Activities: Map and Compass

Determining General Directions

Modified with permission from *Outdoor Living Skills Series: Map and Compass*, Missouri Department of Conservation

Overview:
Students use the sun and stars to determine general directions.

Associated Objectives:

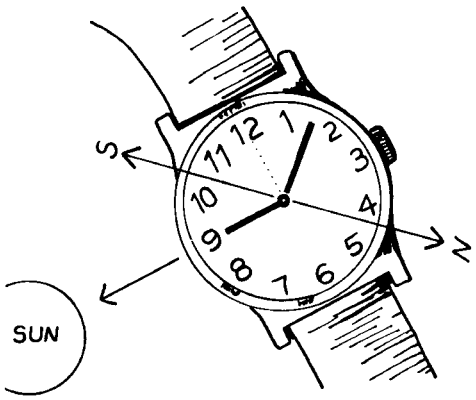
- ❑ Students will become familiar with navigational tools (map and compass) and demonstrate their ability to use them to navigate successfully.

Time:
One 30 – 60 minute session

Materials:
Analog watch (Part 1)

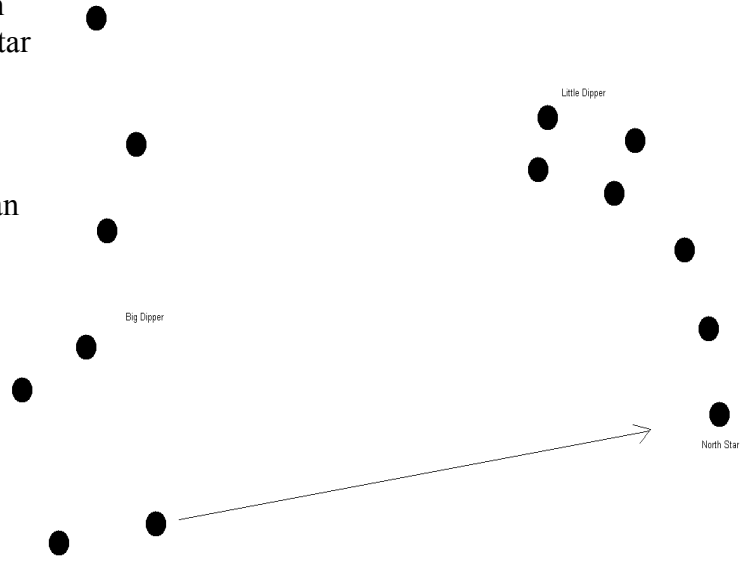
Part 1(A Watch as a Compass)

Directions:
Hold an analog watch horizontally with the hour hand pointing toward the sun. South is mid-way between the hour hand and the number twelve going the shortest way around the face of the watch. Notes: The watch must be set to standard time for the time zone you are in. This method works between 6 a.m. and 6 p.m. on a sunny day, but is not very reliable if the sun is high.



Part 2 (Finding the North Star)

Directions:
Use the stars to determine north on a clear night. Imagine a line extending from the bottom edge of the "pan" of the Big Dipper to the tail star (end of the handle) of the Little Dipper. This is Polaris, the North Star.



Evaluation:
Students will be able to determine south using an analog watch on a sunny day and north using Polaris on a clear night.

Extension:
Research and/or construct a sundial. Research and learn to locate additional stellar objects used in navigation.

Topographic Mapping Exercise 1: Reading the Map

Modified with permission from *Outdoor Recreation Education Opportunities*, Wyoming Game and Fish Department

Overview:
Students locate features on a topographic map.

Associated Objective:
- ❑ Students will become familiar with navigational tools (map and compass) and demonstrate their ability to use them to navigate successfully.

Time:
One or two 30 – 60 minute sessions

Materials:
7.5-minute (1:24,000) topographic map (laminated), erasable markers [For a comprehensive listing of map symbols, go to the USGS topographic map symbol web page (web site at the end of this activity).]

Directions:
Obtain topographic maps of a local area. If possible, laminate them so students can write on them with erasable markers. The 7.5 minute (1:24,000 scale) maps work well for beginning exercises. For more information about topographical maps and a complete listing of symbols, check out the U.S. Geological Survey mapping web site (erg.usgs.gov/isb/pubs/booklets/symbols/).

