

# Introduction Maps, Compass, and Navigation Aids

## Module I – Map Reading

Presented by:  
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## Objectives

### Navigation Module 1 - Maps

- Define these terms or concepts
  - Scale / Distance
  - Topography
  - Contour Lines
- Identify location from topography of map
- Demonstrate working knowledge of UTM
  - Identify coordinates
  - Report location

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## Map

- Map (noun): a representation, usually on a flat surface of the whole or a part of an area
- GPS Receiver (noun): an electronic device subject to misinterpretation and failure in the field.

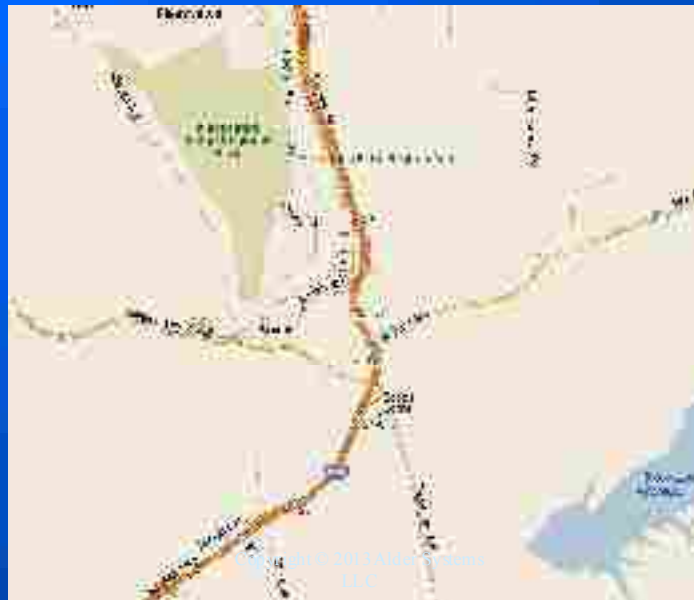
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## Types of Maps in SAR

- Street map
  - identify street routes for driving
  - used for urban search
- Aerial Photo
  - Provides more current view of area
- Topographical Map
  - Identifies physical and land characteristics

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## Street Map

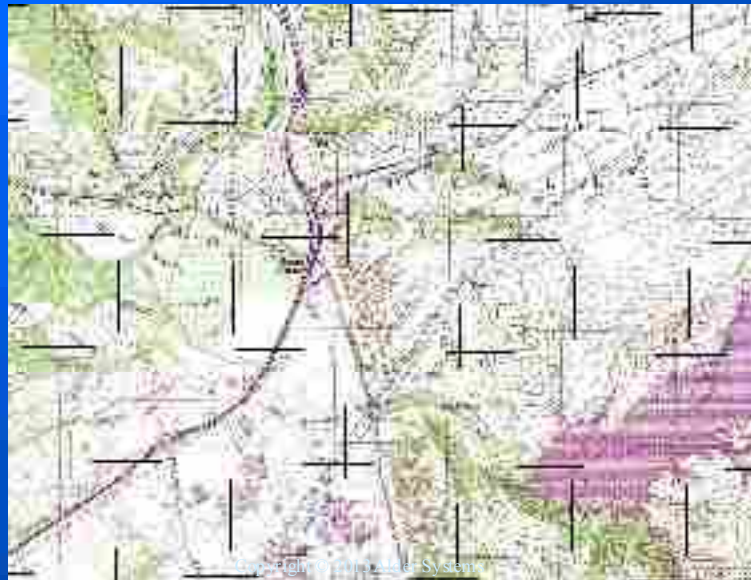


## Aerial Photo



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## Topo Map



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## Topographical (Topo) Maps

- Show major characteristics
  - Rivers
  - Waterways
  - Roads
  - Structures (may be outdated)
  - Land contours

