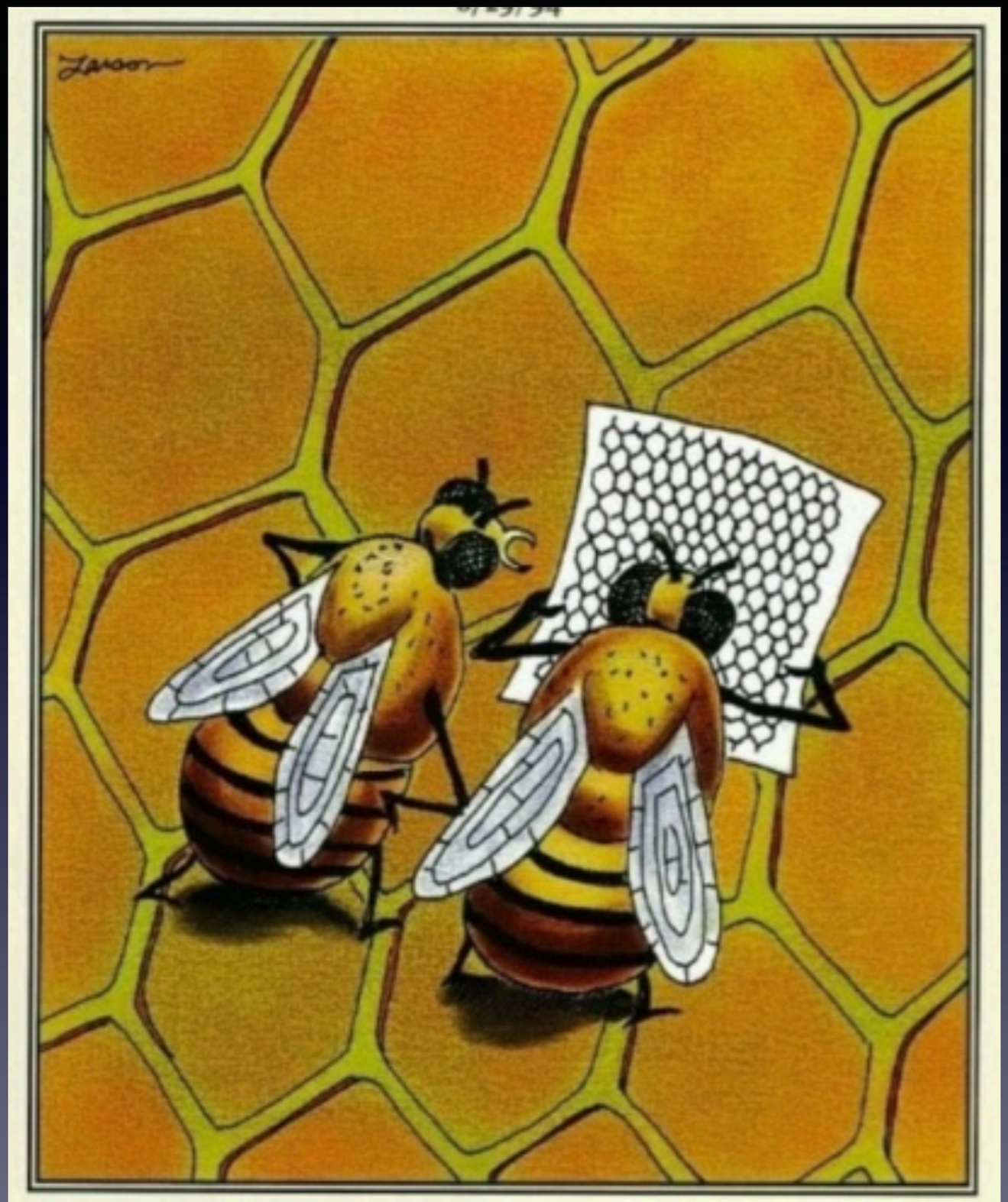
Staying Found in Modern Times - Smartphone GPS

John Godino



"Face it, Fred—you're lost."

- No student left behind! If you have a question, ask.
- **Class goal:** Get comfortable with the app so you can practice on your own.
- **Disclaimer 1:** I'm not an iPhone expert, Gaia employee or GPS engineer, but I know enough to get you started.
- **Disclaimer 2**: Practice with Gaia in town BEFORE you rely on it in the woods!

General Program

1. Overview of GPS
2. In depth with Gaia GPS app
3. Classroom exercises
4. Field exercises

(please don't use your phone until part three :-)

Lost in the Gorge

- Could this easily happen to anyone?
- What are some things she did right / wrong?

Lost in the Gorge

Good

- Stayed put
- Had phone and cell coverage
- Knew how to transmit GPS coordinates to 911
- Good clothing
- Physically fit, experienced

Not so good

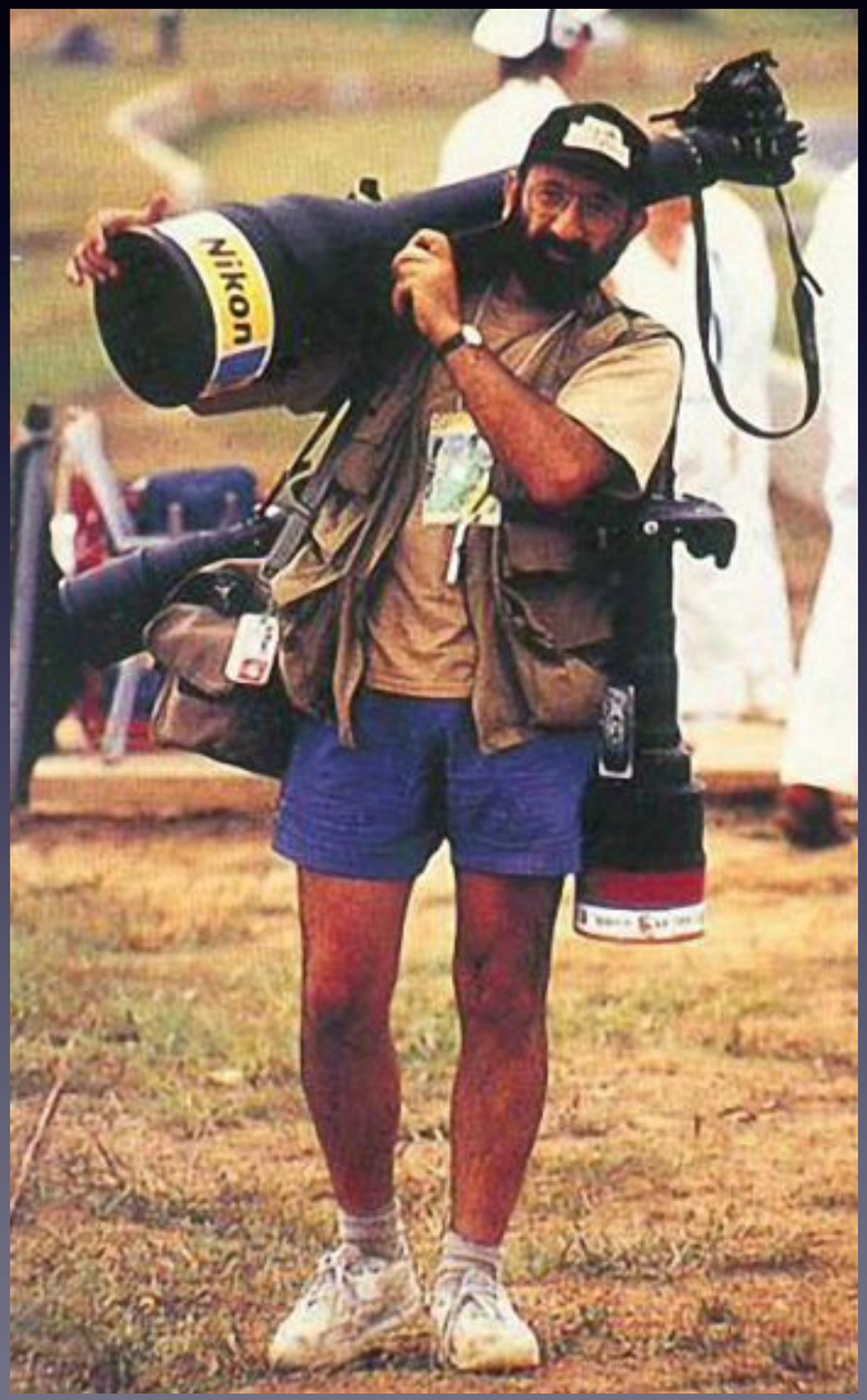
- Split up team
- Listening to audio book
- Took an off-trail “shortcut”
- Dead phone battery, no backup
- No headlamp or fire starter

Hmmm, should we keep going?

EVERY climber or hiker with a smart phone should have a GPS app (or at least know how to get their coordinates.)

Use these Navigation Tools <u>before</u> your phone.

Sort of like cameras . . .



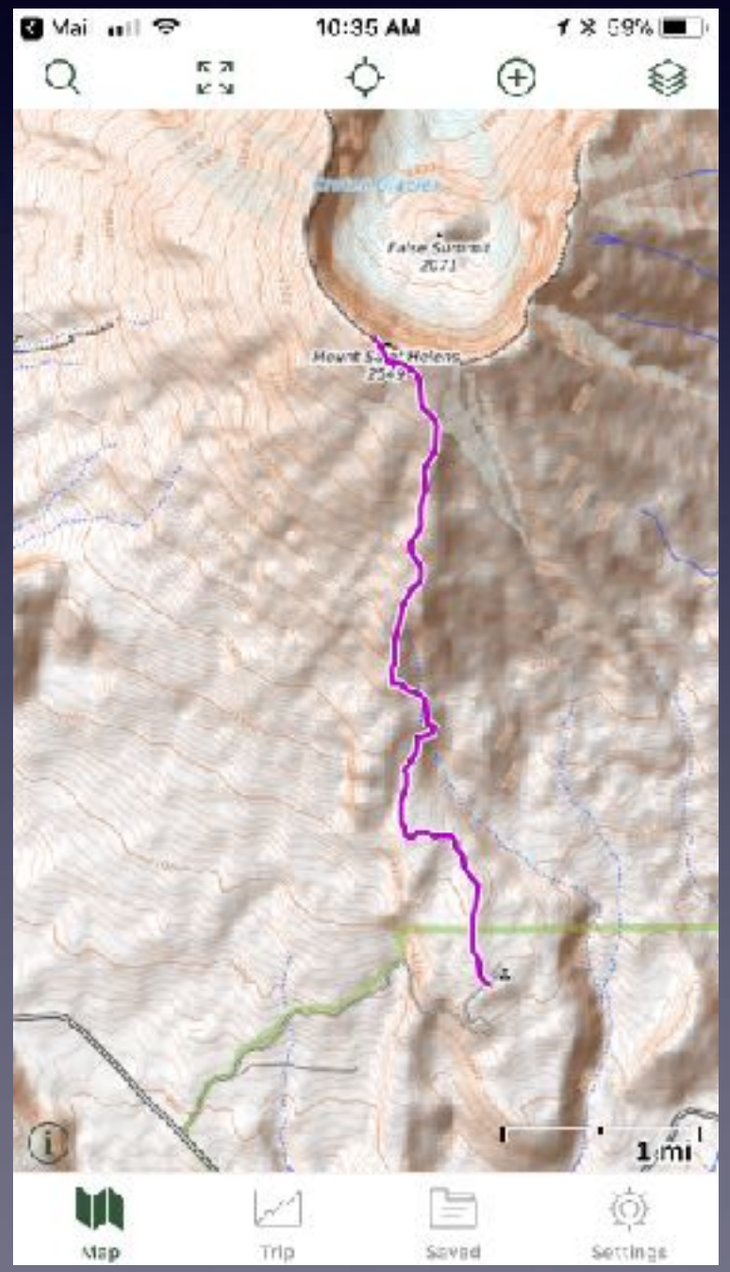
- Pros will always carry heavy, expensive, specialized photo gear.
- For the rest of us, a smartphone works fine.

GPS downsides . . .

- They can be damaged
- Not a substitute for a printed map
- Not good in extreme temperatures
- Battery dependent
- Need a good view of the sky to receive satellite signals

Why use a smartphone for wilderness GPS?

- Easy, intuitive interface
- Better screen resolution
- Much better selection and quality of map sources
- Superior price, $10 vs $300+



GPS: biggest leap in navigation technology in 1,000 years.

Compass (China, AD1000)

GPS (USA, 1970s)

Progression of GPS

Secret military technology

Limited commercial use (ships, airplanes)

Limited civilian use (surveying, cartography)

Now, used by <u>every</u> smartphone dozens of times a day!

Often in the background on your phone, and you don't even know it . . .

History of GPS

- 1973: GPS started by USA, Dept. of Defense
- 1978: First satellite placed in orbit
- 1983: Korean Air shot down, starting civilian GPS availability worldwide with Selective Availability. *Accuracy about 300 feet*
- 1994: 24th satellite launched, system in full operation
- 2000: Selective Availability turned off. *Accuracy about 50 feet*
- 2003: *Accuracy about 10 feet*
- 2008 to present: EU, Russia (GLONASS) China and India build(ing) systems

iPhones use both the US system and the Russian satellite system for a slightly faster satellite lock.

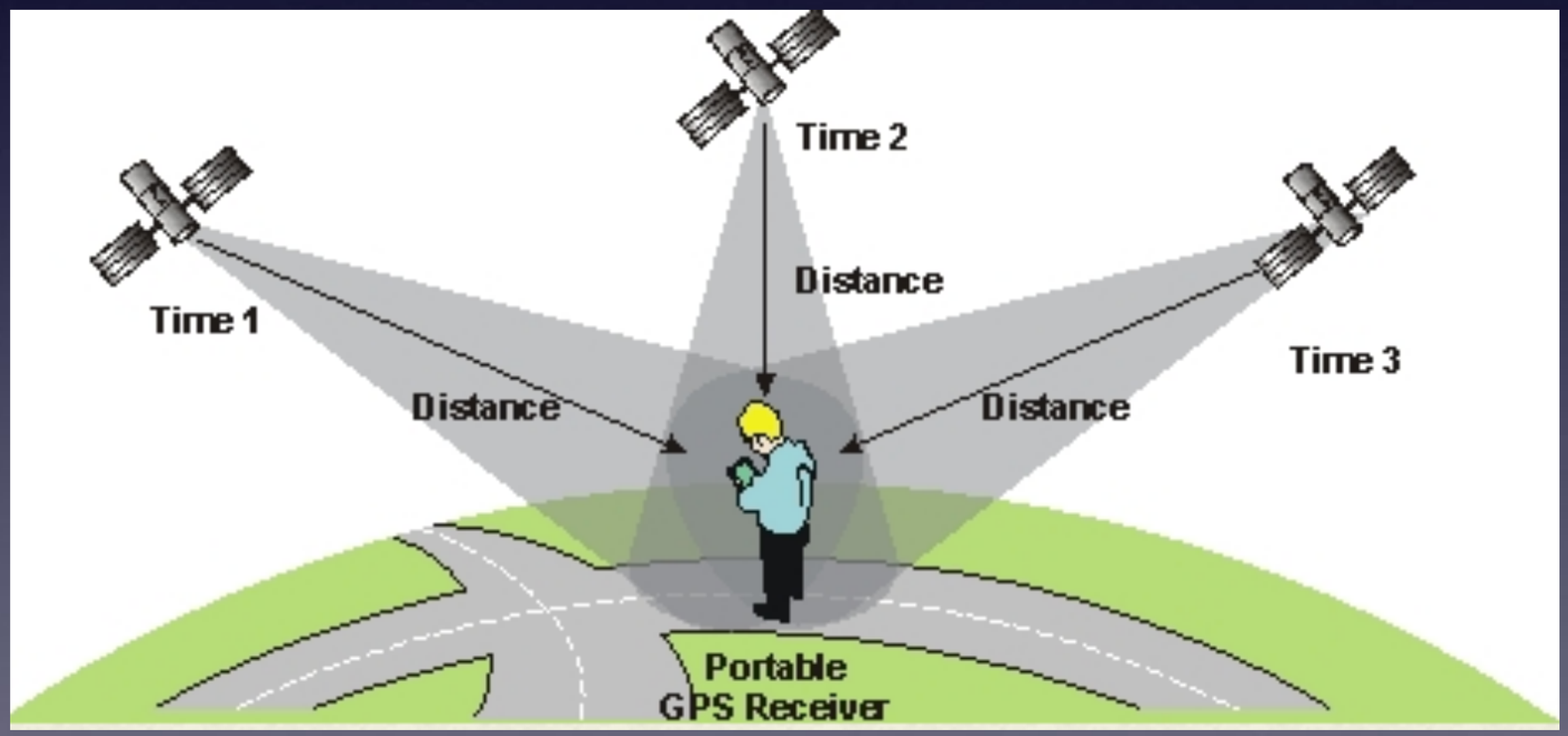
Your tax dollars at work!