Distribute the *worksheet*. Have students locate basic map features on their map. (If maps are laminated, students can mark features with erasable markers.)

Sources for Topographic Maps:
baykal.gis.iastate.edu/gaplandcover/
mcmcweb.er.usgs.gov/topomaps/ordering_maps.html
www.usgs.gov/
www.topozone.com/

USGS topographic map symbol web page:
erg.usgs.gov/isb/pubs/booklets/symbols/

Evaluation:
Students will be able to locate and describe selected information and features on a topographic map.

Extension:
none

Topographic Mapping Exercise 1: Reading the Map

Directions: Locate the following on your map. Be prepared to discuss each with the class. If your map is laminated, label each of the following with the marker provided by your instructor.

Map name: in upper and lower margins of the map
Scale: lower map margin (e.g., 1:24,000); relationship between distance on the map and actual distance on the terrain
Date: note when the map was last revised and field-checked, lower map margin
Latitude lines: run parallel to the equator (east and west), which is 0 degrees
Longitude lines: intersect at the poles and are measured in degrees east and west of the prime meridian (runs through Greenwich, England).
Contour lines: these lines connect points on the map that are at the same elevation. Note the contour interval of the map; find index and intermediate contour lines.
Map symbols: find the map legend and note the symbols for different features
Color scale: note the colors used for different types of features; see if students can figure out the color scale: black – human built features; blue – water; green – vegetation, woodland; red – special emphasis, important roads; brown – relief (contours), land; purple – aerial photograph updates
Distance rulers: at bottom of map; rulers with bars divided into miles, feet, and kilometers
Declination diagram: bottom of the map; graphical sketch, not necessarily to scale, of the angular relationship between true (map) north and magnetic (compass) north
Declination: angular relationship between true (map) north and magnetic (compass) north

Topographic Mapping Exercise 2: The Concept of Contours

Creating Contour Lines

Modified with permission from *Outdoor Living Skills Series: Map and Compass*, Missouri Department of Conservation

Overview:
Students construct contour lines for a three-dimensional object.

Associated Objective:
- ❑ Students will become familiar with navigational tools (map and compass) and demonstrate their ability to use them to navigate successfully.

Time:
One 30 – 60 minute session

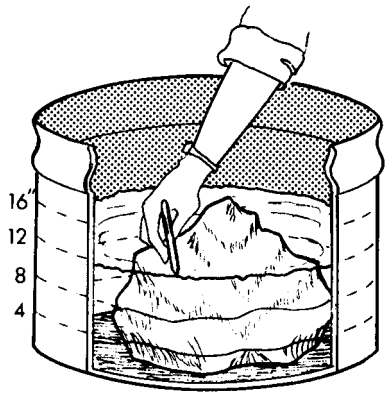
Materials:
(Part 1) dark marker, light colored bowl; (Part 2) large irregular-shaped rock, water, siphon, grease pencil, large container (see diagram)

Part 1

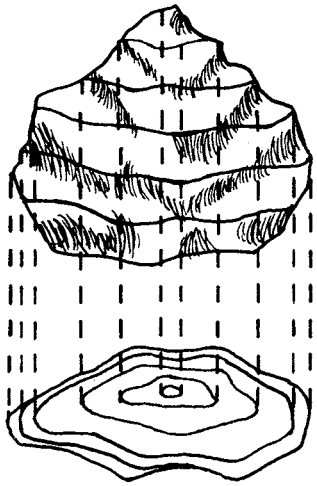
Directions:
(The following can be done as a demonstration, or as a group activity.) Using a dark marker, draw lines parallel to the rim of a bowl at one-inch intervals. View the bowl from above. Note how the lines form concentric circles that look much like contour lines.

Part 2

Directions:



To further illustrate the concept, place a large, irregular-shaped rock in a container of water so it is completely covered. Siphon water out of the container until one inch of the rock is exposed. Use a grease pencil to mark a line around the rock at water level. Repeat the procedure until the rock is completely exposed. View the rock from above.



Evaluation:
Students will be able to construct contour lines for a three-dimensional object.

Extension:
none

Visualizing Structures Based on Contour Lines

Modified with permission from *Outdoor Recreation Education Opportunities*, Wyoming Game and Fish Department

Overview:

Students match vertical profiles and written descriptions with contour lines that represent them.

