University of Nevada
Cooperative Extension

PEER REVIEWED

Curriculum 15-03

Land Navigation at Nevada Youth Range Camp

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This curriculum is used at Nevada Youth Range Camp for teaching high school-age campers about using maps and compasses to develop land navigation skills.

SETTING THE STAGE

Maps are used almost every day by land managers. Maps help to find places, tell distances and directions, record events, inventory resources, and make or follow plans.

There are many reasons you might wish to improve your navigational skills. Here are a few very special reasons:

1. Skillful use of maps and compasses opens new opportunities for outdoor exploration and travel. You have greater freedom to choose where to go, when and with whom.
2. You will be more self-reliant and confident during your travels.
3. Knowledge of an area might be a timesaver— even a lifesaver.
4. Compasses work with no batteries (not so for a Global Positioning System (GPS) receiver).

Rational

Training and practicing land navigation on foot provides the following everyday navigation (how not to get lost) benefits:

1. Tracking present location – *Where am I?*
2. Determining distance – *How far is it to my destination* and *am I there yet?*
3. Sense of direction – *Where do I want to go and where am I actually going?*
4. How to read a topographic map – *Do I understand the map?*
5. Terrain and map association – *Which hill or river am I looking at?*

In this session we will:

1. Examine a topographical map of the Big Creek and adjacent watershed, and use it to identify your location.
2. Orient the map and determine the correct direction and distance from where you are to some other location.
3. Find out how many steps/paces it would take you to reach that point.
4. Learn how to use contour lines to find your location and navigate on a topographical map.
5. Complete a day and night navigation course.

APPLICATION

Understanding the parts and features of a compass.

There are different kinds of compasses, but we will discuss only the Silva-type compass. The compass housing is divided into 360 equal parts numbered clockwise in consecutive order. Each equal part is called a degree or an azimuth.

The main parts of a compass (Figure 1):

Compass needle - The red end points to magnetic north, and the white end points south.

Compass housing - A movable dial with a 360 degrees circle marked on the outer edge. The space between

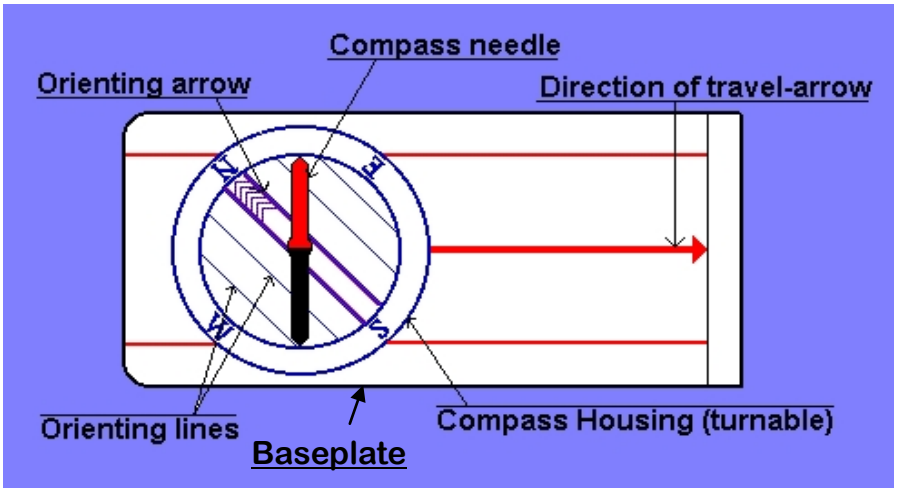

Figure 1. *The Silva Compass, http://www.learn-orienteering.org/old/lesson1.html*

each line marked on the housing represents 2 degrees. There are four principal directions marked on a compass dial (figure 2): North (0 degrees and 360 degrees), East (90 degrees), South (180 degrees), and West (270 degrees). An orienting arrow also appears on the bottom of and inside the housing.

Baseplate - The baseplate is used to indicate the line of travel as shown by the “direction of travel arrow” on the plate. The base can also be used to scale distances on a map.