$**12 billion** to put 24 satellites into orbit.

$**2 million** per day operating costs.

What other US program benefits the entire world as much as GPS?

How it works: Triangulation



Your GPS does not transmit.

Receiver only

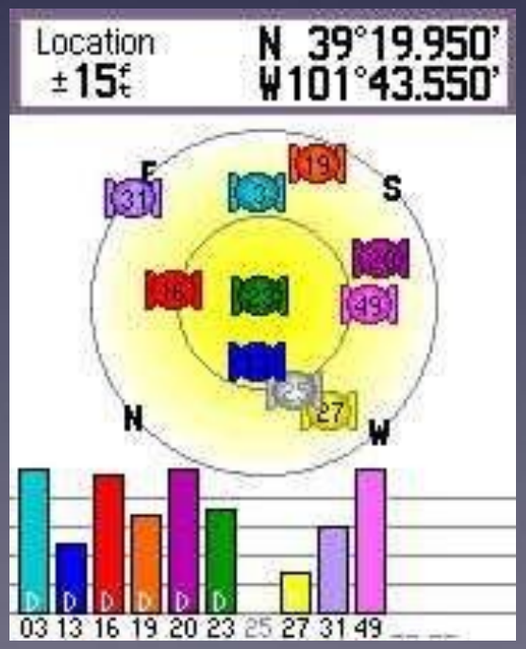
Receives, then transmits location with more software

Expedition option: **Garmin inReach**

- Low end GPS and a low end sat phone
- Can send texts / SOS messages via satellite
- **Co$t**: about $400 for the unit, then subscription fees of about $150 per year, yikes!

How accurate is GPS?

Civilian GPS:
+/-**15 feet.**



$urveying GPS:
sub-centimeter!

Satellite Signal display

- Gaia for Android has this, iPhone does not.

- Shows you the satellites your phone is connecting with, and their location.

- Can be helpful to move you to a new location to possibly get a better signal.

Garmin vs. smart phone

Garmin

iPhone

Phone GPS works without cell coverage

- Wifi and cell coverage helps with faster position lock, but they are not required.

- But, if no wifi or cell coverage, you must download maps first! *(More on that later)*

Getting a signal - be patient

In town, your phone works with cell towers, last known location, Wifi, etc to fix your location almost instantly.

But . . . beyond cell coverage, in a new area, it take up to 10 minutes to get a location fix.

If you are lost, this can can feel like a <u>really</u> long time!

New phones = more satellites

The iPhone 8 and X can receive signals from 3 major satellite constellations:

- **GPS** *(USA)*
- **GLONASS** (Russia)
- **Galileo** *(European Union)*

This means about 60 satellites rather than 24, so we get a faster and more accurate signal. *(BeiDou, Chinese system, will be added after 2020.)*

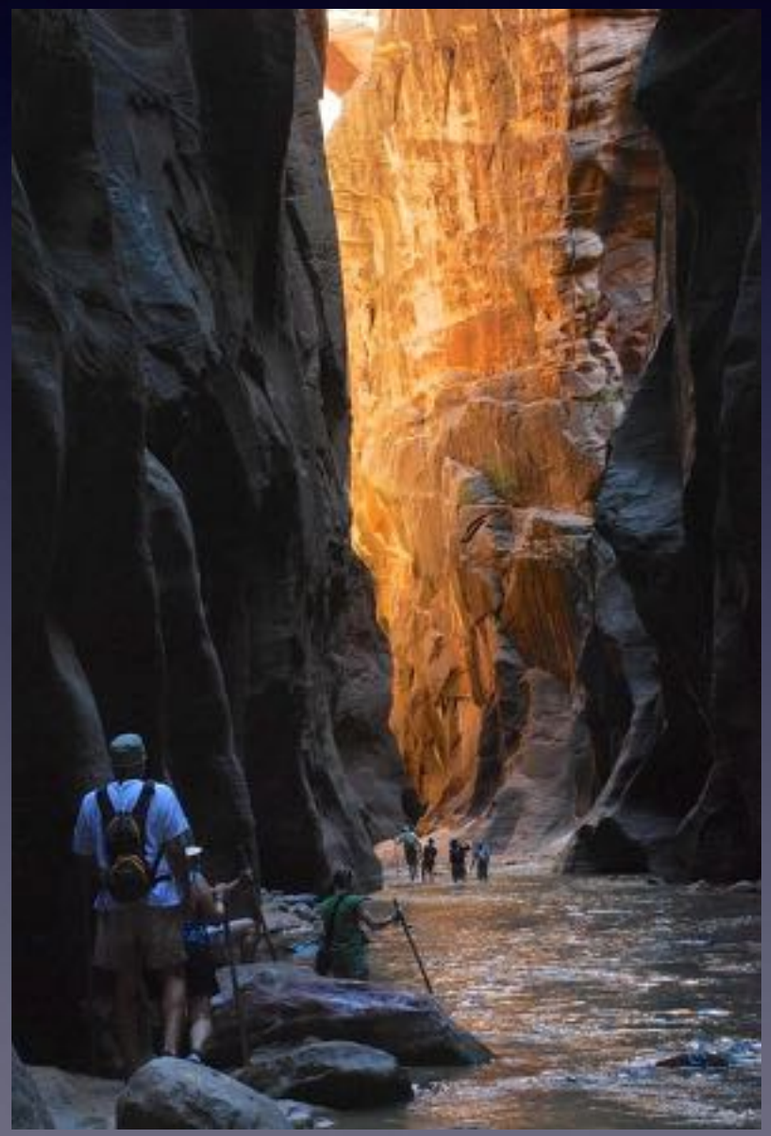
What about iPads?

A “regular” iPad does **not** have a GPS chip,
so it can only show your location with a WiFi connection.
The more $$$ 3G iPads have a GPS chip.

iPad solution: external GPS receiver

An external GPS receiver can be connected via Bluetooth
to a “regular” iPad, giving full GPS capabilities.
(example: Bad Elf, about $130)

GPS limitations



Definitions - .GPX file

GPX file: a universal file format for sharing geographic data.

Tracks and waypoints you download from the web are usually in this format.

```
</trkpt>
<trkpt lat="46.15094150" lon="-122.185487">
  <ele>1203.0000</ele>
  <time>2010-01-01T00:03:07Z</time>
</trkpt>
```

text file with:

1 - **latitude longitude** coordinate

2 - **elevation**

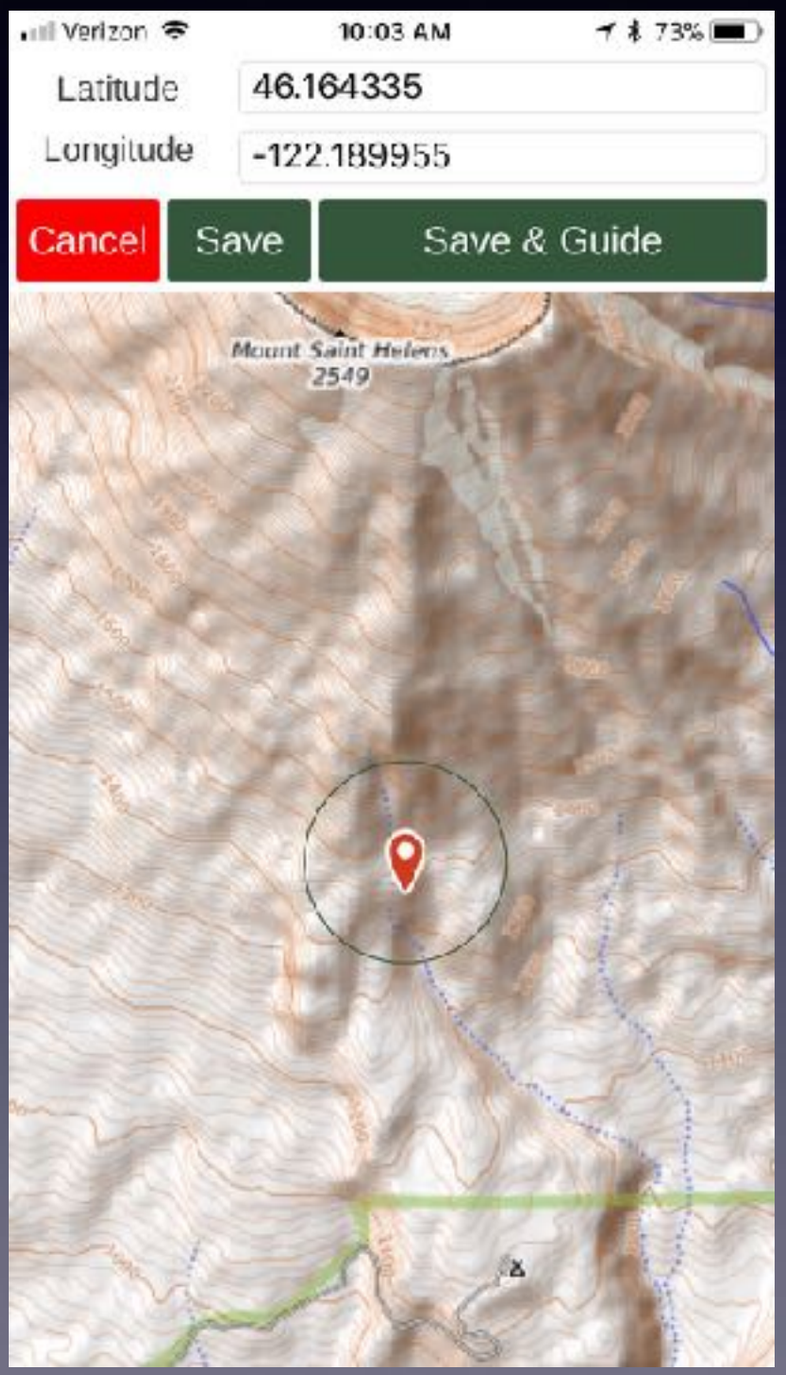
3 - **time signal** from satellite

Definitions - Waypoint

A **waypoint** is a single point location (car, trailhead, campsite, favorite huckleberry patch.)

It can be placed at your current location, or anywhere on your map screen.

Best practice: Always mark your starting point (car, trailhead . . .)

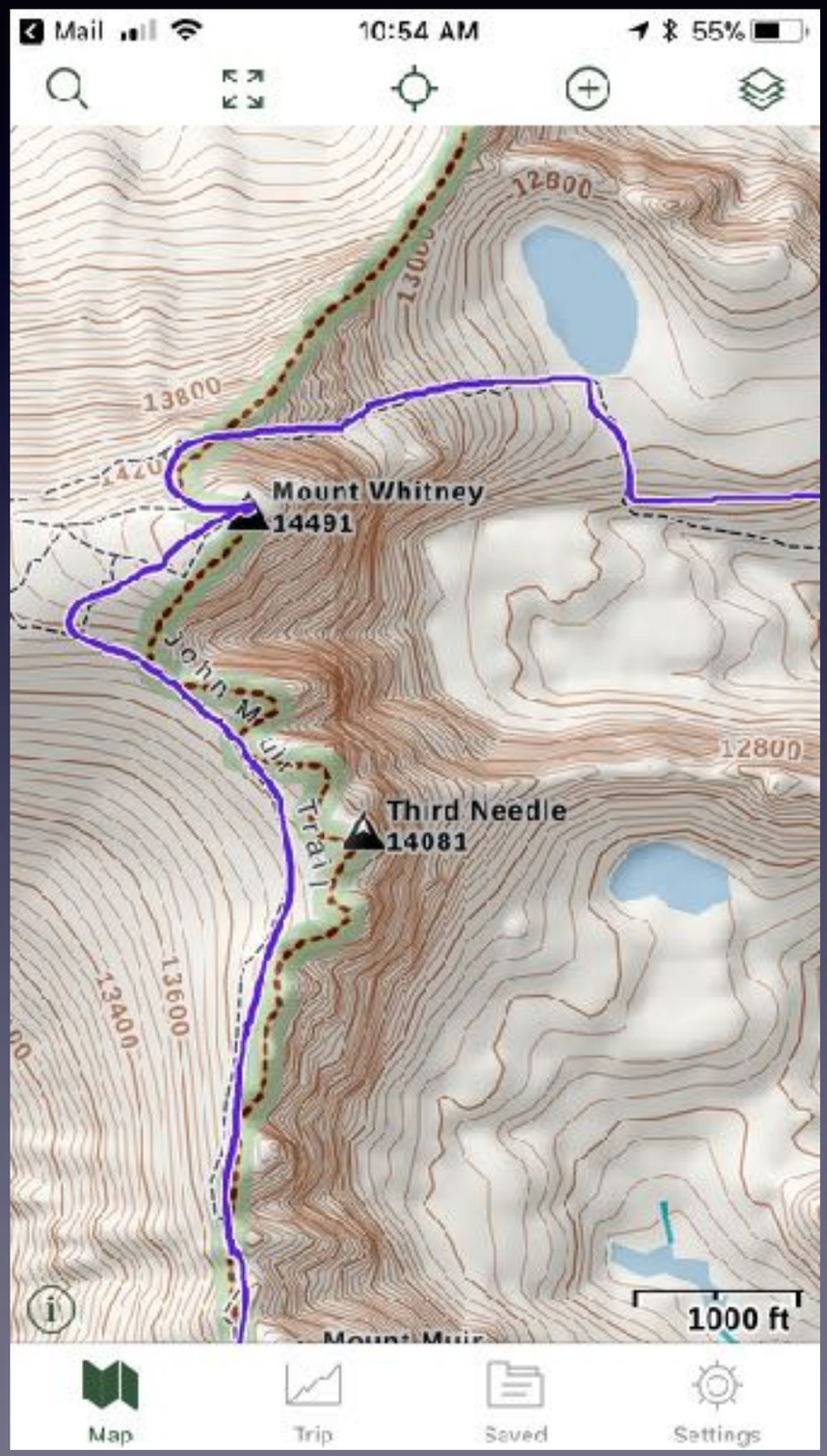


Definitions - Route

- A series of points meant to be followed in order.
- Can be made on your phone in the field, if you know where you are going.
- New feature on Gaia routes- “snap to trail or road” is VERY useful!

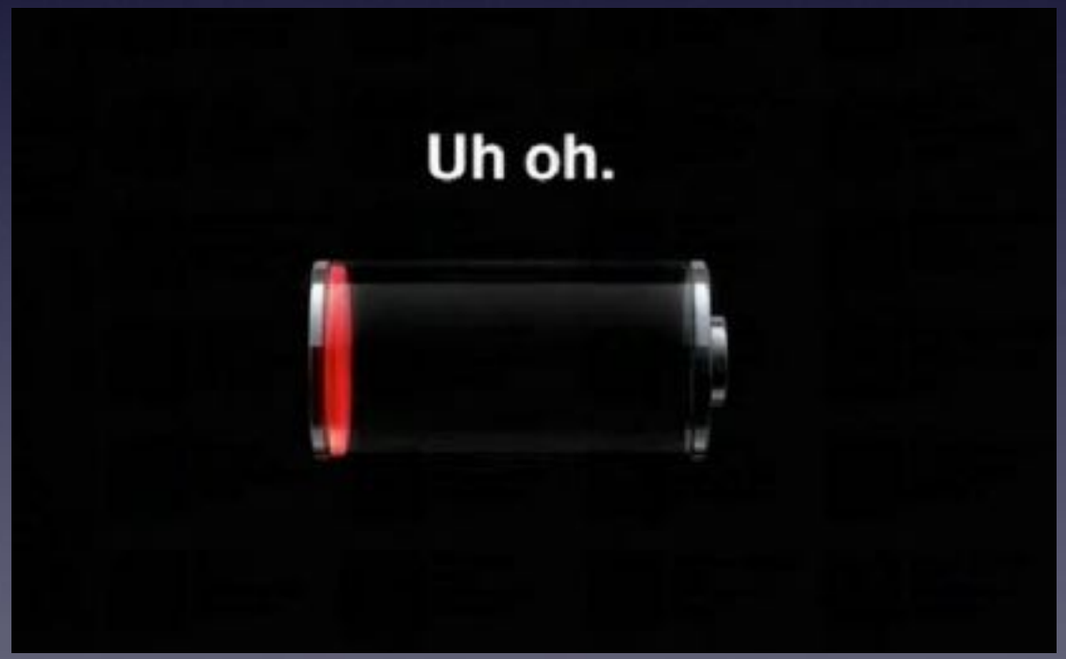
Definitions - Track

- A continuous “breadcrumb trail” that can be followed exactly.
- Recorded directly by you, downloaded from the web, or drawn on mapping software.