Associated Objective:

- ❑ Students will become familiar with navigational tools (map and compass) and demonstrate their ability to use them to navigate successfully.

Time:

One 30 – 60 minute session

Materials:

Contour diagrams, writing utensil (extension: topographic map)

Directions:

It is important to be able to visualize what features on a map look like on the ground and to be able to express what is portrayed on a contour map. Have students complete the *worksheet*.

Evaluation:

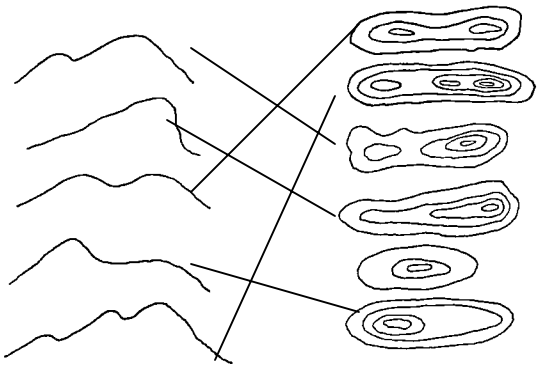
Students will be able to match profiles and verbal descriptions of structures to the correct contour line depiction.

Extension:

After completing this exercise, have students use the topographic map used in Topographic Mapping Exercise 1: Reading the Map and try to locate features similar to those depicted in Part 1 of the worksheet. Have them describe features on the map either verbally or in written form.

Answers to Worksheets:

Part 1:



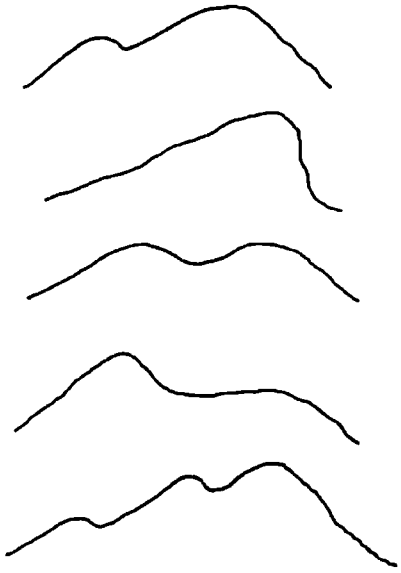
Part 2: 1) D 2) A 3) F 4) B 5) C

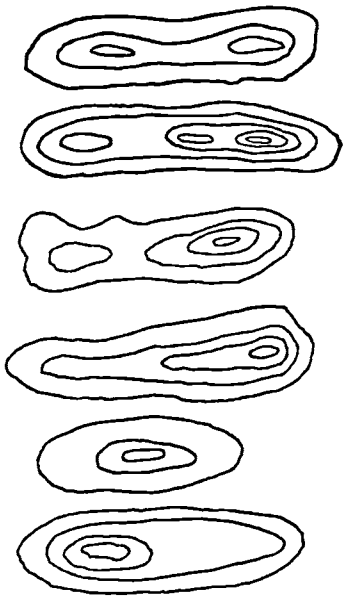
Topographic Mapping Exercise 2: The Concept of Contours

Part 1

Directions:

It is important to be able to visualize what features on a map look like on the ground. Draw a line from each of the following profiles of structures on the left to the correct contour diagram on the right.





Part 2

Directions:

Place the letter next to the contour drawing in the space to the left of the appropriate written description. Assume the top of the page is north.

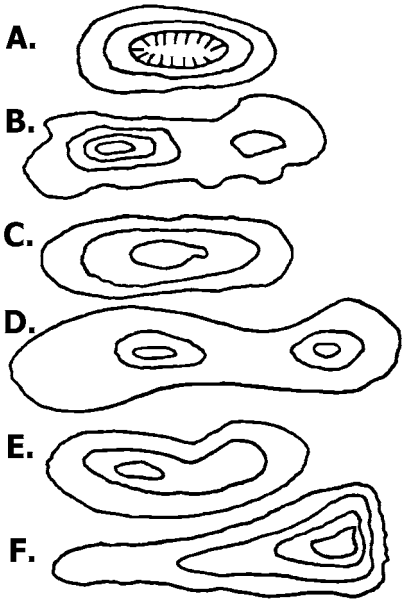
_____1. Has two peaks of equal height with a saddle between them

_____2. Has a crater in the top

_____3. West slope is gradual; east slope is steep

_____4. Has two peaks; the west is two contour intervals higher than the east

_____5. Symmetrical hill



Orienteering Compass Exercise 1: Identify the Parts of a Compass

Modified with permission from *Outdoor Recreation Education Opportunities*, Wyoming Game and Fish Department

Overview:
Students identify the parts of a compass.