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## Topo Maps

- Standard size
  - 7.5 minutes of longitude
    - 1:24,000 scale
    - 1 inch represents 2,000 feet
- Original Surveys
  - Completed over 50 years ago
  - Many photo updated more recently
  - Photo updates in purple

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## Contours



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## Contours



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## Mountain out of a Mud Hill



## Saddle & Draw or Gully



## Creating a Topographical Map



## Creating a Topographical Map





## Creating a Topographical Map



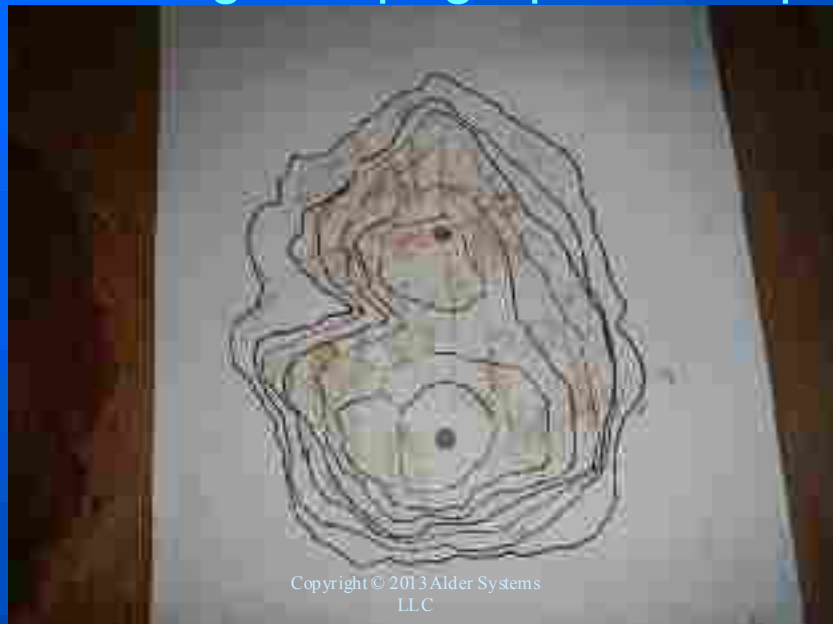
## Creating a Topographical Map



## Creating a Topographical Map



## Creating a Topographical Map



# Contours



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# Contours



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## Contours



## Datum



- NAD27
  - North American Datum 1927
- NAD83
  - North American Datum of 1983
- WGS84
  - World Geodetic System of 1984

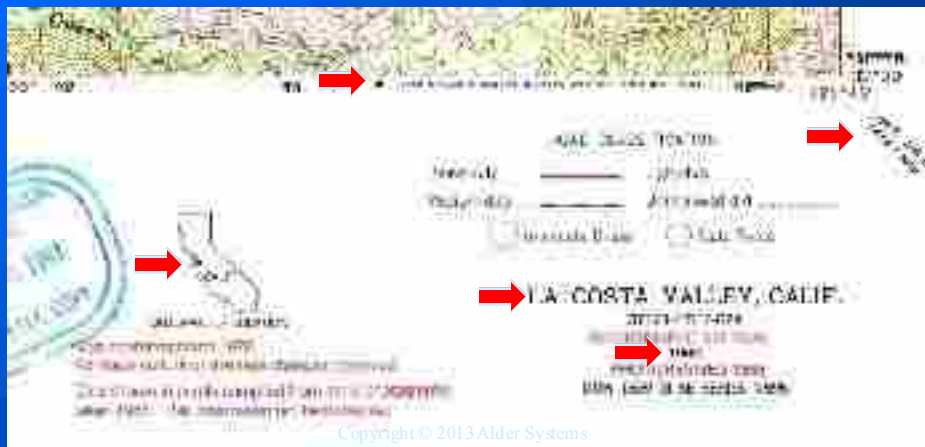
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## Datum