Track recording for a multi day trip can be tough on your battery!

=



If you record tracks a lot, get a “real” GPS.

Always name maps, tracks and waypoints

The smartphone keyboard is great, use it!

Naming waypoints:

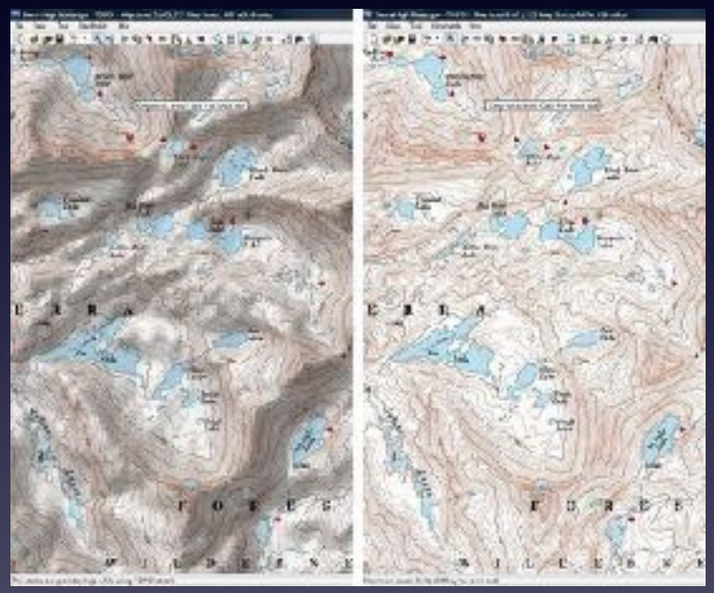
1. Choose a 2 or 3 letter code for your hike
2. Then add a number telling you what order you'll pass them
3. Finally, a short description of the actual point

Example - Mt Hood climb

mh 1 tline
mh 2 silcox
mh 3 top palmer
mh 4 crater rock
mh 5 summit

The Big Three

GPSies.com find tracks, save for later use



Caltopo.com print track on map

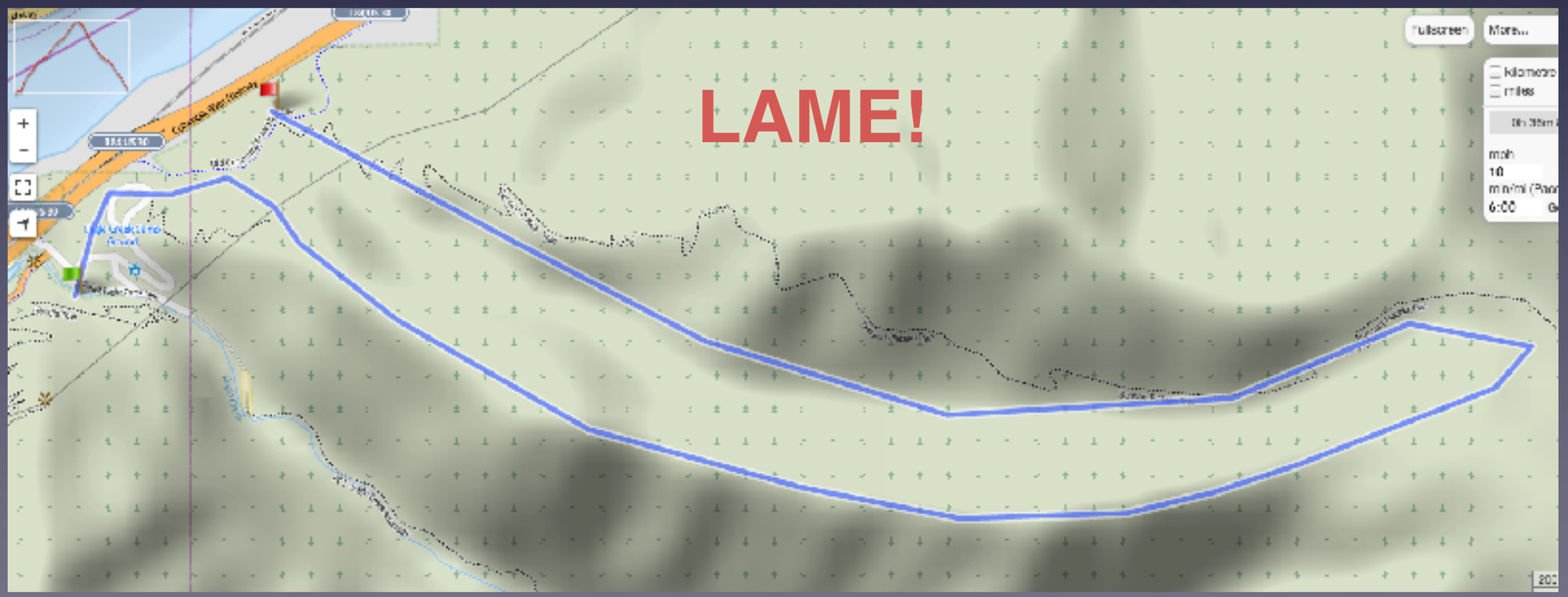
GaiaGPS load track and download maps

50+ maps and tracks for climbers on mazamas.org

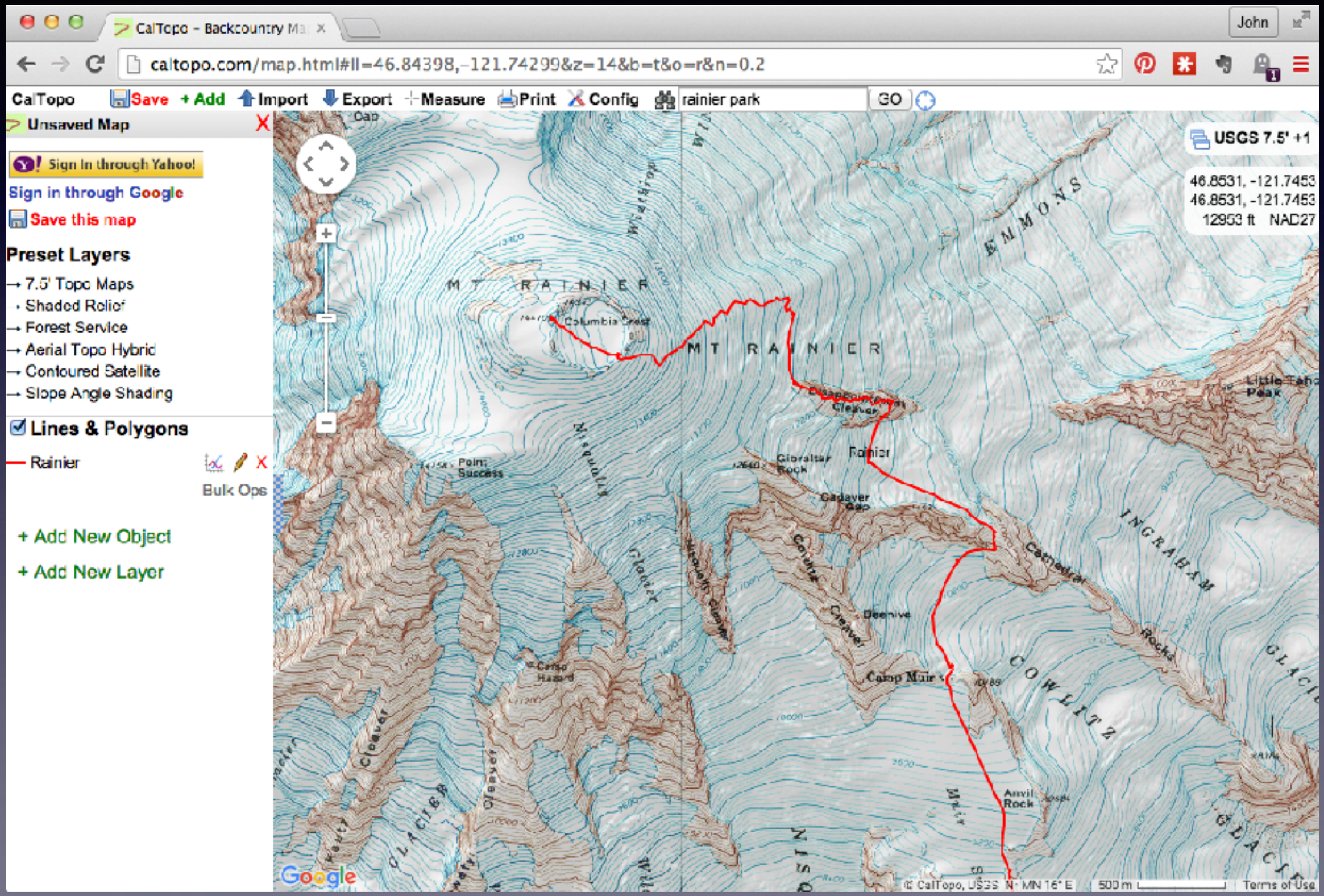
- www.mazamas.org >> Resources >> Maps for Climbing and Hiking
- PDF maps with route drawn in
- GPX track files ready to load to your phone of GPS receiver
- KML files to view track in Google Earth

GPSies.com - hundreds of climb/hike GPS tracks in the NW

Check downloaded tracks

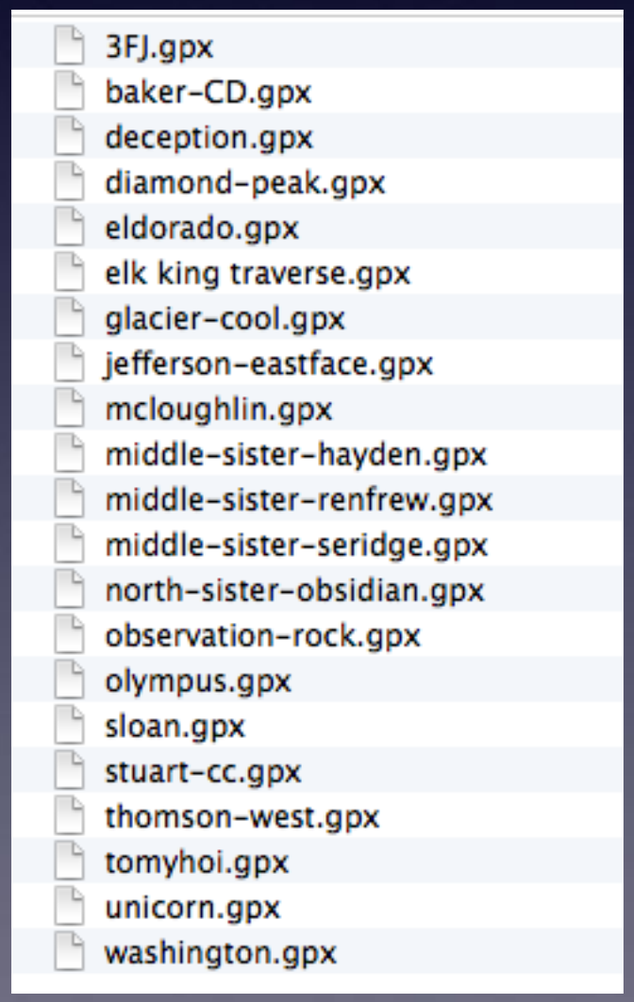


Caltopo.com - Superb web based, free topo mapping software



Track management

Save to Cloud storage for sharing and access away from home



Housekeeping: Remove unused tracks and waypoints from your GPS

- Save them on your computer or the cloud (eg, Dropbox or Google Drive.)

- Make an account at Gaia, and sync your data directly.

Coordinate Systems

Basic concept: **an X-Y coordinate system gives the precise "street address" of anywhere on earth.**

Two main types of coordinates are used in GPS:

1. **Latitude / Longitude**
2. **"UTM"**, or Universal Transverse Mercator"

Do I really need to know this stuff? (Yes, a little.)

“I need help and I’m here!”

The single most important use of coordinate systems:

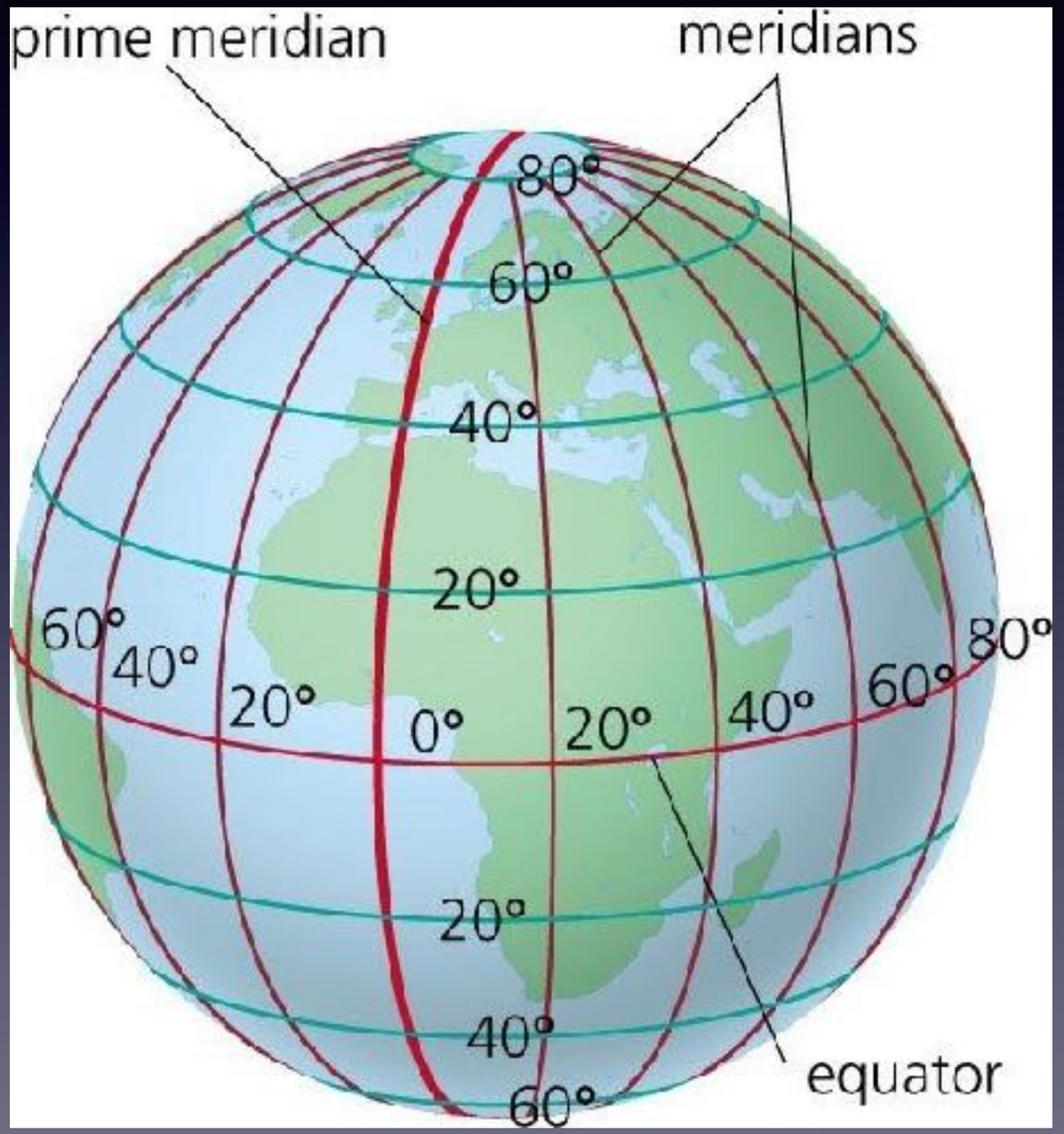
To tell 911 your exact location if you need help.

