





## Using an unfamiliar map




- Date of information
- Intended usage
- Scale
- North Reference
  - Declination
- Coordinate References
  - Grids & Tics
  - Map Datum
- Distance & Elevation Units
- Topography
  - Contour Interval
- Language & Alphabet
- Symbols and Colors
- Overall strengths and weaknesses for your intended use



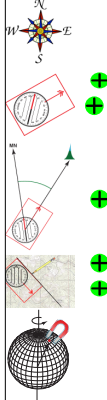


## Evaluating a Compass

So many choices...

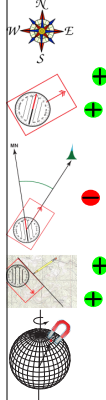



- General Orientation
- Traveling along a heading
  - Setting the bearing, Aligning with North, Sighting, Using in the dark
- Sighting a bearing
  - Sighting mechanism, Aligning with North, Reading the Bearing
- Plotting/Reading a bearing on a map
  - North orienting lines, Straight edge
- North reference adjustment

## Mirrored

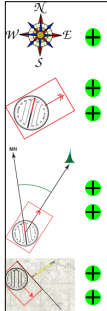

## Baseplate

## Sighting

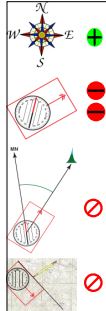




## Sighting Baseplate

- 1° markings
- Best for sight
- Good for plot
- No declination adjustment
- My personal

## Zipper Pull Compass

### Handheld, Wrist, & Thumb

### Lensatic

### Prismatic / Lensatic

### Smart Phone Apps

### GPS with Electronic Compass

<b>POSITION</b>	<b>10 570906E</b>
<b>4130064N</b>	<b>ELEV 800 FT</b>
<b>18 APR 02</b>	<b>18 APR 02</b>
<b>090 00 M</b>	<b>MAGNET UTM</b>
<b>GRS80 120°</b>	<b>GRS80 120°</b>
<b>9.381 234.81</b>	<b>COURSE 180°</b>
<b>120 150 S</b>	<b>120 150 S</b>

<b>1605</b>	<b>26.5</b>
<b>TO GO</b>	<b>TO GO</b>
<b>N</b>	<b>E</b>
<b>W</b>	<b>S</b>
<b>LOCATION</b>	<b>10 570906E</b>
<b>UTM</b>	<b>4130064N</b>

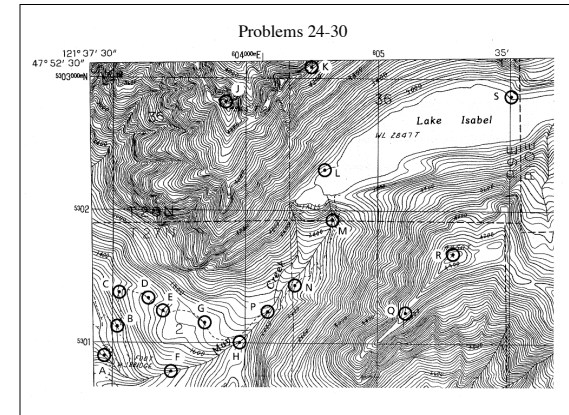
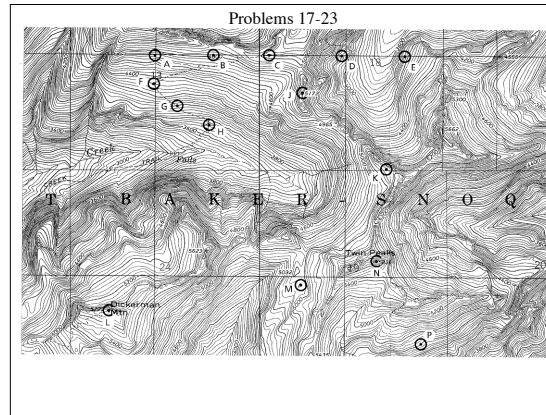
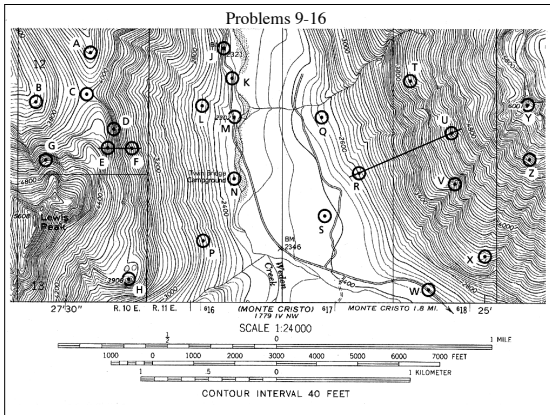
Let's take a break!  
In about 10 minutes, we'll return.

