the six-figure GR.

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### WORKSHEET FOR SIX-FIGURE GRID REFERENCES



Determine the six-figure grid references for the five bridges:

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*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-18)*

Figure 18C-1 Six-Figure Grid Reference Worksheet

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**ANSWER KEY FOR WORKSHEETS AT ANNEXES A AND C**

**Answer Key for Worksheet for Four-Figure Grid References**

Post Office: GR 7433

Hospital: GR 7632

Christian Church: GR 7634

Bench Mark: GR 7334

School: GR 7332

**Answer Key for Worksheet for Six-Figure Grid References**

GR 761326

GR 762321

GR 763320

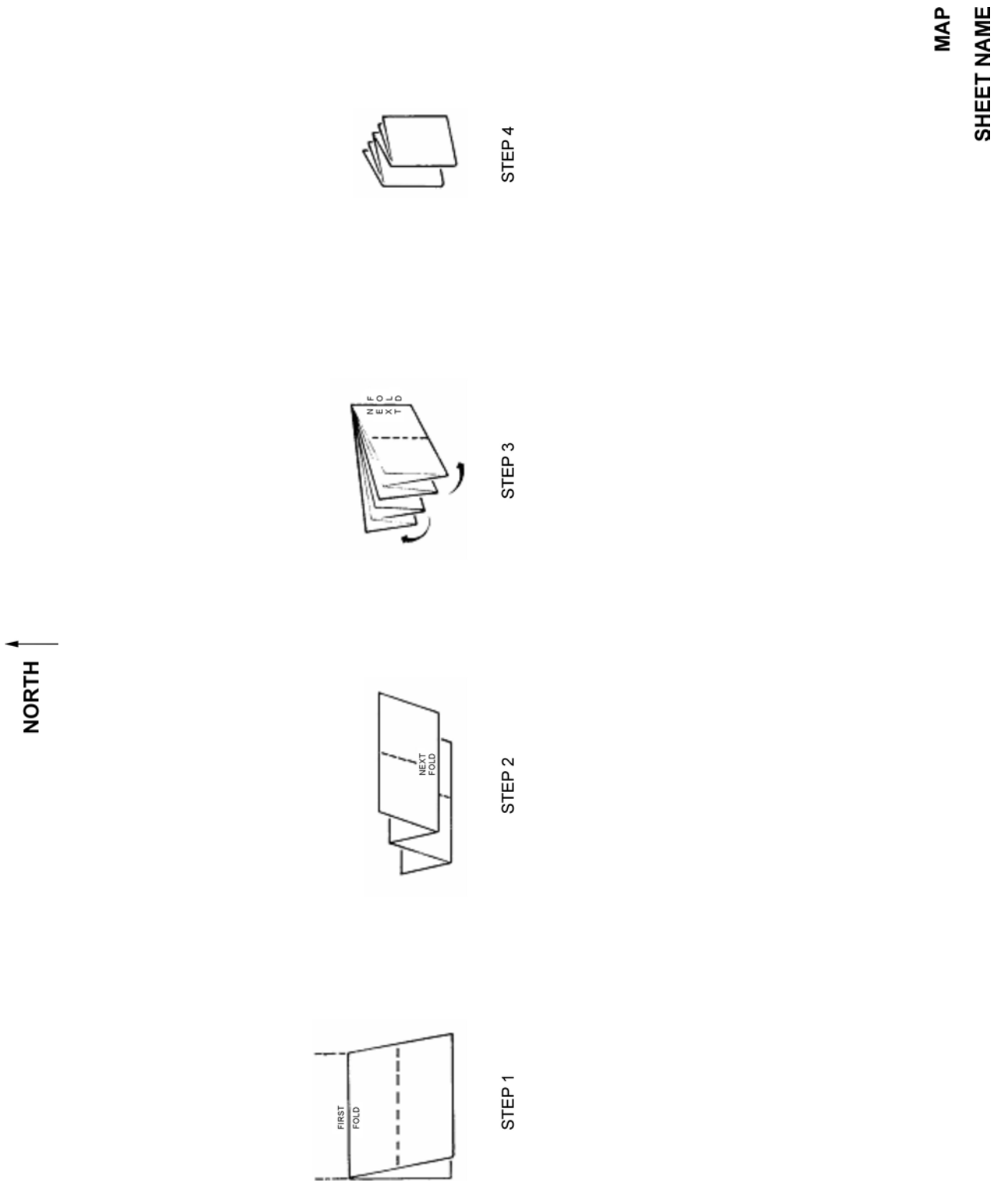
GR 767326

GR 768325

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### STEPS TO FOLD A MAP

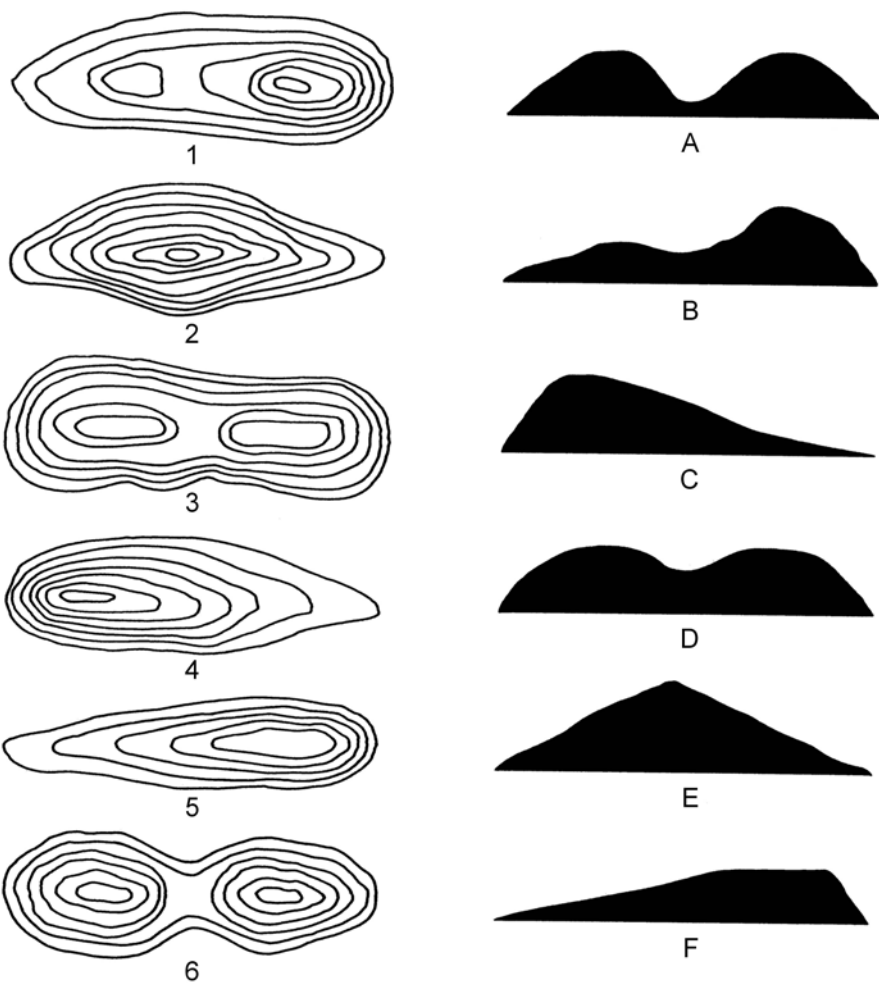


*Director Cadets 3, Royal Canadian Army Cadet Reference Book, Department of National Defence (p. 5-5)*

Figure 18E-1 Steps to Fold a Map

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**MATCH THE CONTOUR DIAGRAM ON THE LEFT TO THE  
APPLICABLE DEPICTION OF A LANDFORM ON THE RIGHT**



- 1.    \_\_\_
- 2.    \_\_\_
- 3.    \_\_\_

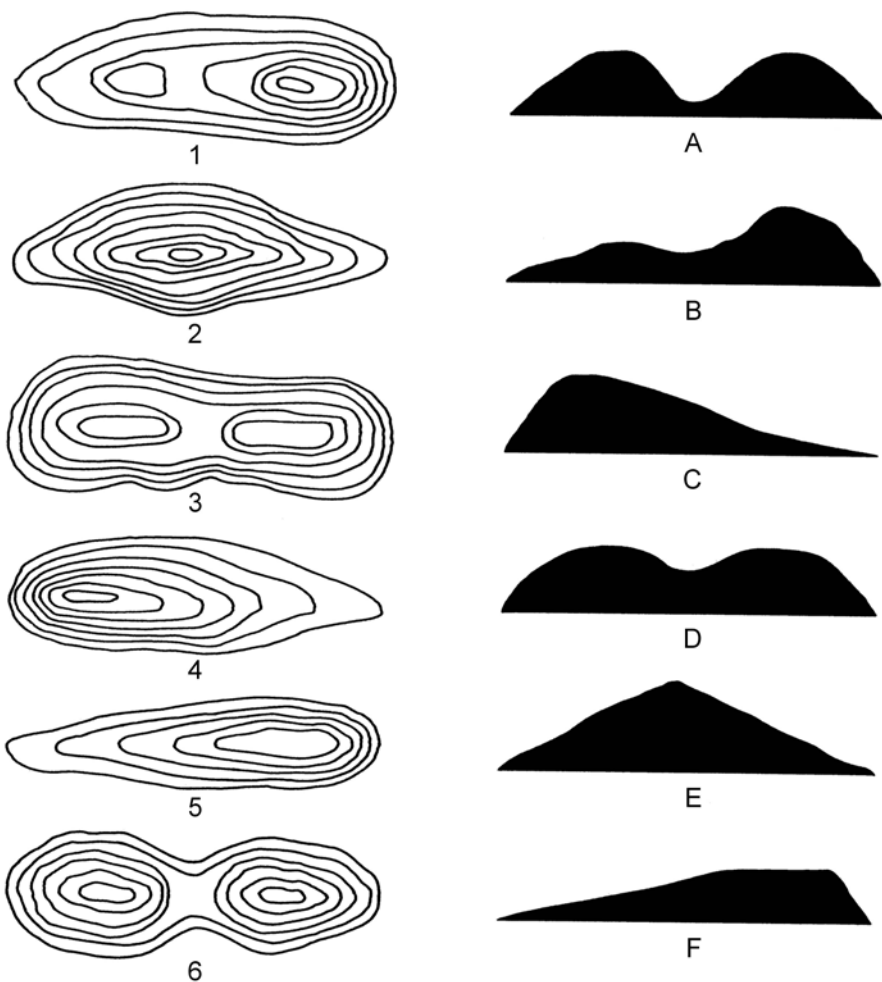
- 4.    \_\_\_
- 5.    \_\_\_
- 6.    \_\_\_

*Director Cadets 3, 2007, Ottawa, ON: Department of National Defence*

Figure 18F-1 Contour Lines Matching Sheet

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**MATCH THE CONTOUR DIAGRAM ON THE LEFT TO THE  
APPLICABLE DEPICTION OF A LANDFORM ON THE RIGHT**



- |    |          |    |          |
|----|----------|----|----------|
| 1. | <u>B</u> | 4. | <u>C</u> |
| 2. | <u>E</u> | 5. | <u>F</u> |
| 3. | <u>D</u> | 6. | <u>A</u> |

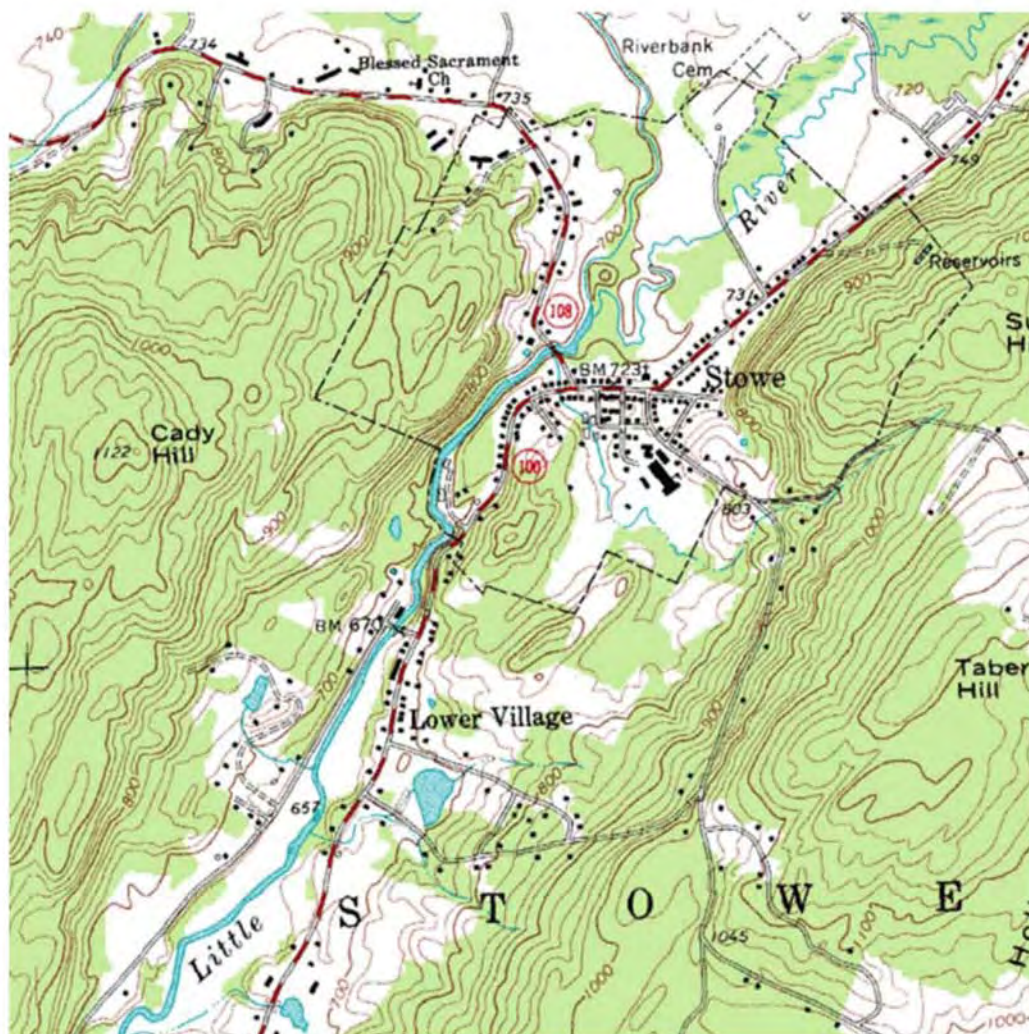
*Director Cadets 3, 2007, Ottawa, ON: Department of National Defence*

Figure 18G-1 Contour Line Matching Answer Key

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### TOPOGRAPHICAL MAP EXAMPLE

**Instructions:** Draw a line to represent a route you would take to travel from your house on Taber Hill to the peak of Cady Hill.



Explain why you picked your route, emphasizing the contour lines you crossed over.