Tip: The free compass app built into your iPhone displays your exact position and elevation.

Must turn on “Location Services” in Settings for the compass.

Latitude Longitude

- Oldest and most widely used coordinate system
- 0° longitude (“X” coordinate”) starts at the Prime Meridian. Divides Earth into 360 degrees of longitude.
- 0° latitude (“Y” coordinate) starts at the Equator. 90 degrees of latitude to each Pole.



Like a clock . . .

- Like a clock, a **degree** (about 70 miles) is divided by 60 to get **minutes**, and by 60 again to get **seconds**.
- Mazamas lat long coordinates (precise to about 100 sq feet):

45° 31’ 8”, -122° 37’ 5”

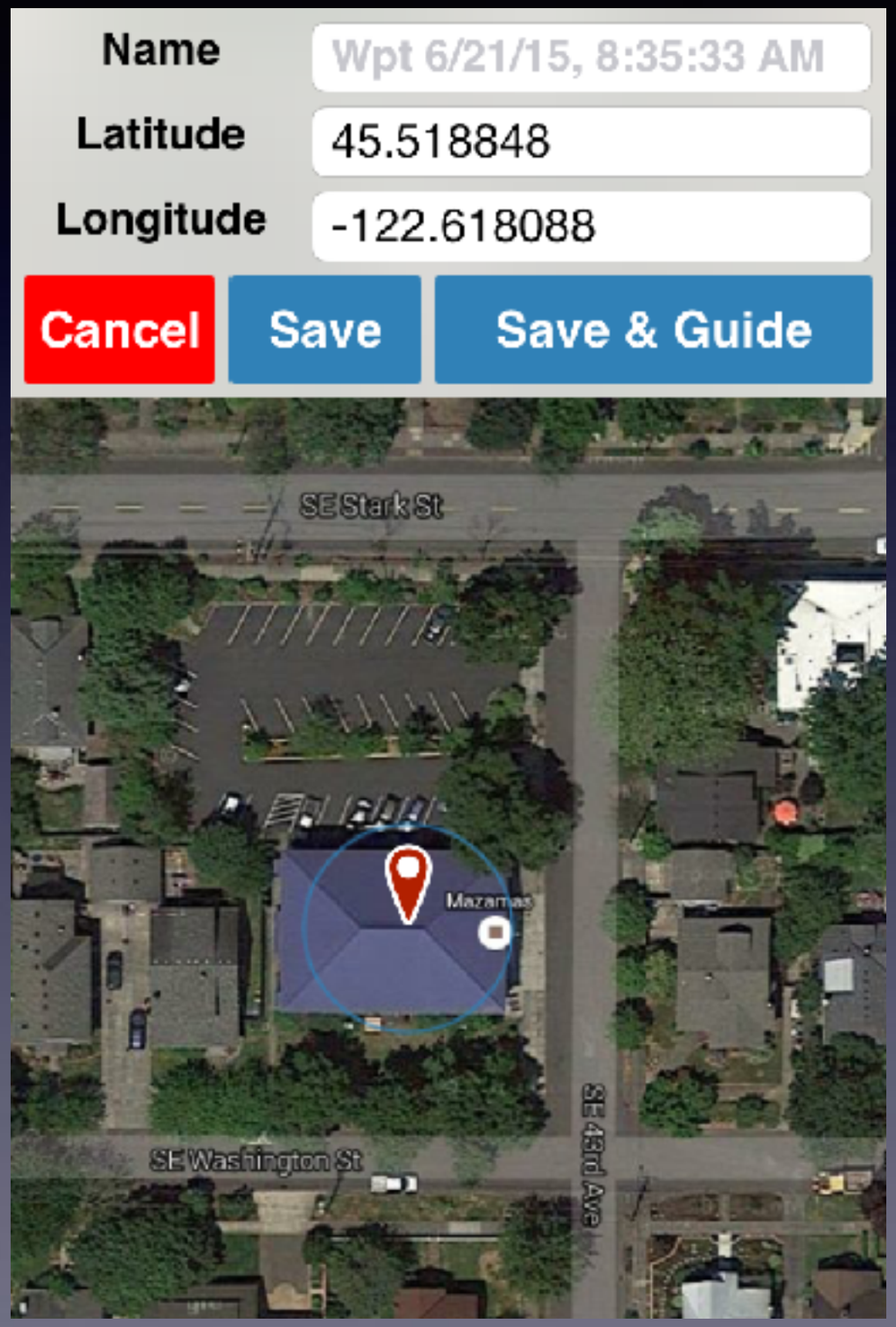
Decimal degrees

- The latitude longitude position calculated by a GPS receiver is a more precise format, called **decimal degrees**.

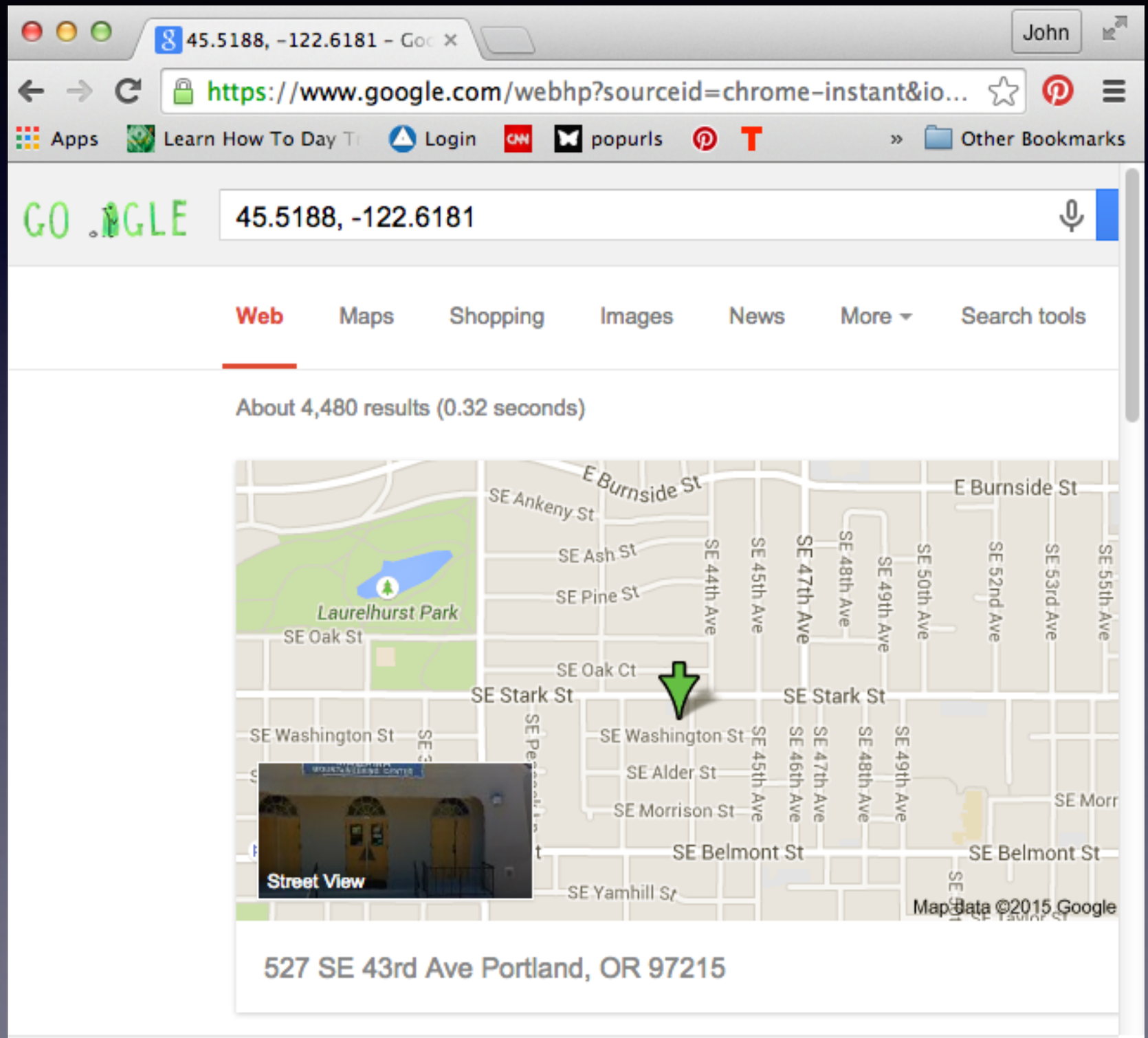
- (911 likes coordinates in this format too!)

```
</trkpt>
<trkpt lat="46.15094150" lon="-122.185487">
  <ele>1203.0000</ele>
  <time>2010-01-01T00:03:07Z</time>
</trkpt>
```

Lat-Long coordinates in Gaia:



Pro tip: Googling lat/long coordinates in decimal degrees gives you a map of that exact spot.
Get coordinates from nGaia GPS or Caltopo.

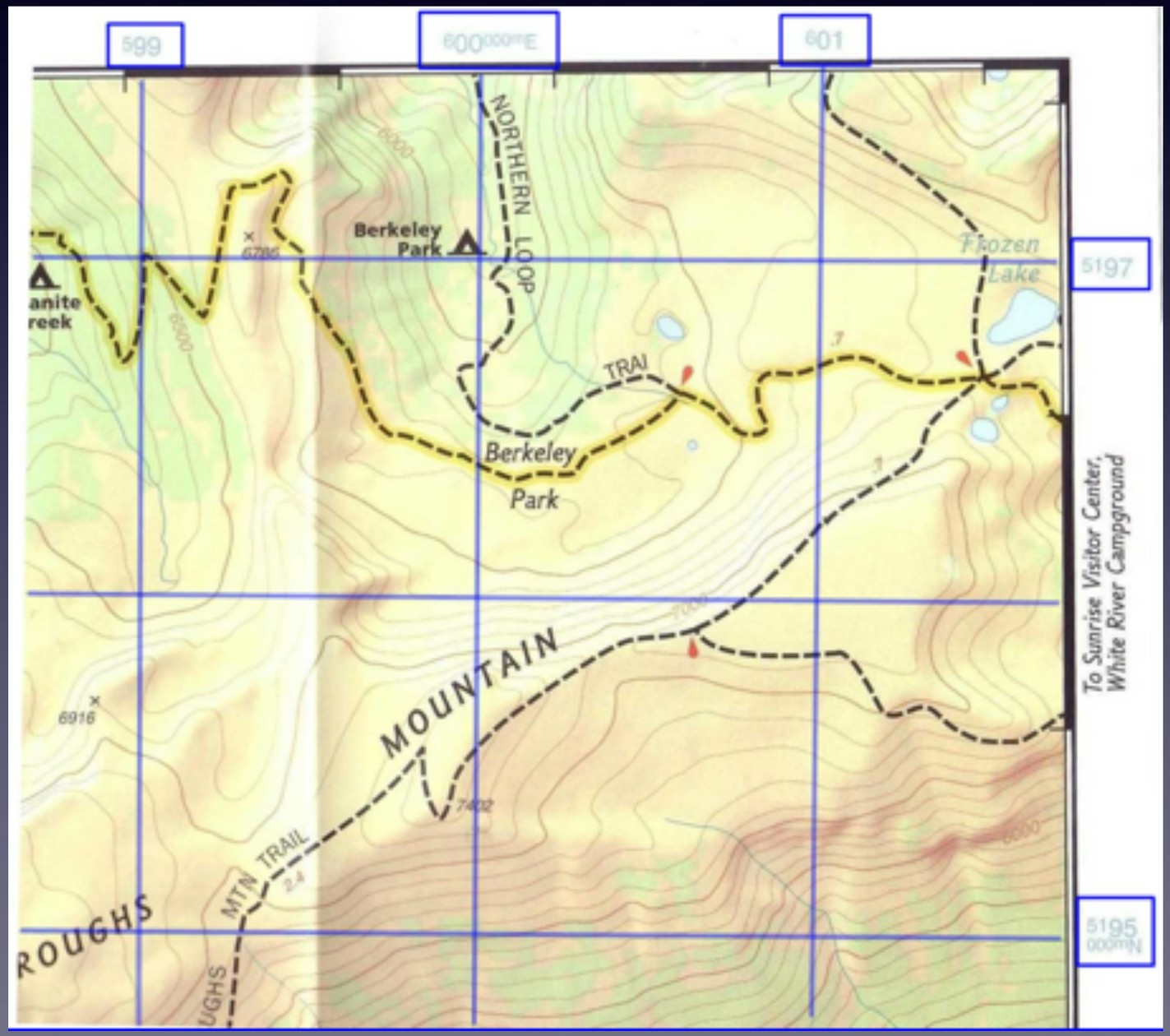


UTM coordinate system

- The metric based UTM system is generally better for land navigation
- Designed by US military in the 1940s
- Can precisely identify your position down to 1 meter anywhere on earth

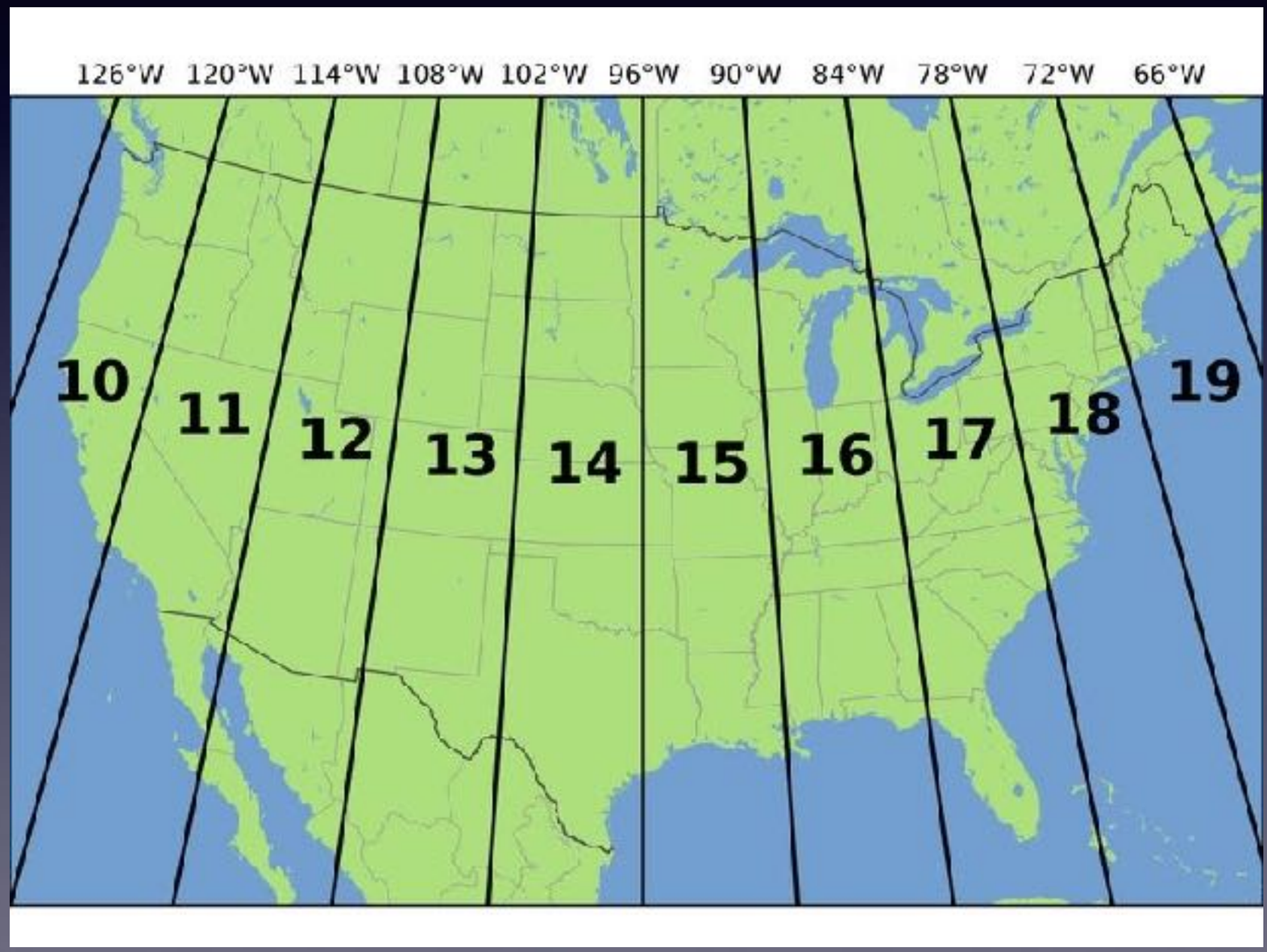
Newer maps often have a UTM grid already printed.