### Homework Review and Questions

### Problems 1-8

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET



## More Useful GPS Techniques

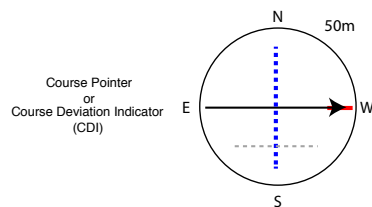
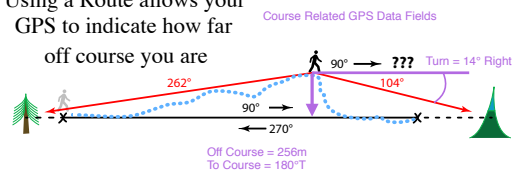
## Routes

- A sequence of waypoints defines a route.
- First your GPS will navigate you to the nearest point on the route.
- Then your GPS will navigate you to each waypoint in the route sequence.
- It is still only straight lines from waypoint to waypoint.

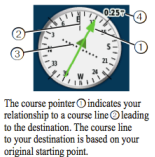
## Routes

- A route containing your course change points can help you to avoid missing them. Especially in low visibility conditions.
- Pre-planned “safety routes” may be useful for getting down off the mountain, while avoiding hazards.

Using a Route allows your GPS to indicate how far off course you are



**About the Course Pointer**  
The course pointer is most useful if you are navigating on water or where there are no major obstacles in your path.



The course pointer indicates your relationship to a course line leading to the destination. The course line to your destination is based on your original starting point.

As you drift from the intended course to the destination, the course deviation indicator (CDI) provides the indication of drift (right or left) from the course.

The scale refers to the distance between dots on the course deviation indicator.

**Navigating with the Course Pointer**  
Before you can navigate with the course pointer, you must change the pointer setting to **Course (CDI)** (page 34).

### Heading Settings

This function is available on the cTrex 30.

Select **Setup > Heading**.

- **Display**—sets the type of directional loading on the compass.
- **North Reference**—sets the north reference of the compass.
- **Go To Line (Pointer)**—allows you to select how the course appears.
  - **Bearing (Small or Large)**—sets the direction to your destination.
  - **Course (CDI)**—the course deviation indicator displays your relationship to a course line leading to a destination.

## Customizable Data Fields

### Accuracy of GPS

Ambient Pressure  
Ascent - Average  
Ascent - Maximum  
Ascent - Total  
Barometer  
Battery Level  
**Bearing**  
Cadence (cadence accessory required)  
Course  
Descent - Average  
Descent - Maximum  
Descent - Total  
Distance to Next  
**Elevation**  
Elevation - Maximum  
Elevation - Minimum  
ETA at Destination  
ETA at Next  
Glide Ratio  
Glide Ratio to Dest.  
GPS Signal Strength  
**Heading**  
Heart Rate (heart rate monitor required)

### Location (lat/lon)

**Location (selected)**  
Odometer  
Off Course  
Pointer  
**Speed**  
Speed - Maximum  
Speed - Moving Avg.  
Speed - Overall Avg.  
**Sunrise**  
**Sunset**  
Time of Day  
Time to Destination  
Time to Next  
To Course  
Trip Odometer  
Trip Time - Moving  
Trip Time - Stopped  
Trip Time - Total  
Turn  
Velocity Made Good  
Vert. Speed to Dest.  
Vertical Speed  
Waypoint at Dest.  
**Waypoint at Next**