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Wikimedia.org, 2006, Topographic Map Example. Retrieved March 26, 2008, from [http://upload.wikimedia.org/wikipedia/commons/7/79/Topographic\\_map\\_example.png](http://upload.wikimedia.org/wikipedia/commons/7/79/Topographic_map_example.png)

Figure 18H-1 Topographical Map Example

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## TOPOGRAPHICAL MAP EXAMPLE

### Relief Version of Map at Figure 18H-1

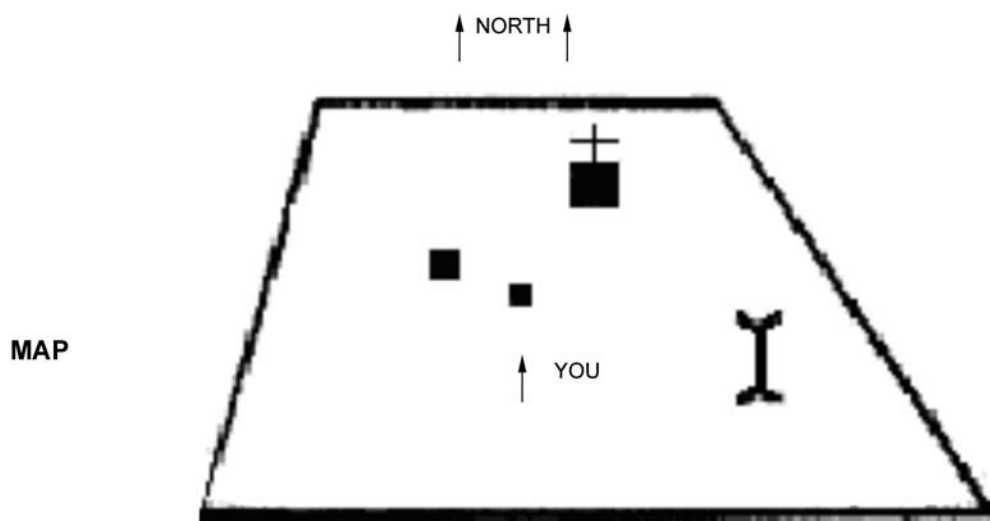


*Wikimedia.org, 2007, Topographic Relief Perspective Sample. Retrieved March 26, 2008 from <http://upload.wikimedia.org/wikipedia/en/4/4c/Topographic-Relief-perspective-sample.jpg>*

Figure 18I-1 Topographical Relief Perspective Sample

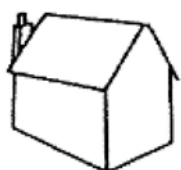
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### ORIENTING A MAP BY INSPECTION



*Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 79)*

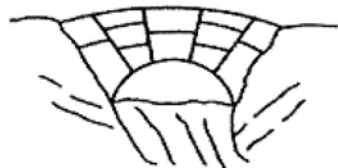
Figure 18J-1 Demonstration Map



# House

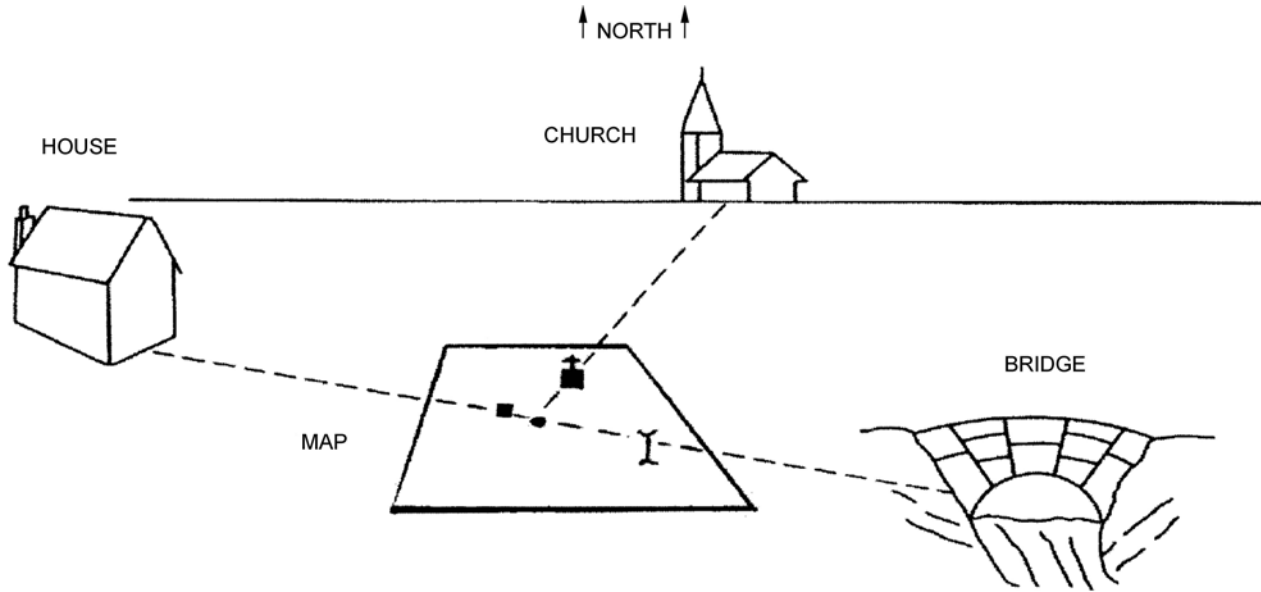


# Church



# Bridge

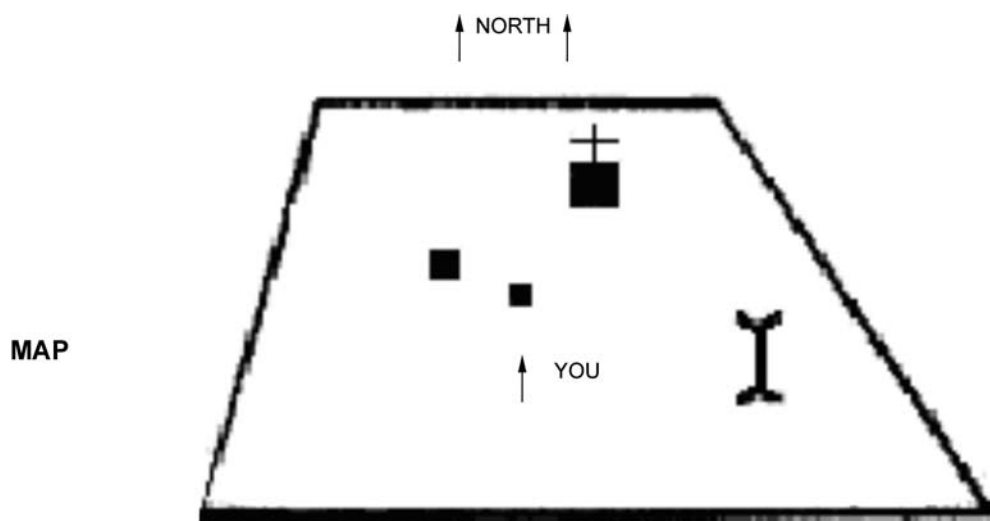
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*Canadian Forces, Maps, Field Sketching, Compasses and the  
Global Positioning System, Department of National Defence (p. 79)*

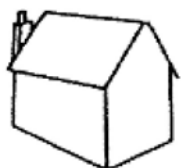
Figure 18J-2 Orienting a Map by Inspection

### ORIENTING A MAP USING A COMPASS



*Canadian Forces, Maps, Field Sketching, Compasses and the Global Positioning System, Department of National Defence (p. 79)*

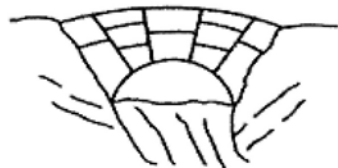
Figure 18K-1 Demonstration Map



# House

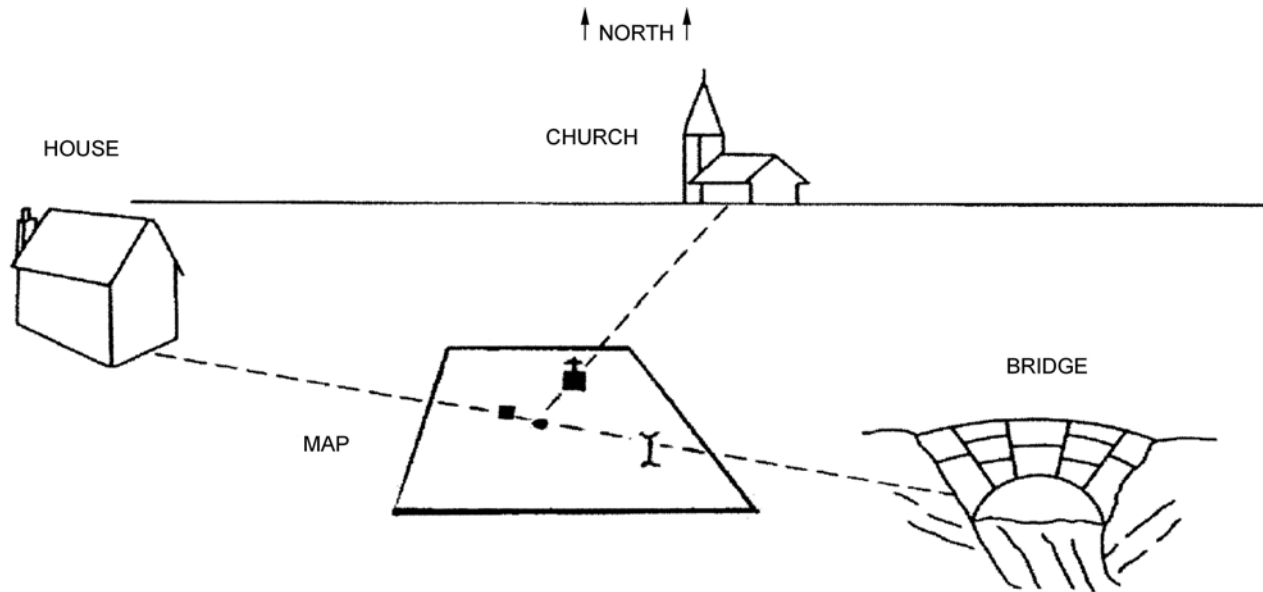


# Church



# Bridge

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*Canadian Forces, Maps, Field Sketching, Compasses and the  
Global Positioning System, Department of National Defence (p. 79)*

Figure 18K-2 Orienting a Map Using a Compass

## FACT SHEET: CALCULATING MAGNETIC DECLINATION

**Formula:** Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination

**Grid Magnetic Angle.** The angle between grid north and magnetic north, found on the declination diagram. Written in degrees and minutes.



1 degree (°) = 60 minutes ('), similar to calculating time (eg, 1 hour = 60 minutes).

This ratio is very important to remember when adjusting the grid magnetic angle to the current declination. This is where most errors occur.

**Current Year.** The current calendar year.

**Year of Declination Information.** Found below the declination diagram.

**Annual Change.** Found below the declination diagram and is written in minutes.



It is important that the annual change be inserted into the formula correctly:

- If annual change is **increasing**, insert into formula as a **positive** number.
- If annual change is **decreasing**, insert into formula as a **negative** number.

**Current Declination.** This is the result of the formula. It is the magnetic declination to be set on the compass.

**East Declination.** When magnetic north is east (to the left) of grid north on the declination diagram.

**West Declination.** When magnetic north is west (to the right) of grid north on the declination diagram.



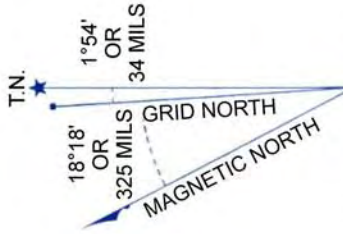
If the current declination calculates to a negative number, an east declination changes to a west declination and vice versa.

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## DECLINATION DIAGRAMS

### EXAMPLE 1: CALCULATING MAGNETIC DECLINATION

 <p>USE DIAGRAM ONLY TO OBTAIN NUMERICAL VALUES APPROXIMATE MEAN DECLINATION 1975 FOR CENTRE OF MAP ANNUAL CHANGE DECREASING 1.4'</p> <p>ONE THOUSAND METRE UNIVERSAL TRANSVERSE MERCATOR GRID ZONE 20</p>	<p>Grid Magnetic Angle: 18° 18'</p> <p>Current Year: 2008 (used for this example)</p> <p>Year of Declination Information: 1975</p> <p>Annual Change: decreasing 1.4' (decreasing means 1.4' becomes -1.4')</p> <p>Grid Magnetic Angle + [(Current Year - Year of Declination Information) x (Annual Change)] = Current Declination</p> <p>Inputting the information into the formula:</p> $18^{\circ} 18' + [(2008 - 1975) \times (-1.4')] = \text{Current Declination}$ <p>Solving for current declination.</p> $18^{\circ} 18' + [(33) \times (-1.4')] = \text{Current Declination}$ $18^{\circ} 18' + [-46.2'] = \text{Current Declination}$ $18^{\circ} 18' - 46.2' = \text{Current Declination}$ <p><b>Note:</b> Since 46.2' cannot be easily subtracted from 18° 18', 1° is converted into 60' (similar to time calculations), which converts 18° 18' to 17° 78'.</p> $17^{\circ} 78' - 46.2' = \text{Current Declination}$ $17^{\circ} 31.8' = \text{Current Declination}$ <p>Since magnetic north is west of grid north and the result is positive, the magnetic declination for the topographical map in 2008 is 17° 31.8' west declination.</p>
---	---

Natural Resources Canada, 2008, Topo Declination Diagram. Retrieved April 11, 2008, from [http://gsc.nrcan.gc.ca/geomag/field/magdec\\_e.php?p=1](http://gsc.nrcan.gc.ca/geomag/field/magdec_e.php?p=1)

Figure 18M-1 Declination Diagram

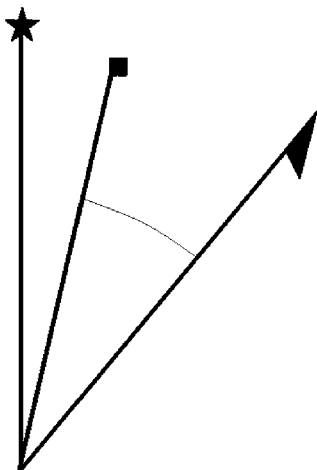
**EXAMPLE 2: CALCULATING MAGNETIC DECLINATION**

<p>USE DIAGRAM ONLY TO OBTAIN NUMERICAL VALUES          APPROXIMATE MEAN DECLINATION 1996          FOR CENTRE OF MAP          ANNUAL CHANGE DECREASING 2.7</p> <p>ONE THOUSAND METRE          UNIVERSAL TRANSVERSE MERCATOR GRID          ZONE 18</p>	<p>Grid Magnetic Angle: 10° 28'</p> <p>Current Year: 2008 (used for this example)</p> <p>Year of Declination Information: 1996</p> <p>Annual Change: increasing 2.7'</p> <p>Increasing means 2.7' becomes +2.7'</p> <p>Inputting the information into the formula:  <math>10^{\circ} 28' + [(2008 - 1996) \times (+2.7')] = \text{Current Declination}</math></p> <p>Solving for current declination.  <math>10^{\circ} 28' + [(12) \times (+2.7')] = \text{Current Declination}</math></p> <p><math>10^{\circ} 28' + [+32.4'] = \text{Current Declination}</math></p> <p><math>10^{\circ} 28' + 32.4' = \text{Current Declination}</math></p> <p><math>10^{\circ} 60.4' = \text{Current Declination}</math></p> <p><b>Note:</b> Since 60.4' is greater than 1°, 60' is converted into 1° (similar to time calculations), which converts 10° 60.4' to 11° 0.4'.</p> <p>11° 0.4' = Current Declination</p> <p>Since magnetic north is west of grid north and the result is positive, the magnetic declination for the topographical map in 2008 is 11° 0.4' west declination.</p>
---	--

Figure 18M-2 Declination Diagram

### MAGNETIC DECLINATION WORKSHEET

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination



**Question 1:**

Grid Magnetic Angle: 10° 46'  
 Current Year: 2011  
 Year of Declination Information: 1988  
 Annual Change: decreasing 5.2'

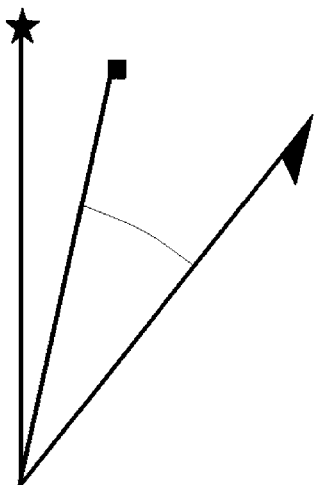
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Answer: \_\_\_\_\_ E/W declination (circle correct one)