Associated Objective:
- ❑ Students will become familiar with navigational tools (map and compass) and demonstrate their ability to use them to navigate successfully.

Time:
One 30 – 60 minute session

Materials:
Copies of *worksheet*, writing utensil

Directions:
Have students complete the *worksheet*. See the *Additional Resources* section for more compass activities, including an on-line tutorial at *www.learn-orienteering.org* (includes navigating in difficult conditions and discusses magnetic declination).

Evaluation:
Students will locate and describe the parts of a compass.

Extension:
Obtain orienteering compasses and have students locate the part of the compass.

Answers to Worksheet:
1) orienting arrow 2) degree reading (bearing) 3) magnetic needle 4) orienting lines 5) declination scale 6) compass base (base plate) 7) compass housing (vial) 8) direction of travel arrow

Orienteering Compass Exercise 1: Identify the Parts of a Compass

Directions: Write the correct term (defined below) noted by each number in the drawing next to the appropriate number.

Terms:

compass housing (vial): center part of the compass that is sealed; contains the magnetic needle in a liquid so it can move freely

compass base (base plate): bottom of the compass; part you hold in your hand; shows direction-of-travel arrow and millimeter and inch scales for computing distances on a map

direction of travel arrow: points the direction you need to travel after the bearing has been set

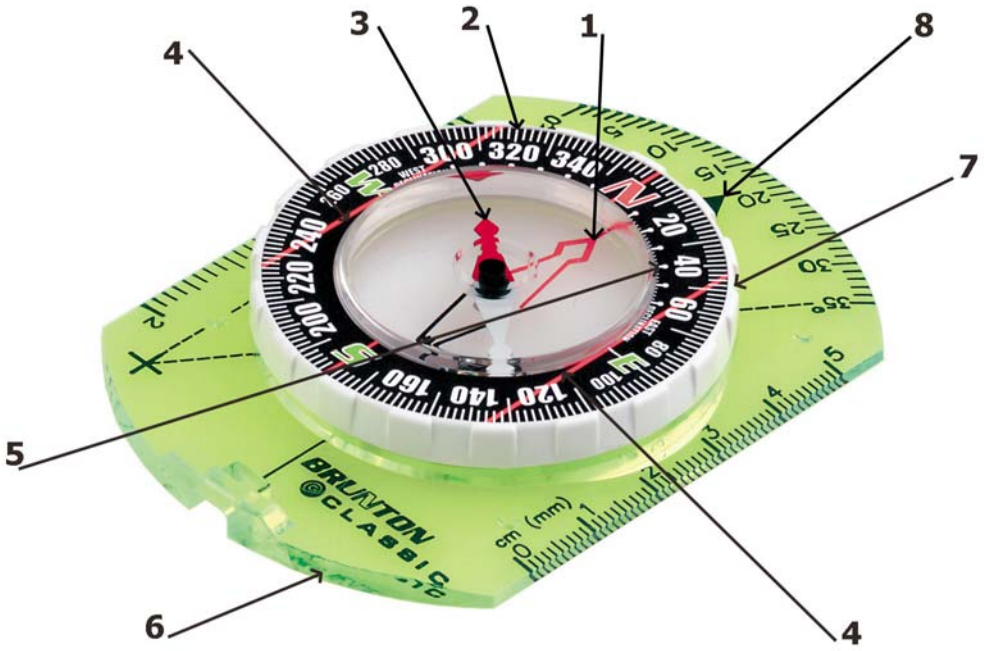
magnetic needle: red and white needle; moves inside the compass housing; the red end of the needle always points north when at rest

degree readings (bearings): the numbers on a compass; angular difference, measured in degrees, between any point and north; given either as a magnetic (compass) bearing or a true (map) bearing; a compass has 360^{O}; 90^{O} = east, 180^{O} = south; 270^{O} = west.; 0^{O} or 360^{O} = north

orienting lines: parallel lines inside or on the compass housing

orienting arrow: stationary arrow inside the compass housing

declination scale: used to determine the angle difference between true north (from your map reading) and magnetic north (reading from your compass) (Note: Declination must be added or subtracted to compass bearings.)



