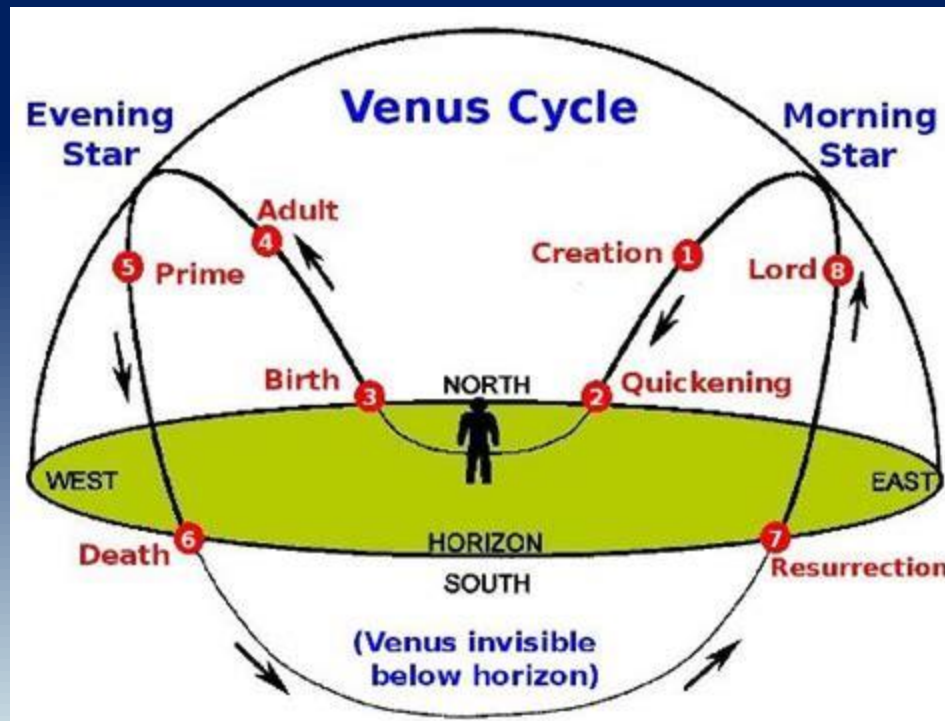
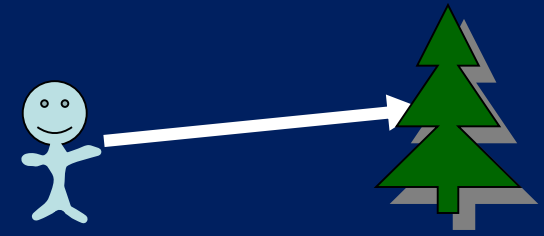


Introduction to Maps

Direction and Map Orientation

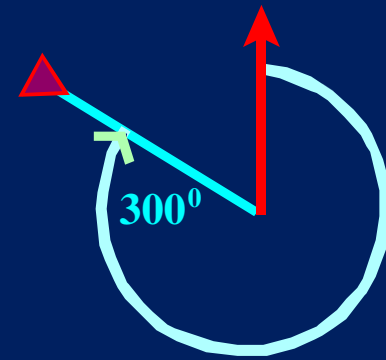


Direction



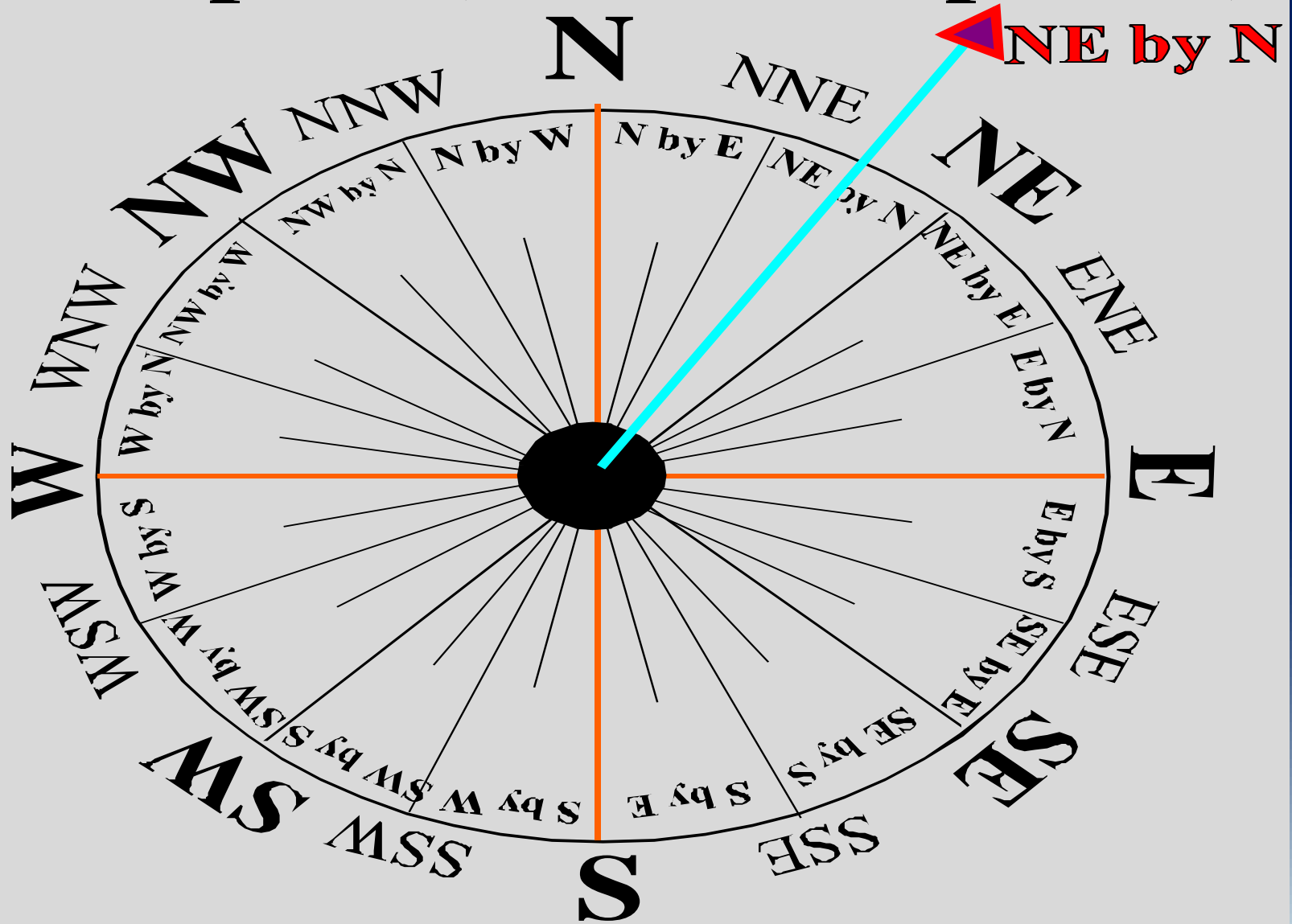
- **The path along which something is pointing or moving.**
 - In map use, it is usually related to a fixed frame of reference (i.e. a baseline).
- **Precise direction is described in terms of angular measurements from a baseline.**
 - Baselines are lines associated with a fixed point of reference.