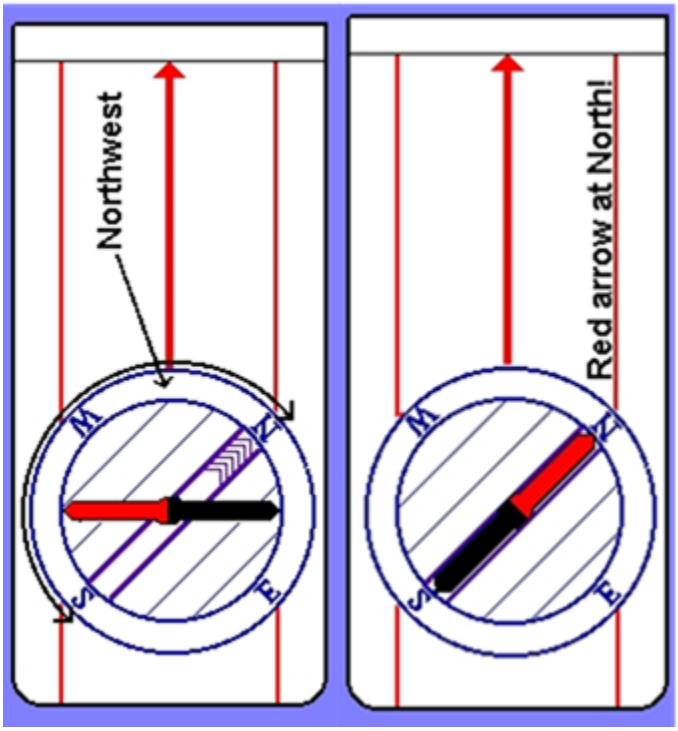

Figure 2. Illustration of “Red in the Shed” technique,
The Silva Compass, http://www.learn-orienteering.org/old/lesson1.html

How to use the compass to determine your direction of travel.

1. Hold the rounded end against your belly button, so that it points straight away from your body. This way the bearing arrow is showing you what direction you are headed in. Turn the dial so that “Red Fred,” the red half of the needle, is in the “shed” (red arrow on the compass face). **“Red in the Shed” is when the red tip of the needle is between the two heavy lines that connect the N and S letters and it touches the N (Figure 2).**
2. Look at where the bearing arrow lines up with the dial, and determine the closest letter on each side. This tells you the direction you are headed in.
3. In this case, you have already put “Red in the Shed,” so you are ready to read the bearing arrow. The two closest letters are N and W. You are equally between the two, so your bearing is northwest.
4. To travel in a different direction, turn the compass dial so your desired direction (degree of bearing or direction) aligns with the direction of travel arrow. Then, move the baseplate to put “Red in the Shed.”

Give each pair of students a compass, and let them practice using it for a few minutes. After they can name the key parts, have the students practice the procedure for finding a bearing at least twice, with each partner taking the lead at least once.

Understanding the effects of metal and electricity on the compass.
These sources affect the performance of a compass during use. Be aware of these features and their potential influences on your compass. They can cause substantial error in your compass reading (*Estela, K., Land Navigation with Map and Compass*).

1. High tension power lines - 180 feet / 55 meters
2. Truck, car, barbed wires - 33 feet / 10 meters
3. Hunting rifle - 6 feet / 2 meters
4. Knife, flashlight, binoculars, camera - 1 foot / 0.5 meter
5. Belt buckle, paper clip, jewelry, etc. - 2.5 inches / 1 centimeter

Understanding map information.
The map margins contain the following information (figure 3):

1. Key to types of roads on the map.
2. Map name and state.
3. Date of the map.
4. Quadrangle location shown as a black square superimposed on a state map.

At bottom center is the Map Scale Ratio – size of area covered and terrain detail.

Distance bar scales show several alternative units for the measurement of distance.

The contour (elevation) intervals are the brown lines.

In the lower left corner is the credit legend, a complex of information, including the following:

1. The magnetic declination.
2. The star indicates True North: the direction of the North (rotational) Pole.
3. "MN" indicates the direction of the North Magnetic Pole.
4. "GN" (Grid North), the Universal Transverse Mercator (UTM) grid.