- Know your map
  - If it ain't there, ask
- NAD27
  - USGS printed TOPO maps
- NAD83/WGS84
  - NAD83 = WGS84 for SAR purposes
  - USGS National Map
- NAD 27/NAD83:
  - Approx 300m difference in California
  - Approx 1/2 that in Colorado

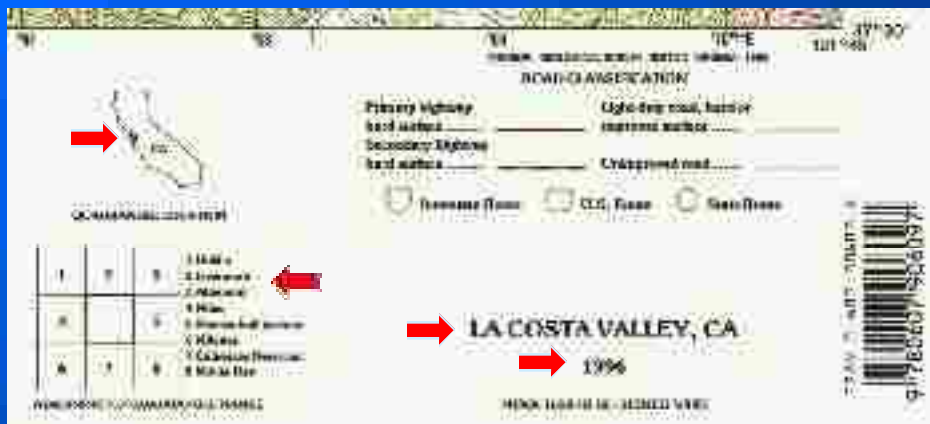
## Map Info

- Lower Right (1991 map)



## Map Info

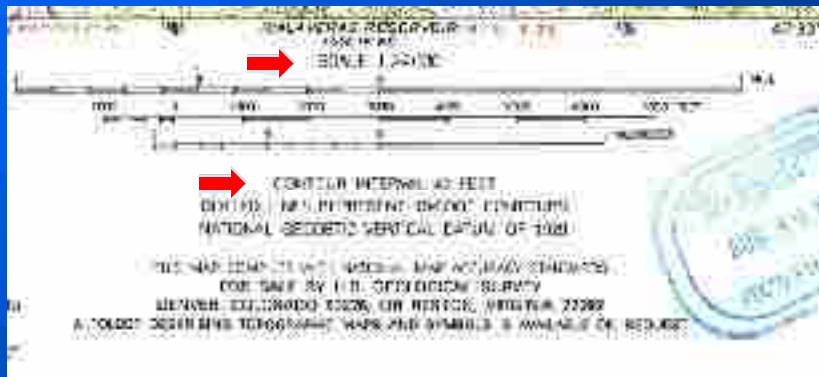
- Lower Right (1996 map)



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## Map Info

- Lower Middle (1991 map)



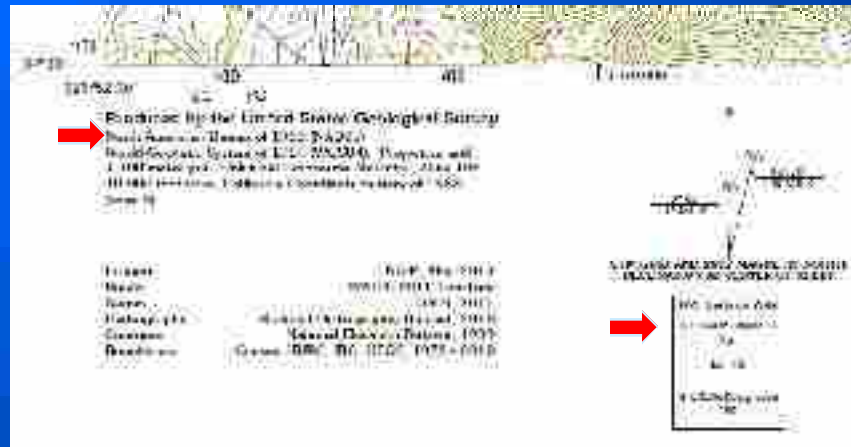
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## Map Info