Direction Designation

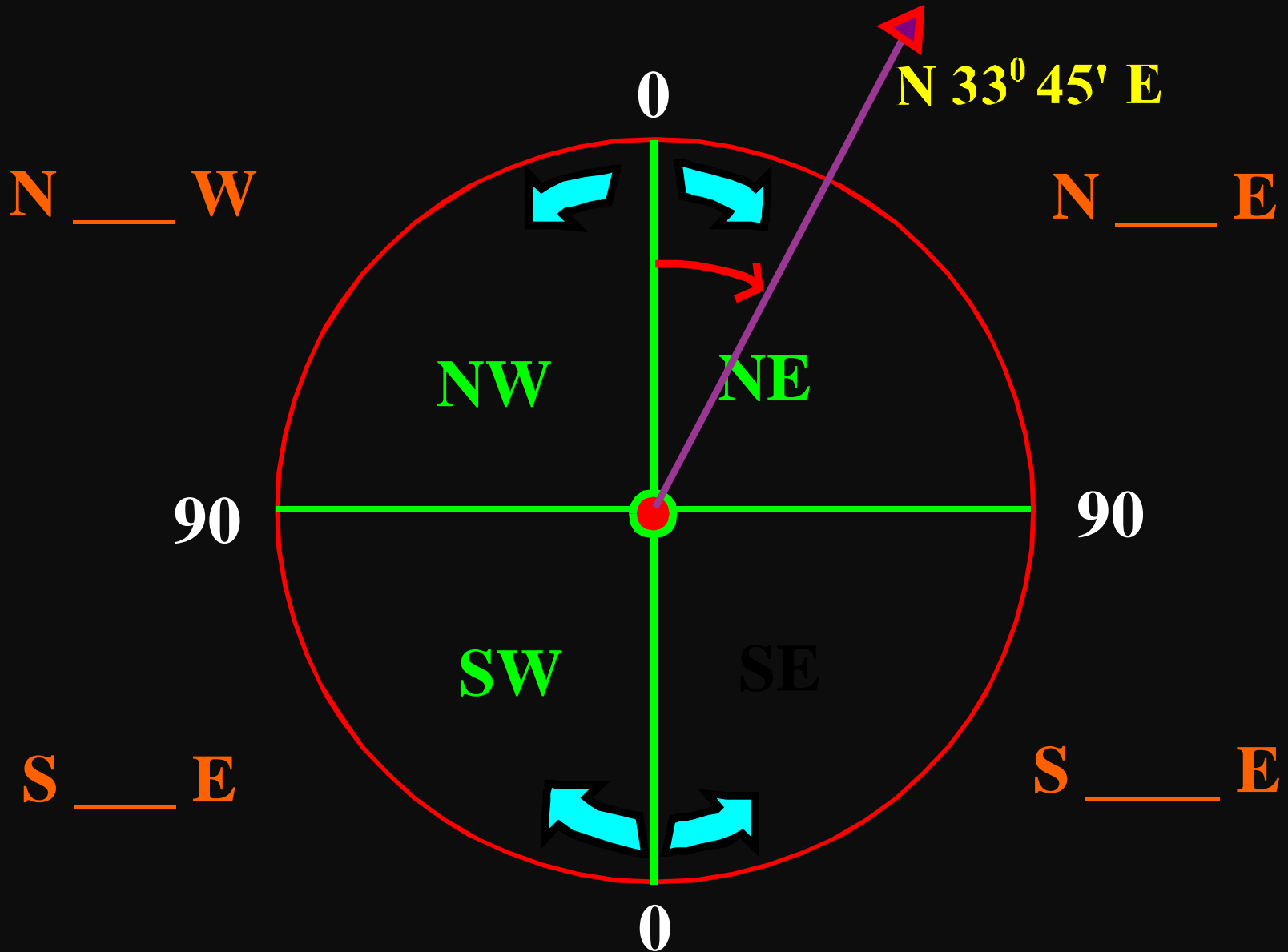


- **May be described as azimuths, bearings or compass directional names:**
 - **Compass Directional Names**
 - Traditional method using major and minor compass directions (32 in total, each 11.25°).
 - **Bearings**
 - Divides compass into four quadrants each with $0-90^\circ$ angular measurement in reference to a north-south reference line.
 - **Azimuths**
 - $0-360^\circ$ angular measurements from a north-south reference line; most commonly used system on most compasses.

