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Process Analysis Essay – Informational and Directional

Do You Know Where You Are?

Do you know where you are? I don't mean whether you are at home, or at work, or where you consider yourself to be in your life's journey. I mean do you know your exact coordinates on the planet? In modern times, this is a question that can be answered easily with the aid of a GPS (Global Positioning Satellite) system that, as the name infers, uses signals from satellites to determine position. For as little as $100, anyone can purchase a GPS unit and know, within seconds, their exact latitude and longitude coordinates on Earth. Navigation for hiking, sailing, and just driving around in a car has been made accurate and easily available for anyone, but it wasn't always so easy. Knowledge of this position has always been important for navigation, but it has been especially important at sea, where navigators lacked landmarks to help guide them and losing their way could mean death. The techniques eventually developed seem fairly simple now, but it took centuries to perfect them and if you ever find yourself with dead batteries in your GPS unit, a basic understanding of how this information was once determined can come in handy.

First, let's be clear on a few definitions. Latitude and longitude, together, comprise the system of how we determine and relate our location on the globe of the Earth. Latitude is the coordinate typically stated first, and it denotes location on the north-south axis as a degree either north or south of the Equator. 0° is at the Equator and 90° is on either the north or south pole. Longitude is stated second and denotes position on the east-west axis. Longitude is stated as a degree either east or west of the Prime

Meridian, an imaginary line that runs north to south through Greenwich in London, England. This is considered the 0° Longitude mark.

In the late 1400's, seamen began to use the cross-staff and astrolabe, devices designed to measure latitude at sea. Prior to this, navigation at sea was inaccurate and dangerous and most navigation was done with land-based markers, crude compasses and by dead-reckoning, a system used to determine distance traveled by multiplying time by speed. With these devices, and later, the more accurate sextant, mariners were able to accurately determine their latitude. This system remained mostly unchanged until the introduction of the GPS.

The method for determining longitude eluded sailors for another three centuries. Navigators still relied on inaccurate and primitive methods. The common method for navigating without the ability to determine one's longitude was to sail to a port that was known to have the same longitude of the destination and once at that port, to sail as directly east or west and they could manage. Many ships were lost at sea and many actually ran into things, a common problem being that land would "appear" where there was thought to be none. The cost of losing ships was rising and the problem became so serious that in 1714, England's parliament offered a sum equal to around $12 million today as an award to anyone who could create a device or a method to accurately determine longitude at sea.

After many failed ideas, political maneuvering and sabotage, (after all, this was a lot of money) John Harrison, a self-taught watchmaker, is credited with having solved the problem. Harrison invented and built the first chronometer, a device for keeping accurate time at sea. With the chronometer, a navigator could now set time at a given location of known longitude, find the local time at his location, find the difference in those times and then convert that time into degrees to accurately determine his longitude. Today, this can be accomplished with an inexpensive wristwatch. This invention made navigation safe, accurate, and armed with this knowledge and these devices, the British Navy began its rule of the seas. This system also remained relatively unchanged until the introduction of the GPS.

Centuries of work went into these methods. Mistakes cost people their lives. These were technological advances that greatly improved the quality of life at the time. Knowledge of these coordinates allowed for more accurate maps and better navigation meant more reliable shipping, exploration, and naval defense, or offense for that matter. The systems are so tried and true now that they almost seems trivial as you learn the method for each.

<u>Latitude</u>

The determination of latitude is fairly easy and can be accomplished with a minimum of tools.

1. Find Polaris. Polaris, the North Star, is easy to recognize. It lies along the northern axis and because of this, its position in the sky is not affected by the rotation of the earth. It is the one star in the northern hemisphere that seems to never move. The two bottom stars of the constellation Big Dipper also point to it. It is, contrary to popular belief, not the brightest star in the sky.

2. Locate the horizon. If you are on land, you may have to move to higher ground to get a clear view of the horizon. The horizon is easy to see at sea, if the weather is clear.

3. Measure the angle between the horizon and Polaris. This can be done with something as complicated as a sextant, as simple as a protractor, or as thrown together as 2 pencils and the face of a pocket watch. Any device that will allow you to measure the angle will work. Some are more accurate than others.

4. Determine the latitude. The angle you measured translates directly into your latitude. For example, if the angle is 32, as it is in Dallas, then your latitude is 32 N, or north of the equator.

This same process can be applied in the Southern Hemisphere except that you will be measuring the angle from the horizon to a point based on the constellation Southern Cross.

<u>Longitude</u>

The determination of longitude is a more complicated process, although not so complex that the novice, armed with a few simple facts and formulas, can't master it quickly.

To understand the process, the reader needs to understand a few basics. The Earth is, for our purposes, a sphere. In one day, or 24 hours, the Earth rotates one full turn, or 360°. With some simple math, we find that the Earth rotates 15° in 1 hour, or 1° every 4 minutes. This is important to remember because we need to, as mentioned before, convert an amount of time into a number of degrees to find longitude. Here's how.

1. Determine the time of a known longitude. This will work for any time at a known longitude, but most commonly Greenwich Mean Time, or GMT, is used. This is the time at 0° longitude. This time can be found on radio broadcasts, or you could have set a clock or watch to this time previously.

2. Determine local time at the longitude that you are trying to find. This can be found from a radio broadcast, local weather report, or even by using a makeshift sundial. A straight stick placed perpendicular to the ground will cast no shadow at noon. This can determine local noon if need be.

3. Compare the two times and determine the difference between them.

4. Convert this time into degrees using the formulas we determined earlier. For example, if you measured a one hour difference, then you are 15° off of the Prime Meridian, or the longitude you chose to measure from. If you measured 8 minutes difference, then you are 2° off of the Prime Meridian. Remember, every hour equals 15° and every 4 minutes equals 1°.

5. Determine East or West. You know how many degrees you are removed now, but you still need to determine in which direction of the known longitude you are removed. If your local time is ahead of GMT time, or your other known time, then you are east of the Prime Meridian, or your other known longitude. If local time is behind GMT, then you are west of the Prime Meridian. For example, if you measured 18° difference and your local time is ahead of GMT, then your longitude is 18° E, or east of the Prime Meridian.

Now that the methods are a bit more clear, a few well-recognized examples might add more clarity to the system. Here are the latitude and longitude of some US cities:

Dallas, TX	32° 51' N	96° 51' W
Miami AP	25° 48' N	80° 16' W
NY, NY-Central Park	40° 47' N	73° 58' W
Seattle, WA	47° 39' N	122° 18' W

Notice that as the cities move higher north, the latitude moves closer to 90° and the farther south they go, the closer to 0° it gets. For the longitude readings, notice that the US is west of the Prime Meridian and the farther west you move, the farther west of the Prime Meridian you get.

The ability to accurately determine latitude and longitude is knowledge that was vital to the progression of human civilization. For centuries, sailors took to the seas without knowledge of these methods and many died as a result. In well-planned cities or a country with a well-designed highway system, this information seems almost unnecessary to the average person, but on a mountain trail, or at sea, if your GPS unit ever fails you, and it will, a simple understanding of these methods does nothing but improve the odds of finding a positive outcome to the situation.