- Lower Left (2012 map)



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## Distance Measurement

Reference Scale

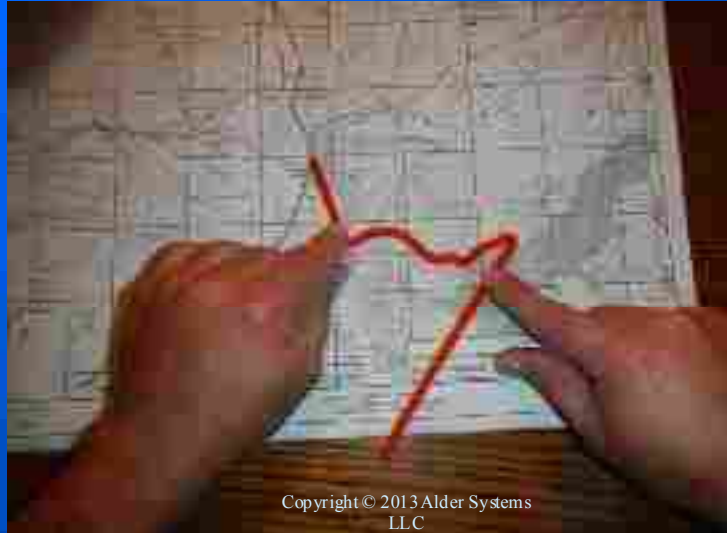


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## Distance Measurement

Utilization of high-tech measuring device

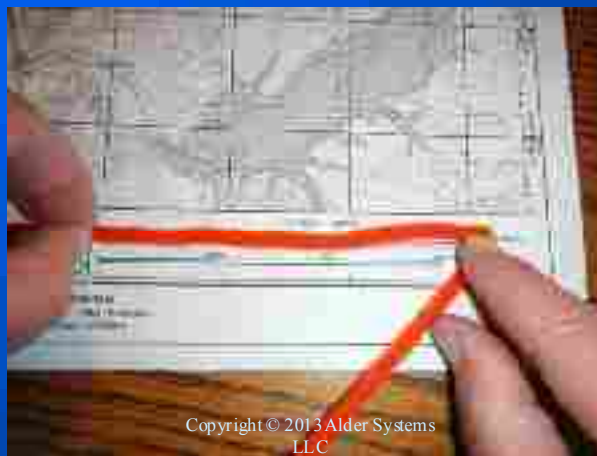


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## Distance Measurement

Measure from end of distance

If length exceeds scale pinch overlap



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## Distance Measurement

