Using Coordinates in the Study of Remote Sensing Images

In maps, coordinates are used to determine location. If you will be using a topographic map with your remote sensing images, then you may be asked questions relating to *geographic coordinates*. Geographic coordinates are based upon the intersection of lines of latitude and longitude. The Science Olympiad *Road Scholars* Event Training Manual and my own book *MapMatics* give a very through treatment of how to use orient topographic maps to geographic coordinates. What I will do here is show you how to use a topographic map to determine the *exact* geographic coordinates of a given feature you may be asked to identify on a remote sensing image.

Geographic Coordinates

To Determine Latitude

1. Measure the distance in millimeters (mm) from the bottom neat line or sector boundary of the topographic map to the feature you are to identify. Keep in mind that each of the nine mental sectors measures 192mm from the bottom of the sector boundary to the top of the sector boundary.
2. Divide your answer by 192- again the distance in millimeters from the bottom of the sector to the top sector boundary. Your answer will be a decimal number.
3. Multiply your answer by 150- the number of seconds in each of the nine 2.5 minute sectors.
4. Your answer will be the number of seconds from the bottom of the sector boundary to the top of the same sector. You then add the number of seconds to the latitude measurement of the bottom sector line as I have shown below.

Example:

If the latitude measurement of the bottom sector line from which you measured is:

43^{o} 15’ 20” N

This is read as forty-three degrees, fifteen minutes, twenty seconds north.

If the number of seconds from the bottom sector boundary to the feature you measured is 42, you then add 42 + 20 for a sum of 62.

Because there are only sixty seconds in one minute, you convert 60 of the 62 seconds into an additional minute with 2 seconds left. Your answer is given:

43^{o} 16’ 02” N

To Determine Longitude

1. Measure the distance in millimeters from the right sector boundary to the feature that you are asked to identify. The distance from the right sector boundary to the left boundary of a sector is approximately 140 millimeters. I strongly recommend that you take an exact measure of this distance, as it will vary from north to south depending on the location given in your map.
2. Divide your measurement from the right sector line to the feature by 140 (or the distance from the right to left sector boundaries). Your answer will be a decimal number.
3. Multiply this answer by 150- again the number of seconds in a 2.5-minute sector of a 7.5-minute series topographic map used in many competitions.

4. Your answer will be the number of seconds from the right sector boundary to the feature that you measured. You then add the number of seconds to the longitude measurement of the right sector line as I have shown below.

83° 10’ 50” W

If the number of seconds that you measured from the right sector boundary to the feature is 35, you will then add 35 to the number of seconds in the right sector measurement for a sum of 85. Because there are only 60 seconds in a minute, you will first need to add 10 of the 85 seconds to 50 to create an additional minute with a remainder of 75 seconds. Then, create a second additional minute from the remainder leaving 15 seconds. The answer is given below.

83° 12’ 15” W

The exact geographic coordinates of the feature are shown below. Remember to write latitude coordinates first directionally oriented as North (all locations in the United States are north of the Equator), followed by longitude coordinates directionally oriented as West (all locations in the United States are west of the Prime Meridian).

43° 16’ 02” N
83° 12’ 15” W

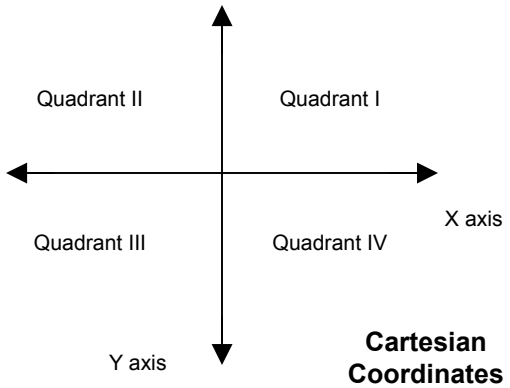
Cartesian Coordinates

Remember Cartesian Coordinates from algebra class? Cartesian Coordinates are nothing more than creating a system for locating a given point on a plane. That’s really all geographic coordinates are- the intersection of imaginary lines of latitude and longitude used to provide an exact location anywhere on the surface of the Earth. Your state road map also has a grid of numbers and letters that you can use to find the approximate locations of places. Cartesian Coordinates are an easy and precise way of locating points on remote sensing images as well as on maps as you will see.

Cartesian Coordinates locate a given point on a plane by the distance of the point from each of two intersecting lines. You can easily create the two-dimensional coordinate plane needed to determine coordinates by crossing a horizontal (left to right) line with a vertical (up and down) line as shown below. The horizontal line is the *x-axis* while the vertical line is the *y-axis*. The plane is in turn divided into four regions called *Quadrants*. A Roman numeral labels each quadrant.