**Question 2:**

Grid Magnetic Angle: 11° 2'  
 Current Year: 2014  
 Year of Declination Information: 1995  
 Annual Change: increasing 3.8'

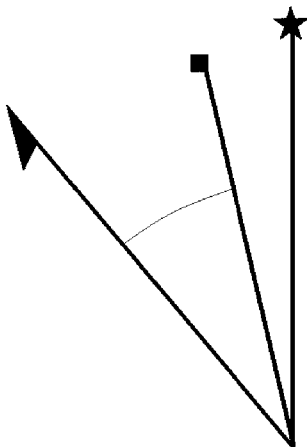
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Answer: \_\_\_\_\_ E/W declination (circle correct one)



**Question 3:**

Grid Magnetic Angle: 18° 43'  
 Current Year: 2013  
 Year of Declination Information: 1986  
 Annual Change: decreasing 6.5'

---

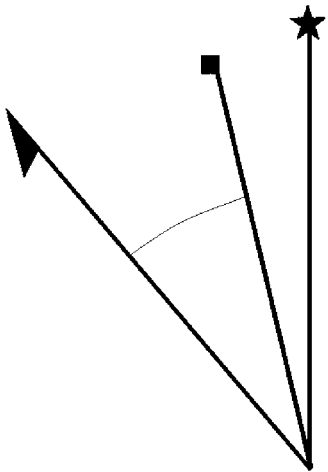
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Answer: \_\_\_\_\_ E/W declination (circle correct one)

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination



**Question 4:**

Grid Magnetic Angle: 9° 14'  
Current Year: 2018  
Year of Declination Information: 1999  
Annual Change: increasing 4.1'

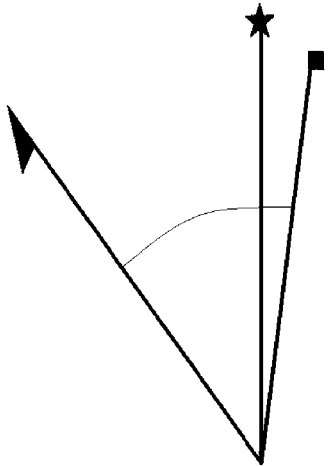
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Answer: \_\_\_\_\_ E/W declination (circle correct one)



**Question 5:**

Grid Magnetic Angle: 19° 35'  
Current Year: 2016  
Year of Declination Information: 1981  
Annual Change: decreasing 5.4'

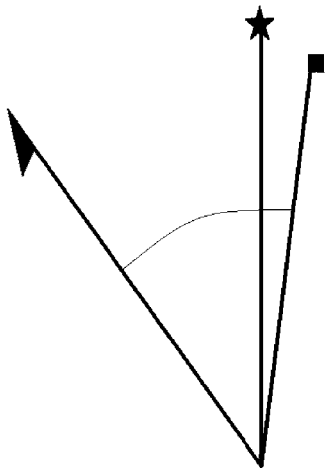
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Answer: \_\_\_\_\_ E/W declination (circle correct one)



**Question 6:**

Grid Magnetic Angle: 18° 22'  
Current Year: 2010  
Year of Declination Information: 1976  
Annual Change: increasing 4.7'

---

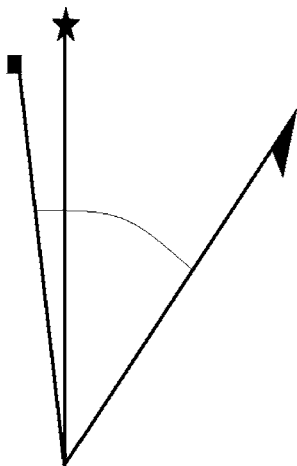
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Answer: \_\_\_\_\_ E/W declination (circle correct one)

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination



**Question 7:**

Grid Magnetic Angle: 12° 34'  
Current Year: 2020  
Year of Declination Information: 1991  
Annual Change: increasing 1.2'

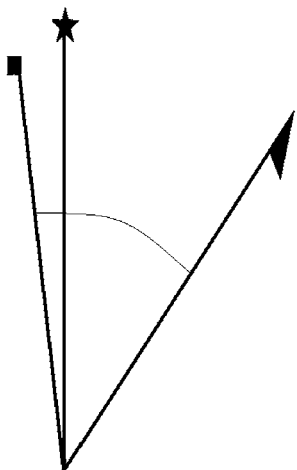
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Answer: \_\_\_\_\_ E/W declination (circle correct one)



**Question 8:**

Grid Magnetic Angle: 13° 21'  
Current Year: 2017  
Year of Declination Information: 1994  
Annual Change: decreasing 2.9'

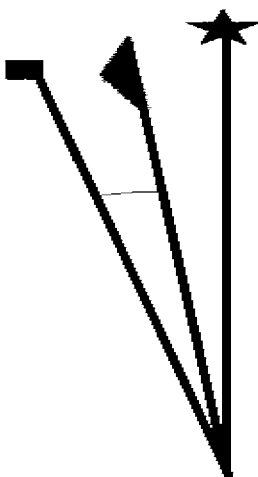
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Answer: \_\_\_\_\_ E/W declination (circle correct one)



**Question 9:**

Grid Magnetic Angle: 3° 16'  
Current Year: 2012  
Year of Declination Information: 1980  
Annual Change: decreasing 6.2'

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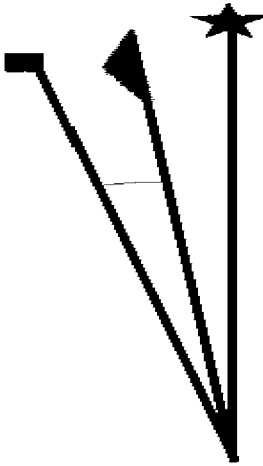
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Answer: \_\_\_\_\_ E/W declination (circle correct one)

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination



**Question 10:**

Grid Magnetic Angle: 4° 27'  
Current Year: 2019  
Year of Declination Information: 1977  
Annual Change: increasing 2.2'

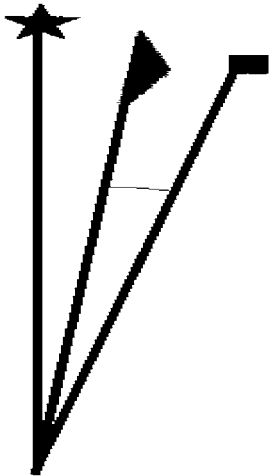
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Answer: \_\_\_\_\_ E/W declination (circle correct one)



**Question 11:**

Grid Magnetic Angle: 7° 7'  
Current Year: 2021  
Year of Declination Information: 1992  
Annual Change: increasing 5.5'

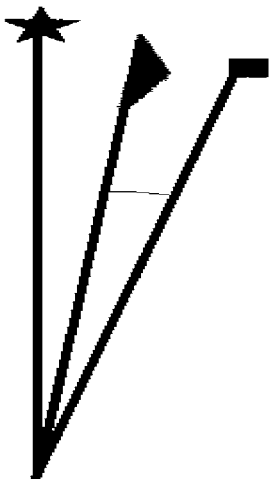
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Answer: \_\_\_\_\_ E/W declination (circle correct one)



**Question 12:**

Grid Magnetic Angle: 9° 36'  
Current Year: 2015  
Year of Declination Information: 1983  
Annual Change: decreasing 3.3'

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Answer: \_\_\_\_\_ E/W declination (circle correct one)

### MAGNETIC DECLINATION WORKSHEET: ANSWER KEY

Grid Magnetic Angle + [(Current Year - Year of Declination Information) × (Annual Change)] = Current Declination

#### Question 1:

Grid Magnetic Angle: 10° 46'  
Current Year: 2011  
Year of Declination Information: 1988  
Annual Change: decreasing 5.2'

$$10^{\circ} 46' + [(2011 - 1988) \times (-5.2')] = \text{Current Declination}$$

$$10^{\circ} 46' + [(23) \times (-5.2')] = \text{Current Declination}$$

$$10^{\circ} 46' + [-119.6'] = \text{Current Declination}$$

$$10^{\circ} 46' - 119.6' = \text{Current Declination}$$

$$9^{\circ} 106' - 119.6' = \text{Current Declination}$$

$$8^{\circ} 166' - 119.6' = \text{Current Declination}$$

$$8^{\circ} 46.4' = \text{Current Declination}$$

Magnetic declination is 8° 46.4' east.

#### Question 2:

Grid Magnetic Angle: 11° 2'  
Current Year: 2014  
Year of Declination Information: 1995  
Annual Change: increasing 3.8'

$$11^{\circ} 2' + [(2014 - 1995) \times (+3.8')] = \text{Current Declination}$$

$$11^{\circ} 2' + [(19) \times (+3.8')] = \text{Current Declination}$$

$$11^{\circ} 2' + [+72.2'] = \text{Current Declination}$$

$$11^{\circ} 2' + 72.2' = \text{Current Declination}$$

$$11^{\circ} 74.2' = \text{Current Declination}$$

$$12^{\circ} 14.2' = \text{Current Declination}$$

Magnetic declination is 12° 14.2' east.

#### Question 3:

Grid Magnetic Angle: 18° 43'  
Current Year: 2013  
Year of Declination Information: 1986  
Annual Change: decreasing 6.5'

$$18^{\circ} 43' + [(2013 - 1986) \times (-6.5')] = \text{Current Declination}$$

$$18^{\circ} 43' + [(27) \times (-6.5')] = \text{Current Declination}$$

$$18^{\circ} 43' + [-175.5'] = \text{Current Declination}$$

$$18^{\circ} 43' - 175.5' = \text{Current Declination}$$

$$17^{\circ} 103' - 175.5' = \text{Current Declination}$$

$$16^{\circ} 163' - 175.5' = \text{Current Declination}$$

$$15^{\circ} 223' - 175.5' = \text{Current Declination}$$

$$15^{\circ} 47.5' = \text{Current Declination}$$

Magnetic declination is  $15^{\circ} 47.5'$  west.

**Question 4:**

Grid Magnetic Angle:  $9^{\circ} 14'$

Current Year: 2018

Year of Declination Information: 1999

Annual Change: increasing  $4.1'$

$$9^{\circ} 14' + [(2018 - 1999) \times (+4.1')] = \text{Current Declination}$$

$$9^{\circ} 14' + [(19) \times (+4.1')] = \text{Current Declination}$$

$$9^{\circ} 14' + [+77.6'] = \text{Current Declination}$$

$$9^{\circ} 14' + 77.6' = \text{Current Declination}$$

$$9^{\circ} 91.9' = \text{Current Declination}$$

$$10^{\circ} 31.9' = \text{Current Declination}$$

Magnetic declination is  $10^{\circ} 31.9'$  west.

**Question 5:**

Grid Magnetic Angle:  $19^{\circ} 35'$

Current Year: 2016

Year of Declination Information: 1981

Annual Change: decreasing  $5.4'$

$$19^{\circ} 35' + [(2016 - 1981) \times (-5.4')] = \text{Current Declination}$$

$$19^{\circ} 35' + [(35) \times (-5.4')] = \text{Current Declination}$$

$$19^{\circ} 35' + [-189'] = \text{Current Declination}$$

$$19^{\circ} 35' - 189' = \text{Current Declination}$$

$$18^{\circ} 95' - 189' = \text{Current Declination}$$

$$17^{\circ} 155' - 189' = \text{Current Declination}$$

$$16^{\circ} 215' - 189' = \text{Current Declination}$$

$$16^{\circ} 26' = \text{Current Declination}$$

Magnetic declination is  $16^{\circ} 26'$  west.

**Question 6:**

Grid Magnetic Angle:  $18^{\circ} 22'$

Current Year: 2010

Year of Declination Information: 1976



Annual Change: increasing 4.7'

$$18^{\circ} 22' + [(2010 - 1976) \times (+4.7')] = \text{Current Declination}$$

$$18^{\circ} 22' + [(34) \times (+4.7')] = \text{Current Declination}$$

$$18^{\circ} 22' + [+159.8] = \text{Current Declination}$$

$$18^{\circ} 22' + 159.8' = \text{Current Declination}$$

$$18^{\circ} 181.8' = \text{Current Declination}$$

$$19^{\circ} 121.8' = \text{Current Declination}$$

$$20^{\circ} 61.8' = \text{Current Declination}$$

$$21^{\circ} 1.8' = \text{Current Declination}$$

Magnetic declination is  $21^{\circ} 1.8'$  west.

**Question 7:**

Grid Magnetic Angle:  $12^{\circ} 34'$

Current Year: 2020

Year of Declination Information: 1991

Annual Change: increasing 1.2'

$$12^{\circ} 34' + [(2020 - 1991) \times (+1.2')] = \text{Current Declination}$$

$$12^{\circ} 34' + [(29) \times (+1.2')] = \text{Current Declination}$$

$$12^{\circ} 34' + [+34.8'] = \text{Current Declination}$$

$$12^{\circ} 34' + 34.8' = \text{Current Declination}$$

$$12^{\circ} 68.8' = \text{Current Declination}$$

$$13^{\circ} 8.8' = \text{Current Declination}$$

Magnetic declination is  $13^{\circ} 8.8'$  east.

**Question 8:**

Grid Magnetic Angle:  $13^{\circ} 21'$

Current Year: 2017

Year of Declination Information: 1994

Annual Change: decreasing 2.9'

$$13^{\circ} 21' + [(2017 - 1994) \times (-2.9')] = \text{Current Declination}$$

$$13^{\circ} 21' + [(23) \times (-2.9')] = \text{Current Declination}$$

$$13^{\circ} 21' + [-66.7'] = \text{Current Declination}$$

$$13^{\circ} 21' - 66.7' = \text{Current Declination}$$

$$12^{\circ} 81' - 66.7' = \text{Current Declination}$$

$$12^{\circ} 14.3' = \text{Current Declination}$$

Magnetic declination is  $12^{\circ} 14.3'$  east.

**Question 9:**

Grid Magnetic Angle:  $3^{\circ} 16'$

Current Year: 2012  
Year of Declination Information: 1980  
Annual Change: decreasing 6.2'

$$3^{\circ} 16' + [(2012 - 1980) \times (-6.2')] = \text{Current Declination}$$

$$3^{\circ} 16' + [(32) \times (-6.2')] = \text{Current Declination}$$

$$3^{\circ} 16' + [-198.4'] = \text{Current Declination}$$

$$3^{\circ} 16' - 198.4' = \text{Current Declination}$$

$$2^{\circ} 76' - 198.4' = \text{Current Declination}$$

$$1^{\circ} 136' - 198.4' = \text{Current Declination}$$

$$196' - 198.4' = \text{Current Declination}$$

$$-2.4' = \text{Current Declination}$$

Since the current declination calculated has a negative value, the east declination, as shown on the declination diagram, becomes a west declination.

Magnetic declination is 2.4' west.

**Question 10:**

Grid Magnetic Angle:  $4^{\circ} 27'$   
Current Year: 2019  
Year of Declination Information: 1977  
Annual Change: increasing 2.2'

$$4^{\circ} 27' + [(2019 - 1977) \times (+2.2')] = \text{Current Declination}$$

$$4^{\circ} 27' + [(42) \times (+2.2')] = \text{Current Declination}$$

$$4^{\circ} 27' + [+92.4'] = \text{Current Declination}$$

$$4^{\circ} 27' + 92.4' = \text{Current Declination}$$

$$4^{\circ} 119.4' = \text{Current Declination}$$

$$5^{\circ} 59.4' = \text{Current Declination}$$

Magnetic declination is  $5^{\circ} 59.4'$  east.