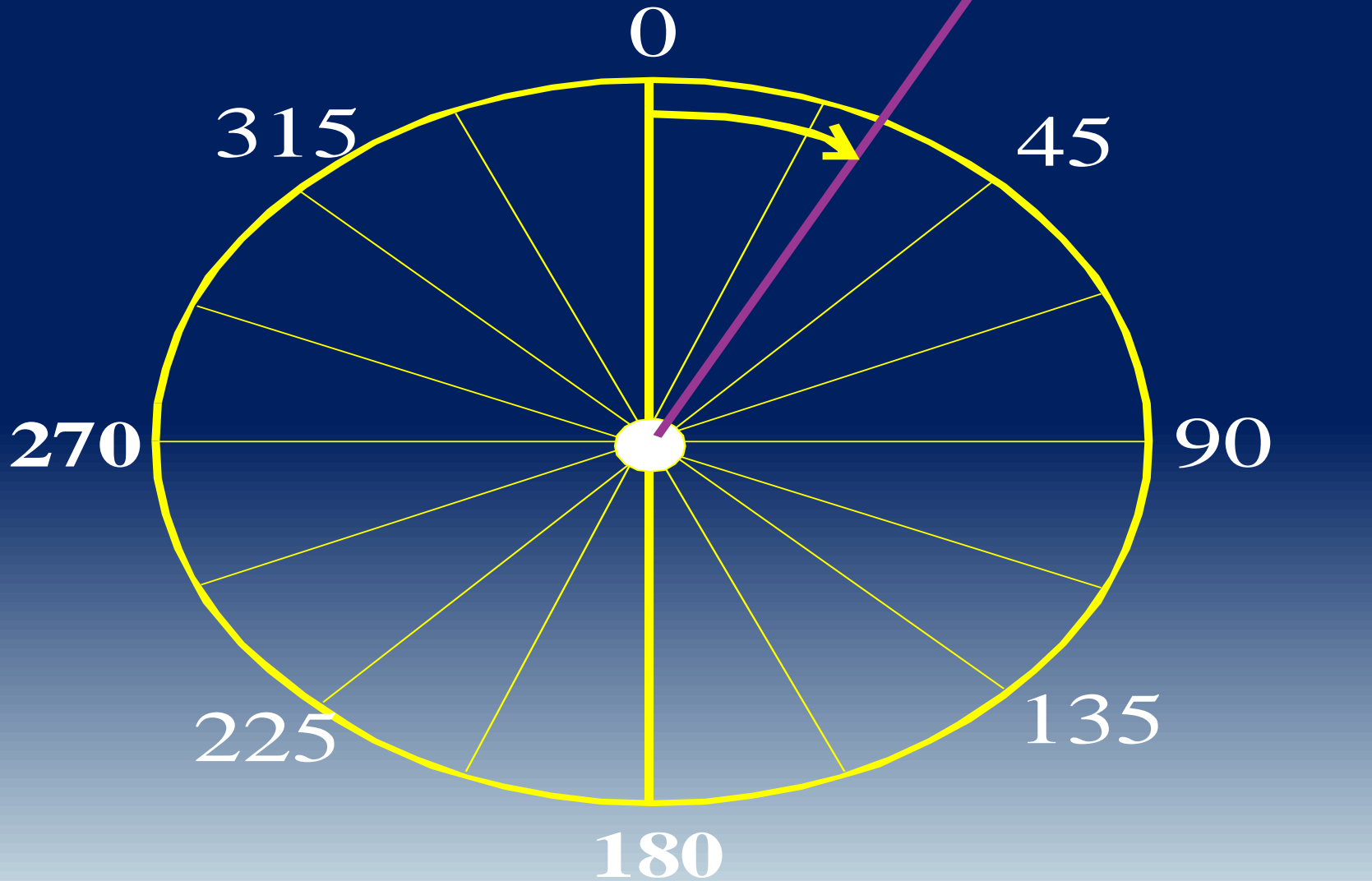
Compass (32 named points)



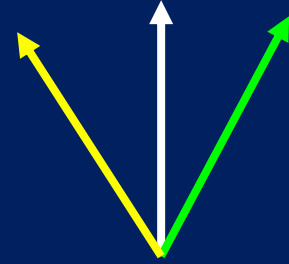
Bearings (4 quadrants)



Azimuth 0-360⁰



Baselines



- **Typically north-south trending lines:**
 - **True North**
 - **Northerly direction along a line of longitude (true north lines are aligned with the north pole on maps).**
 - **Magnetic North**
 - **Direction to the magnetic north pole of the earth (direction that a compass north arrow points).**
 - **Grid North**
 - **North trending direction aligned to specialized grid lines on the maps (SPC, UTM, Township and Range Section Lines)**

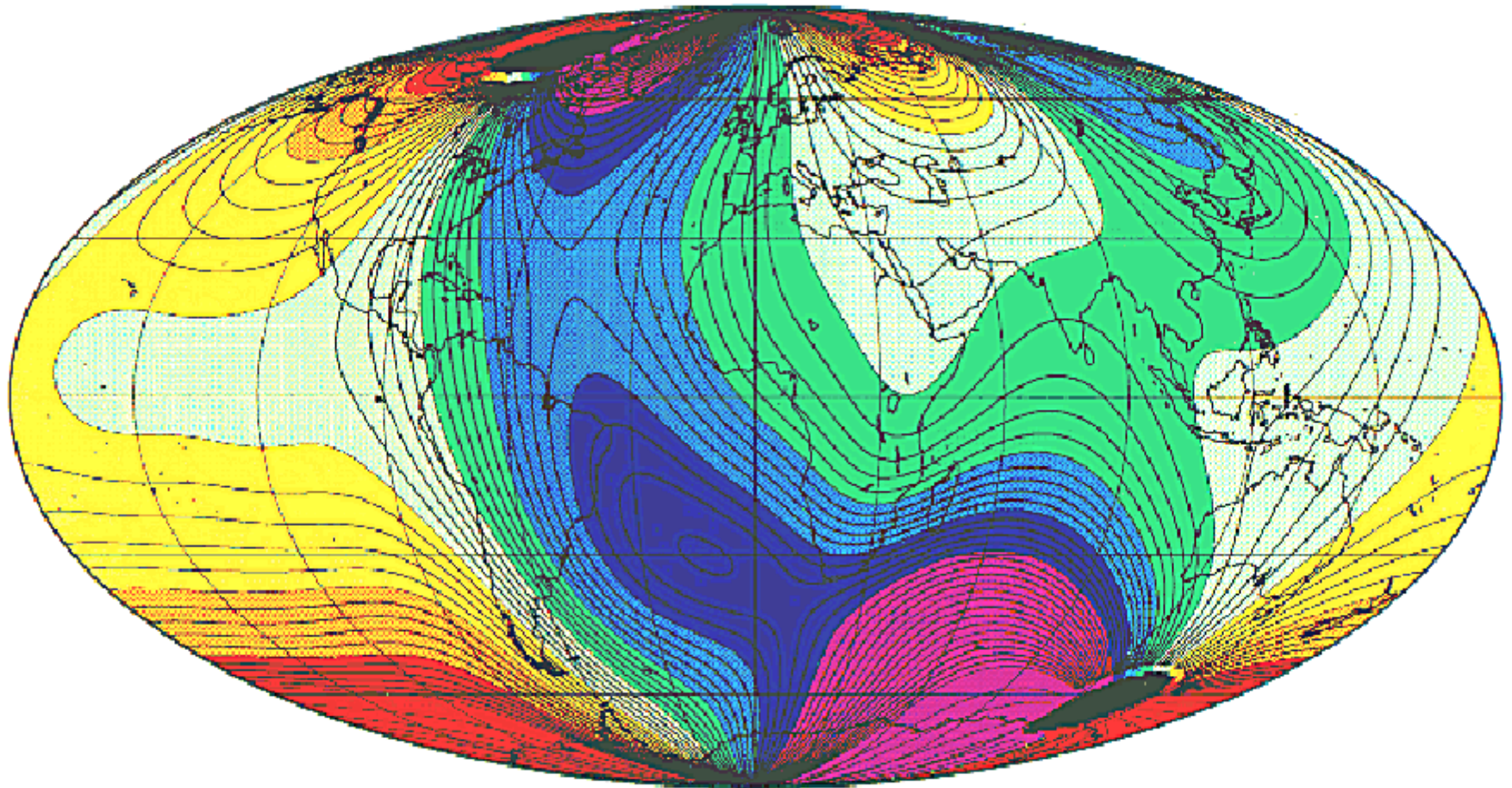


Magnetic Declination

- **Angular difference between true north and magnetic north at any given location.**
 - Isogonic charts show magnetic declination using isogonic lines.
 - The agonic line shows the place where there is no declination.
- **A declination diagram is often placed on maps to show the relationships of the baselines.**
 - To the west of the agonic line, the compass points too far to the east (i.e. east declination).
 - To the east of the agonic line, the compass points too far to the west (i.e. west declination).