Result 2mi + ~900yds = 2.5+ miles

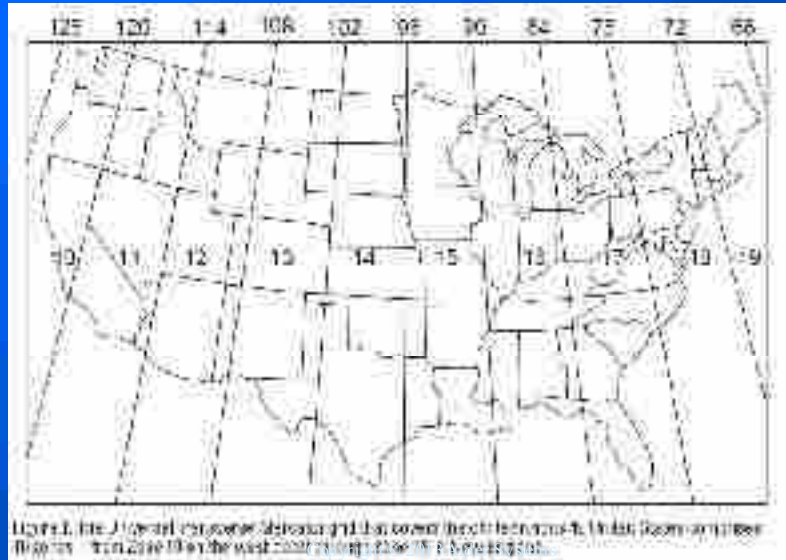


## UTM

- Universal Transverse Mercator
  - Based on Transverse Mercator Projection

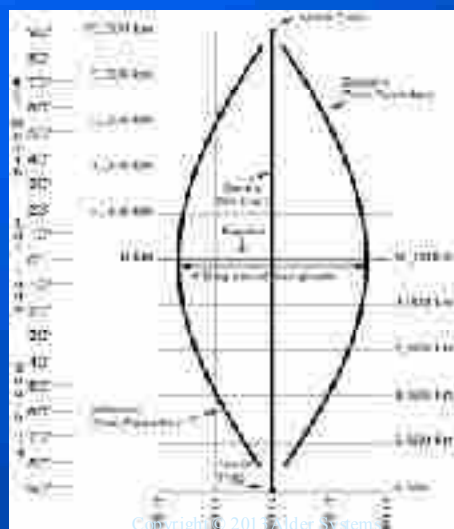


# UTM



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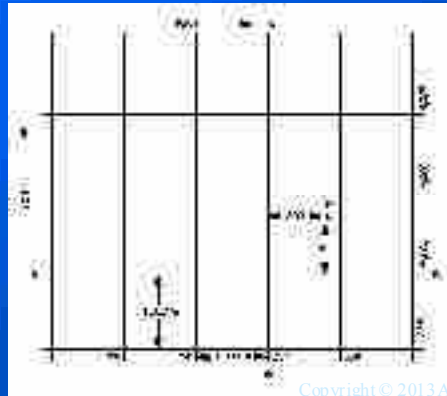
# UTM



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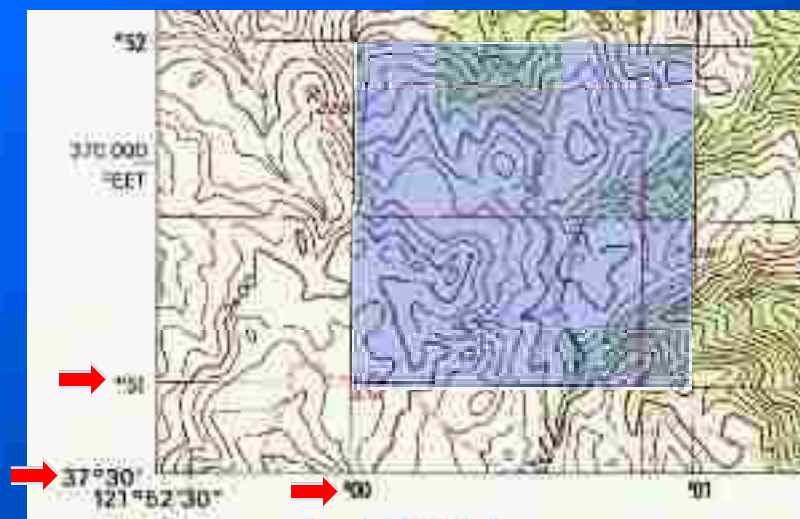
# 1000 meter Squares (km)

- Read as Easting then Northing



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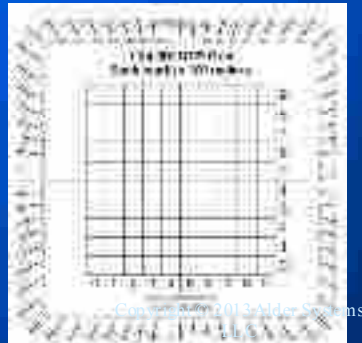
## UTM USGS