**Question 11:**

Grid Magnetic Angle:  $7^{\circ} 7'$   
Current Year: 2021  
Year of Declination Information: 1992  
Annual Change: increasing 5.5'

$$7^{\circ} 7' + [(2021 - 1992) \times (+5.5')] = \text{Current Declination}$$

$$7^{\circ} 7' + [(29) \times (+5.5')] = \text{Current Declination}$$

$$7^{\circ} 7' + [+159.5'] = \text{Current Declination}$$

$$7^{\circ} 7' + 159.5' = \text{Current Declination}$$

$7^{\circ} 166.5' = \text{Current Declination}$

$8^{\circ} 106.5' = \text{Current Declination}$

$9^{\circ} 46.5' = \text{Current Declination}$

Magnetic declination is  $9^{\circ} 46.5'$  west.

**Question 12:**

Grid Magnetic Angle:  $9^{\circ} 36'$

Current Year: 2015

Year of Declination Information: 1983

Annual Change: decreasing  $3.3'$

$9^{\circ} 36' + [(2015 - 1983) \times (-3.3')] = \text{Current Declination}$

$9^{\circ} 36' + [(32) \times (-3.3')] = \text{Current Declination}$

$9^{\circ} 36' + [-105.6'] = \text{Current Declination}$

$9^{\circ} 36' - 105.6' = \text{Current Declination}$

$8^{\circ} 96' - 105.6' = \text{Current Declination}$

$7^{\circ} 156' - 105.6' = \text{Current Declination}$

$7^{\circ} 50.4' = \text{Current Declination}$

Magnetic declination is  $7^{\circ} 50.4'$  west.

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### SKY MAP

#### NOVEMBER, 2007

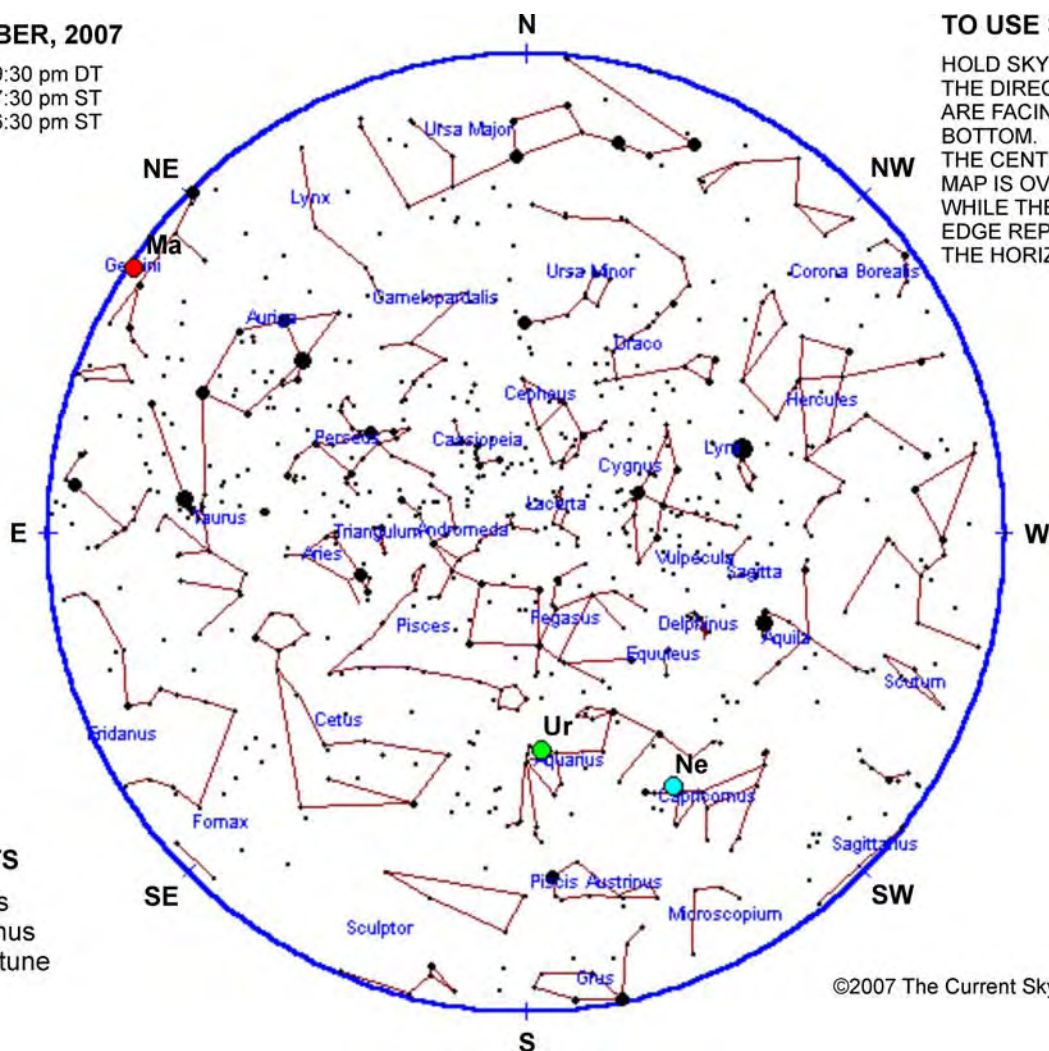
NOV 1 9:30 pm DT  
NOV 15 7:30 pm ST  
NOV 30 6:30 pm ST

#### TO USE SKY MAP:

HOLD SKY MAP WITH THE DIRECTION YOU ARE FACING AT THE BOTTOM. THE CENTER OF THE MAP IS OVERHEAD WHILE THE CIRCULAR EDGE REPRESENTS THE HORIZON.

#### PLANETS

**Ma** Mars  
**Ur** Uranus  
**Ne** Neptune

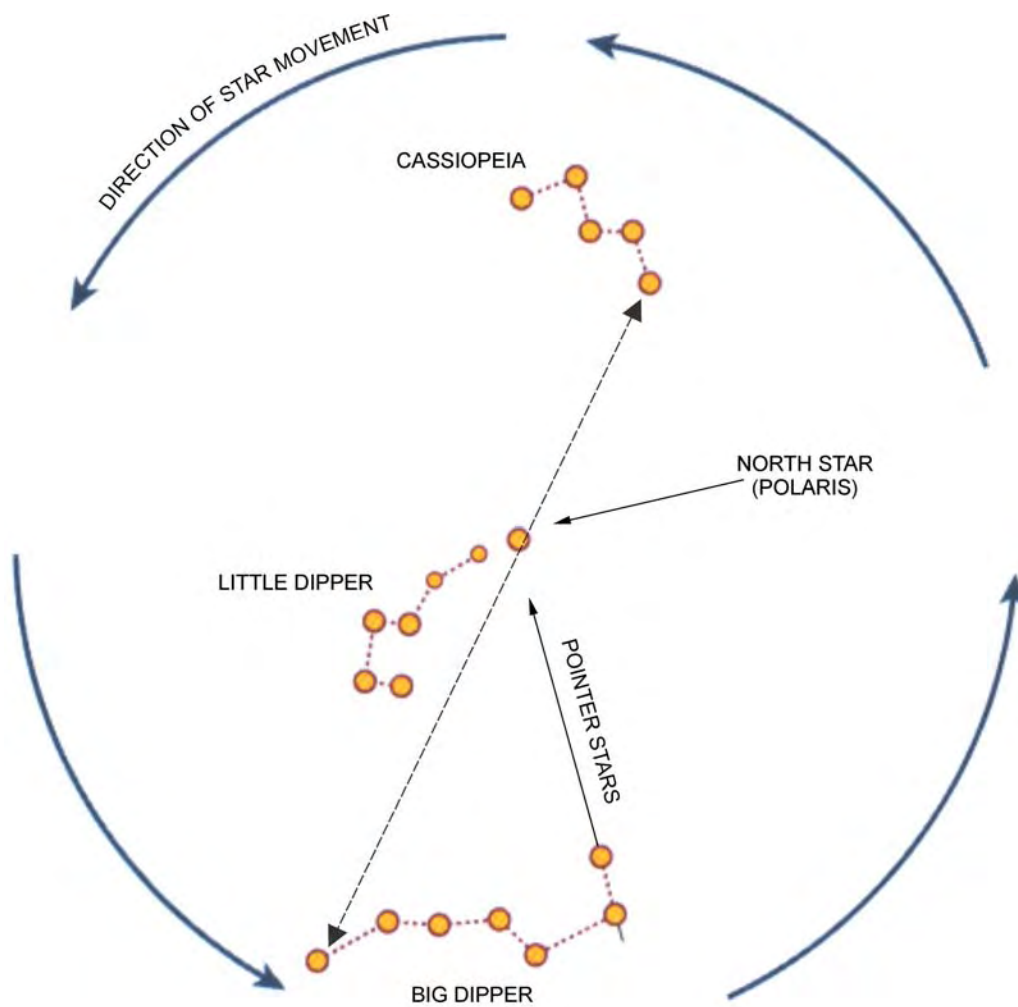


*Sky Map, 2007, Sky Map for Chicago, IL, November 2007, Copyright 2007 by CyberSky 3.3.1. Retrieved November 30, 2007, from <http://77illinois.homestead.com/files/astro/skypage.html>*

Figure 18P-1 Sky Map

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### FINDING POLARIS



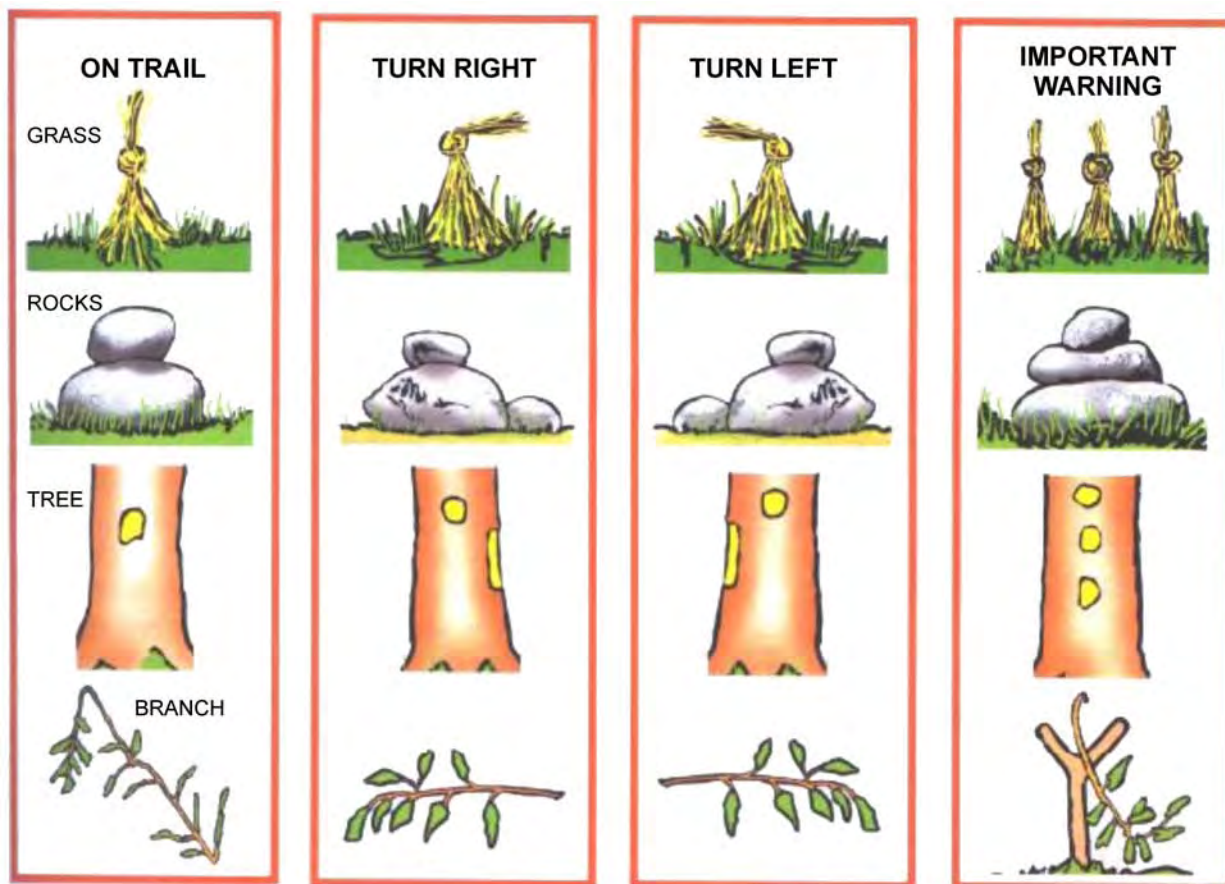
*National Association of Search and Rescue, Fundamentals of Search and Rescue, Jones and Bartlett Publishers, Inc. Copyright 2005 by Jones and Bartlett Publishing (p. 76)*

Figure 18Q-1 Finding Polaris

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### BLAZING TECHNIQUES



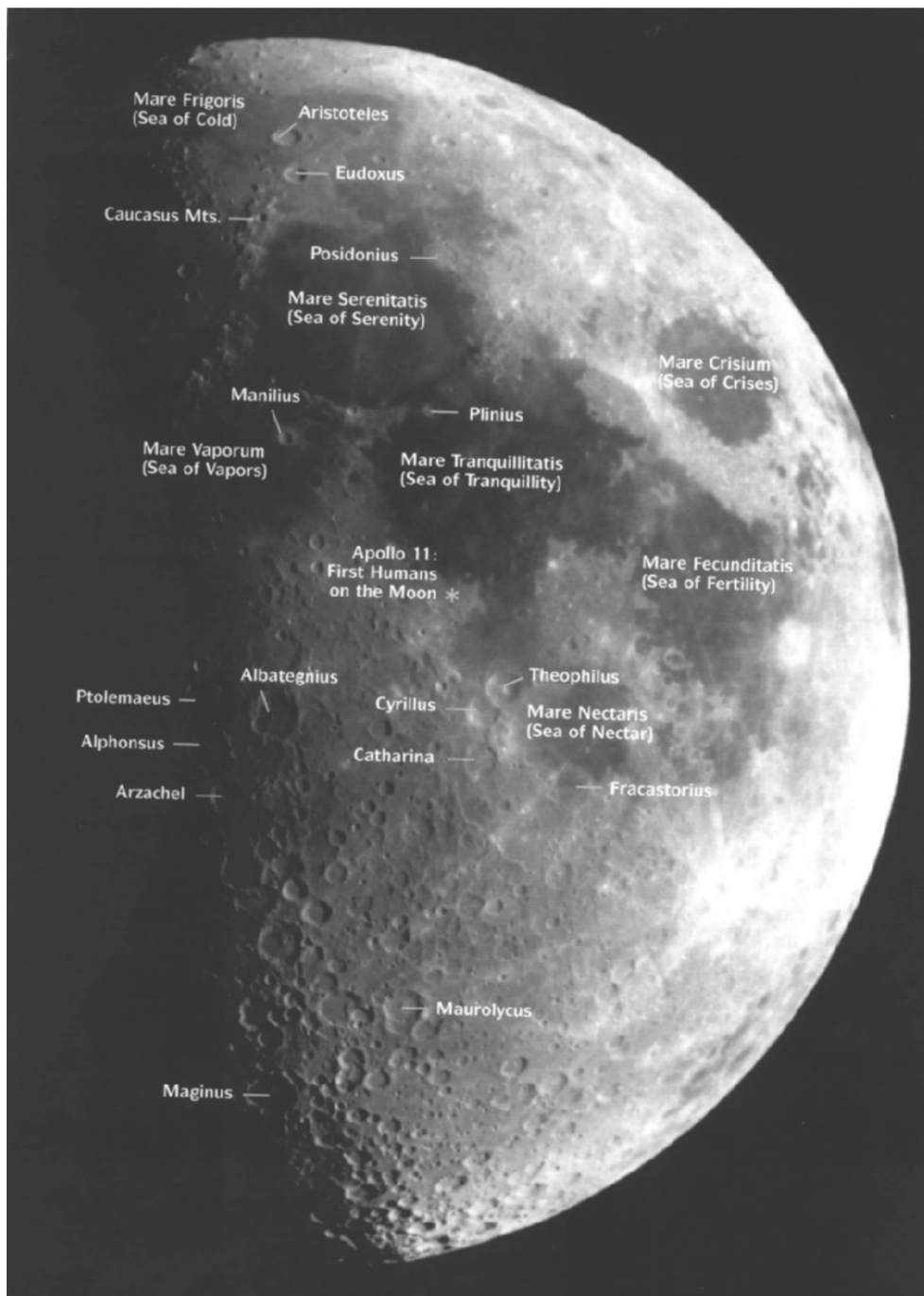
*P. Tawrell, Camping and Wilderness Survival: The Ultimate Outdoors Book, Paul Tawrell (p. 547)*

Figure 18R-1 Blazing Techniques

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## MOON QUARTERS

### FIRST QUARTER MOON



*T. Dickinson, NightWatch: A Practical Guide to Viewing the Universe, Firefly Books Ltd. (p. 141)*

Figure 18S-1 The First Quarter of the Moon

## LAST QUARTER MOON



*T. Dickinson, NightWatch: A Practical Guide to Viewing the Universe, Firefly Books Ltd. (p. 140)*

Figure 18S-2 The Last Quarter of the Moon

## **VENUS: PERIODS OF PROMINENT VISIBILITY**

Although Venus is the brightest object in the night sky, apart from the moon, it is often close to the horizon. If possible, observe from a location with an unobstructed horizon in the specified direction.