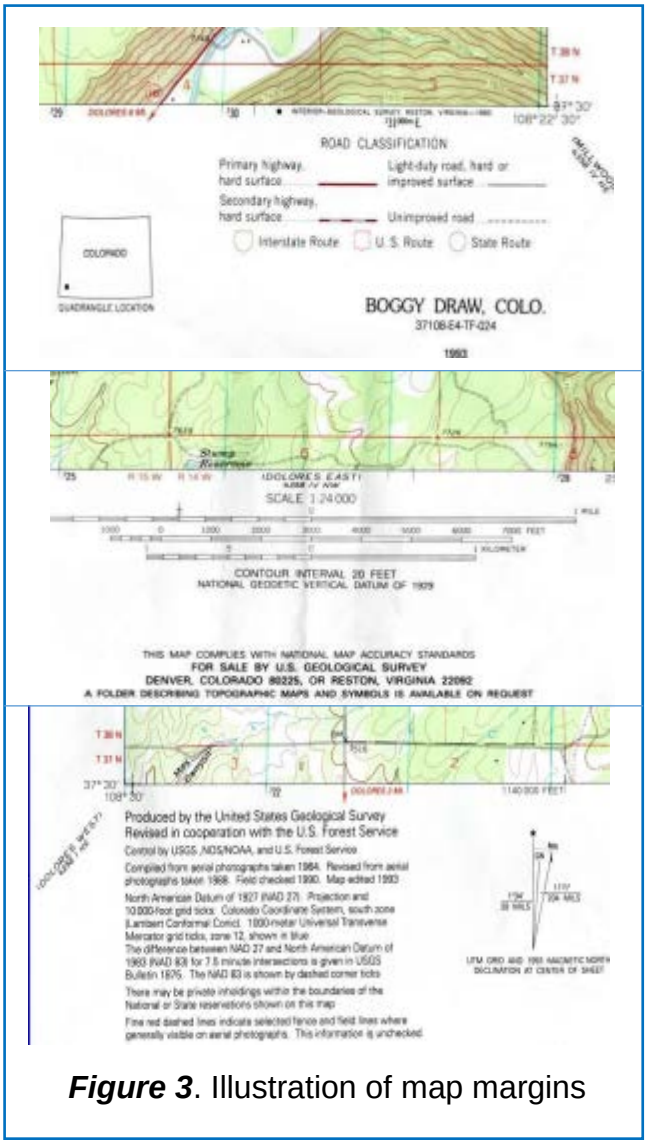

Figure 3. Illustration of map margins

Understanding the angle of declination.
Maps and land surveys are oriented to True North or Grid North. Compass needles point to earth's North Magnetic Pole located approximately 1,000 miles south of the geographic North Pole, near Prince of Wales Island in northern Canada.

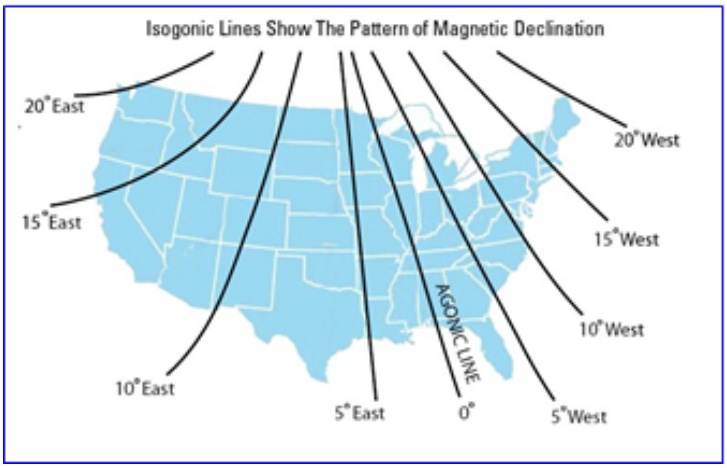

Figure 4. Illustration of the Pattern of Magnetic Declination, *USGS, http://education.usgs.gov/lessons/compass.html*

In different parts of the country the angle of declination varies.
This is one reason why manufacturers do not build this correction factor directly into the compass. Declination in Nevada is approximately 12 to 13 degrees east.

Since Nevada is west of the declination zero line, our compass needle will point east of True North as is shown in Figure 4. This is called easterly declination. **We would always add our easterly declination to a magnetic compass bearing to get a True North bearing.**

Orienting a map.

A map represents the real world. When you orient a map, you are positioning the map so its North arrow is pointing True North. When you orient a map and know where you are on the map, you can look in a certain direction and see a real landmark and find it on the map, (Estela, K., 2009), (Figure 5).

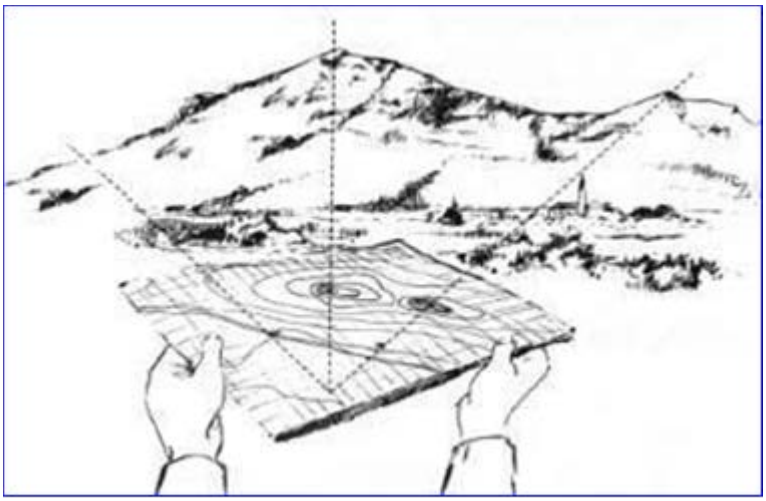

Figure 5. Illustration of orienting a map to identify terrain features,
Estela, K., Land Navigation with Map and Compass