This is typically 1 km.



UTM - Zones

The earth is divided into 60 zones, each 6° of longitude.



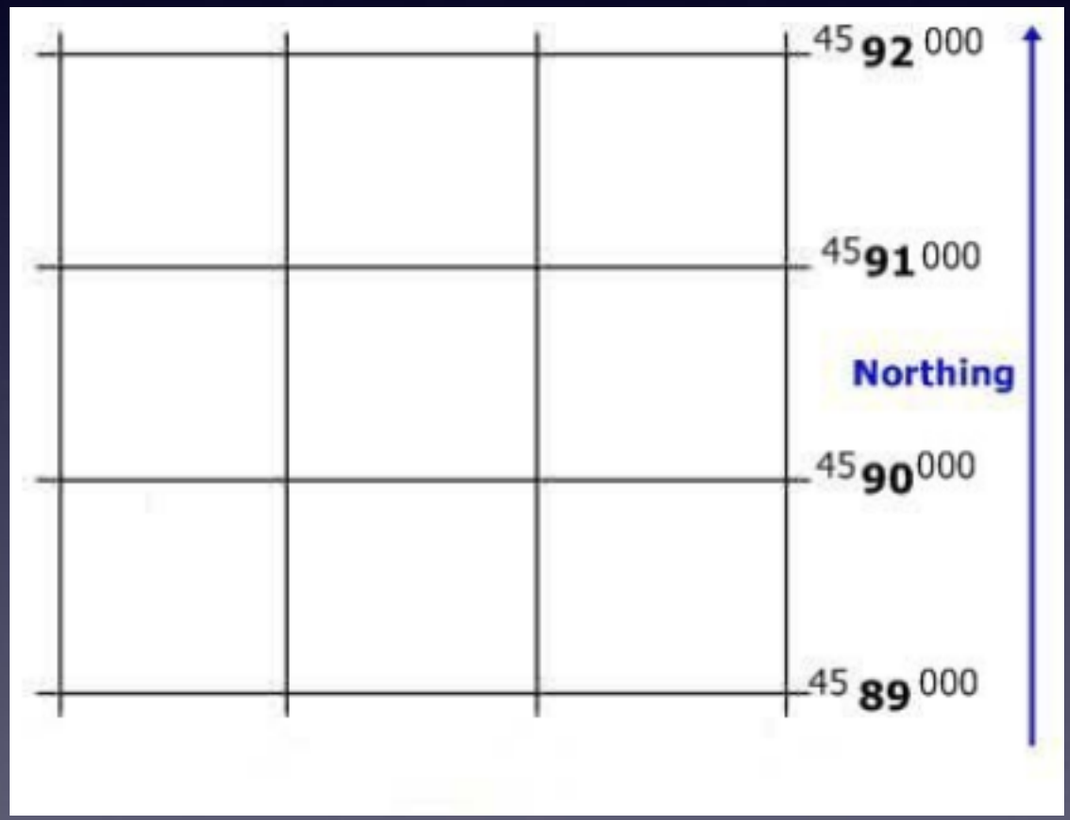
The “X” coordinate - Easting

- The X coordinate of the UTM system is called an **Easting**.

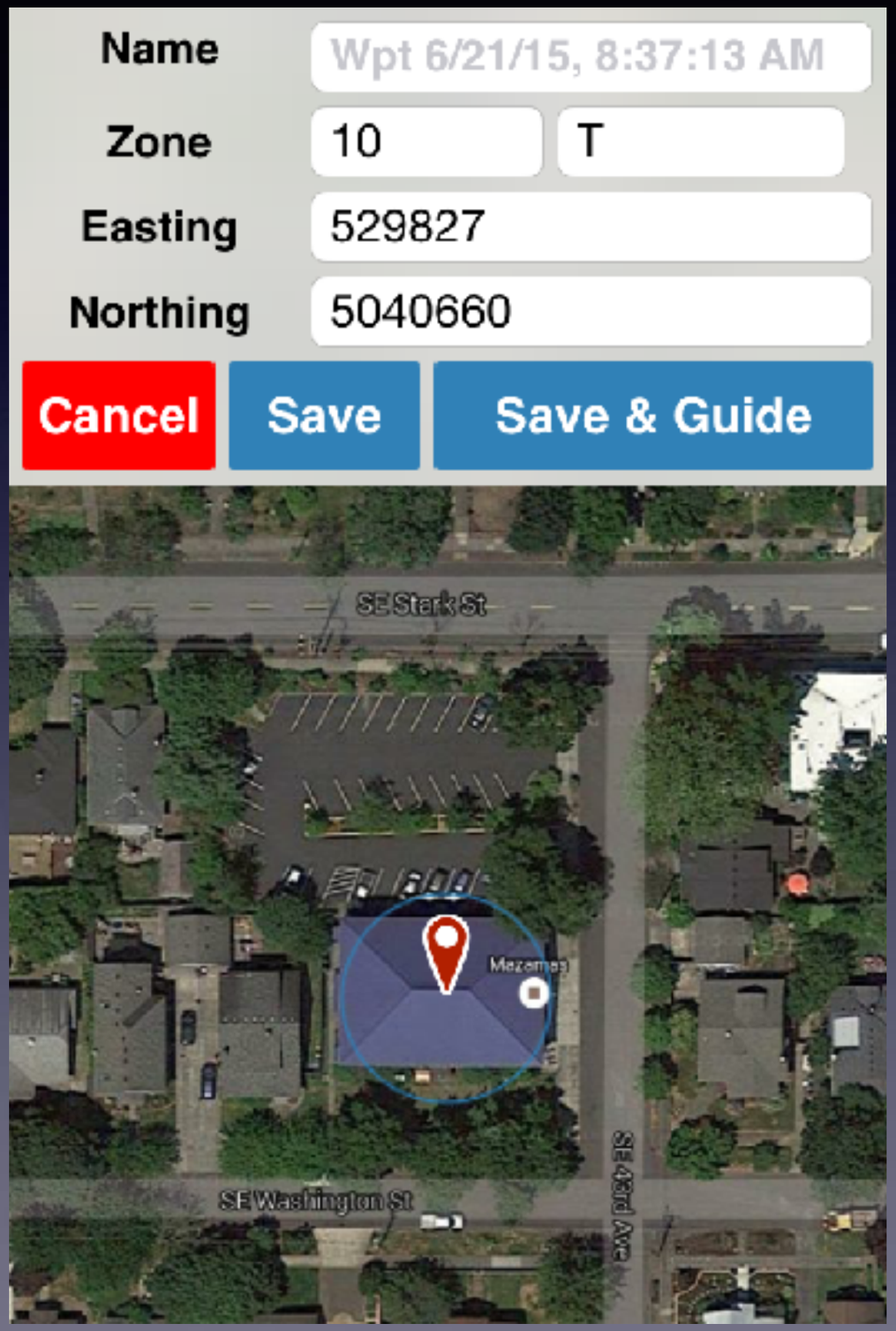
- It's measured in meters east of the zone origin.

The “Y” coordinate - Northing

- The Y coordinate of the UTM system is called a **Northing**.
- It's measured in meters north of the equator.

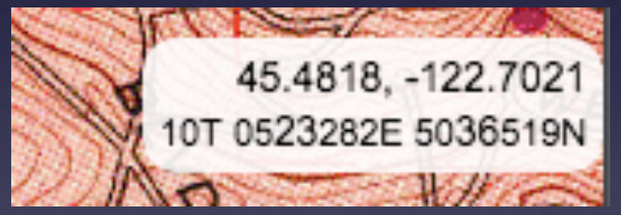


UTM coordinates in Gaia:

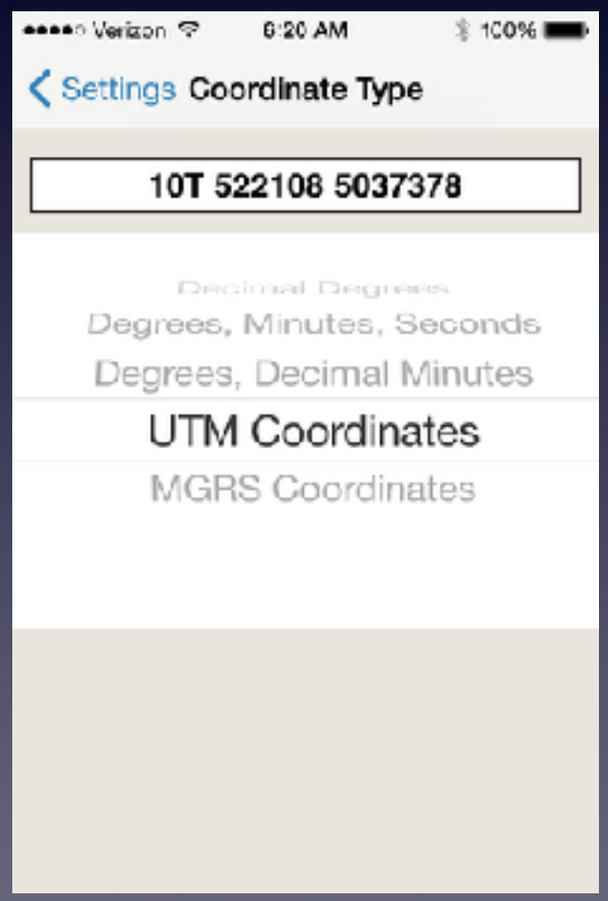


Both coordinate systems are on your phone and almost all mapping software.

In Gaia, change in **Settings > Units > Coordinate Type**

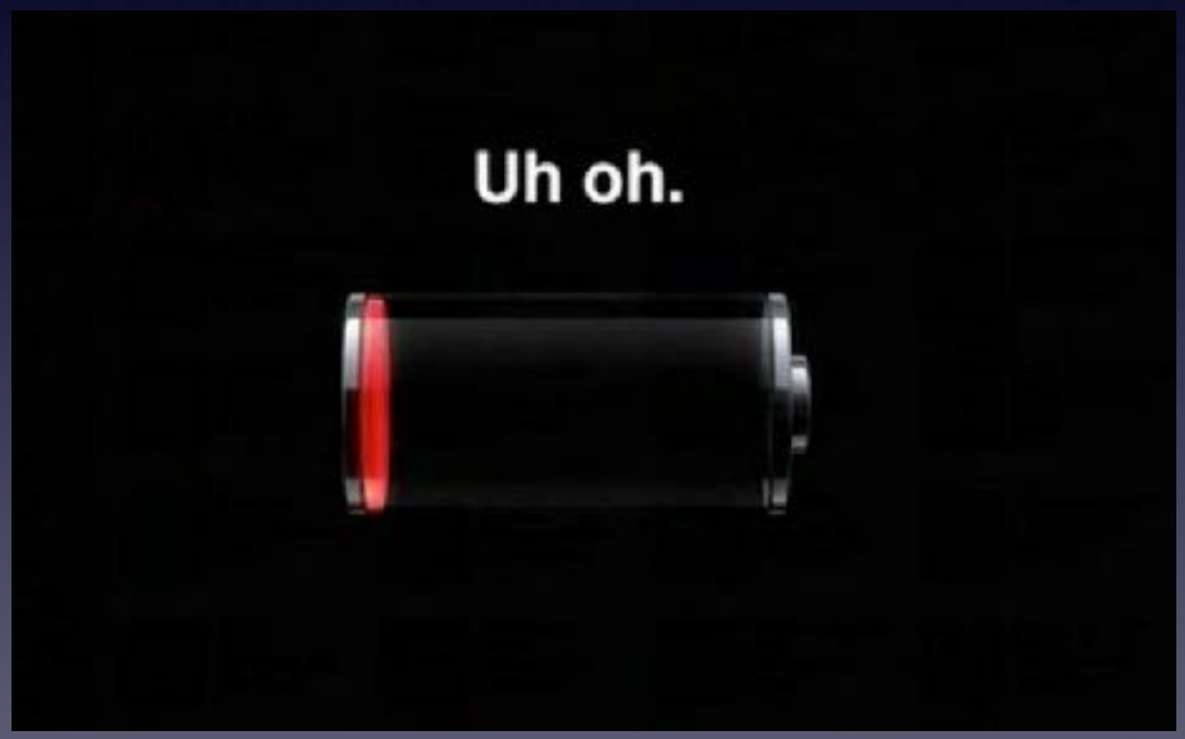


Caltopo



Gaia GPS (Settings)

Smart phone problems



Solutions:

extra battery pack and sturdy case.

The 11th Essential

Anker aux. battery and 4 inch charging cable

(pen shown for scale)

- $20
- 3.5 ounces

Why Battery Drain?

- *“My phone’s on standby in my pocket on a hike, and it’s dead in 3 hours.”*

- GPS is a big power consumer, even with cell coverage.

- When out of cell range (even with no GPS use) your phone is constantly trying to locate cell towers, another battery suck.

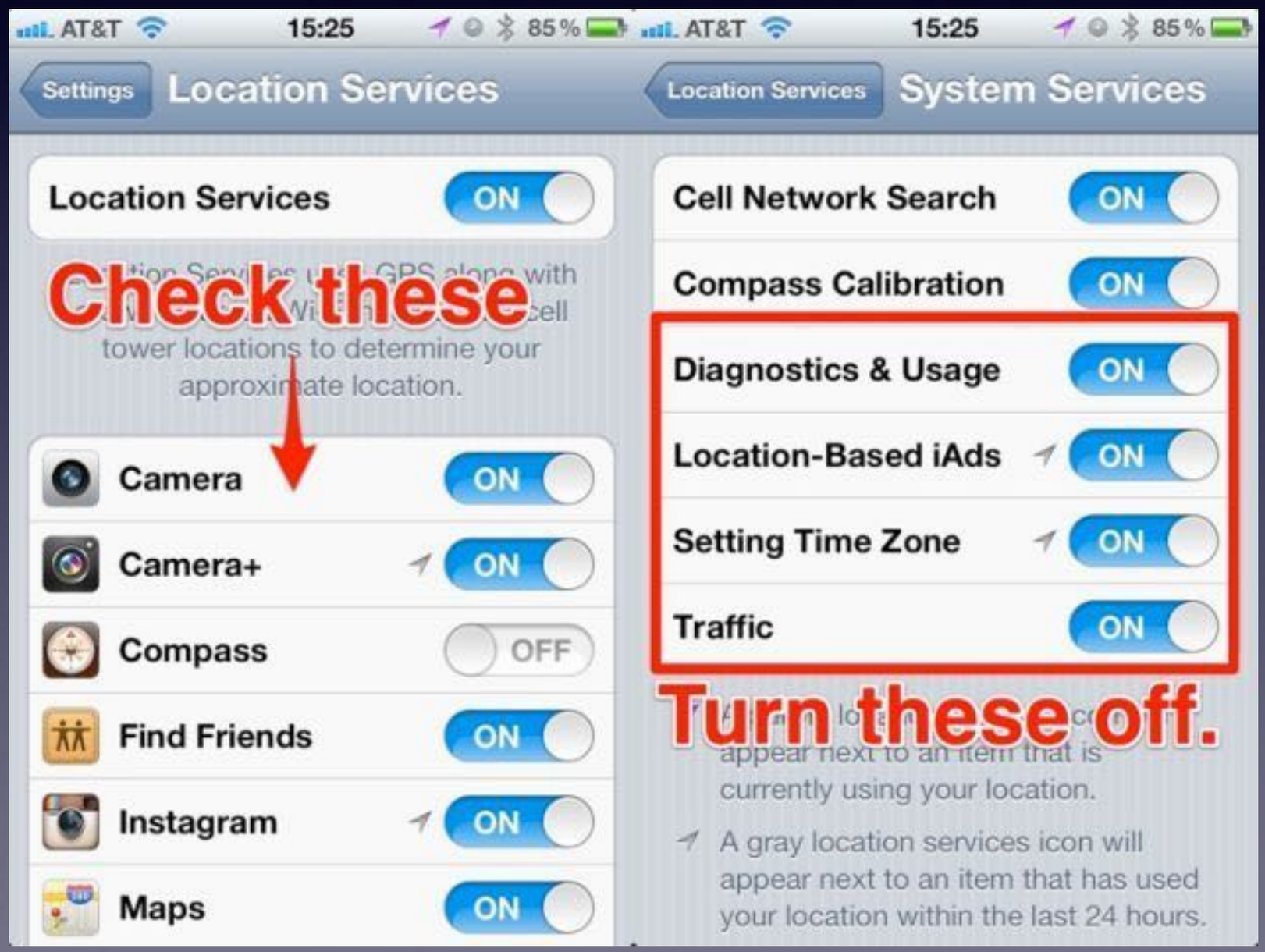
- When you combine BOTH, it’s a huge battery draw.