### **Western Sky at Dusk**




- early March 2010 to mid-September 2010
- early November 2011 to mid-May 2012
- late May 2013 to late December 2013
- early January 2015 to mid-July 2015
- mid-September 2016 to mid-March 2017
- mid-March 2018 to early September 2018




### **Eastern Sky at Dawn**

- mid-November 2010 to mid-March 2011
- late June 2012 to late December 2012
- late January 2014 to late August 2014
- late August 2015 to mid-February 2016
- mid-April 2017 to late October 2017
- mid-November 2018 to early April 2019



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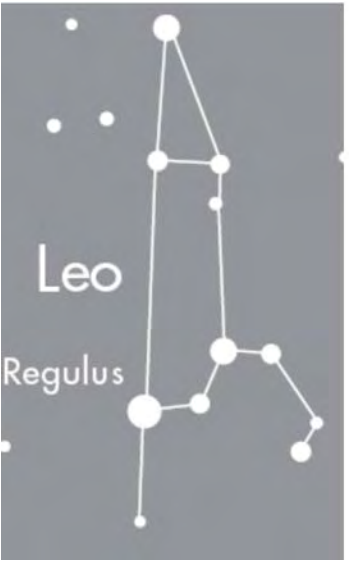
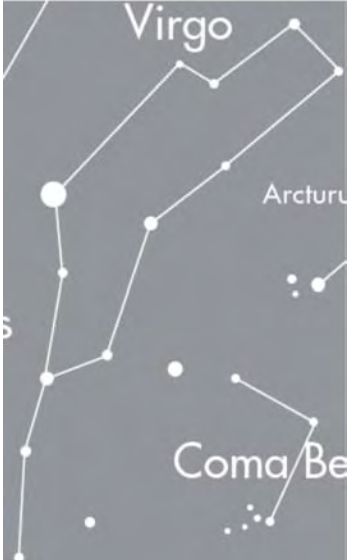
### CONSTELLATIONS

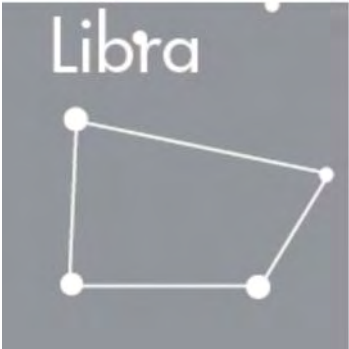


Constellations	Description	Picture
<p>Ursa Major (the Great Bear) and Ursa Minor (the Little Bear)</p>	<p>The Great Bear was actually a beautiful nymph named Callisto. Callisto was turned into a bear by Zeus to protect her from his jealous wife Hera. One day, Callisto ran into her son, Arcas, who was hunting in the woods. Arcas raised his spear towards the bear, his mother. Zeus, watching from above, acted quickly to save his beloved, Callisto. He turned Arcas into a bear and hoisted them both into the sky by their tails. In doing so, Zeus stretched the bears' tails and they now appear that way in the sky.</p> <p>The legends of some Canadian First Nations, including the Micmac and Iroquois, also identify this constellation as a bear.</p> <p>Ursa Major includes the Big Dipper which is also known as "The Plough" in Europe. The Big Dipper's handle is the bear's tail, while its scoop is the bear's side.</p> <p>The second star from the end of the Big Dipper's handle is really two stars. In ancient times these stars were used to test eyesight. An individual had good eyesight if they could see two distinct stars.</p> <p>At the end of the Little Dipper, Ursa Minor, is the pole star, Polaris. Polaris, also known as the North Star, is about 50 times larger than the sun but it appears very faint as it is 600 light years away.</p> <p>Polaris is due north and was important in early northern hemisphere navigation.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-1 Ursa Major</p>  <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-2 Ursa Minor</p>
<p>Cassiopeia (the Queen of Ethiopia)</p>	<p>When Cassiopeia died, she was placed next to her husband, Cepheus, in the sky. Her vanity and cruelty had never been forgotten by her enemy, Poseidon, who tilted her throne as she was placed in the sky. For half the night Cassiopeia is sitting upright, but for the rest of the night she must cling to her throne as she hangs upside-down in the sky.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-3 Cassiopeia</p>

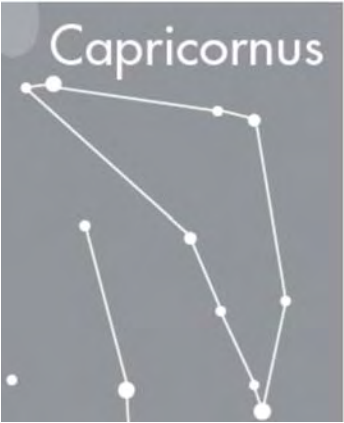

Constellations	Description	Picture
<p>Orion (the hunter)</p>	<p>Orion was a famous hunter who claimed he could kill any animal. Nothing could protect him from the scorpion that stung his heel and killed him. Orion and Scorpius are placed at opposite ends of the sky so they will not fight again.</p> <p>Look for a star with a fuzzy appearance just below Orion's belt as this is the Orion Nebula where baby stars are born.</p> <p>Betelgeuse, or the "armpit" of Orion, is a red supergiant star that is 300–400 times the diameter of the sun and is among the best candidates to become a supernova in northern skies. Betelgeuse is a variable star; its brightness varies, but on average it is the 12<sup>th</sup> brightest star in the sky.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-4 Orion</p>
<p>Aries (the ram)</p>	<p>Aries was a magical ram who could speak, think and fly. The god Hermes gave Aries two children, Helle and Phrixus, who wanted to escape their evil stepmother. Helle fell off Aries during the escape, but Phrixus made it to safety and sacrificed Aries to show his thanks. He gave Aries' fleece to King Aetes, who sent Draco the dragon to guard it. Eventually, Aries' Golden Fleece was stolen by Jason and the Argonauts.</p> <p>Aries' brightest star is Hamal, which means "the lamb." It is one of the few stars that has had its apparent size measured. Most stars are so far away they appear as just a point of light, but astronomers have measured the size of Hamal to be 0.00680 arcseconds. That is the same size as a penny would seem to be if you held it 60 km away.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-5 Aries</p>
<p>Taurus (the bull)</p>	<p>Taurus represents a bull. When Zeus fell in love with Europa, he transformed himself into a white bull. One day, as Europa was playing near the seashore, she noticed the new white bull. She went over for a closer look, and the bull knelt down to allow her to climb up. Once she was on, the bull leapt into to the sea and swam to the island of Crete. Then Zeus changed back into human form and told Europa of his love for her.</p> <p>Taurus is easy to spot from the constellation Orion. Follow the three stars of Orion's belt towards the west until a bright red-orange star is encountered. This is Aldebaran, the Eye of the Bull.</p> <p>Nearby are five more stars that make a V with Aldebaran and trace out the face of the bull.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-6 Taurus</p>

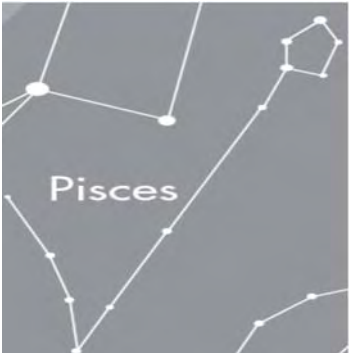


Constellations	Description	Picture
<p>Gemini (the twins)</p>	<p>The Twins, Castor and Pollux, were born to Leda, who was seduced by Zeus in the form of a beautiful swan. Every December, meteors appear to spray out of this constellation. This event is called the “Geminid meteor shower.”</p> <p>Castor and Pollux, the heads of the Twins, are the two brightest stars in the constellation Gemini. Castor, “the Beaver” and Pollux, “much wine” are the 20<sup>th</sup> and 16<sup>th</sup> brightest stars in the night sky respectively.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-7 Gemini</p>
<p>Cancer (the crab)</p>	<p>Cancer represents a crab that played a small role in the story of Hercules whose stepmother, the goddess Hera, was his mortal enemy. Hera sent the crab to try to distract Hercules who was battling the dreaded Hydra. The crab grabbed on to Hercules’ toe with its claws, but Hercules just shook him off and crushed him underfoot. To thank the crab for its brave attempt, Hera placed it in the sky.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-8 Cancer</p>

Constellations	Description	Picture
<p>Leo (the lion)</p>	<p>Leo was a lion that was sent from the moon down to Earth by Hera, the stepmother and mortal enemy of Hercules. Leo lived in a cave and would attack the people who lived nearby. Hercules was sent to fight Leo but his spears and arrows just bounced off the lion’s invincible skin. Hercules finally decided to wrestle Leo and eventually managed to strangle the lion to death. Hercules then made a cloak from the lion’s skin so that he could be invincible too.</p> <p>Regulus, the brightest star in the constellation Leo, means “the little king” in Latin. It is the 25<sup>th</sup> brightest star in our night sky and is relatively close to the Earth at a distance of 77 light years. Regulus is much brighter than our own star; it shines 350 times more brightly than the sun.</p> <p>The easiest way to find Leo in the sky is to look for a backwards question mark. This shape, often called The Sickle, marks the head and front paws of the lion.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-9 Leo</p>
<p>Virgo (the goddess of agriculture)</p>	<p>To the ancient Greeks, Virgo represented Demeter, the goddess of agriculture. Demeter’s daughter, Persephone, was kidnapped by Hades, the god of the underworld, and taken to be his wife. Demeter searched high and low for her daughter neglecting the crops. Eventually, Zeus persuaded Hades to release Persephone.</p> <p>While she was in the underworld, Persephone had eaten some pomegranate seeds and could never fully leave. Each year Persephone returns to the underworld for a time and winter occurs as the crops die and her mother mourns. When Persephone returns, her mother rejoices and the earth becomes fruitful again.</p> <p>The brightest star in Virgo is called Spica. It is easy to find by following the arc of the Big Dipper’s handle to Arcturus and then continuing in a straight line: “Arc to Arcturus, then speed on to Spica”.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-10 Virgo</p>

Constellations	Description	Picture
<p>Libra (the scales)</p>	<p>To the ancient Babylonians, Libra represented scales or balance. This might be because the sun was in front of the stars of Libra during their autumnal equinox, when days and nights were of equal length. To the Greeks, the stars of Libra were not their own constellation but rather the claws of the scorpion Scorpio. The Romans resurrected the idea of Libra representing scales and sometimes drew Virgo holding the scales, just like the goddess of justice.</p> <p>The two brightest stars in Libra have interesting Arabic names: Zubenelgenubi, “the southern claw,” and Zubenelchemale, “the northern claw.”</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-11 Libra</p>
<p>Scorpius (the scorpion)</p>	<p>Scorpius represents the scorpion that killed the hunter Orion. Orion was so proud of his hunting skills that he boasted he could track down and kill any animal on earth. His claim was so outrageous that the earth trembled in rage and cracked open. Out of the crack crawled a scorpion which stung and killed Orion. Out of pity, the gods placed Orion and Scorpius on opposite sides of the sky so there could be no more trouble between them.</p> <p>The brightest star in Scorpius is called Antares. This star is quite red and many people mistake it for Mars.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-12 Scorpius</p>
<p>Sagittarius (the archer)</p>	<p>Sagittarius was the ultimate archer, keen-eyed and with deadly aim. He is usually drawn as the Babylonians saw him, a centaur: half-man and half-horse. To the Greeks, though, he was a satyr: half-man and half-goat. He was the son of the pipe-playing god Pan and invented archery.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-13 Sagittarius</p>

Constellations	Description	Picture
<p>Capricornus (the goat-fish)</p>	<p>Capricornus is one of the oldest known constellations. The ancient Babylonians called it the goat-fish and said it ruled the part of the sky from which the mighty Tigris and Euphrates rivers flowed. The Greeks also saw Capricornus as a creature that was half-goat and half-fish. They associated it with the god Pan, who had a human torso and face, but goat legs and goat horns. One story about Pan is that he jumped in the river Nile to escape the sea monster, Typhon. The part of him below the water turned into a fish, while the rest of his body remained a goat.</p> <p>Capricornus is a hard constellation to find because it does not have any bright stars and it never gets very high in the sky.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-14 Capricornus</p>
<p>Aquarius (young man pouring water from a pitcher)</p>	<p>To the Babylonians, Aquarius was the ruler of all the watery constellations – Pisces, Capricornus, Piscis Austrinus and Cetus. To the Egyptians, Aquarius caused the yearly flooding of the river Nile. The Greeks personified Aquarius, drawing him as a young man pouring water from a pitcher.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-15 Aquarius</p>

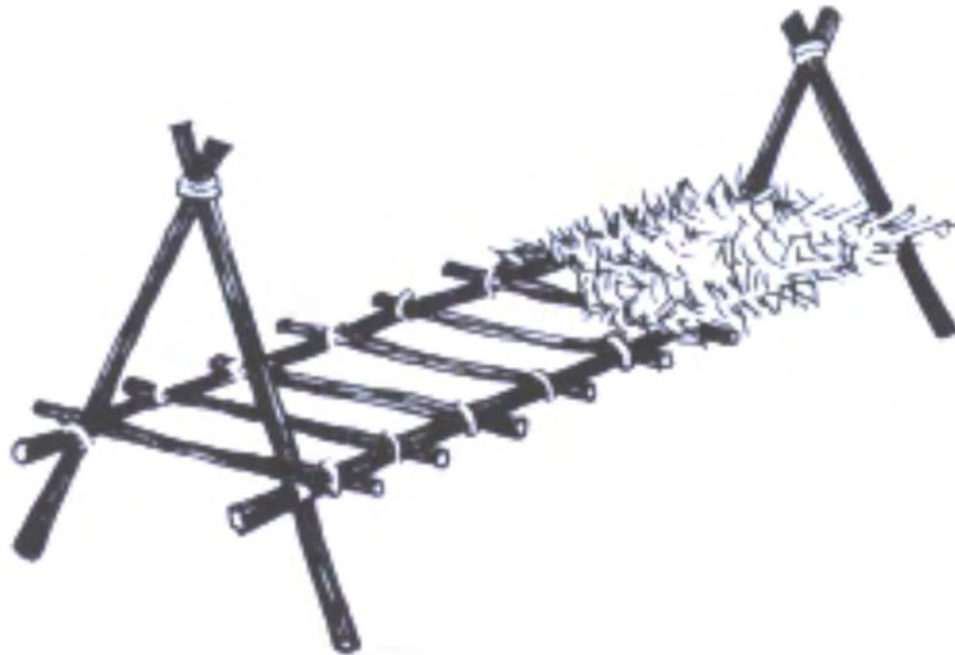
Constellations	Description	Picture
<p>Pisces (two fish)</p>	<p>Pisces represents two fish in the sky. One day, the goddess Aphrodite and her son Eros were fleeing the terrible sea monster Typhon. They hid in the rushes along the bank of the river Euphrates but could not escape. The monster was just about to attack when two fish swam up and carried Aphrodite and Eros to safety. As a reward for their help, the fish were placed in the sky as the constellation Pisces.</p> <p>Pisces is a hard constellation to find. The easiest way is to locate the square of Pegasus and look underneath it towards the south. A ring of stars, called the Circllet of Pisces may be seen. This represents the body of one of the fish.</p>	 <p><i>Constellations, by National Research Council of Canada. Retrieved December 3, 2007, from <a href="http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf">http://www.nrc-cnrc.gc.ca/docs/education/planisphere_e.pdf</a></i></p> <p>Figure 18U-16 Pisces</p>

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## LADDER BED

Using natural resources and cord, a ladder bed can be constructed. Steps to constructing a ladder bed:

1. Collect the natural resources, including:
  - a. four poles 75–100 cm long to construct the A-frames,
  - b. two sturdy poles approximately 180 cm long to make the frame (length will depend on the height of the person), and
  - c. several crosspieces 50–60 cm long, the more flexible the better; length will depend on the width of the person.
2. Construct two A-frame supports using round lashings.
3. Attach the two frame poles to the A-frames, ensuring that the knots and wood are strong and will hold the weight of the individual.
4. Tie the crosspieces making a ladder along the frame.
5. Lay a bedding of boughs, leaves or moss, as desired. Ensure there is enough material to prevent heat from being transferred away from the body during the night.