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Orienteering Compass Exercise 2: Get Your Bearings

Modified with permission from *Outdoor Recreation Education Opportunities*, Wyoming Game and Fish Department

Overview:
Students use a compass to determine bearings/direction.

Associated Objective:
- ❑ Students will become familiar with navigational tools (map and compass) and demonstrate their ability to use them to navigate successfully.

Time:
One 30 – 60 minute session

Materials:
Copies of diagrams, orienteering compass, writing utensil

Directions:
Review the parts of a compass. Show students how the magnetic needle always points north. Have students align the orienting arrow and magnetic needle, then use the compass to complete the worksheet.

Evaluation:
Students will correctly use a compass to determine bearings from one point to another.

Extension:
Mark locations on a topographical map and have students take bearings between points.

Answers to Worksheet:

Part 1:

A) 0 ^{o} or 360^{o}, north B) 180 ^{o}, south C) 135 ^{o}, southeast D) 315 ^{o}, northwest E) 90 ^{o}, east F) 270 ^{o}, west G) 45 ^{o}, northeast H) 225 ^{o}, southwest

Part 2:

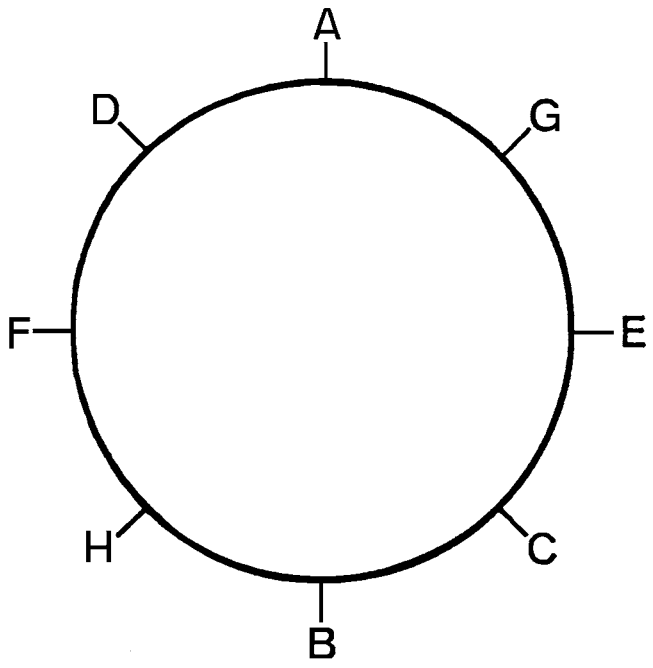
X to A = 2) 316 ^{o}
X to B = 8) 256 ^{o}
X to C = 4) 216 ^{o}
X to D = 1) 34 ^{o}
X to E = 5) 100 ^{o}
X to F = 7) 156 ^{o}

Orienteering Compass Exercise 2: Get Your Bearings

Part 1

Directions:

It is important to know what direction various compass bearings represent. Assume that "A" is zero degrees on a compass. List the direction and degree reading for each point.



	Bearing/Degree Reading	Direction
A.	_____	_____
B.	_____	_____
C.	_____	_____
D.	_____	_____
E.	_____	_____
F.	_____	_____
G.	_____	_____
H.	_____	_____