Task #1: Orienting a Map

Orienting, or aligning, the map to True North is very easy and takes just four steps:

1. Lay your map out on a relatively flat, smooth surface.
2. Turn your compass dial so North (0 degrees or 360 degrees minus the angle of declination 13 degrees = 347 degrees) is at the index pointer or direction of travel line.
3. Place your compass on your map with the edge of the baseplate parallel to the True North or Grid North line on the angle of declination compass rose, located on the bottom of the map.
4. Turn the map and compass together until the compass needle is "boxed" in the orienting arrow (**"Red in the Shed"**) (Figure 6).

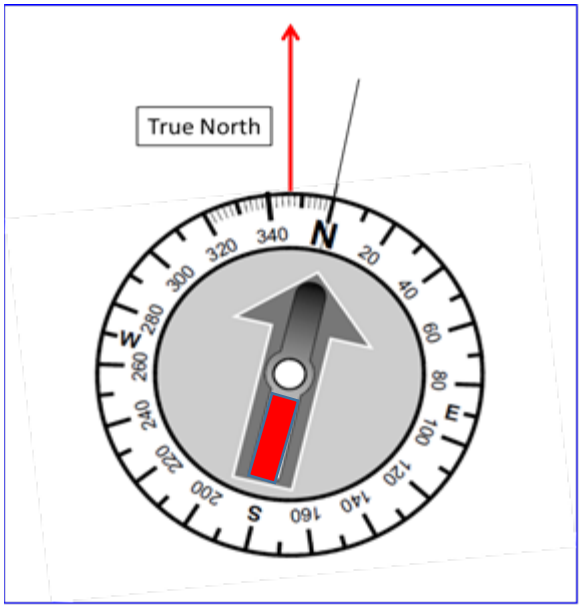

Figure 6. Illustration of orienting a map to True North

True versus Magnetic Bearings

Understanding and applying the differences between True North and Magnetic North bearings might be confusing. A bearing is simply a straight-line direction from one point on earth to another. A compass can describe that direction in angular degrees (0 degrees to 360 degrees), as it varies from one of two reference directions: (1) True North or (2) Magnetic North. The direction of these North references varies, depending on where we are on the earth's surface. However, no matter where we stand, the north end of the compass magnetic needle normally points to earth's North Magnetic Pole (unless influenced by nearby metal or electrical features as previously discussed). Practically all maps have their

north-south lines oriented toward earth's true North Pole. When we combine a map with a compass to determine directions and locations we must know how to convert the compass's Magnetic North readings to True North readings. If we know the angle of difference between True North and Magnetic North at the location on earth we are studying (declination), we can determine these true bearings, (Munn, 2014).

How to read the contour lines, the small brown lines, on a topographical map (Figure 7). Important concepts and their definition:

1. **Index Contour (1)** - a bolder/wider line with the elevation value marked at various intervals.
2. **Intermediate Contour (2)** - a thinner line on a topographic map that also represents a line of equal elevation.
3. **Contour Interval (3)** - The contour interval is the vertical distance (change in elevation) between each contour line. The contour interval is found along the bottom edge, center of the map.