## Map View

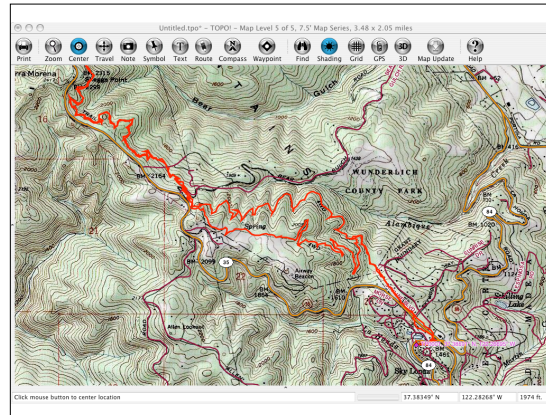
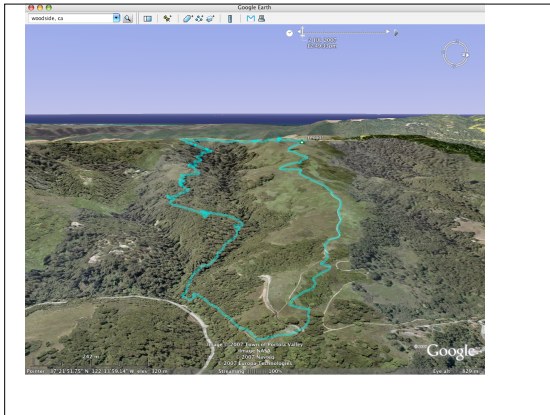
- Visual “Where am I on the map”
- Easier way to create waypoints
- Can show the “boundary” of an area
  - use waypoints along the boundary
  - make a custom map showing the boundary
- Track display can be used to monitor coverage of an area.

## Geofencing

- Use a string of waypoints with overlapping proximity alarms to indicate a hazard or boundary.
  - Set proximity distance based on “safe distance from hazard” or “warning distance for approaching boundary”
  - Overlap by about twice the expected GPS accuracy, to avoid “holes in the fence.”

## Track Logs

- Track logs can be downloaded into most computer topo map programs.
- GPS must be on and tracking for entire route to log
  - GPS unit position, must “face the sky”
  - Batteries
  - Good satellite signals
- Setup options are important



## Track Loggers

- Standalone devices that do nothing but log a track.



- Timestamped photos, videos, and voice recordings can be linked to the track by their timestamp, and thus their position can be determined.
- Geotagging a Photo
- Many new digital cameras and most smartphone cameras can geotag photos and voice recordings



## Track Back

- Most GPS receivers can turn a track log into a route that you can follow back to your starting point.
- IMHO, this is relying on your GPS a bit more than you should be.



## Tricks for Finding North

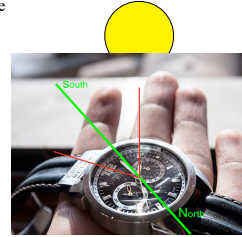
## Use the Time of Day and a Watch Face to Find North

### Northern Hemisphere

- Point the hour hand at the sun.
- A line from the center of the watch face half way between 12 and the hour hand will point South.
- Use 1 instead of 12 when Daylight Savings Time is in effect.
- Digital watch, draw a watch face, on a scrap of paper.

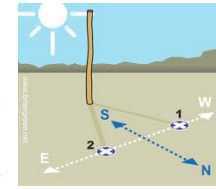
### Southern Hemisphere

- Swap 12 and the hour hand. (12 at the sun)
- North is the line halfway between



## Finding North with a Shadow

- Mark the position of the end of the shadow cast by a stick. (a ski poll, walking stick, etc.)
- Wait at least 15 minutes.
- Mark the position of the end of the shadow cast by a stick again.
- The line between the marks runs approximately East-West. In the Northern Hemisphere, The first mark will be to the West of the second mark.

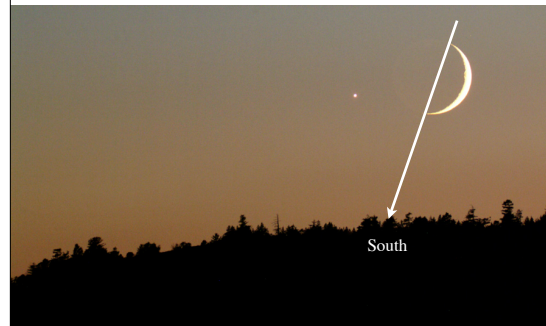


## Find North using the North Star

## Using the "Horns of the Moon"

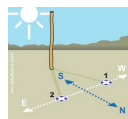
## Afternoon Navigation Exercise

- Parking Lot #2 Bearing and Distance Course
  - Work with a partner
  - You will need
    - Course Sheet
    - Compass
    - Writing surface
    - Pen or pencil



## Afternoon Navigation Exercise

- Find North Without Using A Compass
  - Watch face method
- Shadow from a stick method



## Afternoon Navigation Exercise

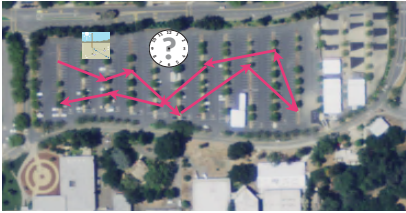
- Parking Lot #2 Bearing and Distance Course
  - Work with a partner
  - Do at least half the course with a bag over your head to simulate low visibility
  - You will need
    - 2nd course sheet
    - 2 paper bags
    - Compass
    - Writing Stuff



## Tips for traveling along a bearing in poor visibility

- Hold the compass with both hands in front of you.
- Stop walking to correct your heading.
  - Move your feet, not just your body when correcting.