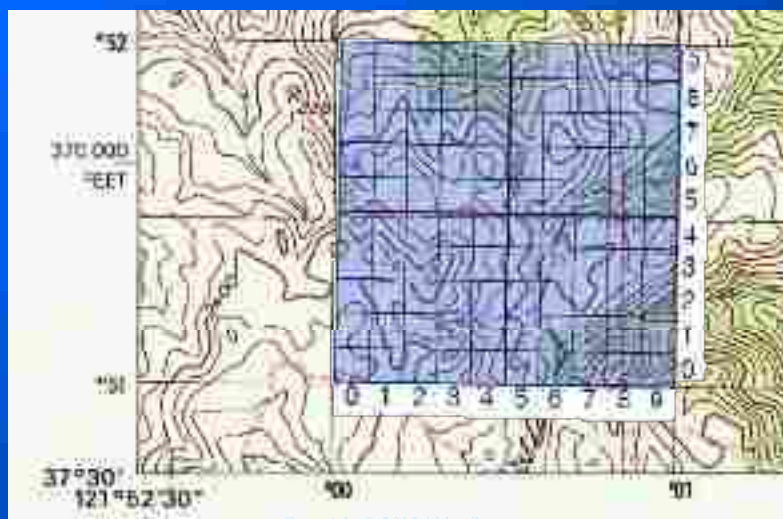
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## UTM Grid

- Breaks map up into 1KM squares
- Read with “Grid Reader”
- Easting then Northing
  - (X coordinate then Y just like HS)



## UTM USGS



# UTM



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# GPS



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## Section 1 Exercises

- Identify the UTM coordinates for the Northern most point of the San Antonio Reservoir Dam
- Plot the location of UTM: 10S 0596250E 4162520N
- Find the distance on the Jeep Trail from Northwest of Sunol Valley Golf Course at  
UTM: 10S 0597790E 4159940N  
to the end of the trail at  
UTM: 10S 0597055E 4160990N

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## Sources and Resources

- USGS National Map:  
<http://nationalmap.gov/ustopo/index.html>
- Classic USGS Topos: <http://www.usgs.gov/pubprod/>
- Map Symbols:  
<http://egsc.usgs.gov/isb/pubs/booklets/symbols/reading.html>
- WA6OTP.com
- [FUNSAR Chapter 10 \(2005\)](#)
- United States Army Field Manual (FM) 3-25.26
- [http://www.armystudyguide.com/content/army\\_board\\_study\\_guide\\_topics/land\\_navigation\\_map\\_reading/land-navigation-map-reading.shtml](http://www.armystudyguide.com/content/army_board_study_guide_topics/land_navigation_map_reading/land-navigation-map-reading.shtml)
- <http://www.itstactical.com/skillcom/navigation/landnav-101-introduction-to-map-terminology/>

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# Introduction Maps, Compass, and Navigation Aids

## Module II – Compass Use

Presented by:  
Lt. Brian Erickson

Alameda County Sheriff's Office  
Search and Rescue volunteer

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## Objectives Navigation Module 2 - Compass

- Define these terms or concepts
  - Azimuth
  - Bearing
  - True North, Grid North, Magnetic North
  - Declination
- The candidate will be able to demonstrate the ability to obtain a back azimuth
- Take bearing in the field and transfer it correctly to the map and obtain a bearing on the map and transfer it correctly to the field

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## Compass

- A device for determining direction
- Compasses used in SAR are magnetic
- Points toward the North Magnetic Pole
  - Different than North
- Divided into degrees
  - 0 through 359