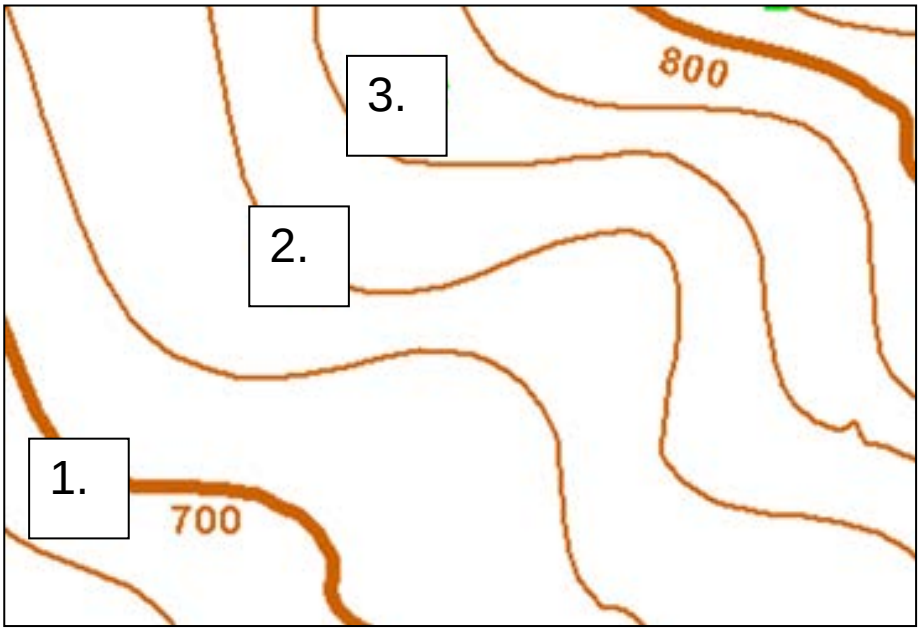

Figure 7. Illustration of contour lines on a topographic map*,*
Estela, K., Land Navigation with Map and Compass

How can you use contour lines to help you navigate (Figure 8)?
Contour lines indicate five major Terrain Relief Features:

1. Ridge
2. Hill
3. Saddle
4. Valley
5. Depression

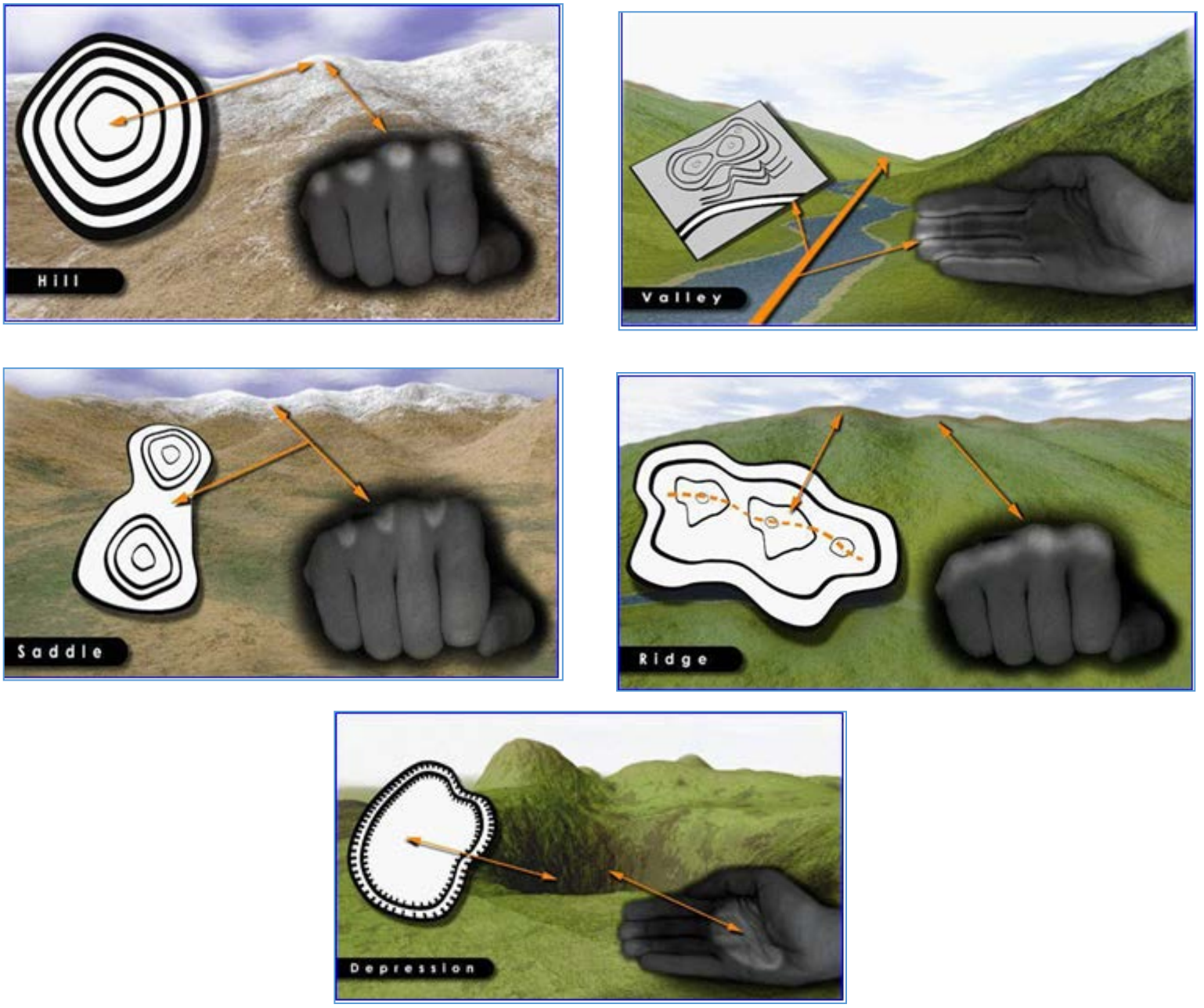

Figure 8. Illustration of terrain features that can be easily identified on a topographic map, *Estela, K., Land Navigation with Map and Compass*