Solution - Airplane mode

As of spring 2015, iPhone allows GPS use in airplane mode!

Huge improvement in battery life.

See your class handouts for lots more on battery saving settings.

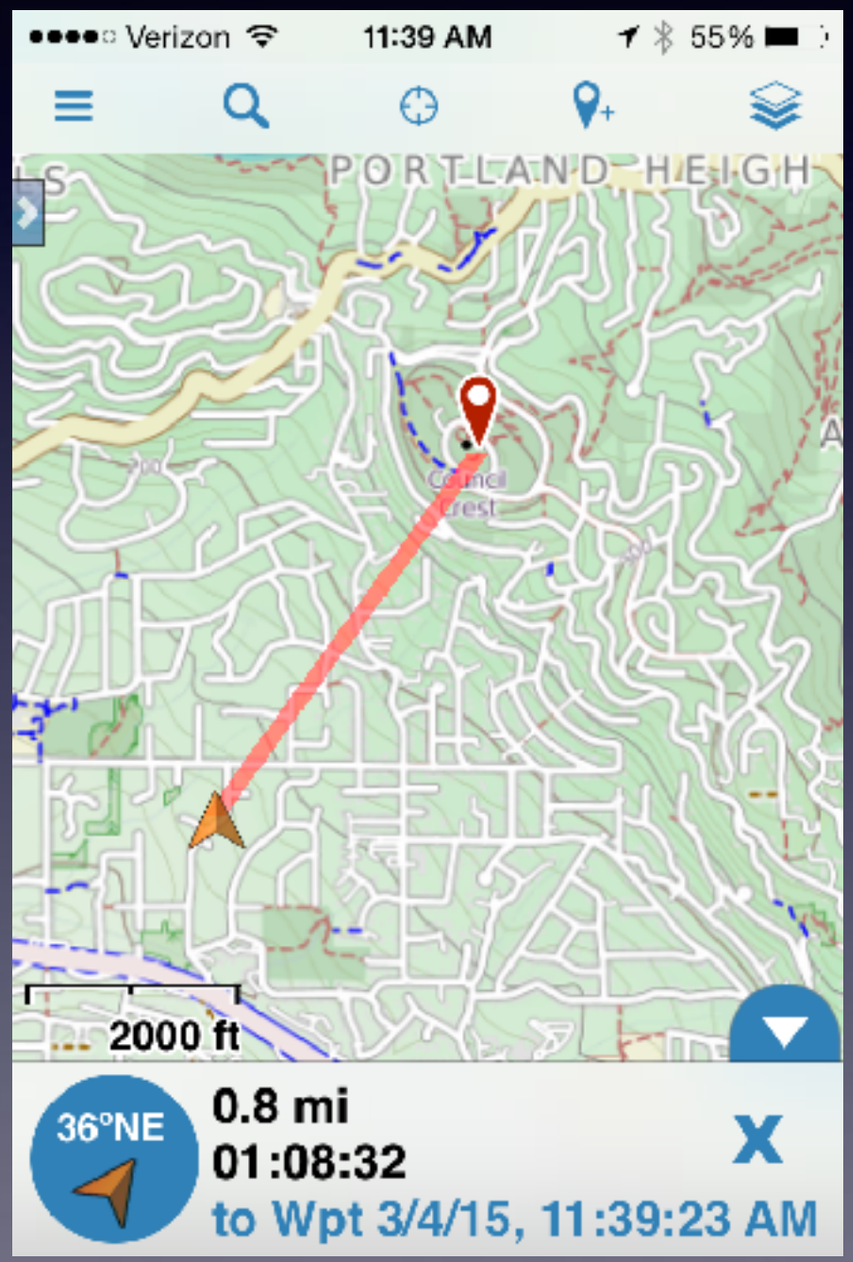


Power saving in Gaia

Turn the screen off if you do not need it!

Best practice to find a waypoint:

1. Tap“Guide Me”
2. Note the distance and bearing
3. Use a compass to follow the bearing, and put your phone back in airplane mode.



Cold and phone batteries

- Batteries are happiest from 62 to 72°.
- A battery is not dead until a it's "warm and dead.'
- Sometimes warming a phone next to your skin can be enough to get a partial charge. (Armpit works well.)
- The battery level indicator is calibrated at a normal temperature. When the battery gets cold it shows a lower percentage then it really has. The phone shuts off as a result and that is why mysteriously it's at 30% when you plug it in.

Gaia GPS

Verizon
10:12 AM
72%
Calgary
San Jose
Los Angeles
Phoenix
Ciudad Juárez
San Antonio
Monterrey
Guadalajara
Ciudad de México
500 mi
Map
Trip
Saved
Settings

Verizon
10:26 AM
68%
Saanich
Victoria
Port Angeles
Marysville
Everett
West Peak
Redmond
Seattle
Bellevue
Bremerton
Renton
Kent
Auburn
Tacoma
South Hill
Lakewood
Olympia
Aberdeen
Mount Rainier
Astoria
Longview
Vancouver
Portland
20 mi
Map
Trip
Saved
Settings

Mail
10:25 AM
69%
MOUNT RAINIER
Columbia Crest
West Crater
East Crater
Disappointment Cleaver
Point Success
Gibraltar Rock
Camp Muir
Ingraham Glacier
Nisqually Glacier
Cowlitz Cleaver
Wilson Glacier
2000 ft
Map
Trip
Saved
Settings

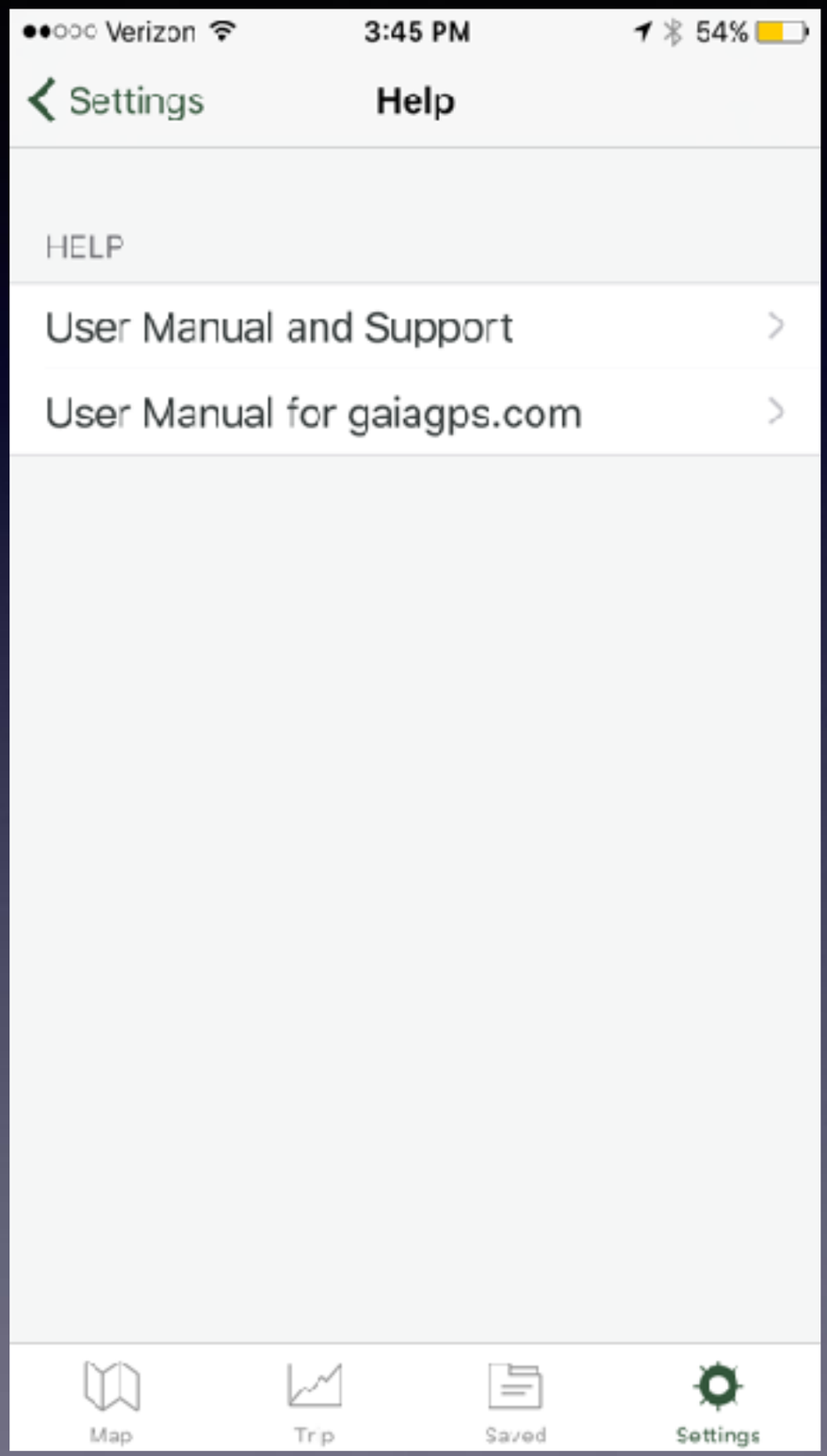
Why Gaia GPS?

Generally regarded as the best smart phone backcountry GPS app.

- The features you need, not extra fluff.
- MANY different map layers
- Good management of tracks and waypoints
- Great for international travel