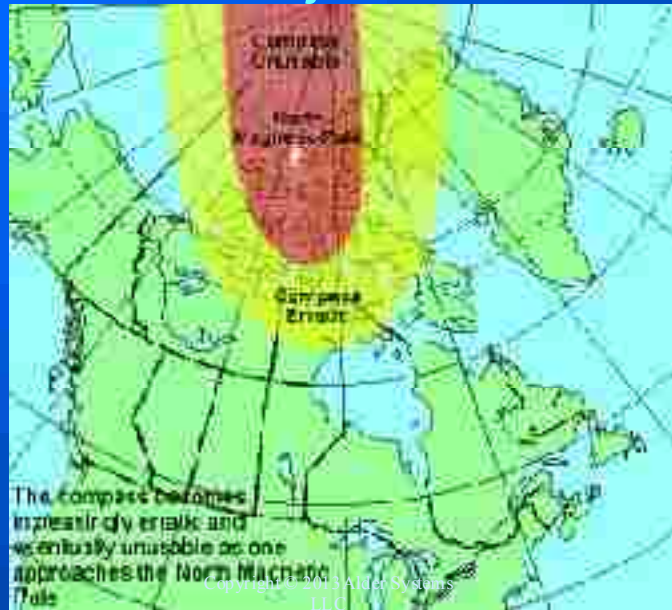
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## What is North?

- North pole
- North Star
- Magnetic North
- Grid North (Don't Use it!)
  - Too many grids on the map
  - Longitude lines are True North

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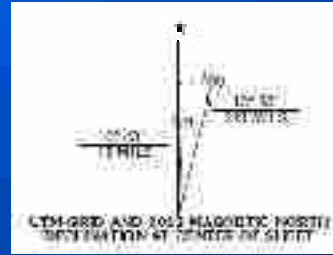
## There are Major Differences



## Declination

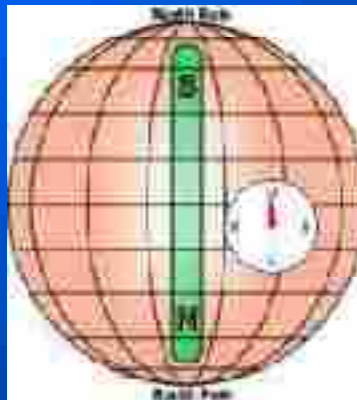


# Compass Rose



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# How does a Compass Work?



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## How Does a Compass Work?



## How Does a Compass Doesn't Work?



## How Does a Compass Doesn't Work?

- Obvious:
  - Car Hood
  - Another compass
- Not So Obvious:
  - Microphone / Radio
  - Picnic Table
  - Osprey Hydration Pack hose tender
  - Concrete (rebar)
- **If you move the compass and the needle moves when it shouldn't....**

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## Types of Compasses

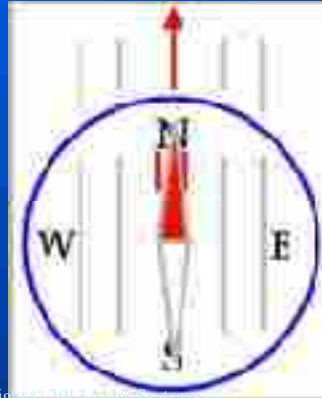
- Sighting
  - Lensatic
  - Prismatic
- Baseplate



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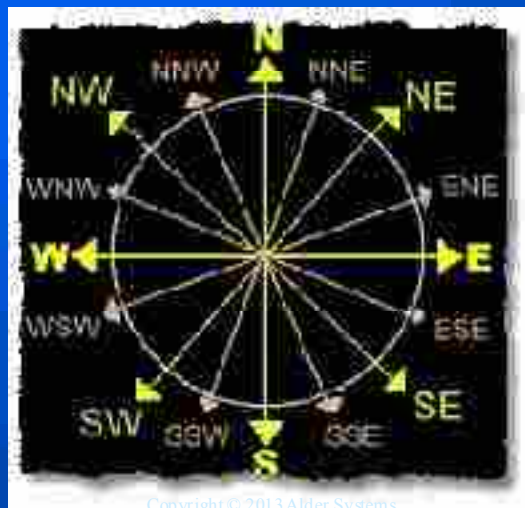
## Cardinal Points

- North ( $0^\circ$ )
- South ( $180^\circ$ )
- East ( $90^\circ$ )
- West ( $270^\circ$ )



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## Incardinal Points



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## Parts of a Compass



## How to Use a Compass Sighting a Bearing

- Map / Directional
  - The compass is simply aimed at an object or direction.
  - Rotate Azimuth Ring (dial) to align North end of needle in the orienting arrow (Box the Needle).
  - The bearing is read at the azimuth ring and index pointer closest to the object being sighted.