## Afternoon Navigation Exercise



## Afternoon Navigation Exercise

- Lot #2 Bearing & Distance
- Lot #2 Low Visibility



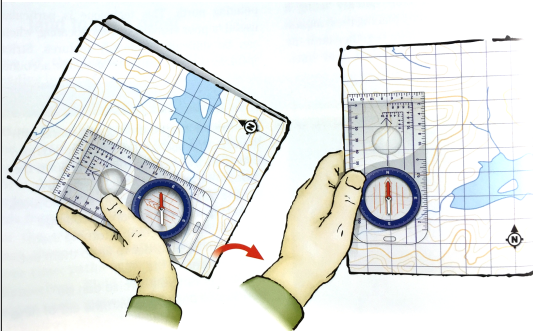
## Your Navigation Tool Kit

- Orienting yourself and your map
- Locating yourself on your map
- Planning and finding your route

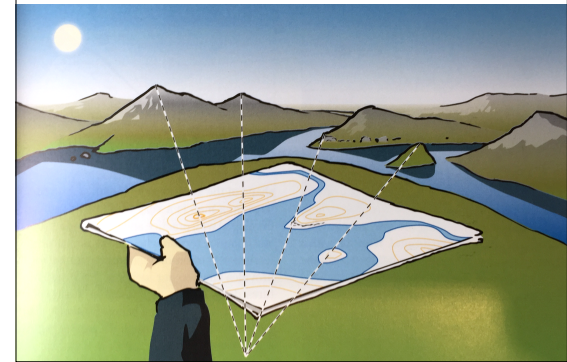
## Orienting Yourself and Your Map

- Finding North
  - Use your compass
  - Use you map and orient it using the surrounding terrain
  - Use the Sun
    - Rises in the “east” and sets in the “west”
    - Use the time of day and a watch face
  - Use a shadow stick
  - Use the North Star

- Use your compass



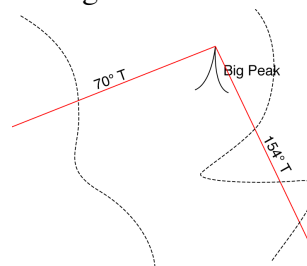
- Use the surrounding terrain to orient your map



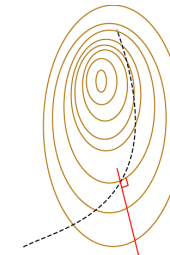
## Locating Yourself on Your Map

- GPS Coordinates
  - or bearing and distance to known waypoints
- Observation of terrain and man made features
- Compass resection
- Altitude and terrain feature intersection
- Combinations of the above techniques

## Bearing to known point intersecting with a known feature

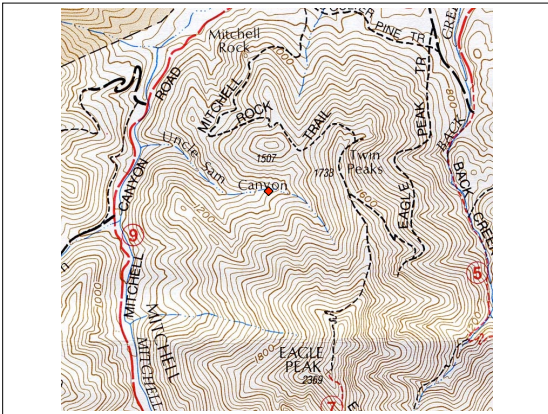
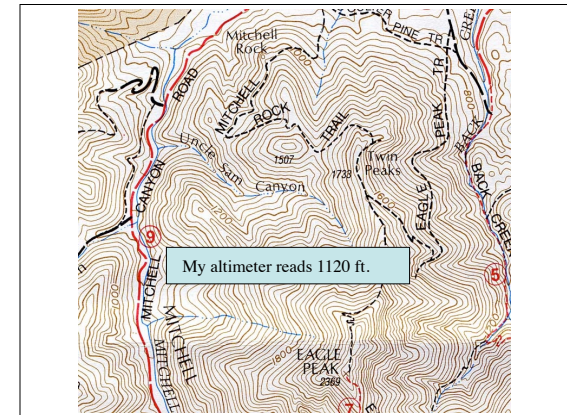
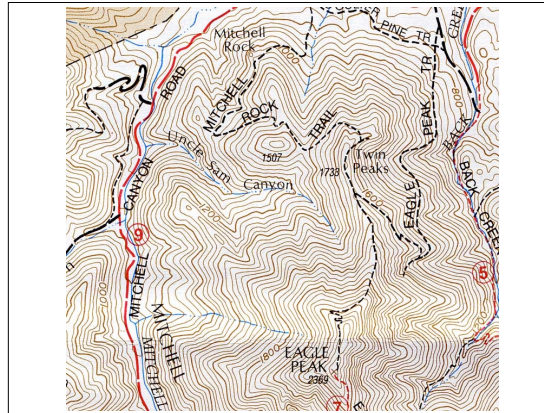