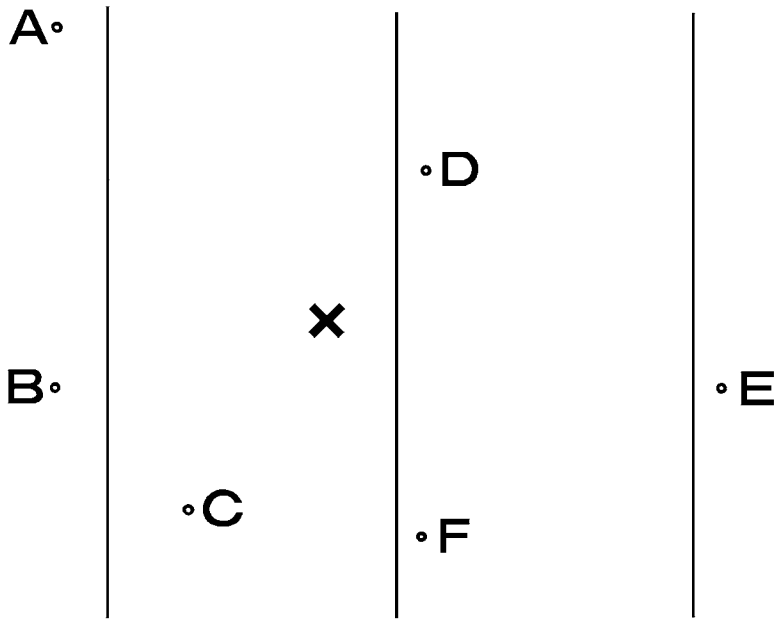
Part 2

Directions:

Your location is noted by the "X" below. Set the declination of your compass at 0^{o}. Determine the compass bearing from the center of "X" to the dot next to each letter. Select the correct reading from the list of possible answers below and write it in the appropriate space.

Possible Answers:

1) 34^{o} 2) 316^{o} 3) 10^{o} 4) 216^{o} 5) 100^{o} 6) 188^{o} 7) 156^{o} 8) 256^{o}



_____ X to A
_____ X to B
_____ X to C

_____ X to D
_____ X to E
_____ X to F

Hint: The "N" on the compass should point toward the top of the map or be parallel to the "N" lines on your map.

Orienteering Compass Exercise 3: Orienteering in the Field

Modified with permission from *Outdoor Living Skills Series: Map and Compass*, Missouri Department of Conservation

Overview:

Students determine their pace using a pre-measured course, then practice pacing.

Associated Objective:

- ❑ Students will become familiar with navigational tools (map and compass) and demonstrate their ability to use them to navigate successfully.

Time:

One 30 – 60 minute session

Determine Your Pace

Materials:

Measuring tape, flags or stakes to mark distance, paper and writing utensil, clipboard to hold writing materials (optional)

Directions:

Mark off a pace course by putting a marker at either end of a set distance (e.g., 30 meters/100 feet). Determine the number of paces (distance covered in two steps) it takes to cover the distance by counting how many times you put down your left OR right foot (whichever you put down second). Have students walk the course from one end to the other three times and average the number of paces it takes to cover the distance. Determine the length of the pace by dividing the distance of the course (e.g., 100 feet) by the number of paces needed to cover it.

	Number of paces to walk 100 feet
1st time	
2nd time	
3rd time	
Total paces	

Total paces / 3 = ave. number paces to walk 100 feet

100 feet / ave. number paces = length of average pace

(Note: round length of average pace to nearest ½ foot.)

Students can estimate how far they travel by multiplying the number of paces they take by the average length of their pace.

For example: 34 paces x 5 feet/pace = 170 feet traveled

Pace a Square

Materials:
Flags to mark corners, compass, worksheet, writing utensil, clipboard to hold worksheet (optional)

Directions:
1. Find an area where there are no obstacles at least 50 feet in either direction. Place a flag in the ground to mark your starting point.
2. Determine the number of paces you must take to travel 50 feet. (See "Determine Your Pace.") Number of paces to travel 50 feet: _____
3. Stand next to the flag marking your starting point. Set any bearing you wish on your compass and travel 50 feet.
4. When you have traveled 50 feet, STOP. Place a flag to mark your new location.
5. Add 90^{o} to the bearing on your compass. Travel 50 feet in the new direction, STOP and mark the new location. Repeat this procedure twice. You should end up at your original location. If not, how far are you from your starting point? _____

Straight Ahead, or Not?

Materials:
Blindfold, partner

Directions:
Most people travel in a circle with a radius under one-half mile when they are lost. The direction of the circle depends on the terrain and the length of each leg. (Most people have one leg slightly longer than the other.) You usually veer the direction of the shorter leg on level ground. This exercise helps demonstrate why you need a compass to travel in a straight line.