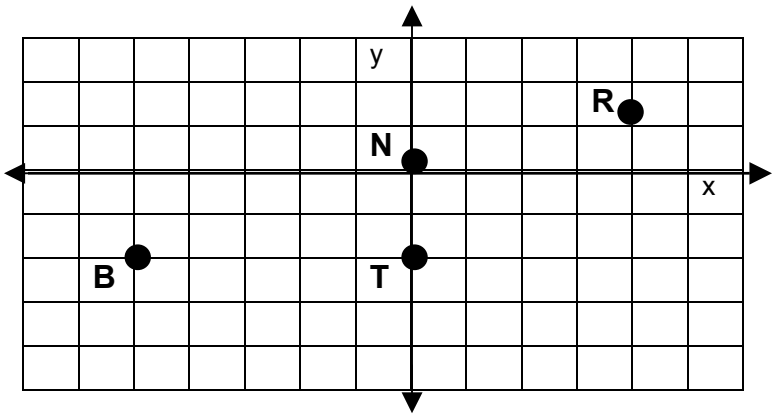
Points represent locations on coordinate planes. The location of any point is given in relation to where the vertical and horizontal axes intersect. The location of any point given in relation to where these two axes intersect is called the *origin*.

In Cartesian Coordinates, two numbers are required to identify the location of a point. The *X* coordinate tells how far to the right or left of the origin the point lies. The *Y* coordinate tells how far up or down from the origin the point lies. Together, the *X* coordinate and *Y* coordinate form what is called an *ordered pair* (*x, y*)



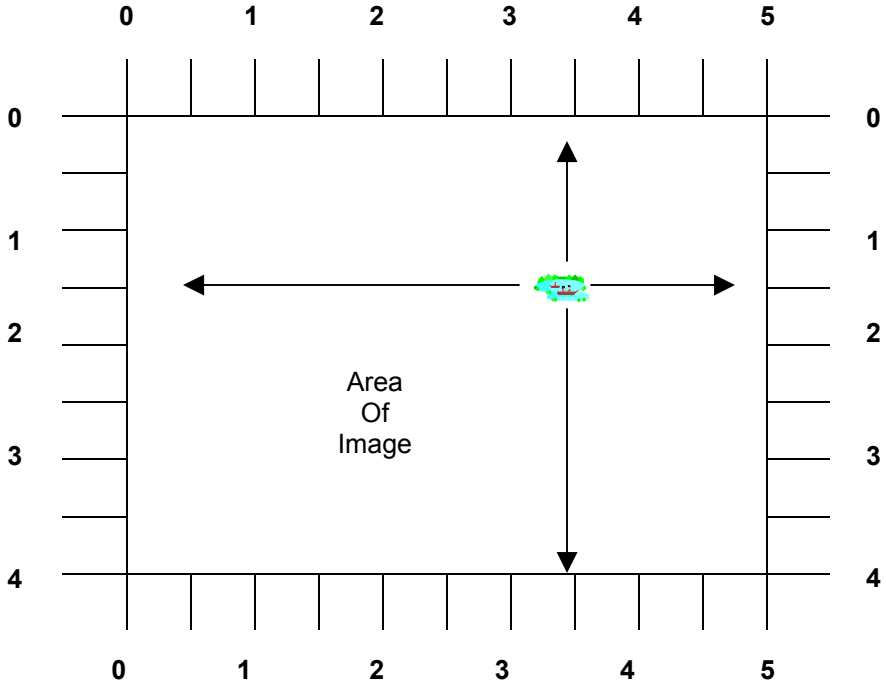
Cartesian Coordinates

The drawing below shows the location of the ordered pair (4,1):



Since Point R is 4 units to the right of the origin (N) and one point up, it's ordered pair is (4,1). Point B is five units to the left of the origin and two points down. Therefore, its ordered pair is read (-5,-2). Point T is zero points from the origin and two points down, so its ordered pair is (0,-2). The ordered pair of Point N- the origin is read as (0,0).

On a remote sensing image, you can use Cartesian Coordinates to identify features such as lakes, buildings, barns, or anything else. You might first want to make a template to cover the size of the Image on your computer and then run it off on a transparency so that you can lay it over the top of the image. In the example I give below, you can use a straight edge such as a ruler or piece of paper to line up the numbers. The area within the square is the area of the imagined image. Be sure that the straight edge is exactly parallel to the edge of the image.



The small lake shown within the square can be identified using the coordinate template that I drew for the activity. The lake has a horizontal coordinate of 1.5 and a vertical coordinate of 3.4. The ordered pair is thus written as (1.5, 3.4). You can construct templates of your own using

graph paper or a software program and a transparency. In constructing your template, try to calibrate your grid with the scale of the Image if that is known for the most precise measurements possible.

Summary

The use of Cartesian Coordinates is a useful way to identify the exact or approximate features of any given point on a remote sensing image. Once students have successfully located the point, you can them have them complete other activities such as measuring distance, determining the azimuth or bearing of that point in relation to another, or to interpret features that you may see on the image to explain phenomenon.