## The fall line intersecting with a known feature or elevation



## Using an Altimeter to Determine Your Location

- I'm hiking up Uncle Sam Canyon and want to know where I am on the map.
- I can't see out of the canyon to sight on anything with my compass.
- The canyon walls are blocking GPS signals.



## Altimeters

- Altimeters are just barometers that read in feet or meters.
- They work by measuring changes in air pressure.
- A good altimeter can indicate elevation changes as small as 10 ft.
- They can be mechanical or electronic
- They should be temperature compensated

## Altimeters must be calibrated

- Changing weather patterns cause the air pressure at any given location to change over time.
- You must set your altimeter while you are at a known elevation.
- You must set it at least every day
- When the weather is changing, you need to set it more often.

## Using your altimeter to determine your position

- You need to be on an identifiable route on the map
  - Trail, drainage, glacier, hillside, etc.
- Works best with steady elevation gain or loss.
- There will be more position possibilities if you are going up and down in elevation.

## Route Planning & Finding

## Two different needs for following a route

- Need to reach the destination.
  - May not care about being on the planned route.
- Need to travel very close to the planned route.
  - Hazards, man made or natural
  - Project goals

## Factors Driving Your Plan

- Avoiding hazards
- Destination & schedule
- Avoiding difficult terrain & vegetation
- Fastest, Shortest, Easiest
- Area Coverage or Avoidance

## Time Factors

- Many a trip has turned into a disaster because a pressing need to “get back in time” didn’t fit with a route that took longer than planned.
- If you “gotta be back on time” leave plenty of extra time for the unexpected.
- Plan in a few bailout possibilities, and some guidance about when to use them. “Choice Points”

## The Drive Home

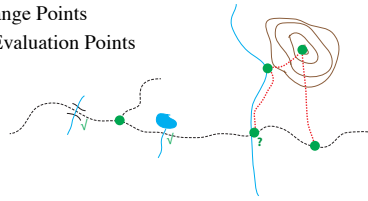
- Don’t forget that it’s often the drive home that is the most dangerous part of the trip.
  - You’re tired, maybe you didn’t sleep well on the ground...
  - It’s a long and windy road back out of the mountains...
  - It’s usually late afternoon, or even later...

## On Trail v.s. Off Trail

- Tradeoff additional distance for potential savings in time and ease of travel
  - A 1.5 to 2.0 X distance is an “easy” trade in most conditions.
  - Difficult cross country travel conditions will weight on-trail travel even more favorably.

## Building a Navigation Story

- Story Components...
  - Course Legs
  - Checkpoints
  - Course Change Points
  - Choice or Evaluation Points

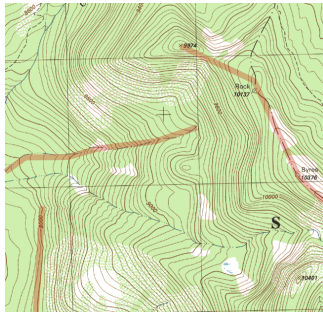


## Man Made Linear Features

- Roads & Trails
- Fences
- Power lines
- Walls

## Using Terrain Breaks as Linear Features

- Where the slope of the terrain makes an obvious change.
- Uphill / Downhill
- Flat / Steep

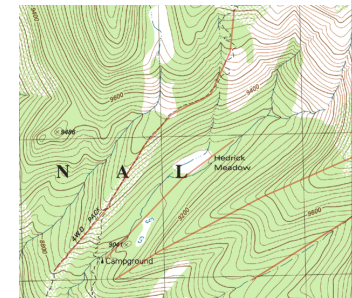


## Natural Linear Features

- Rivers
- Creeks and streams
- Shorelines
- Vegetation transitions, forest to grass, etc.