Main Field Geomagnetism

Magnetic Declination Model for 1995.0



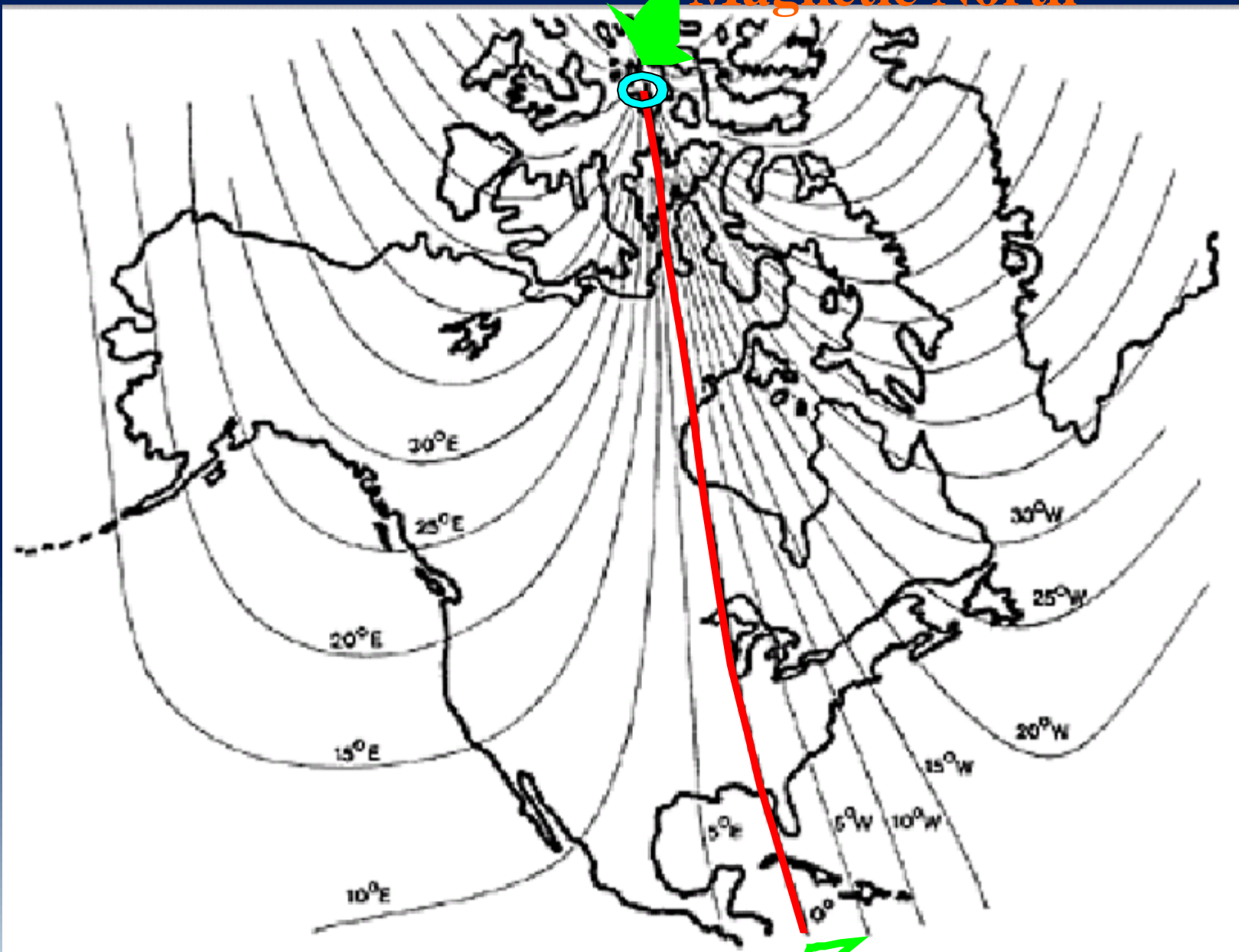
Degrees of declination (east declination is positive):