Task #2: Identifying Terrain Features on a Topographic Map
To help students identify terrain features on a topographic map, have them outline the watershed for their location (on the map below, Figure 9) and identify terrain features inside the watershed area using the contour lines.

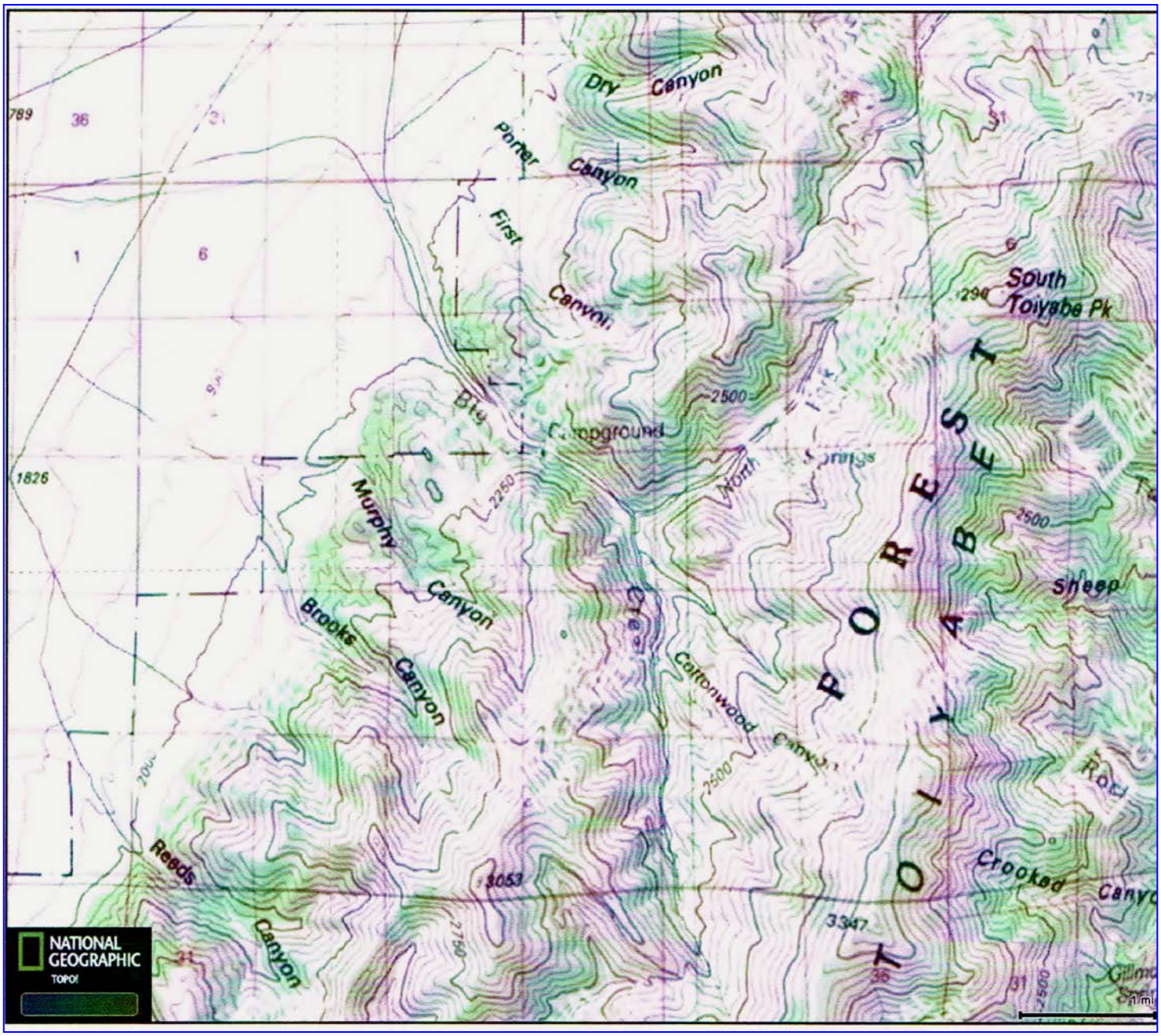

Figure 9. Topographical map of Big Creek Canyon area

Using a compass to find the magnetic bearing between two points on the map, (Figure 10). Once a map is properly oriented, you can use a compass to find the bearing between two points on the map. Also, you can use the compass to travel a straight line between the two points. This allows a point of interest (such as your car or a cabin) to be found even at night and over rough or tree-covered terrain.