Have students work in pairs. One stands next to a tree or other large object facing another object that is at least 100 yards away. (You can use flags to mark starting and ending points if there are no large objects in the area.) Have the other student place the blindfold on the first student. The first student then walks toward the distant object. The partner should walk alongside the first student and alert them only if they are about to run into something. He should not influence the blindfolded student's direction.

After students have traveled about 100 yards (See "Determine Your Pace.") remove the blindfold. The blindfolded student should sight back to the starting point. Did she travel in a straight line? If not, in which direction did she veer?

Evaluation:
Students will be able to pace a square. Students will demonstrate how difficult it is to walk a straight line without using a compass.

Extension:
Have students pace other geometric figures.

Using Map and Compass Together Exercise 1: Reconciling Magnetic North and True North

Overview:
Students practice using a topographical map and compass together.

Associated Objective:
- ❑ Students will become familiar with navigational tools (map and compass) and demonstrate their ability to use them to navigate successfully.

Time:
One 30 – 60 minute session

Materials:
Compass, copies of *worksheet*

Directions:
Review how to read a topographic map and use an orienteering compass. Have students answer the questions on the worksheet using the sample topographic map and an orienteering compass. Alternative: Use a topographic map of a local area and develop your own set of questions. For more information about using map and compass together, check out the following web sites:

mac.usgs.gov/mac/isb/pubs/factsheets/fs03501.html ("Finding Your Way with a Map and Compass" fact sheet)
interactive2.usgs.gov/learningweb/teachers/exploremaps.htm (online lesson plans, activities, and teacher's guide for grades 7-12)
interactive2.usgs.gov/learningweb/teachers/mapadv.htm (online teaching packet for grades K-3)
www.geocities.com/Yosemite/Falls/9200/navigation_map_compass.html ("Navigating with a Map and Compass" lesson plans and activities)
www.isu.edu/outdoor/mapshort.htm (general map and compass teaching principles and suggested curriculum)

Evaluation:

Students will be able to reconcile true north with magnetic north, then determine compass bearings between locations on a topographic map.

Extensions:
Geocaching
Students could go geocaching and use a topographical map, GPS unit, and compass to locate a cache. This is an activity where people hide containers around the world and post the GPS coordinates on a web site. Locations of some 35,000 geocaches are listed on the geocaching web site: *www.geocaching.com*. There is an on-line form if you would like to place a cache. Be sure to follow the guidelines on the site and get permission before placing a cache. Also, get permission before searching on private land. Iowa State University Extension has GPS kits located at Extension offices and area education agencies around the state.

Answers to Worksheet:
1) E; 1230 feet 2) A or H; 1050 feet 3) 10 feet 4) F 5) 180 feet 6) G 7) 5½^{o} east 8) 340^{o} 9)64.5^{o} 10) H

Using Map and Compass Together Exercise 1: Reconciling Magnetic North and True North

Directions:

