

Topic: Bearing Triangulation

Primary Goal: Students will learn how to determine their location by triangulation. They will accomplish this by taking bearings of surrounding objects. This lesson will build on their work with the hand-bearing compass and demonstrate one of the primary uses of a compass.

Lesson Objectives:

- Understand the reasons why you would need to determine your location
- Understand how you would use a compass to take bearings of objects around you
- Learn how to transfer those bearings onto a chart using navigation tools

Lesson Outline:

I. Piloting

- a. This is a great opportunity to give an overview of the 3 different types of navigation
 - i. Electronic Navigation – used inland but critical offshore
 - ii. Celestial Navigation – used primarily offshore
 - iii. Piloting – the use of landmarks, aids to navigation, soundings to navigate a boat while operating along the coast or near land
- b. *Chapman* gives a great explanation of piloting as both a science and an art (Chapter 16)
 - i. Science – uses math principles based on centuries of observation, analysis, and study
 - ii. Art – interpretation of observations and other information require individual judgment and skill
- c. In this lesson we first go over the math and science of triangulation, and then build skills through the practice of taking bearings to determine our location (introduce fix)

II. Triangulation

- a. This is the process of pinpointing your location by taking bearings from 3 remote points
- b. Each of these bearings are considered a Line of Position or “LOP”
- c. What happens if you have only 1 LOP?
 - i. This means that your location could be anywhere along this line
- d. What about 2 LOPs?
 - i. This is more precise because it tells you where your location might be along your first LOP
- e. In order to get an accurate fix you should get 3 LOPs which should create a triangle
 - i. This triangulation tells you that your location is somewhere within the triangle

- III. Triangulation Quality & Reliability**
- a. After plotting your 3 bearings (or LOPs), what if your triangle is very big?
 - i. This is unreliable, as it means you could be anywhere within the triangle
 - ii. You must take another bearing
 - b. What if 2 of your bearings are from the same location?
 - i. This results in shallow angles and makes it difficult to achieve an accurate fix
 - ii. If possible you should use 3 objects at 60 degree angles
- IV. Obtaining a fix**
- 1. Using your magnetic compass, take a bearing from yourself to a landmark in your vicinity (ensure that this landmark is on your chart)
 - 2. Find the landmark on your chart, and draw a line (LOP) from the landmark using the inverse of your bearing
 - a. This is done using the compass rose on your chart, and a slide ruler (make sure you use the inner circle for magnetic)
 - 3. Find a second landmark and take a bearing using your magnetic compass
 - a. Plot on your chart and ensure that the 2 lines intersect
 - 4. Find a third landmark and repeat the previous steps to determine your location
- V. What type of landmarks or objects should you use?**
- a. Objects or landmarks that are affixed (lighthouse, water tower, bridge span, day markers)
 - b. Objects that are far away
 - i. The closer you are to an object, the harder it is to get an accurate bearing
 - c. Are buoys good for obtaining an LOP?
 - i. Not ideal because many buoys move with the current
 - ii. But, buoys can be used if they are your only option

Supplemental Resources:

YouTube Video by *Nautica*: <https://www.youtube.com/watch?v=V8j00E89Bq4>

Exercises/Activities:

Provide the students with charts and navigation tools to complete the 3 exercises at the end of the PPT.