- Reference Fields
- Satellite Surveys

- Observatory Annual Means
- Secular Variation Surveys

Magnetic North



Agonic Line

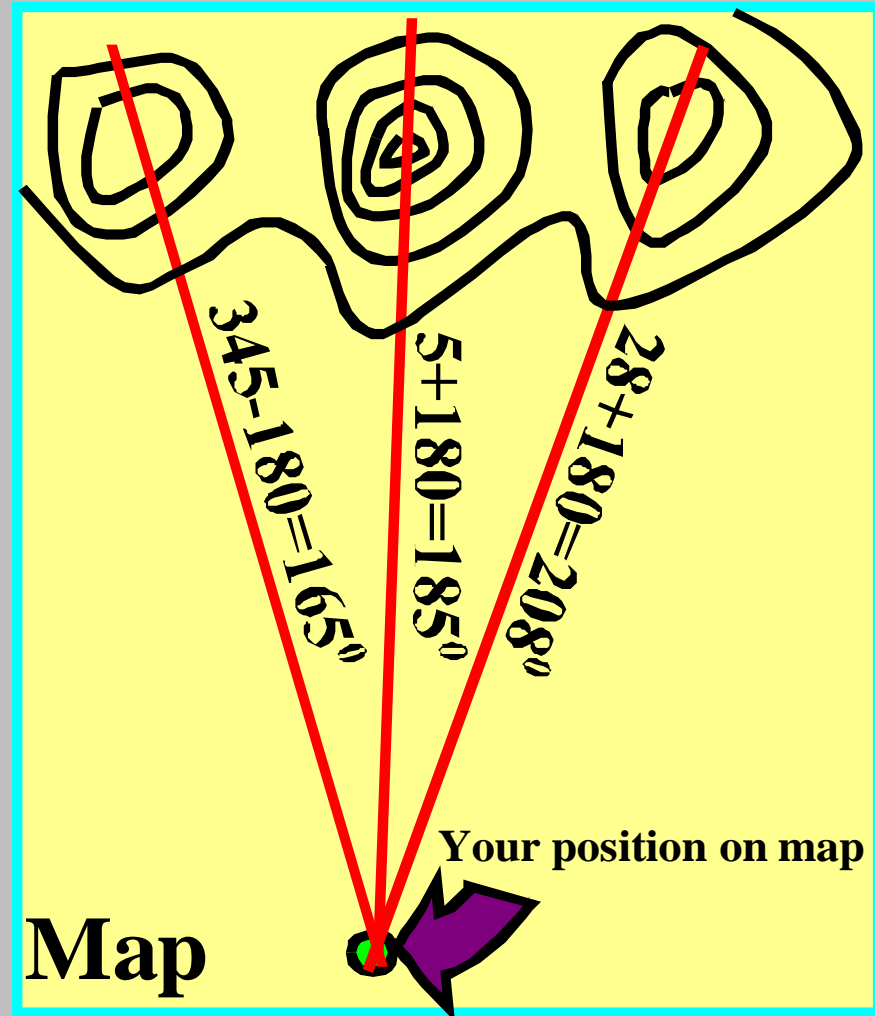
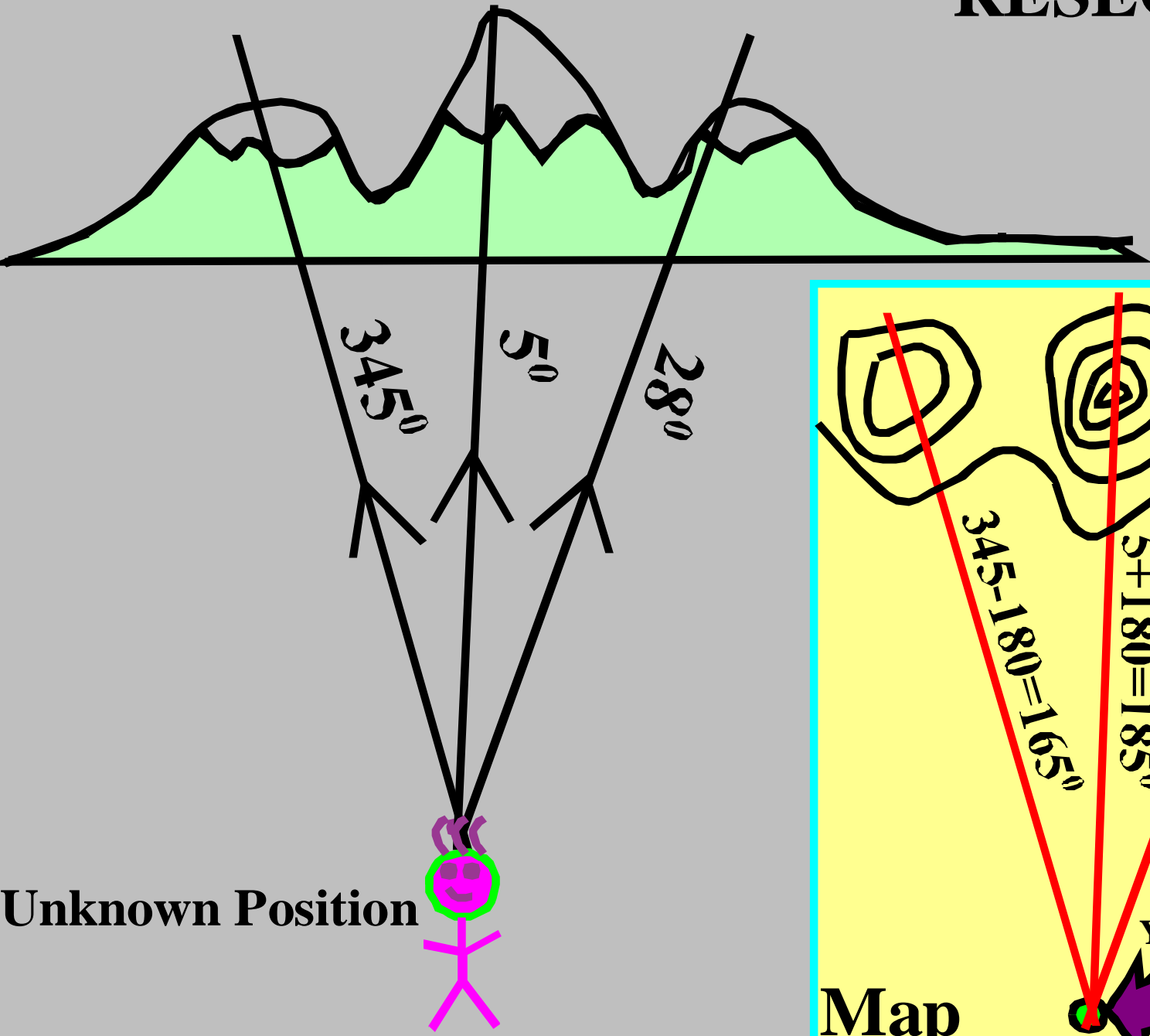
- **Now lets talk a bit about map orientation.**