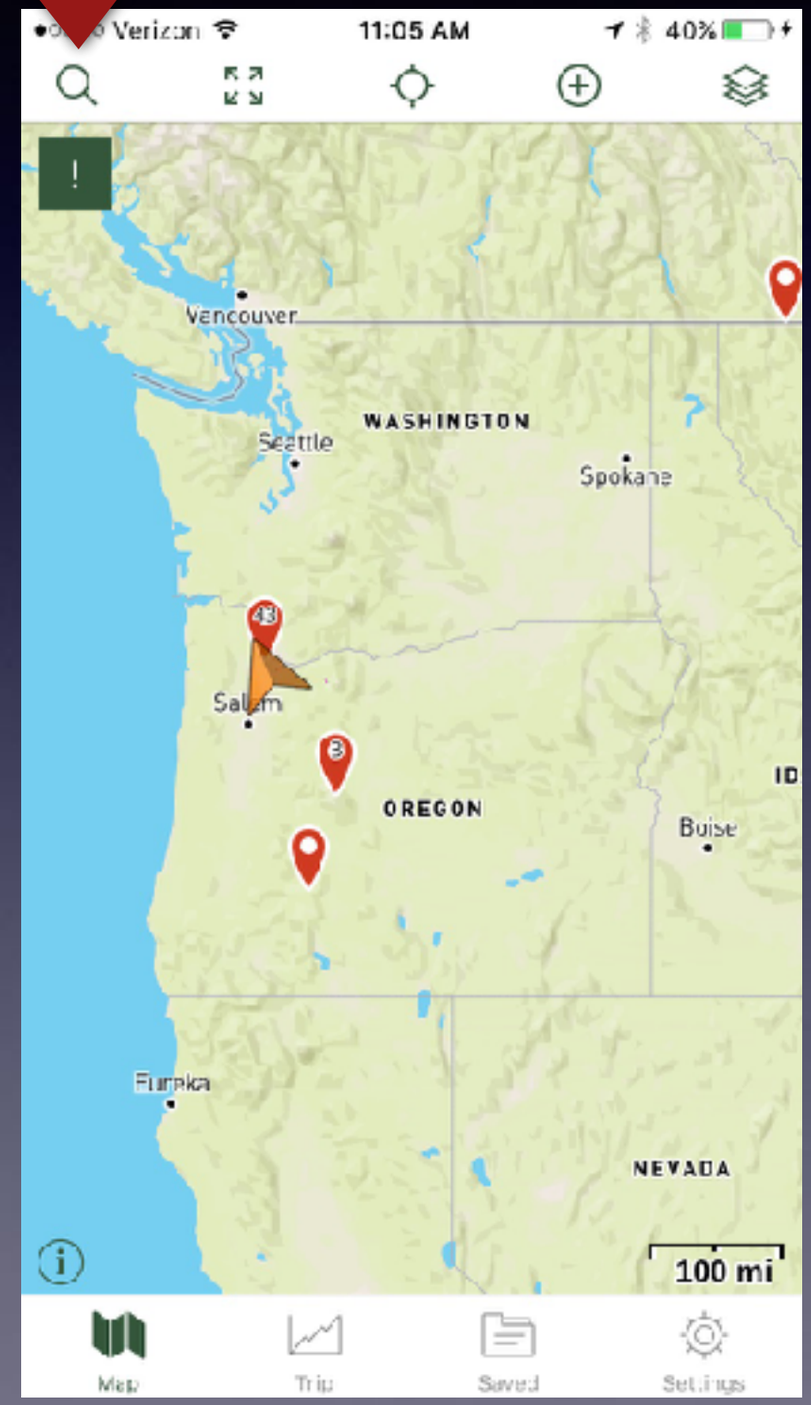
User manual

In the app, under Settings > Help



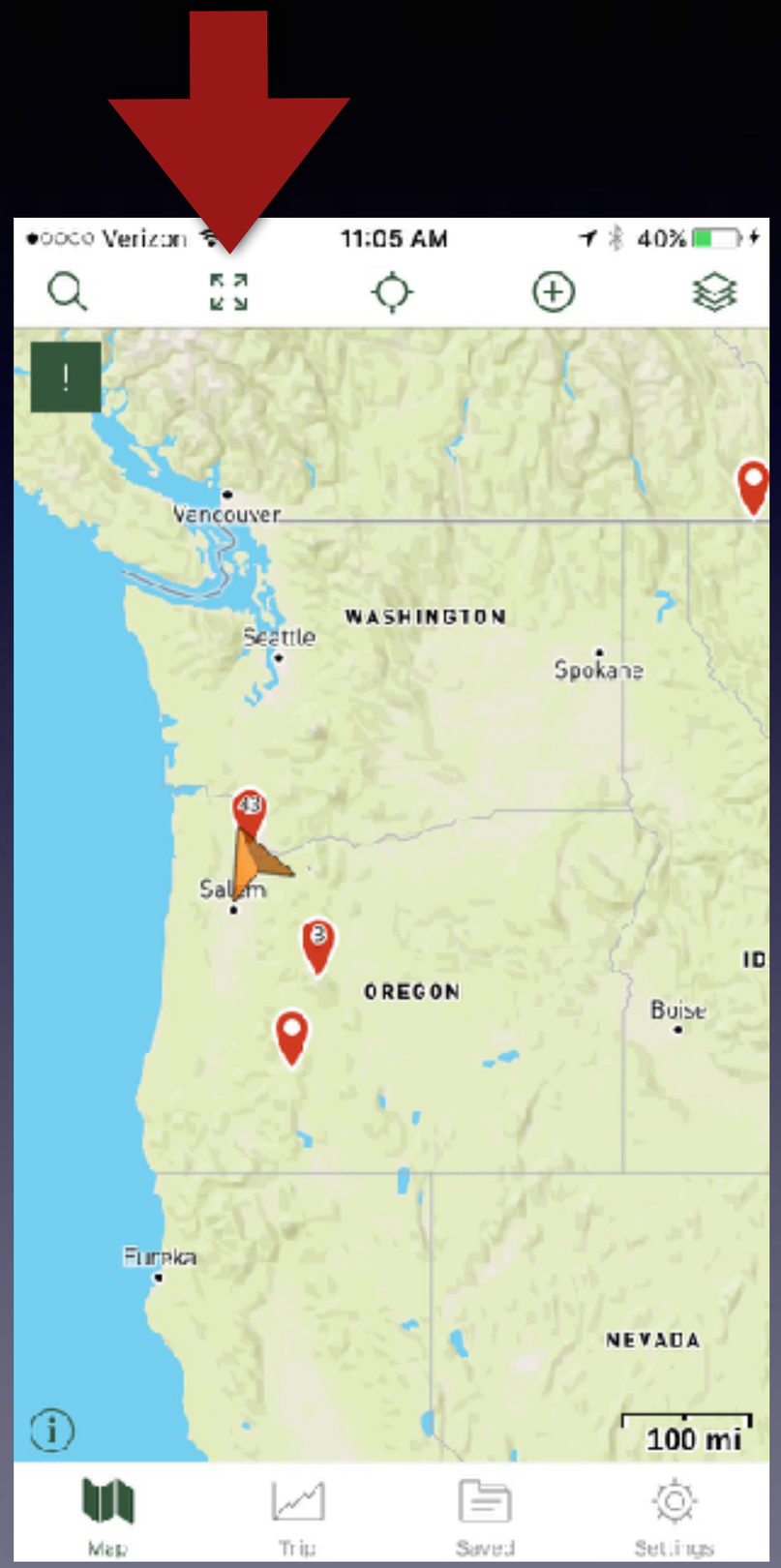
Search

- Mildly useful, still needs some work
- Try: “Yosemite”
- Has autocomplete



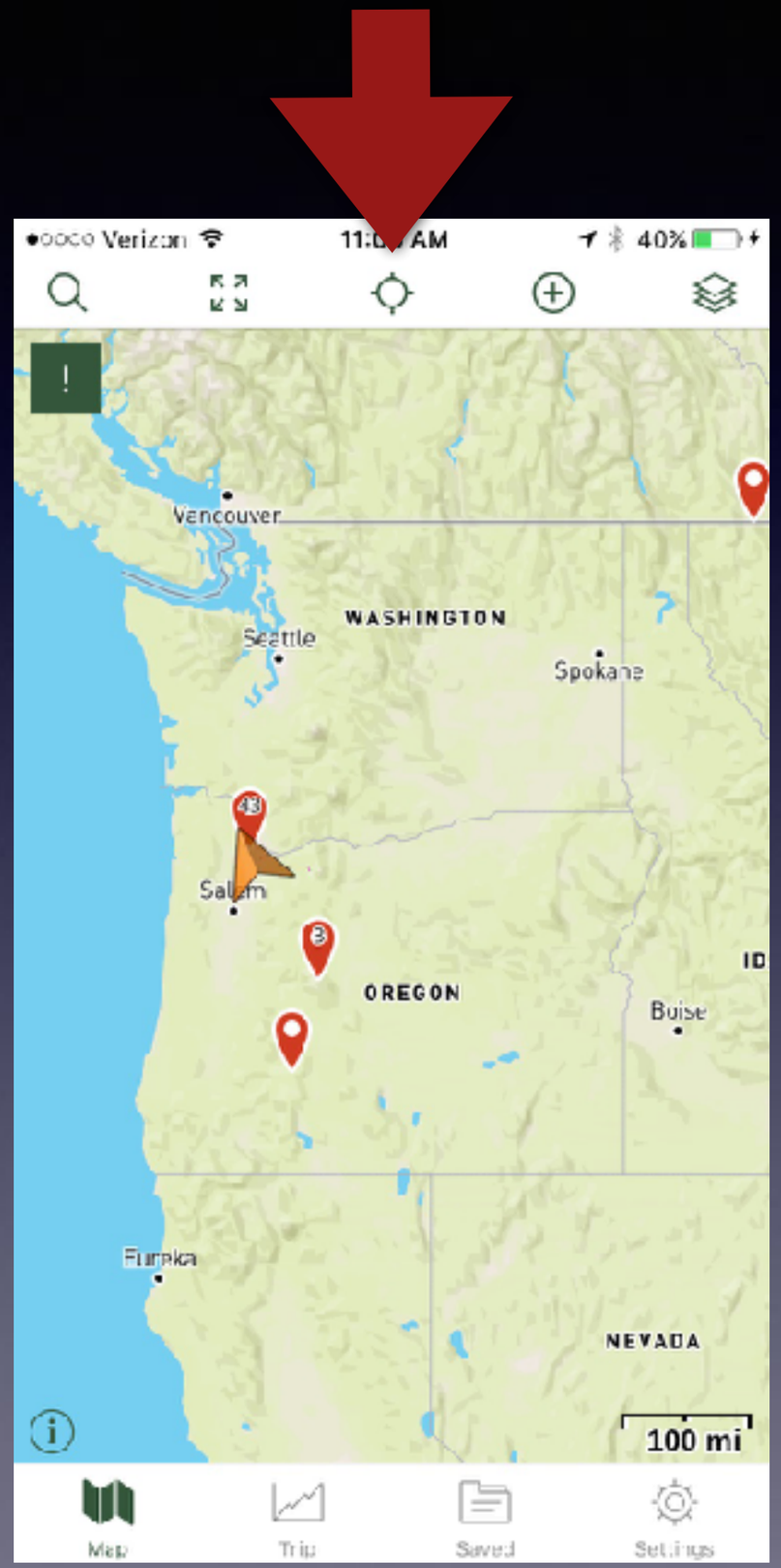
Map display options

- Tap to toggle to full screen
- Long touch to show and toggle map display options



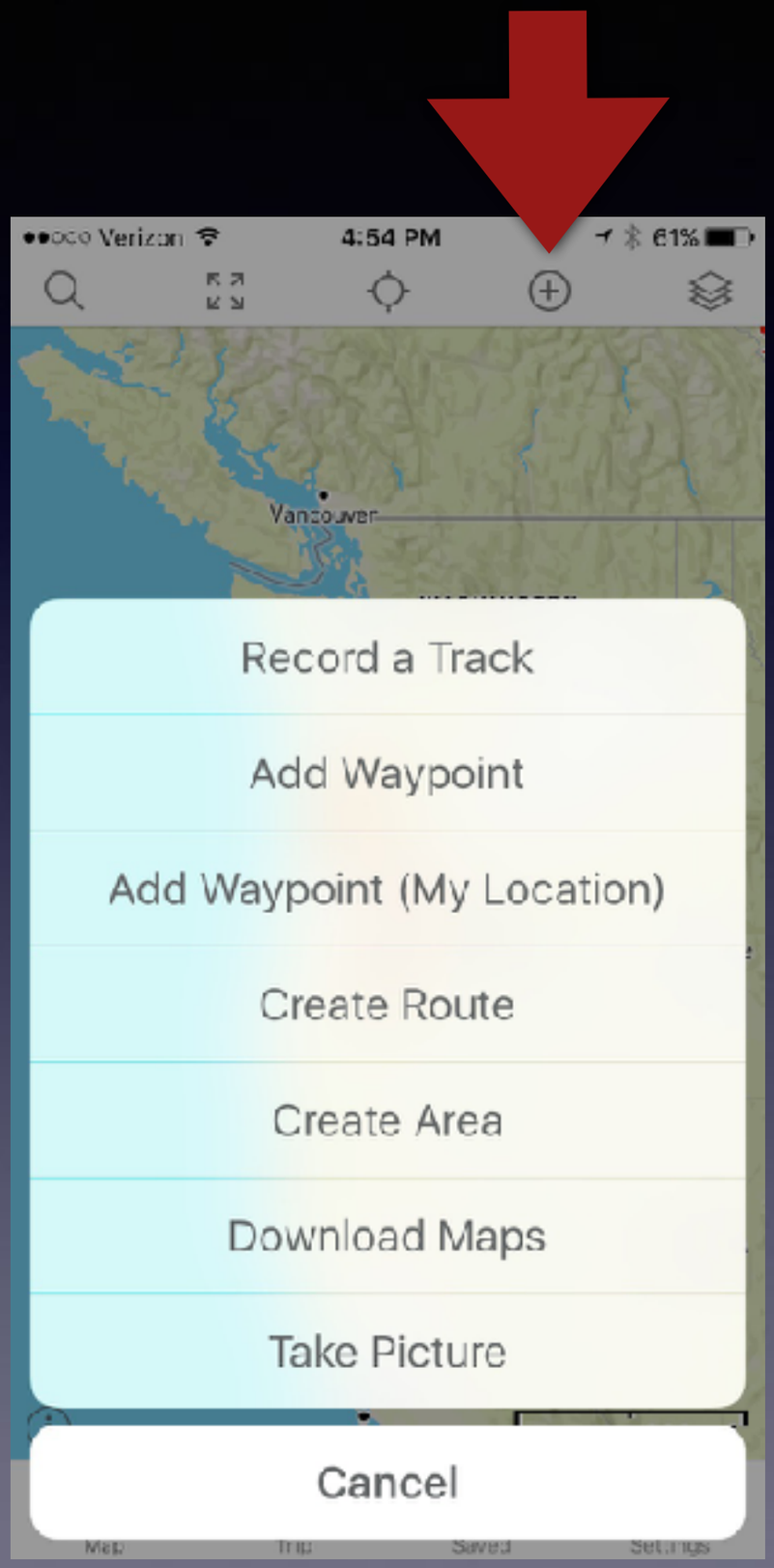
Locate Me

- Tap to show your position on the map.
- Tap once to center your position on the screen (crosshairs red). Good for driving or bike rides.
- Tap twice to show Track Up (green “martini glass”). Cool feature, but uses > battery.



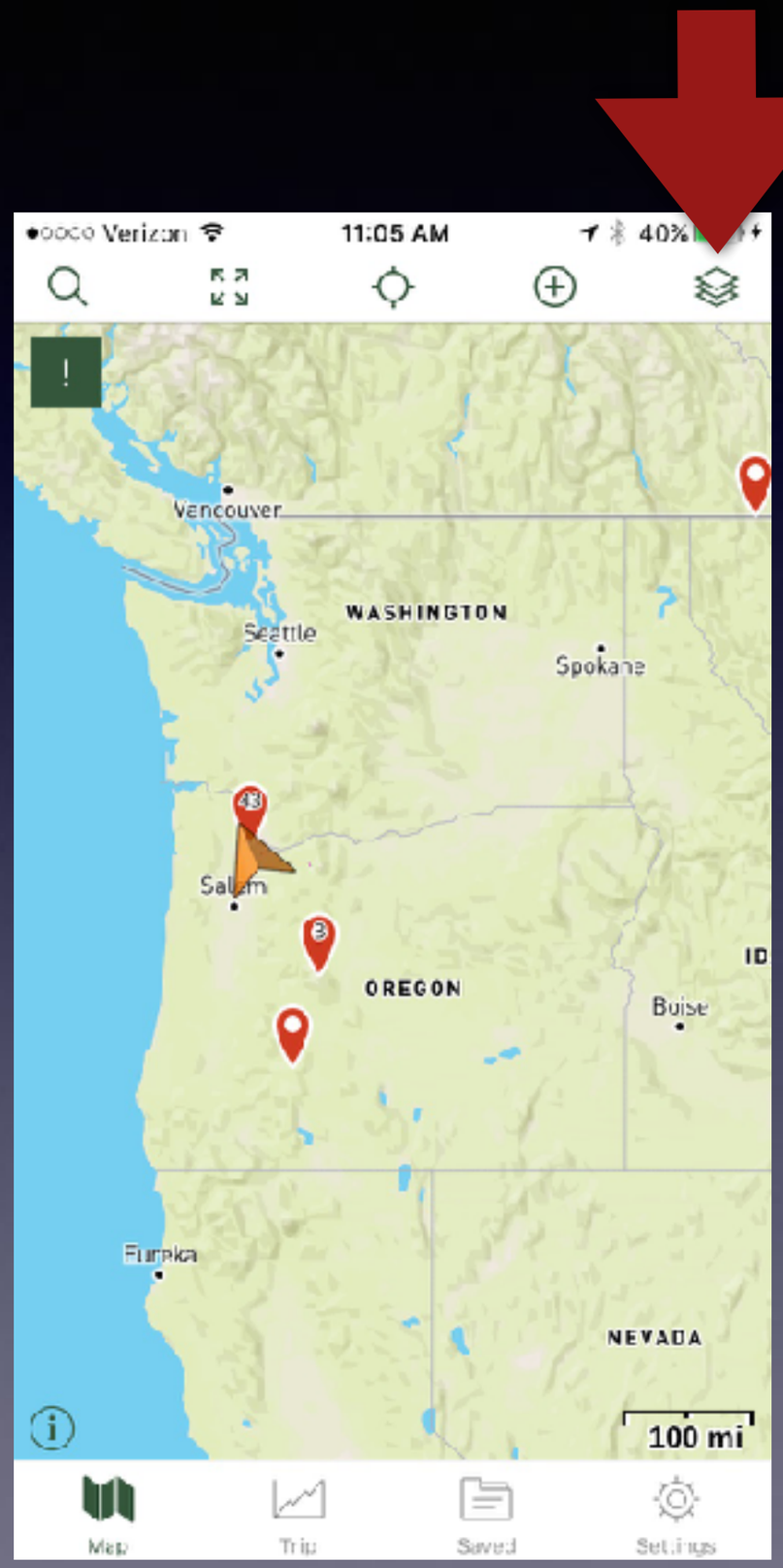
Add to Map

- Tap to record a track, add a waypoint, create route or download maps
- Very useful screen!



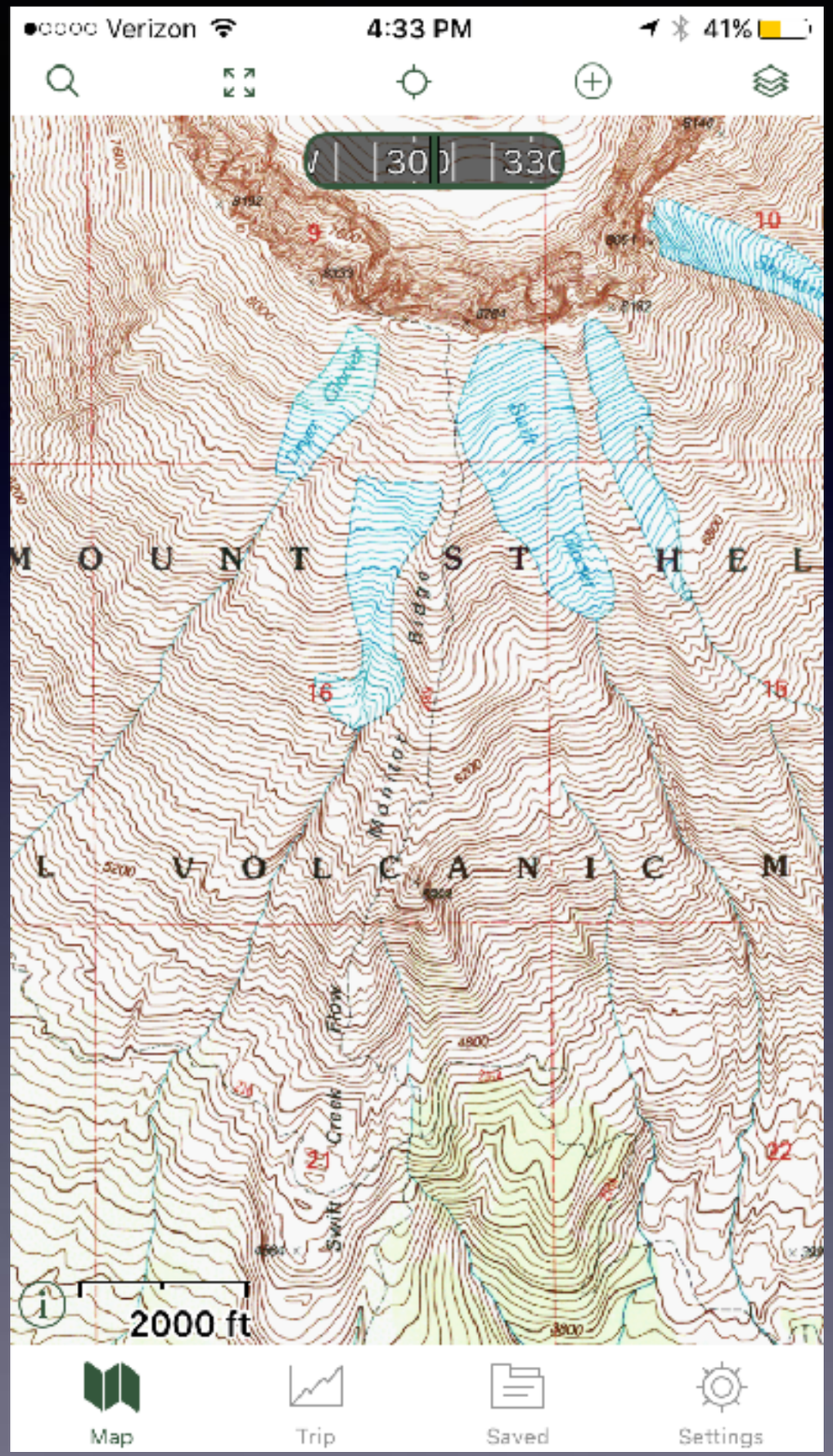
Map Layers

- Where the fun stuff is!
- Choose your favorite map layers to use on or off line.