## Handrails

- Linear features along your route of travel that you can see and follow.





## When You Hike on Trail...

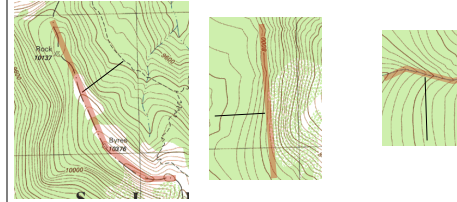
- You are using a network of handrails.
- You can make that network a whole lot bigger, when you learn to use terrain features as handrails.

## Options when you don't have a handrail

- Hike towards an object you can see.
- Hike along a compass bearing or in a general direction.
- Hike along a contour.
  - Without some sort of "aid" you will likely walk in an arc, which will eventually turn into a large circle.

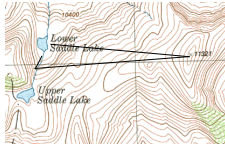
## Catching Features

- Linear features perpendicular to your direction of travel that you can identify.
- Use them to signal a course change point.



## Deliberate Course Offset

- Aiming to one side or the other of your goal positioned along a catching feature.
- Then you know which way to turn when you reach your catching feature.



Plan on errors of...

- ±5° (±100m for every 1km) casual travel
- ±2° (±40m for every 1km) careful travel

## Options when you don't have a good catching feature.

- Use time to estimate distance.
- Count paces to estimate distance.
- Use an altimeter and select a "catching elevation."
- Use a bearing to a distant object.
- Use the visual alignment of two objects.

## Use timing for distance

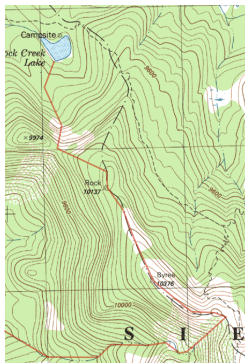
- It's best if you can establish your speed in the field under the current conditions.
  - Time how long it takes to travel a kilometer.
- Use 15-20 min/km plus 2min per 40 ft. elevation gain, until you have better measurements.

## Attack Point

- Something easy to find, nearby something hard to find.
- Easy navigation to the attack point, detailed navigation from there.

## Bailout Features

- Is there a general direction of travel that will eventually lead to "safety"
  - Roads, Shorelines, City Limits
- "Go West and downhill and you will eventually reach State Hwy. 1"



### Sharktooth Peak Bailout Possibilities



6 miles

### Route finding in challenging conditions is harder

- Darkness, Fog, Snow, Whiteout, etc...
  - We can't see the hazards.
  - We don't feel "comfortably on route" because we may not be able to see our checkpoints and handrails.
  - We're not sure when we'll recognize our catching features or our course change points. We're afraid we'll miss them.

### What to do...

- Use very distinct handrails
  - Large terrain breaks
  - Roads and well defined trails
- Select "hugely obvious" catching features that are perpendicular to your direction of travel.
- Plan for larger navigational errors.

### What to do...

- Use your GPS
  - Make waypoints for decision points were you change from one route of travel to another
  - On long legs, make "on route" waypoints to reinforce your route confidence.

Partner up and try planning a virtual hike on the Sharktooth Peak map using what we just discussed

It's already been a long hard day of cross country hiking. You are tired and a bit damp. It's 2pm on a Sunday in October. You have an important meeting at work tomorrow, so you need to be back to the trailhead at Lake Edison before dark. (6pm ish) Then you have a long late drive back to the Bay Area. The first snow of the season has been falling for the last several hours and there is about 4 inches on the ground. Visibility is poor, maybe a kilometer or less.

Plan your hike back to Lake Thomas Edison  
 You have a map and a compass, but no GPS.  
 Plan short course legs of 1km or less.  
 Avoid dangerous terrain.  
 Confidence building checkpoints are good.  
 Use terrain breaks as handrails and catching features.  
 Don't count on being able to find roads and trails under the snow.

Will you make it back before dark?



### Low Visibility Route Finding Exercise

- Plan and follow a route to at least three campus landmarks.
- Use the bag to simulate low visibility.
  - Checkpoints
  - Course Change Points
  - Handrails
  - Catching Features
  - Attack Points



### Low Visibility Route Finding Exercise

- Plan Low Visibility Route & Follow it to 3 Locations
- Back to the classroom by...