Map Orientation

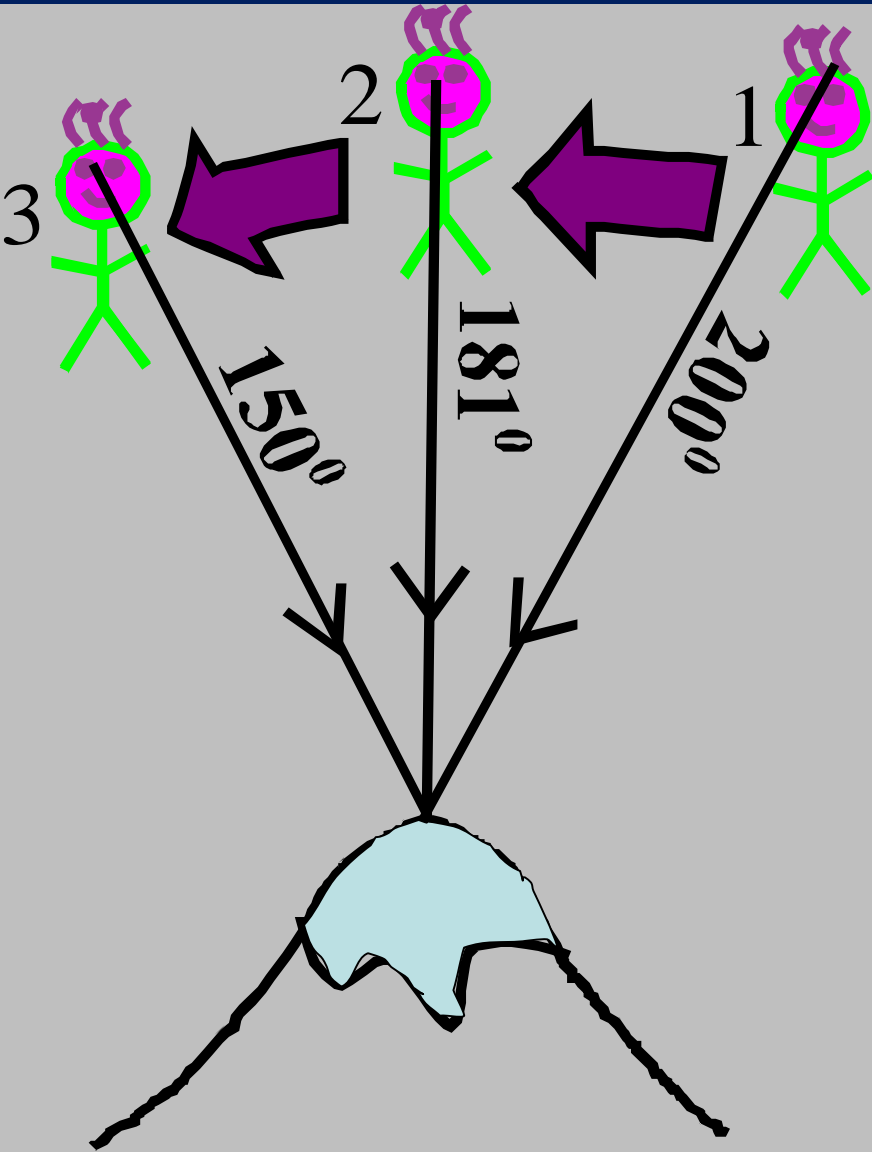


- **Using landmarks and/or a compass to line up the map with reality.**
- **A few major techniques may be used:**
 - **Inspection**
 - **Looking for easily recognizable landmarks and locating the same features on the map, then turning the map until both are properly related to each other.**
 - **Resection**
 - **Method of determining your position by taking sightings on known ground positions.**
 - **Intersection**
 - **Method of determining position of objects of unknown map location by taking sightings from known ground positions.**