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## Sighting a Bearing

- Aim the compass
- Box the Needle
- Read the bearing



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## Sighting a Bearing



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## Sighting a Bearing



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## How to Use a Prismatic Compass Sighting a Bearing

- The compass is simply aimed at an object or direction. Line up the sighting lines (kinda like iron sights).
- Rotate Azimuth ring to align North (Box the Needle) by viewing in mirror.
- The bearing is read at the azimuth ring window.

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## How to Use a Prismatic



## How to Use a Prismatic



## Back Azimuth

- Sometimes when you get to where you thought that you were going, you need to confirm where you have been.
- Back Azimuth is  $180^\circ$  from a normal Azimuth

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## Orienting to Map (Proofing)

- Set azimuth ring to zero degrees
- Place on map next to compass rose and rotate map until magnetic North matches compass.

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## Orienting to Map



## Transferring a Bearing to Map

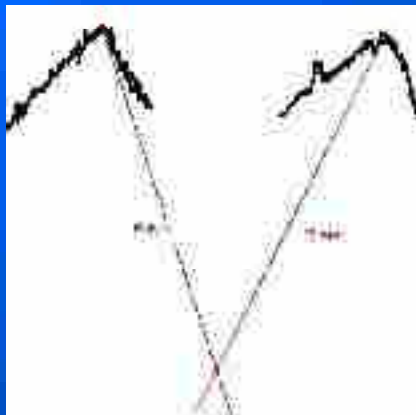
- Orient the map
- Set desired bearing on Azimuth Ring
- Set edge of compass baseplate on known point
- Box the needle
- Draw your bearing line on map
- (Does it matter if you are physically in the area?)

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## Transferring a Bearing to Map



## Location by Biangulation (Tri is better)



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## Pacing

- Easy way to approximate distance
- Measure stride over distance (30m)
- Find conversion factor
  - (actual distance) / (#paces)
- Use Conversion Factor
  - (conversion factor) X paced distance

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## Other Nav Aids

- Counters
  - Used to count paces
- GPS
  - Not covered in depth
  - Accurate
  - Make certain that DATUM is correct
  - Make certain set for appropriate coordinate system
    - UTM or LAT/LONG

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## Exercises

- Locate the land marks in the following pictures on the map.
- Draw an Azimuth line to each. (all bearings are magnetic)
- Intersection of lines is the origin of the pictures
- Origin is approx  $\frac{3}{4}$  mi South of I-680 near Calaveras Road

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Left peak is 115° from location

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270° from location

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250° from location

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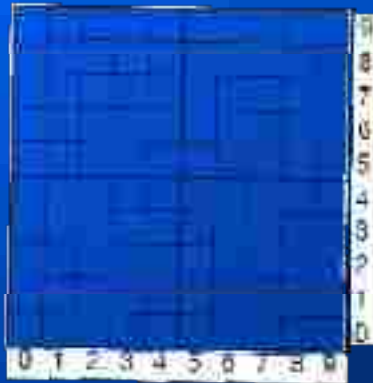


## References

- Material stolen from
  - [www.brunton.com](http://www.brunton.com)
    - manufacturer of Silva and Brunton compasses
  - [www.compassdude.com](http://www.compassdude.com)
  - [SAR\\_Lt@alder-systems.com](mailto:SAR_Lt@alder-systems.com)

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## UTM



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