*J. Wiseman, The SAS Survival Handbook, HarperCollins Publishers (p. 309)*

Figure 18V-1 Ladder Bed

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### PACK FRAME

Using natural resources, cord and two straps, a pack frame can be constructed. Steps to constructing a pack frame:

1. Collect natural resources, including:
  - a. two poles to make the frame 75–100 cm long (length will depend on the height of the person),
  - b. several crosspieces 50–60 cm long, (length and number will depend on the width of the person), and
  - c. five pieces (two 15–20 cm long , two 50 cm long and one 50–60 cm long) to construct the right angle projection at the bottom.
2. Construct the ladder frame to the size of the individual.
3. Construct the right angle projection at the bottom and ensure the knots and wood are strong and will not break with a load.
4. Attach straps made from cord or from improvisation and adjust it to a comfortable position.



*J. Wiseman, The SAS Survival Handbook, HarperCollins Publishers (p. 372)*

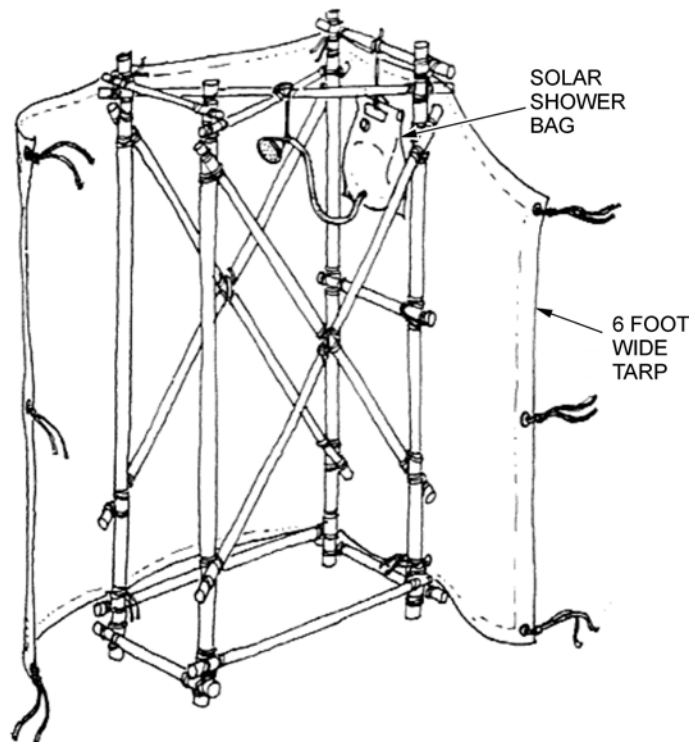
Figure 18W-1 Pack Frame

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## SHOWER

Using natural resources, cord, a large tarp and a shower bag or bucket; a camp shower can be constructed. Steps to constructing a shower:

1. Collect the natural resources, including:
  - a. four poles at least 180 cm in length, but may depend on the height of the person,
  - b. several poles for supports, (number and length will depend on the size of the shower being constructed and the strength of the material being used),
  - c. a tarp at least 180 cm in width and 240 cm in length, and
  - d. a shower bag or a bucket.
2. Lash the four poles at least to a square base frame and a cross-frame top.
3. Add cross-braces on two sides of the shower for support, remembering to leave one side open for accessibility.
4. Tie a large tarp with grommets to the outside of the frame and rig a latch on the open side.
5. Attach the shower bag or bucket to the top of the frame.



*PioneeringProjects.org, 2001, Camp Shower, Copyright 2001 by PioneeringProjects.org.  
Retrieved November 17, 2007, from <http://www.pioneeringprojects.org/projects/images/pion39.gif>*

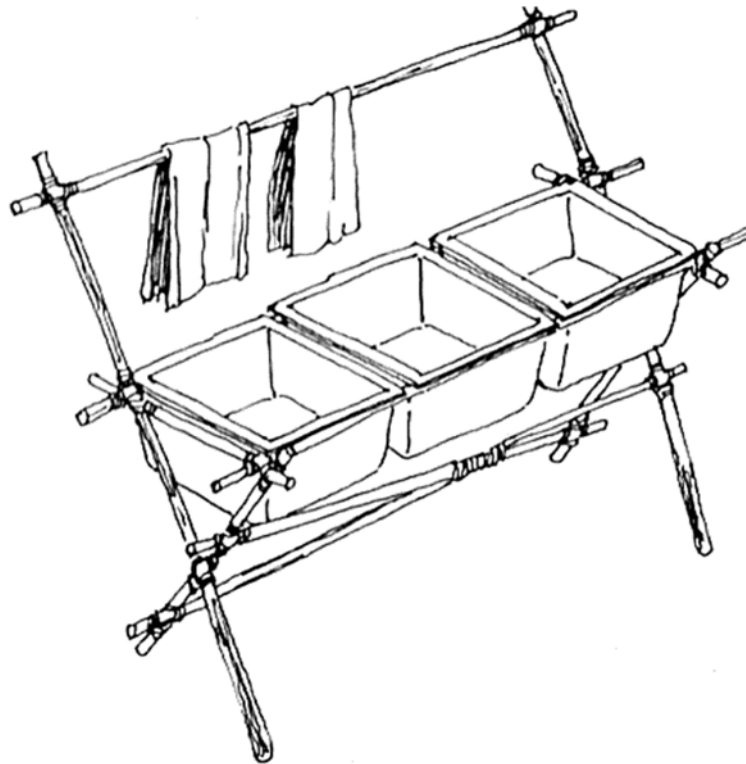
Figure 18X-1 Shower

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## WASHSTAND

Using natural resources, cord and several wash basins or tubs, a washstand can be constructed. Steps to constructing a washstand:

1. Collect the natural resources, including:
  - a. four poles to construct the table top (the dimensions will depend on the size and number of wash basins the washstand is being constructed for),
  - b. four poles to construct the stand, two poles 180 cm in length and two 120 cm in length, and
  - c. two poles the length of the washstand to form a cross-brace at the bottom.
2. Construct a box frame for the wash basins to sit in using square lashings; use the wash basin as a measuring tool.
3. Lash two sets of poles (one pole 180 cm and the other 120 cm long) using square lashings to form the stand.
4. Lash the table top to the sides and add supports as necessary.



*PioneeringProjects.org, 2001, Three Compartment Sink, Copyright 2001 by PioneeringProjects.org.  
Retrieved November 17, 2007, from <http://www.pioneeringprojects.org/projects/images/pion33.gif>*

Figure 18Y-1 Washstand

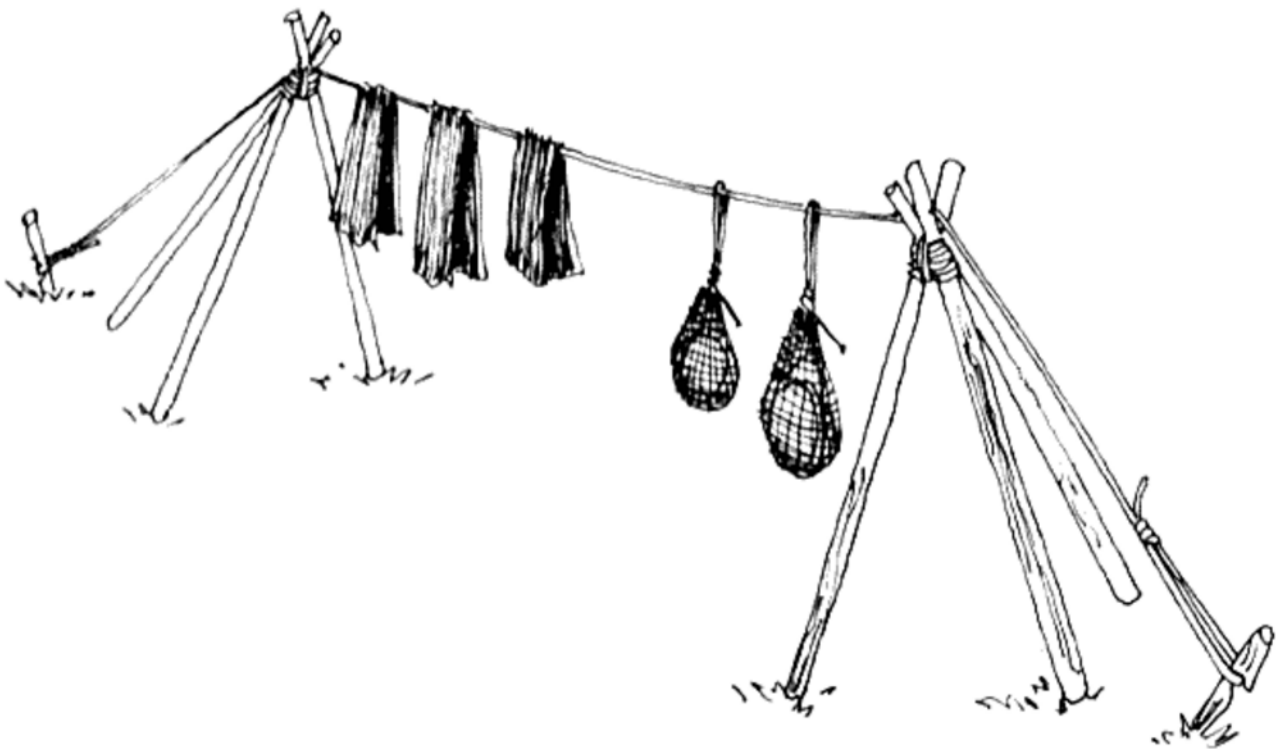
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## DRYING RACK

Using natural resources and cord, a drying rack can be constructed. Steps to constructing a drying rack:

1. Collect six poles 180 cm in length to construct two tripods.
2. Drive two uprights (piece of wood) into the ground and then lash a crosspiece of cord to join them across the top.
3. To ensure the structure is sturdy, add further poles lashed at an angle to form a simple 'A' frame at either end.
4. Attach guy wires to the two ends and peg out to keep the clothes rack on the ground in high winds. Add extra drying lines by lashing cord across the uprights.

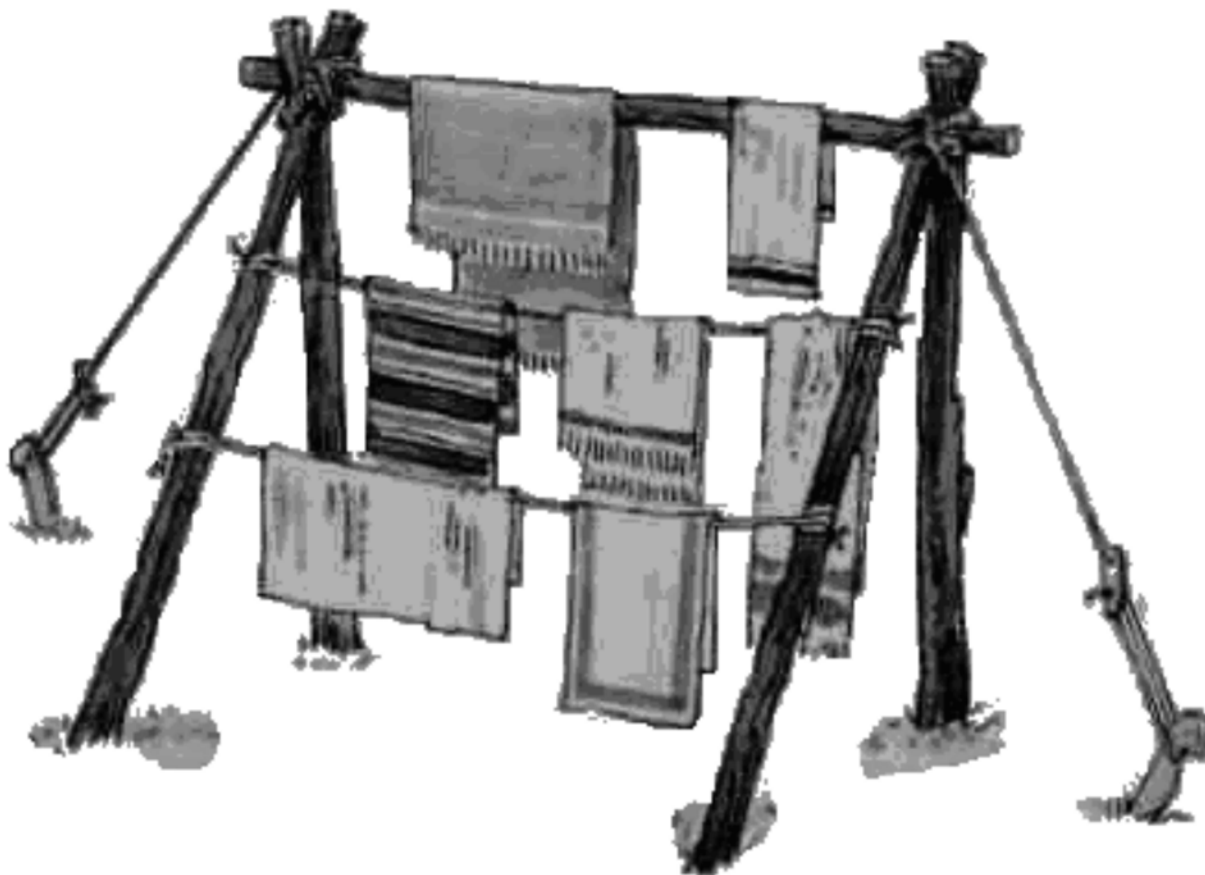
Dry clothing is essential in a survival situation to avoid exposure and possible hypothermia.



*PioneeringProjects.org, 2001, Clothesline, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from <http://www.pioneeringprojects.org/projects/images/pion24.gif>*

Figure 18Z-1 Drying Rack 1

Another option (as illustrated in Figure 18Z-2) is to build the entire frame out of wood.