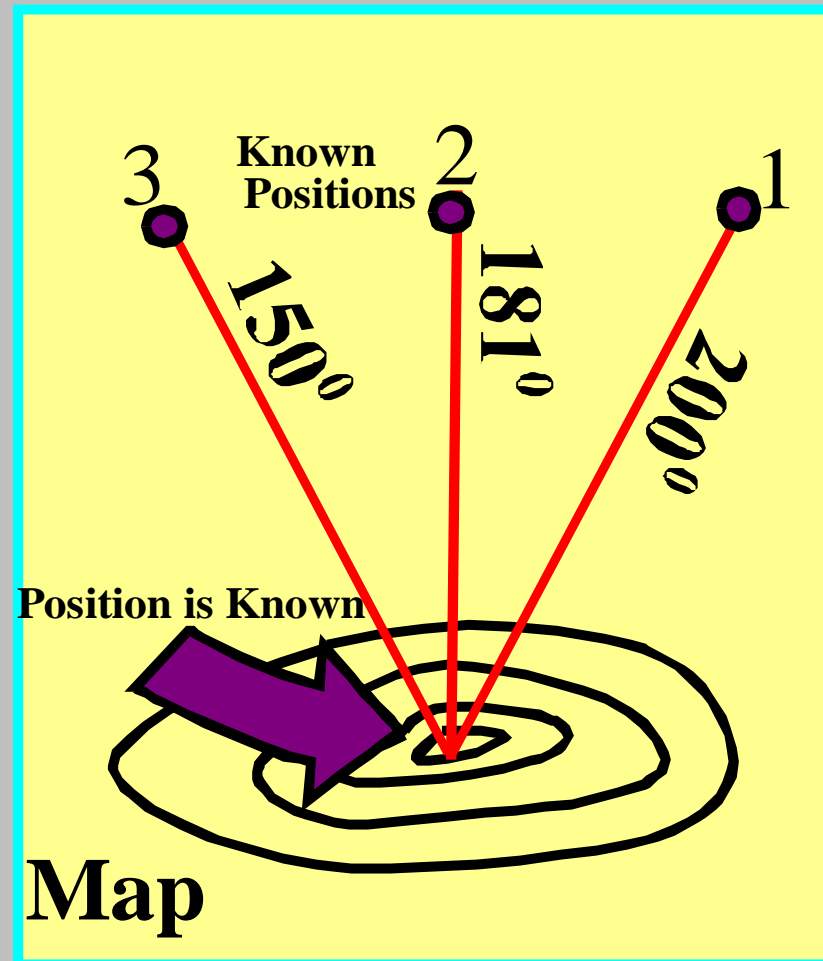
RESECTION



INTERSECTION

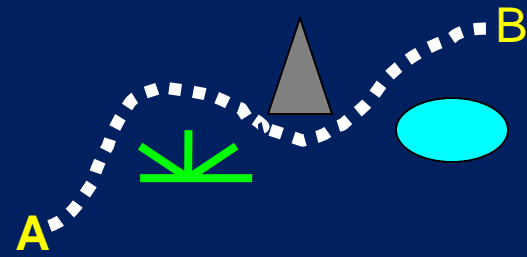


Object with unknown position

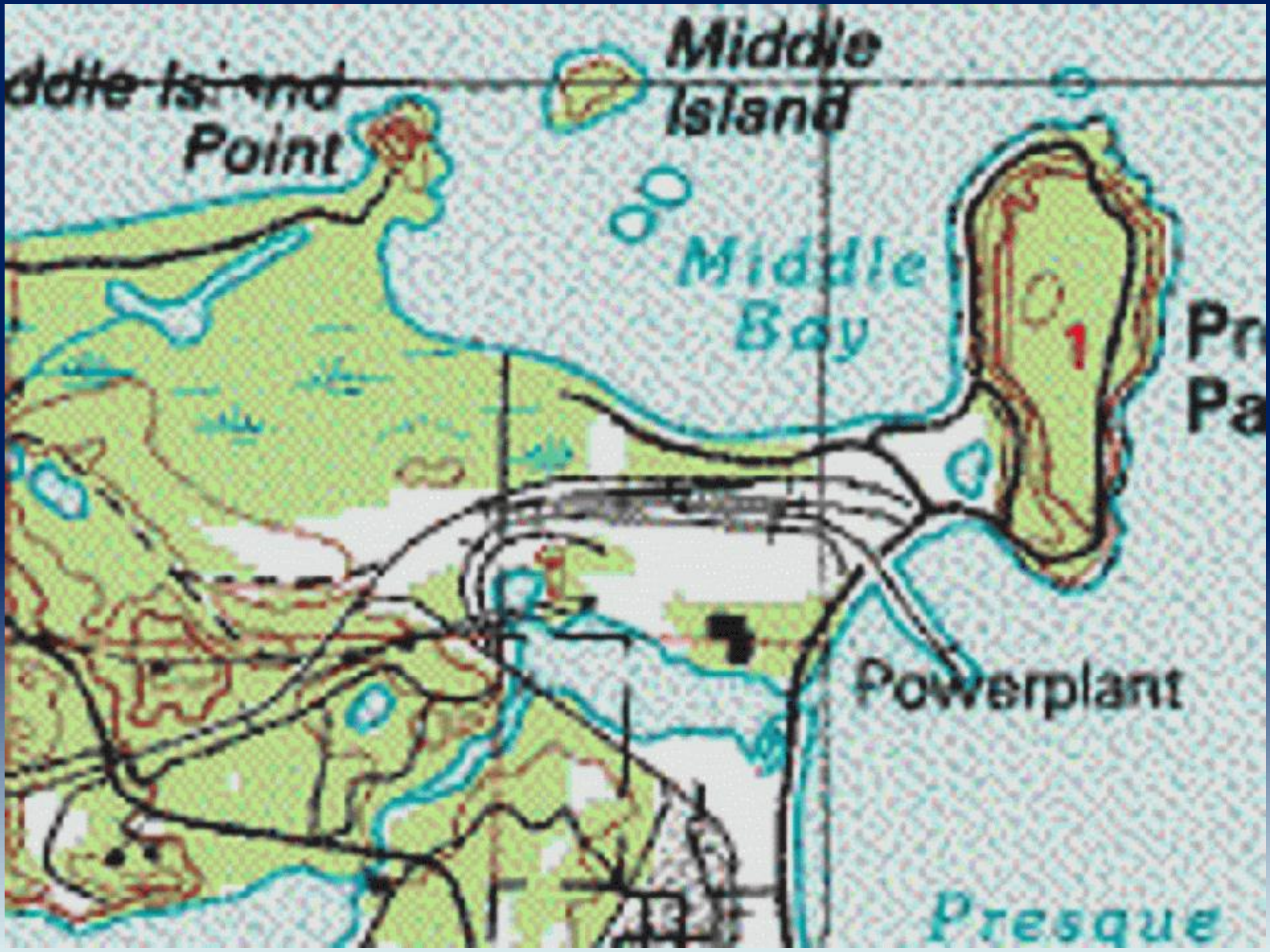


Map

Route Selection

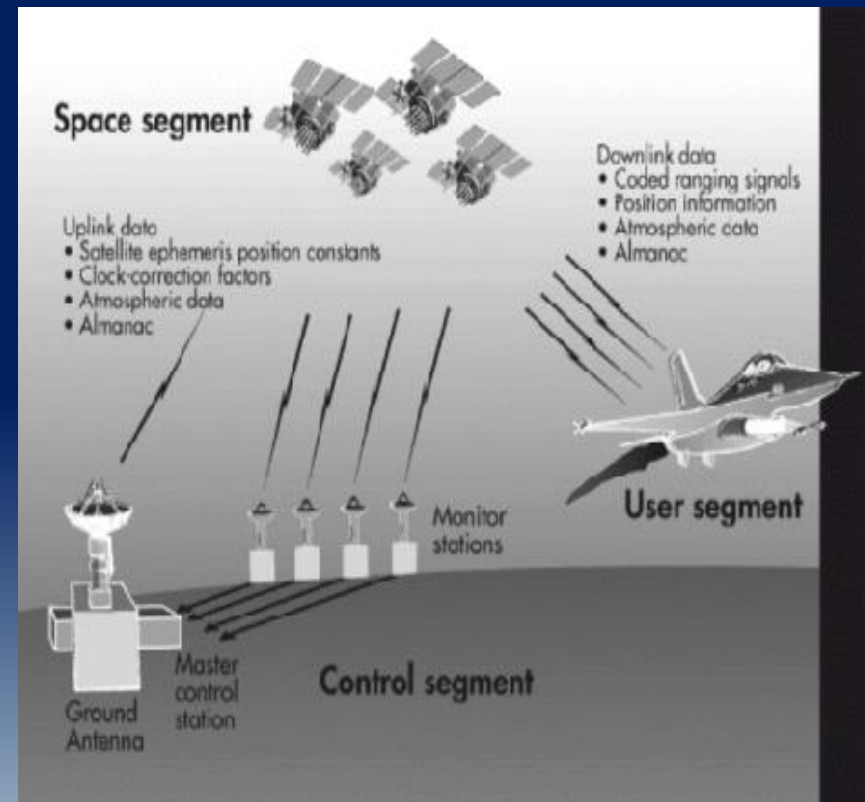


- **Planning the best route (path) from A to B using a map.**
 - By plotting a selected route on a map, you can choose the best path from one place to another, avoiding potential problems, such as steep slopes, cliffs, and other hazards.
- **While on route, you can sight on landmarks (either visually or with a compass) to use as reference points in determining your position along each major segment of your proposed path.**
 - GPS is also helpful in route following . . .