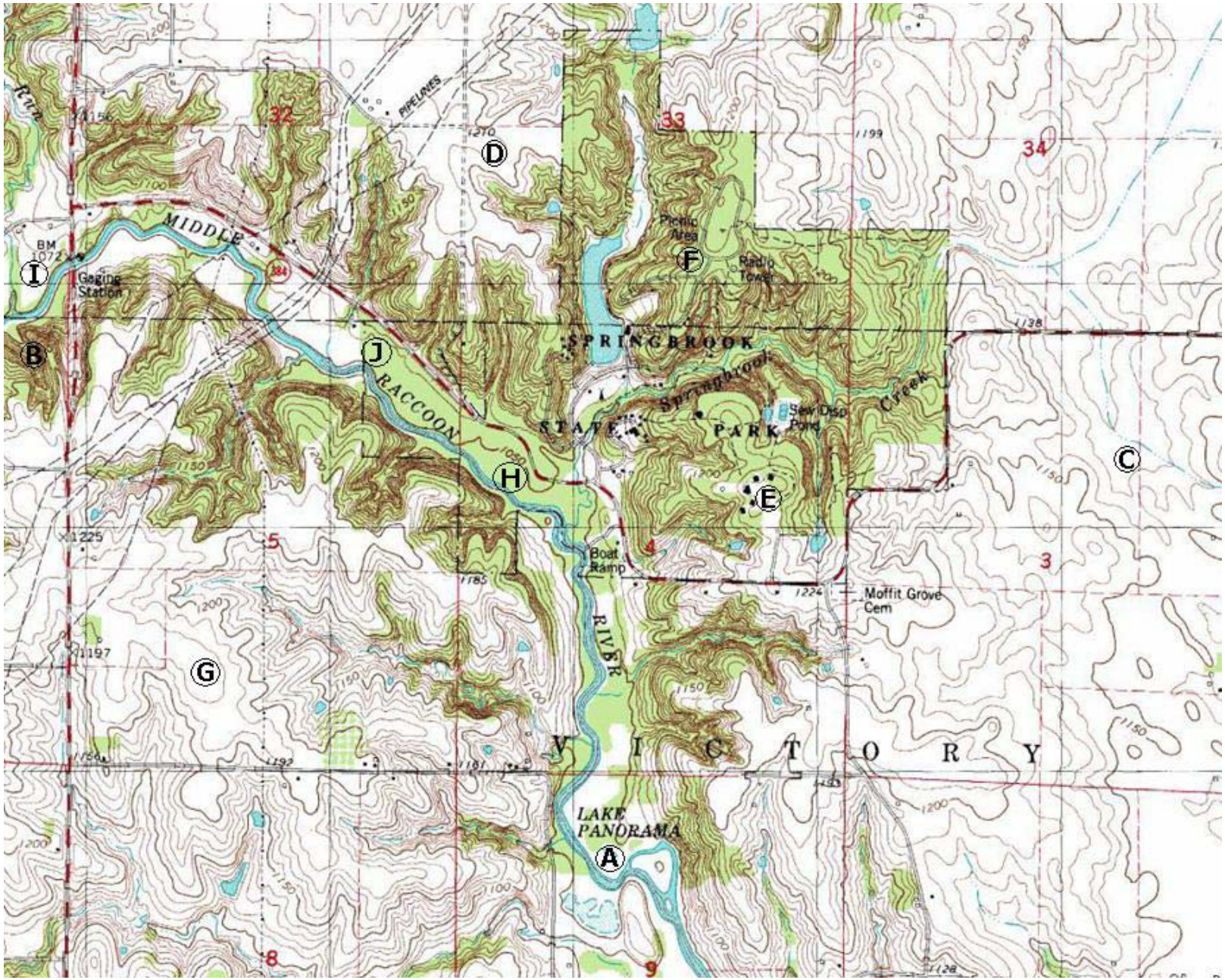
Align the map on the following page so the magnetic needle and orienteering arrow are pointing at its north (top) edge. Find the declination diagram to determine the angle of declination between true north (star/TN) and magnetic north (MN). If the angle of declination is to the east (right), subtract it from the compass reading. If the angle of declination is to the west, add it to your compass readings. Take all compass readings from the center of the circle (where the letter is located).

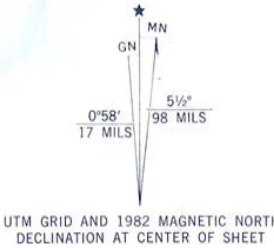
Questions:

1. On the map, which letter denotes the highest point? What is its elevation?
2. On the map, which letter denotes the lowest point? What is its elevation?
3. What is the contour interval of this map?
4. Which letter represents the steepest area: C, F, or I?
5. What is the difference in elevation between point E and H?
6. Which has the higher elevation, C or G?
7. What is the angle of declination on this map?
8. You want to head from point E to point F. What would your bearing be?

   A) 320 ^{o} B) 333 ^{o} C) 340 ^{o} C) 345 ^{o}
9. Suppose you wish to travel from the boat ramp on the river to point E, what bearing would you take?

   A) 64.5 ^{o} B) 74.5 ^{o} C) 296 ^{o} C) 304 ^{o}
10. You are somewhere along the Middle Raccoon River. If the Moffit Grove Cemetery is at a bearing of 110 ^{o} and the Springbrook Lake dam is at a bearing of 43 ^{o}, where are you?





UTM GRID AND 1982 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Bagley Quadrangle **7.5 Minute Map** **Contour interval = 10 feet**