*PioneeringProjects.org, 2001, Drying Rack, Copyright 2001 by PioneeringProjects.org.  
Retrieved November 17, 2007, from <http://www.pioneeringprojects.org/pioneering/index.htm>*

Figure 18Z-2 Drying Rack 2

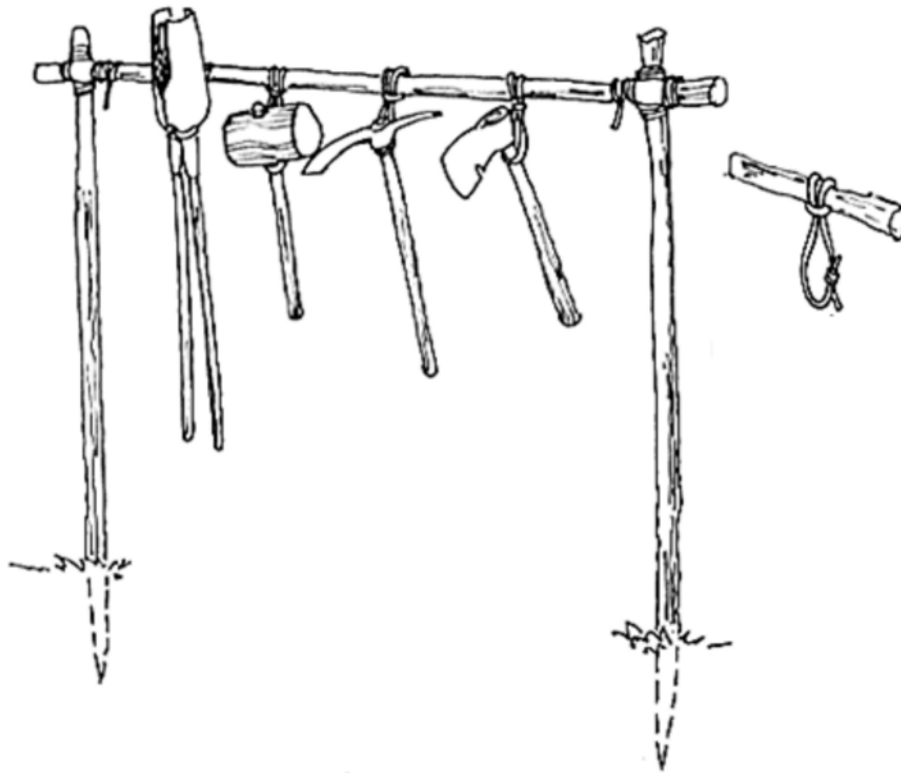


## TOOL RACK

Using natural resources and cord, a tool rack can be constructed. Steps to constructing a tool rack:

1. Collect the three poles 180 cm long from natural resources.
2. Drive two uprights into the ground or use two trees.
3. Lash a ridge pole between the two uprights to hang the tools from.
4. Tie pieces of cord into a loop using a reef knot and then loop it over the ridge pole (as illustrated in Figure 18AA-1).

A tool rack will keep tools off of the ground and prevent them from rusting or becoming dull too quickly. By having tools kept in one place they are less likely to go missing and site safety is increased.



*PioneeringProjects.org, 2001, Tool Rack, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from <http://www.pioneeringprojects.org/projects/images/pion27.gif>*

Figure 18AA-1 Tool Rack 1

Another example (as illustrated in Figure 18AA-2) has two crosspieces of wood for increased stability.



*Scoutmaster, Knots and Pioneering, Retrieved November 18, 2007, from [http://scoutmaster.typepad.com/shared/image.html?photos/uncategorized/chip5\\_copy\\_copy.jpg](http://scoutmaster.typepad.com/shared/image.html?photos/uncategorized/chip5_copy_copy.jpg)*

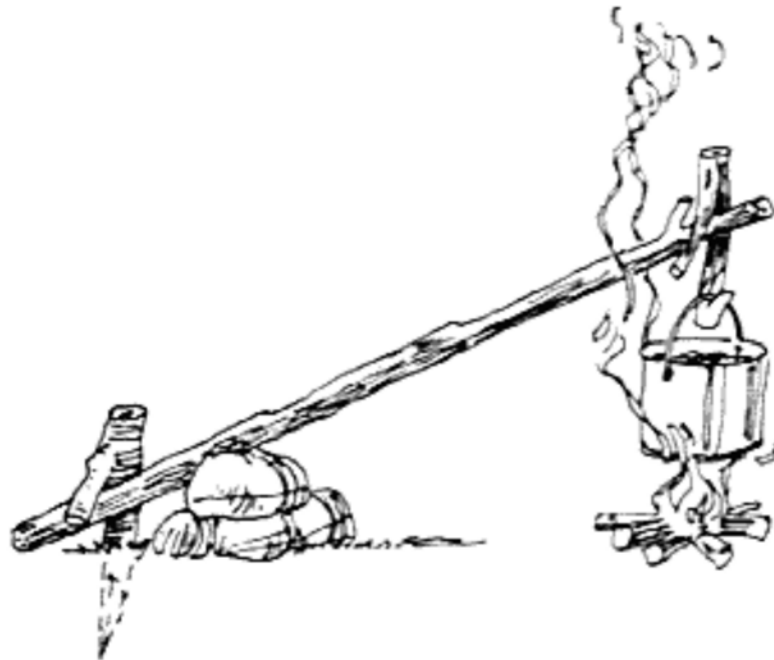
Figure 18AA-2 Tool Rack 2

## CAMP CRAFTS FOR COOKING

### Pot Rod

Using natural materials, cord and a pot, a pot rod for cooking over a fire can be constructed. Steps to constructing a pot rod:

1. Collect the natural resources, including:
  - a. one pole 180 cm long, and
  - b. two forked sticks, match size and shape to the pole.
2. Drive a forked stick into the ground near the fire, so that the forked part is facing down (as illustrated in Figure 18AB-1). Be careful in the placement so it does not catch on fire.
3. Pile rocks on the fire side of the forked stick and insert a long pole between the forked stick and the rocks so that the end is over the fire; add rocks to achieve the desired height.
4. Secure the pot by either lashing another forked stick (as illustrated in Figure 18AB-1) or by notching a groove so the handle stays in one spot.



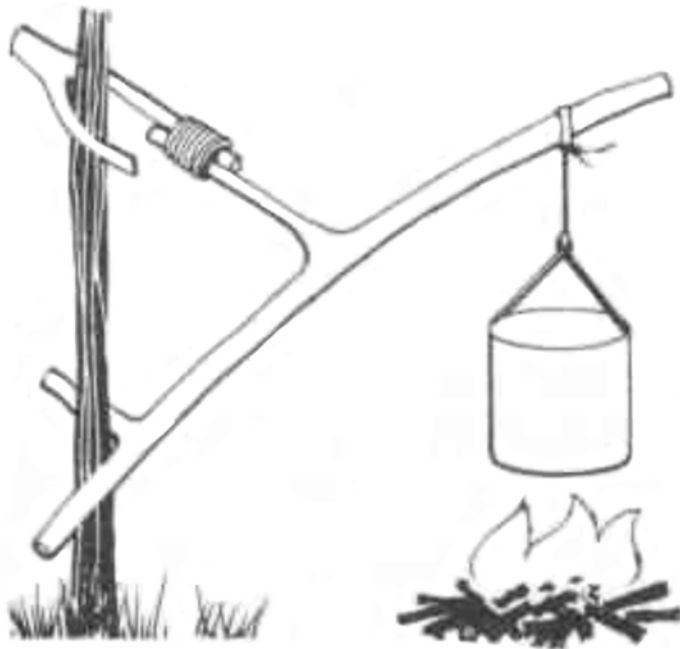
*PioneeringProjects.org, 2001, Various Utensils, Copyright 2001 by PioneeringProjects.org.  
Retrieved November 17, 2007, from <http://www.pioneeringprojects.org/projects/images/pion29.gif>*

Figure 18AB-1 Pot Rod

## Swinging Pot Holder

Using natural materials, cord and a pot, a swinging pot holder for cooking over a fire can be constructed. A swinging pot holder is an extremely useful version of the simple pot rod. Steps to constructing a swinging pot holder:

1. Collect the natural resources, including:
  - a. one pole 150 cm long, with a forked end and another fork at the midway point,
  - b. one pole 90 cm long for an upright, and
  - c. one short stick with a fork (as illustrated in Figure 18AB-2).
2. Drive the 90-cm long upright 15 cm into the ground.
3. Lash the two forked sticks so that the forks fit in opposite directions on the upright. This will produce a cantilever action which not only maintains the height that it is set at, but will also swing freely allowing the pot to move away from the flames. Note that with a longer upright, the cooking height can be better controlled.
4. Secure the pot by either lashing another forked stick (as illustrated in Figure 18AB-2) or by notching a groove so the handle stays in one spot.



*J. Wiseman, The SAS Survival Handbook, HarperCollins Publishers (p. 288)*

Figure 18AB-2 Swinging Pot Holder

## Chippewa Kitchen

Using natural materials and cord, a Chippewa kitchen for cooking over a fire can be constructed. A challenging camp craft, but a nice set-up for long-term cooking, the Chippewa kitchen (as illustrated in Figure 18AB-3) is constructed by the following steps:

1. Collect the natural resources, including:
  - a. eight straight poles 240-cm long and 4 cm thick,
  - b. four straight poles 50 cm long and 4 cm thick, and
  - c. poles 50-cm long to create a table top.
2. Using round lashings and four 240-cm poles, lash two sets of 'A' frames.
3. Lash two 50 cm poles to each of the 'A' frames for support.
4. Lash the two 'A' frames together with the remaining four 240-cm poles (as illustrated in Figure 18AB-3).
5. Add poles to create a table top.

Scale the kitchen to available materials or conditions as appropriate.



*Scoutmaster, Knots and Pioneering. Retrieved November 18, 2007, from [http://scoutmaster.typepad.com/my\\_weblog/2006/05/chippewa\\_kitche.html](http://scoutmaster.typepad.com/my_weblog/2006/05/chippewa_kitche.html)*

Figure 18AB-3 Chippewa Kitchen

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## WHEELBARROW

Using natural materials and cord, a wheelbarrow can be constructed. A wheelbarrow is a tool that assists in gathering firewood or moving heavy objects around a survival site. Steps to constructing a wheelbarrow:

1. Collect the natural resources, including:
  - a. two poles 60–100 cm long,
  - b. two poles for crosspieces,
  - c. one cross-section of a log approximately 15 cm in diameter and 4 cm thick, and
  - d. one rod matched to the size of the hole.
2. Construct the wheel from a cross-section of a small tree that has been bored out and a rod to create an axle. The wheel portion can take a lot of time to create depending on available tools.
3. Insert a rod that has been shaped to fit into the hole.
4. Make a notch into each of the longer poles to match the diameter of the rod.
5. Tightly lash the two poles with a crosspiece as close to the wheel as possible. This crosspiece will hold the wheel in place and must be very tight.
6. Lash another crosspiece near the top of the two poles for support.
7. Add other crosspieces if necessary.



*Ropesandpoles.blogspot.com. Retrieved November 18, 2007, from  
<http://ropesandpoles.blogspot.com/2006/01/camp-wheelbarrow.html>*

Figure 18AC-1 Wheelbarrow

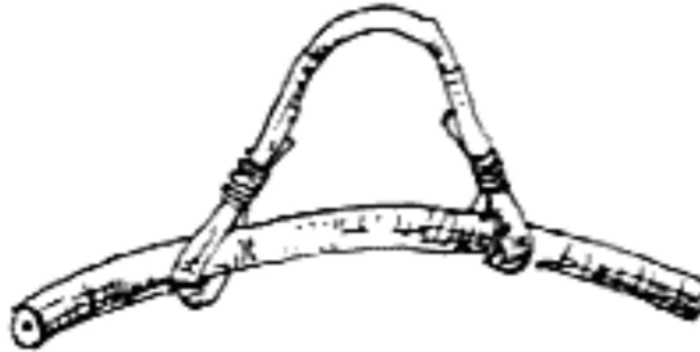
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## COAT HANGER

Using natural materials and cord, a coat hanger can be constructed. Good for using on a drying rack, the coat hanger is one of the easier crafts to construct. Steps to constructing a coat hanger:

1. Collect the natural resources, including:
  - a. one slightly bent pole 60 cm long, and
  - b. one forked stick approximately 15 cm long or a bent stick approximately 30 cm long.
2. Lash either a forked stick or bent stick (as illustrated in Figure 18AD-1), to the slightly bent pole.



*PioneeringProjects.org, 2001, Various Utensils, Copyright 2001 by PioneeringProjects.org.  
Retrieved November 17, 2007, from <http://www.pioneeringprojects.org/projects/images/pion29.gif>*

Figure 18AD-1 Coat Hanger

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## SIMPLE BENCH

Using natural materials and cord, a bench can be constructed. A simple bench can double as a tool storage area or a work bench. Steps to constructing a simple bench:

1. Collect the natural resources, including:
  - a. six sturdy logs approximately 100 cm long and 15 cm thick, and
  - b. one sturdy log approximately 150 cm long and 15 cm thick.
2. Using round lashings, create two tripod frames.
3. Attach a sturdy log to the tripod frames to sit on.



*PioneeringProjects.org, 2001, Miscellaneous, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from <http://www.pioneeringprojects.org/images/pioneering/Miscellaneous.JPG>*

Figure 18AE-1 Simple Bench



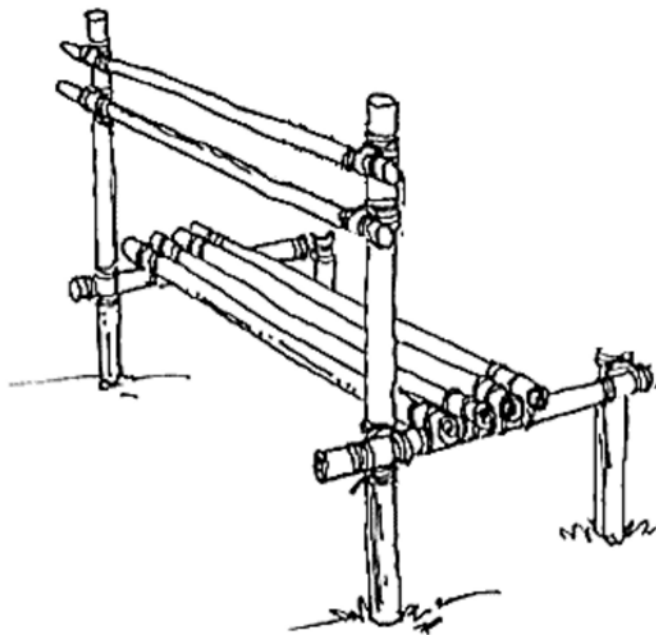
Figure 18AE-1 shows the legs as a pair instead of a tripod frame. Tripod frames are required to make the bench stable.

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### BENCH WITH BACK REST

Another example of a bench (as illustrated in Figure 18AF-1) uses more poles and has a back rest. Steps to constructing a bench with a back rest:

1. Collect the natural resources, including:
  - a. eight poles approximately 2 m each,
  - b. two poles approximately 1 m each, and
  - c. two poles approximately 0.5 m each.
2. Construct the sitting portion of the bench by attaching four long pieces of wood to the 1 m pieces, using square lashings.
3. Drive the two long and two short pieces of wood that will be used as the legs of the bench into the ground.
4. Lash the sitting portion onto the legs, using square lashings.
5. Construct the back rest using square lashings and attach it to the long legs in the ground.