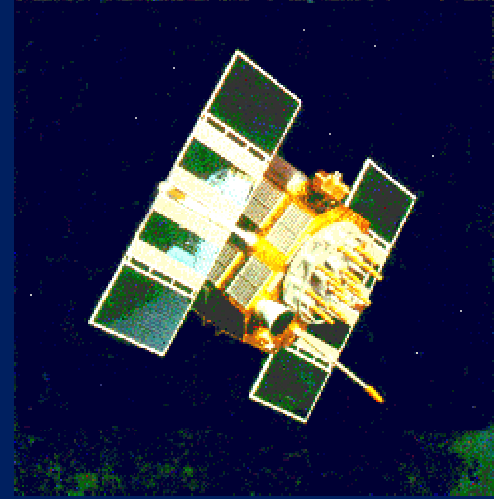


GPS, Global Positioning System

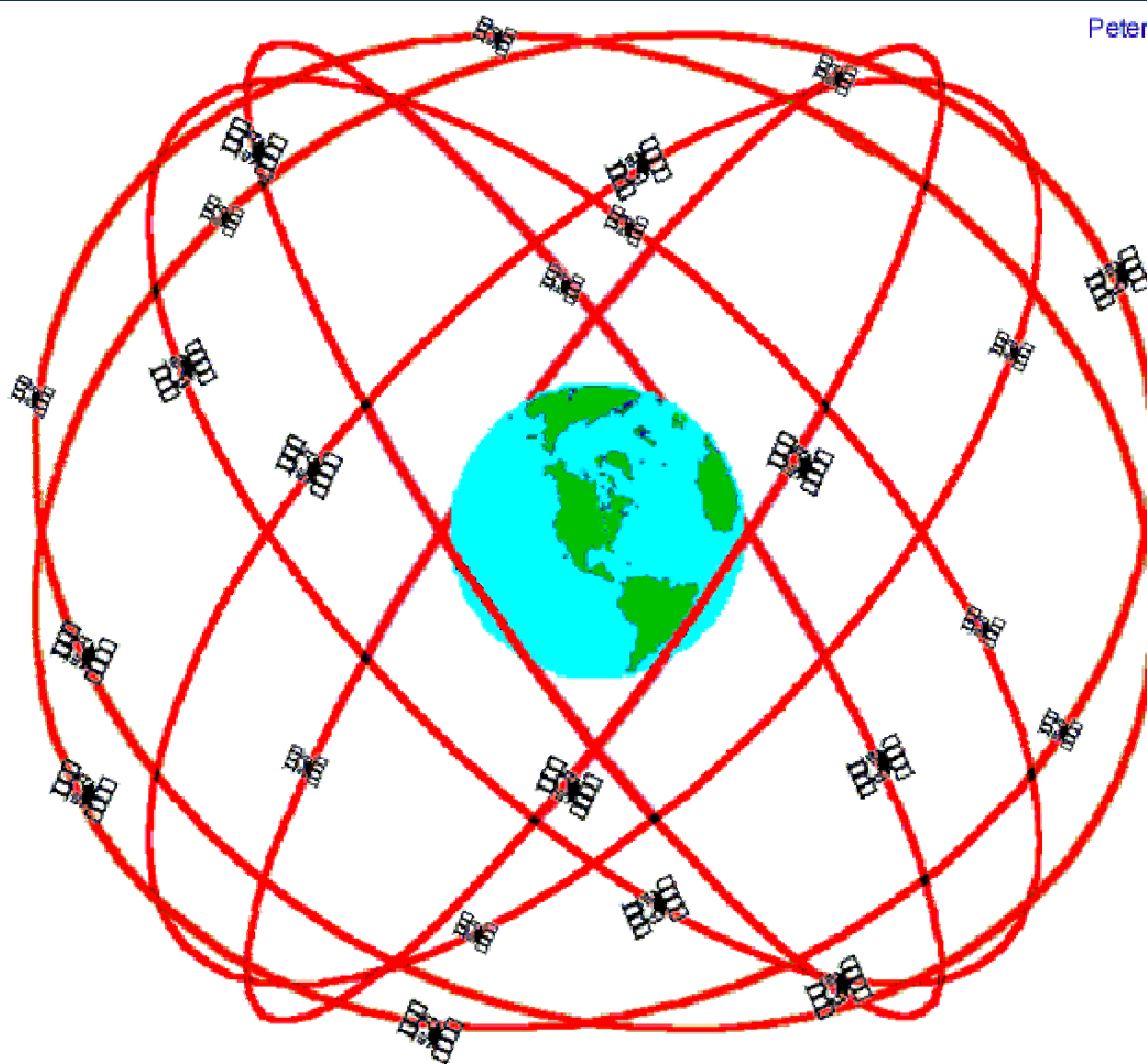
- **Developed and maintained by the U.S. Department of Defense.**
- **Consists of three major components:**
 - **1) Space Segment**
 - **2) Control Segment**
 - **3) User Segment**



GPS: Space Segment



- **Cluster of 24 satellites, 20,200 km above the earth.**
- **Orbiting in 6 planes, with 4 satellites in each plane.**
- **The satellites continually transmit radio signals that contain information about their exact positions in their orbit.**



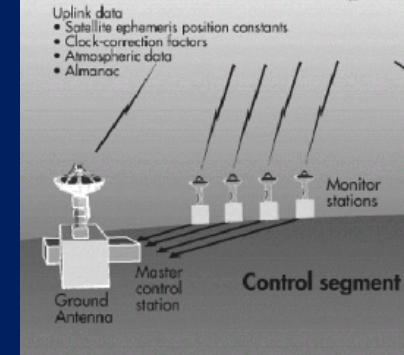
GPS Nominal Constellation

24 Satellites in 6 Orbital Planes

4 Satellites in each Plane

20,200 km Altitudes, 55 Degree Inclination

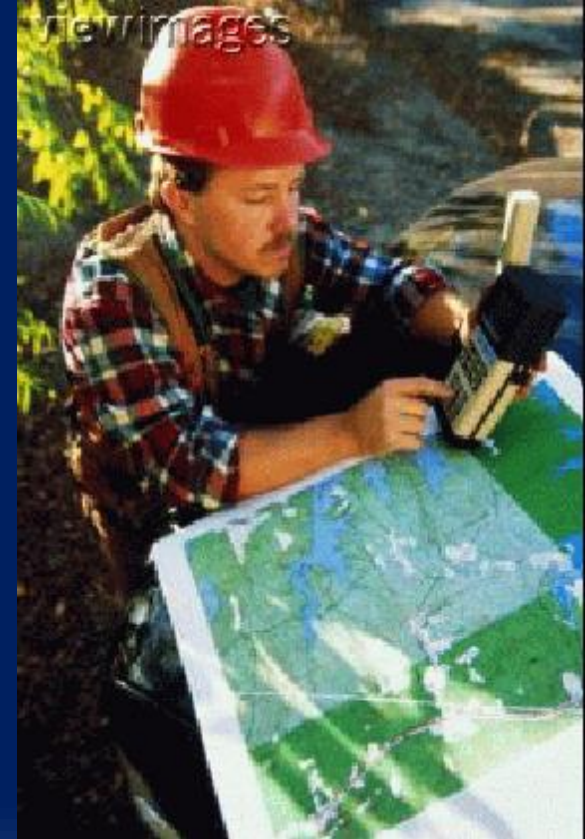
GPS: Control Segment



- **Operates the GPS via a Master Control Station (Colorado Springs, CO)**
 - and several monitoring stations (Hawaii; Ascension Island, S. Atlantic; Diego Garcia, Indian Ocean)
- **Satellite positions are continually monitored and several uploads per day are sent to each satellite, allowing the satellites to continually update their radio messages about their positions.**
 - **Selective Availability (a degraded civilian signal) is also the function of this segment; however, real-time differential correction signals improve accuracy greatly.**

GPS: User Segment

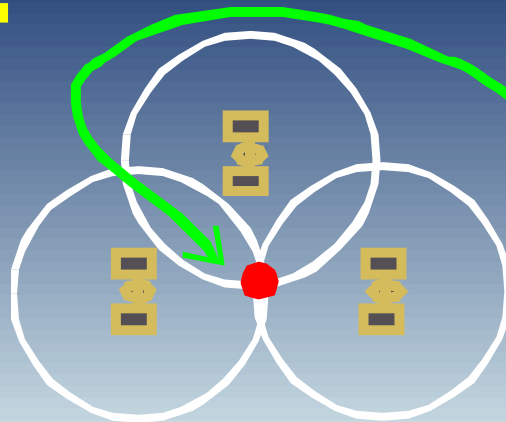
- **Small hand-held receiver units pick up the radio signals from the satellites.**
- **The receivers measure the amount of time it takes for the signals to travel from the each individual satellite (compares digital codes).**
- **Formula used is:**
 - **(Travel time) • (speed of light) = distance**



GPS (continued)



- **A form of triangulation (actually resection) is used.**
- **By combining the information from several satellites, an exact position is determined by the receiver.**



The receiver is here.

THE END