If you wish to know the direction of travel from one location on the map to another, place a side edge of the compass on the map so it intercepts the two points of travel, with the direction of travel arrow pointing in the direction of the place you want to go. Next, turn the compass housing (dial) to put “Red in the Shed.” Read the bearing at the direction of travel line “C.”

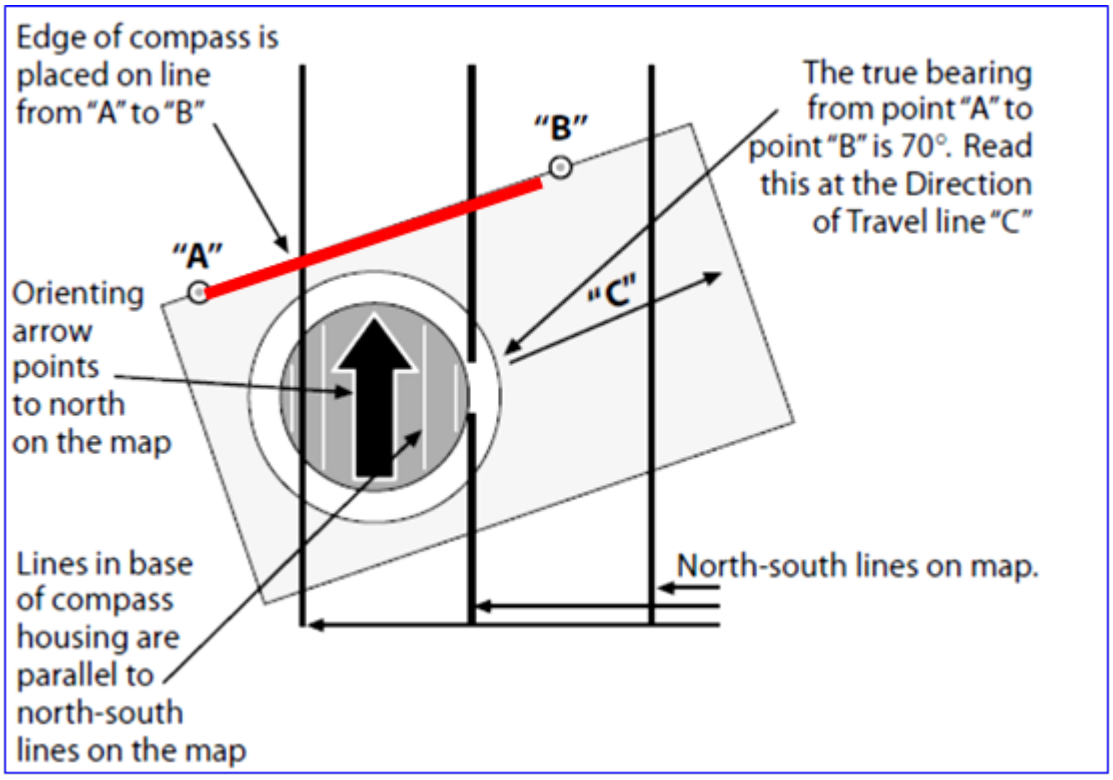

Figure 10. Illustration of finding the magnetic bearing between two points on a map, *Outdoor Navigation, with Map and Compass. Washington State Cooperative Extension, EM2474*

How to determine distances by pacing.
Every outdoorsman must know how to determine distances with some level of accuracy. The trick to accurate pacing is to use your natural walking stride, as you ordinarily would walk in both flat and hilly country (Munn, 2014). To determine your stride, use the following procedures.

Task #3: Determine the distance of your average step or pace.

a. Lay out a step course. Mark the starting point with a stake or other marker and accurately measure out a distance on level ground (recommend100 feet).

b. Stand at the starting point, with your feet together, and start walking naturally straight toward the end point. Count the number of steps you take to walk the entire course. Use the double step pace method counting each two steps as one pace.

c. Determine the number of paces you take to cover the measured distance. On the form below, write down the number of paces required to walk the course. Pace it over again in the same manner, several times, and record the number of paces required, each time.