*PioneeringProjects.org, 2001, Bench With Back Rest, Copyright 2001 by PioneeringProjects.org.  
Retrieved February 20, 2007, from <http://www.pioneeringprojects.org/projects/index.htm>*

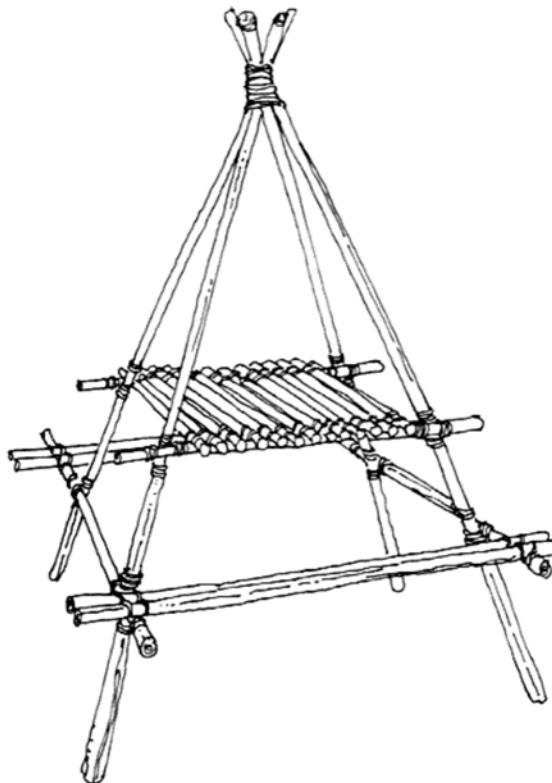
Figure 18AF-1 Bench with Back Rest

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### CAMP TABLE 1

Using natural materials and cord a table can be constructed (as illustrated in Figure 18AG-1). Steps to constructing a camp table:

1. Collect the natural resources, including:
  - a. four poles approximately 3 m long,
  - b. six poles approximately 2 m long,
  - c. two poles approximately 1.5 m long, and
  - d. fourteen poles approximately 0.5 m long.
2. Construct a figure-of-eight lashing around the four long pieces of wood, to make an A-frame.
3. Construct the table top, using square lashings.
4. Attach the table top portion to the long poles, using square lashings.
5. Make the sitting portion using square lashings and attach it to the long poles using square lashings.



*PioneeringProjects.org, 2001, Camp Table, Copyright 2001 by PioneeringProjects.org. Retrieved November 17, 2007, from <http://www.pioneeringprojects.org/projects/images/pion35.gif>*

Figure 18AG-1 Camp Table 1

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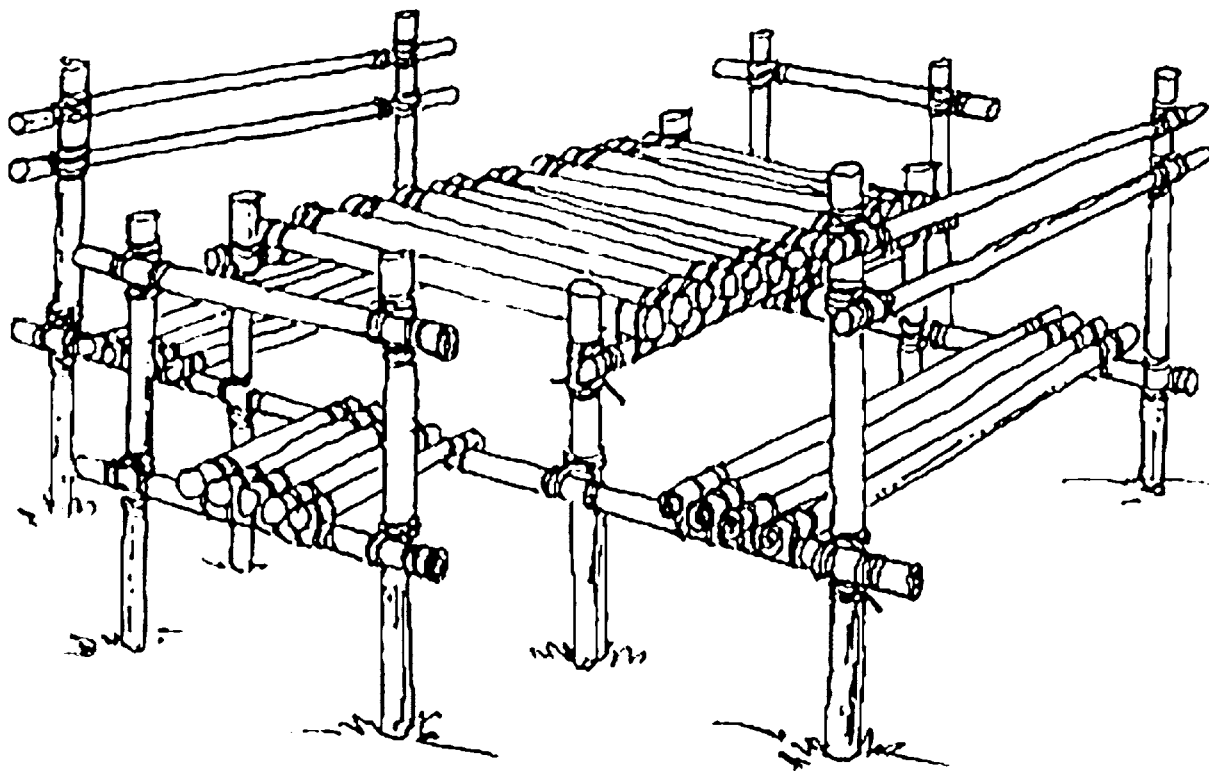


## CAMP TABLE 2

An alternative to Camp Table 1, this camp table is a combination of the steps in Bench with a Back Rest combined with a variation of the steps in Camp Table 1. Steps to constructing camp table 2:

1. Collect the natural resources, including:
  - a. thirty poles approximately 1 m long,
  - b. fourteen poles approximately 2 m long,
  - c. two poles approximately 3 m long, and
  - d. ten poles approximately 0.5 m long.
2. Construct the table by lashing together the four 1-m uprights with two 1-m poles and two 2-m poles.
3. Add twelve 1-m poles as a table top.
4. Lash the two 3-m poles to either end of the table using square lashings.
5. Lash the four 1-m uprights to the end of the 3-m poles using square lashings at each end.
6. Lash eight 2-m long poles to the seat and two 2-m long poles to form the backrest.
7. Lash the five 0.5-m poles to the sides of the table and lash a 1-m long pole to the other end. Repeat on the other side.
8. Then using the 1-m long pole from Step 7., lash two 1-m uprights using square lashings. Repeat on the other side.
9. Finish the end seats by lashing the final 1-m long pole to the top to form a backrest. Repeat on the other side.

This elaborate camp craft can take many hours to build, a lot of personnel and resources are required.



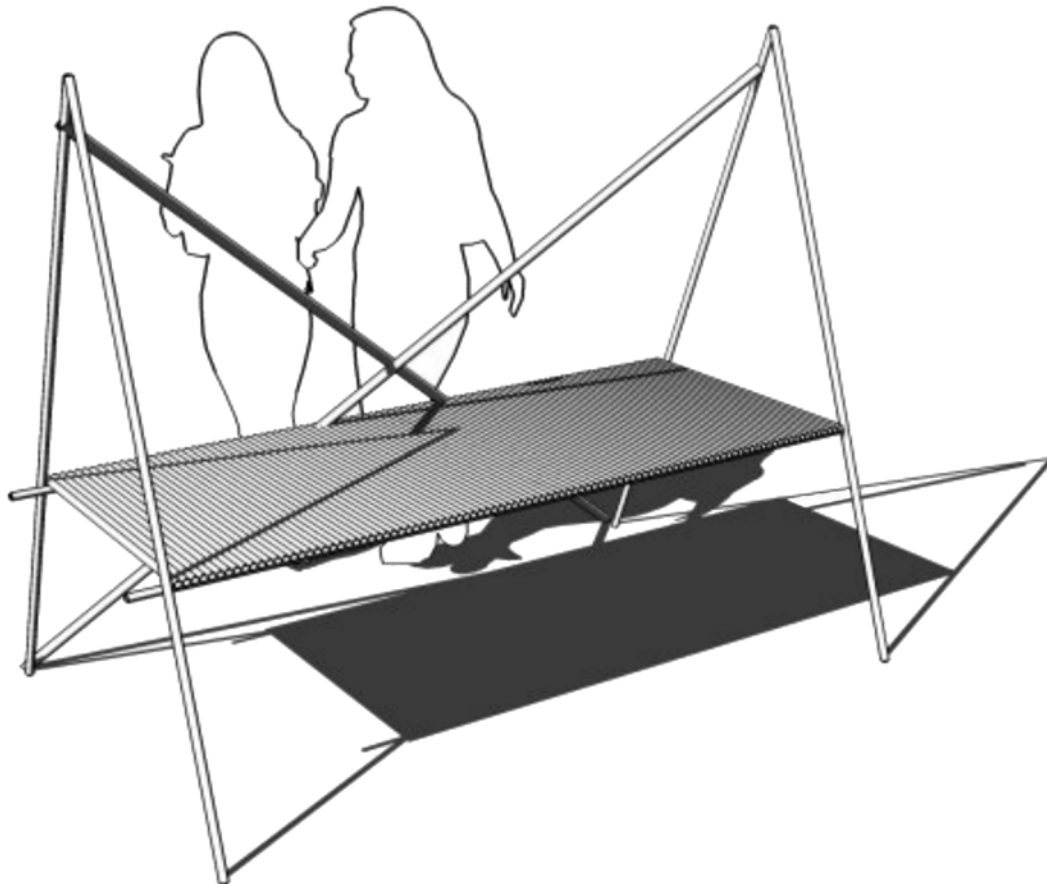
*PioneeringProjects.org, 2001, Camp Table With Bench & Seat, Copyright 2001 by PioneeringProjects.org.  
Retrieved November 17, 2007, from <http://www.pioneeringprojects.org/projects/images/pion38.gif>*

Figure 18AH-1 Camp Table 2

### CAMP TABLE 3

Using natural materials and cord another example of a camp table (as illustrated in Figure 18AI-1).

1. Collect the natural resources, including:
  - a. two poles approximately 2 m long,
  - b. two poles approximately 2.5 m long,
  - c. two poles approximately 3 m, and
  - d. poles approximately 0.5 m long to create the table top.
2. Lash the two 2-m pole to make two 'A' frames.
3. Lash a cross-brace the two 'A' frames using two 3-m poles.
4. Lash the two 2.5-m poles to the frame to form the table top.
5. Add poles to the table top to complete the structure.



*Ropesandpoles.blogspot.com. Retrieved November 18, 2007,  
from <http://ropesandpoles.blogspot.com/2006/01/camp-table.html>*

Figure 18AI-1 Camp Table 3

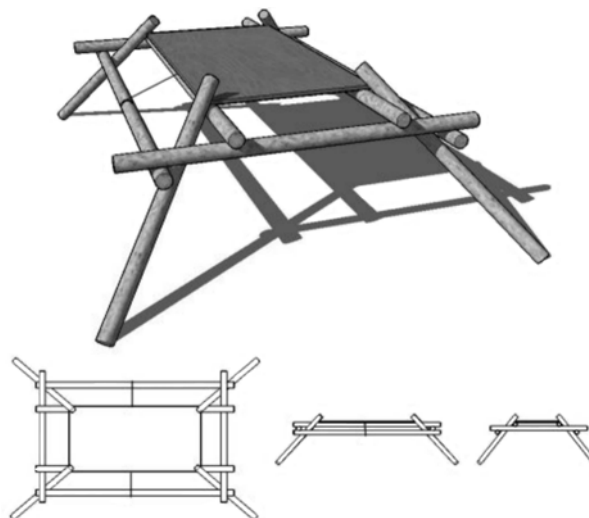
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### FRICITION-LOCK TABLE

Using natural resources and cord, a friction lock table can be constructed. This table only uses one piece of cord (as illustrated in Figure 18AJ-1). Friction locks the whole table together. There is one rope stopping the entire thing from spreading out and falling apart, running across the table (from left to right, under the table top). No lashings are used at all in this construction.

Steps to constructing a friction lock table:

1. Collect the natural resources, including:
  - a. four poles 180 cm in length and at least 15 cm thick, all poles used to construct this table should be of the same thickness to ensure a proper fit,
  - b. six poles 120 cm in length and at least 15 cm thick, and
  - c. natural materials to construct the tabletop.
2. Lay out the four parallel poles (the ones pointing towards the screen (as illustrated in Figure 18AJ-1) and tie together with clove hitches on each pole.
3. Lifting the two centre poles that were just tied, place the two cross-poles under these but over the outside poles.
4. Place natural materials or a piece of plywood to make a table top.
5. Lift the table (by the two outside tied poles) and hold up while the legs are inserted.



*Ropesandpoles.blogspot.com. Retrieved November 18, 2007, from <http://photos1.blogger.com/blogger/3732/1264/1600/friction%20lock%20tableS.jpg>*

Figure 18AJ-1 Friction-Lock Table

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## **SAMPLE BRIEFING**

### **Situation**

A 26-year-old male, Jim Grapevine, was a member of a group of hikers travelling through the park towards Hope Lake. He was lagging behind the group and was told to catch up. An hour after the group reached the lake, he still had not caught up. The group decided to look for him on their own and by nightfall, they returned to the lake without finding any sign of him. All the next day they backtracked along their trail to the point he was last seen. They searched back towards the lake, still finding no signs. After a day and a half of searching, they decided to contact the authorities. As there was no cell phone signal at the lake, they hiked the next morning to where they could make the emergency call. It has now been two days since Jim was last seen and through examining the clues we have, I have decided to concentrate the search in this area (point to the area on the map). Jim is an inexperienced hiker but very cool-headed. He has a very creative personality and was tired but in good spirits when he was last seen. He was only carrying his own gear. No other member of the group can say what he had except for a sleeping bag and clothes.

### **Details of the Confinement Area**

A lookout has been airlifted to the top of Cloud Hill, which overlooks the area. Increasing low cloud cover will make the lookout ineffective in about two hours. The main road is being patrolled by vehicle and the Hope River is being patrolled by boat. Track traps have been set on the main trail from the lake.

### **Formation**

The formation we will be using is the creeping line (as when cadets do a garbage sweep). Remember to move slowly so as to not get too far ahead of the other pairs.

### **Distance Between Pairs**

Based on the type of terrain we will be encountering, the distance between pairs will be 10 m (30 ft).

### **Call Signs and Radio Frequency to be Used**

Call signs that will be used are:

SAR leader: Sierra

Left anchor (end) team: Lima Major

Right anchor (end) team: Romeo Major

First pair to the left of the SAR leader: Lima One

Second pair to the left of the SAR leader: Lima Two

etc...

First pair to the right of the SAR leader: Romeo One

Second pair to the right of the SAR leader: Romeo Two

etc...

The radio frequency will be 6.07, check your radio now to ensure it is on the correct frequency.

### **Magnetic Bearing (Search Direction)**

The magnetic bearing you will be searching on will be 72 degrees. It is important that you stay in your search lane and not veer into a neighbouring team's lane. Remember your pacing techniques when bypassing obstacles. If possible, use a steering point.

**Safety Bearing (If Lost or Disoriented)**

If you become lost or disoriented, radio the SAR leader, who will assist you to get back on track. If you are also out of radio contact, use a magnetic bearing of 260 degrees which will bring you to Highway 43, which is being patrolled. Wait on the side of the road and flag down the patrol vehicle when you see it.

**Actions to Take if the Cadets Discover a Clue/Lost Person: Radio In, Wait for Instructions**

If you find a clue, stop and radio the SAR leader. Follow the instructions given. All other teams should stop and wait for instructions. Depending on the type of clue found, the search may be reoriented based on the new information.

If you find the lost person, one of you shall evaluate the situation to assess whether it is safe to approach. The other person should radio the SAR leader with the discovery and wait for instructions.

**Does anyone have any questions?**