PACING FORM

Name: _____

Course length

Line 1._____ Feet Paces_____
Line 2._____ Feet Paces _____
Line 3._____ Feet Paces _____
Line 4._____ Feet Paces_____

Total Paces: _____
Average Paces: _____

My pace is _____ feet
Determine the length of your pace (course length in feet ÷ number of paces = feet/pace)

Task #4: Follow the azimuth headings and distances given to you for the day land navigation course.

The students are directed to set their compasses to 360 degrees, and they pace out 50 steps and stop. The students are then directed to set their compasses to 120 degrees, and they pace out another 50 steps and stop. Then everyone is directed to set their compasses to 240 degrees, and pace out another 50 steps. At this point, they have completed walking a triangle and should end up fairly close to their starting point. The exercise quickly becomes a challenge game among students to see how close they can come to their starting point (Figure 11).

a. Place your first given azimuth heading on the direction to travel line. Then, while holding the compass in front of you, rotate your body until the floating red needle is in the outline of the orienting arrow or "shed."

b. Begin pacing off the first leg's distance, while keeping on the correct heading.

c. When the first leg is completed, repeat steps a and b for each additional leg of the course.

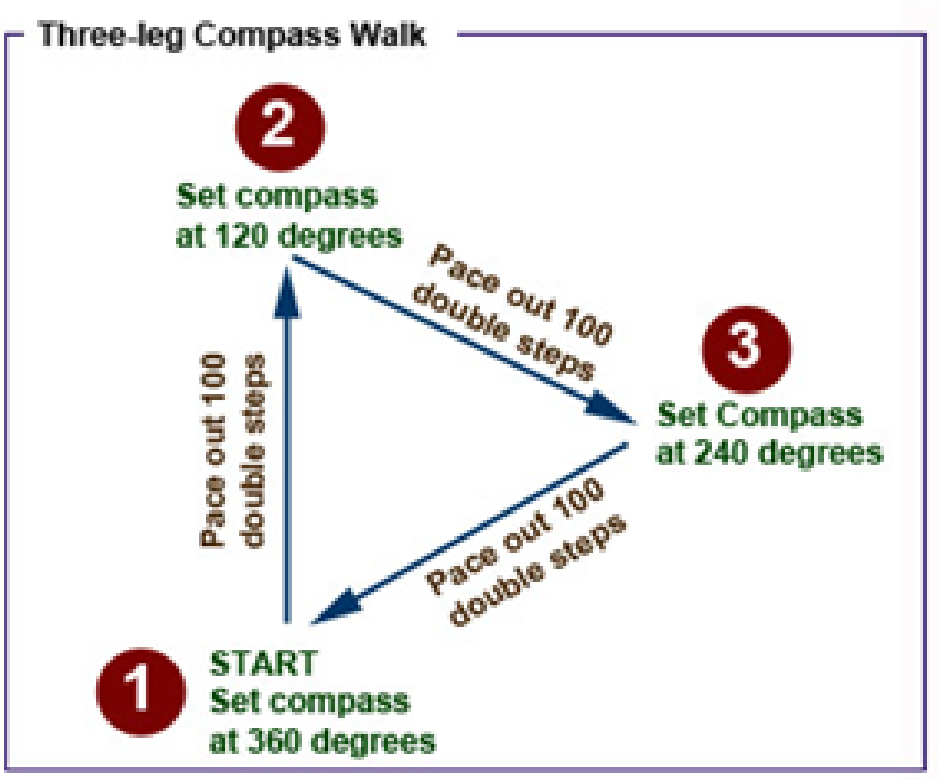

***Figure 11*. Day land navigation course**

Task #5: Follow the azimuth headings and distances given to you for the night land navigation course.

a. Place your first given azimuth heading on the direction to travel line. Then, while holding the compass in front of you, rotate your body until the floating red needle is in the outline of the orienting arrow or "Red in the Shed."

b. Have designated "pacers" begin pacing off the first leg's distance, while keeping on the correct heading by the person holding the compass.

c. When leg is completed, repeat steps a and b for each additional leg of the course.

d. When finished with the last leg, locate the nearest flag to your location and record the flag number and the number of paces your team is from the flag.

References:

Estela, K., 2009. Land Navigation with Map and Compass, Instructional Presentation, http://www.slideshare.net/kevinestela/land-navigation-with-map-and-compass-2417124?next_slideshow=1.

Munn, J., 2014. Outdoor Navigation, with Map and Compass, Washington State Cooperative Extension, EM2474.

United States Geological Survey, 2015. How to use a compass with a USGS Topographic Map, http://education.usgs.gov/lessons/compass.html.