Map Layer - **USGS Topo**

- Complete topographic map coverage of the US.
- Bonus: has “Open Street map” coverage for the rest of the world.

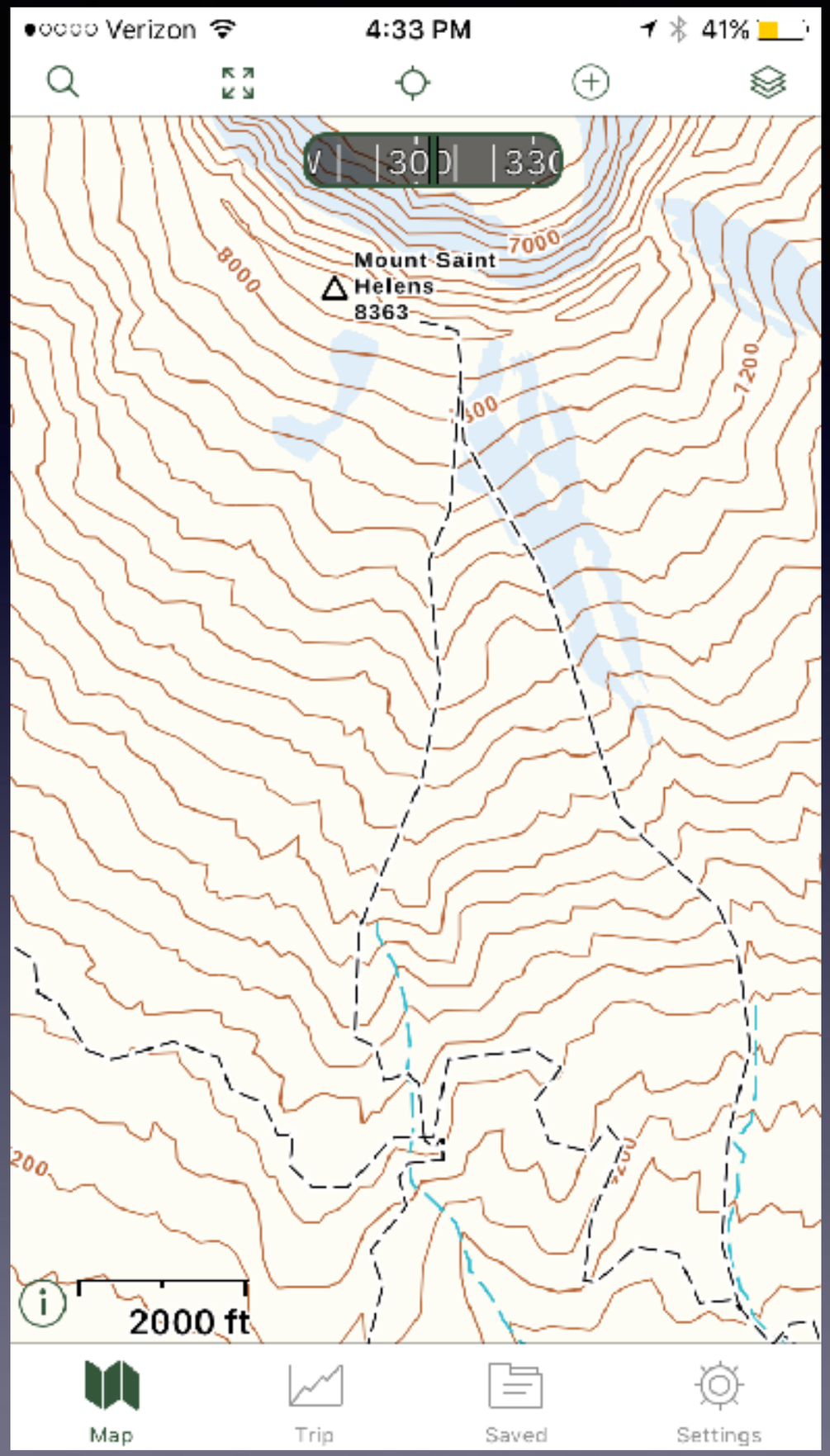


Map Layer - **Gaia Topo (feet)**

- Topo map made by Gaia

- Shows contours, houses, trails, roads; better than USGS!

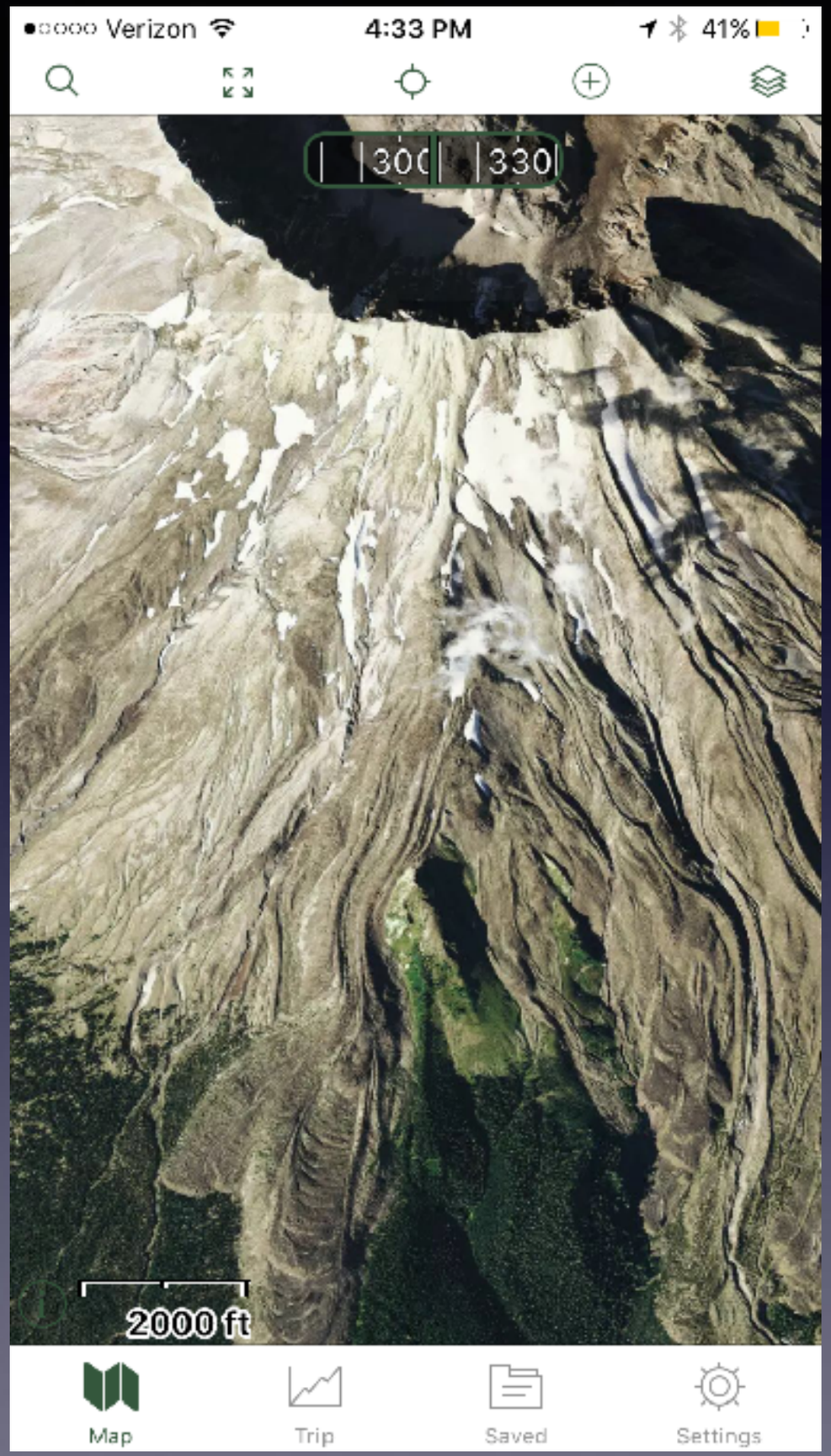
- (But, no shaded relief or vegetation)



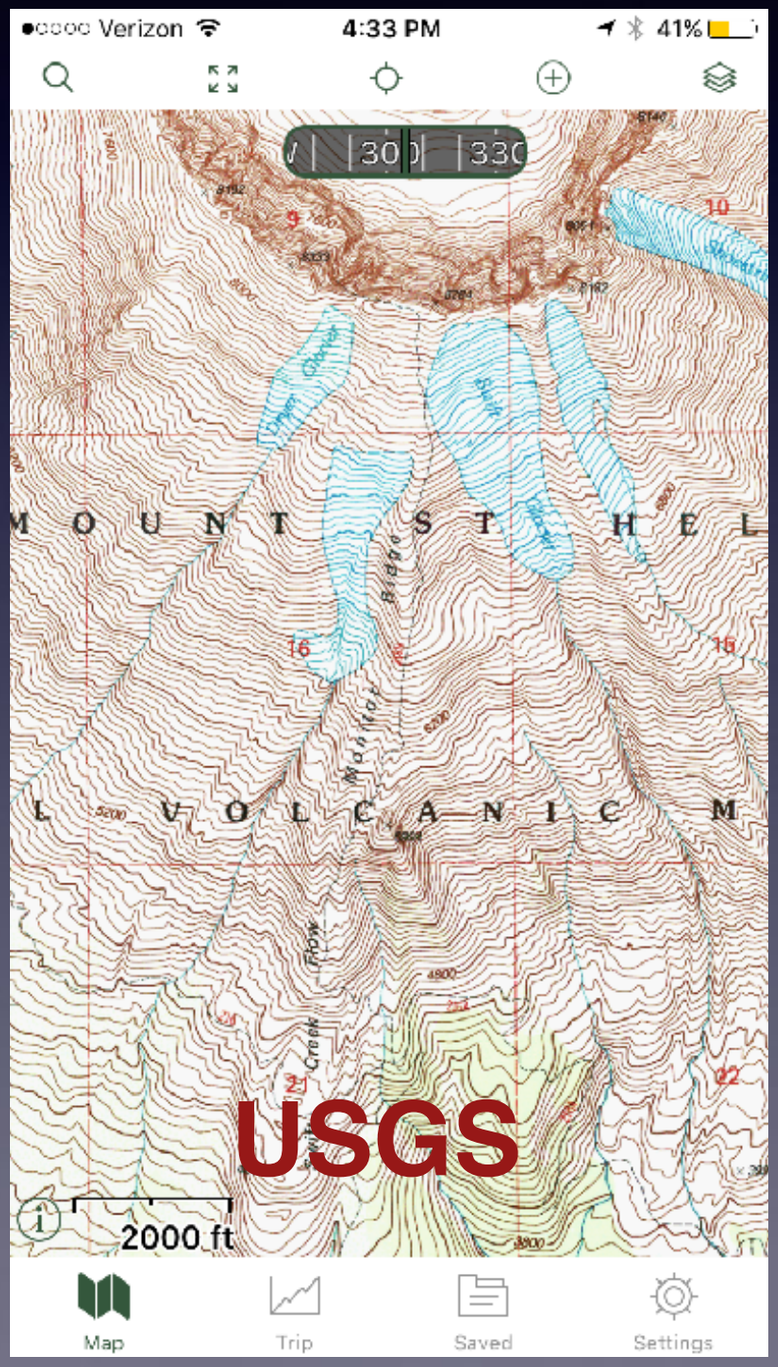
Map Layer - **Satellite**

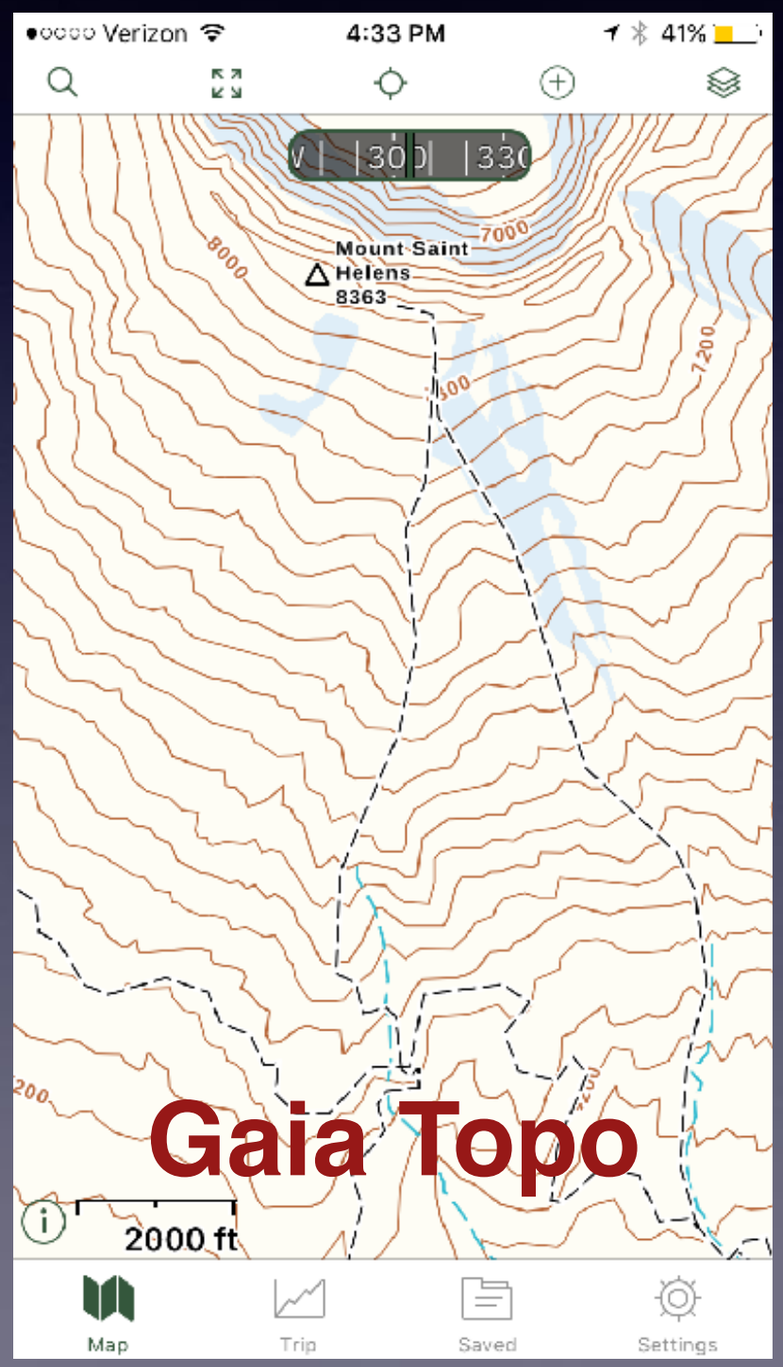
Satellite view can be very helpful for off trail travel.

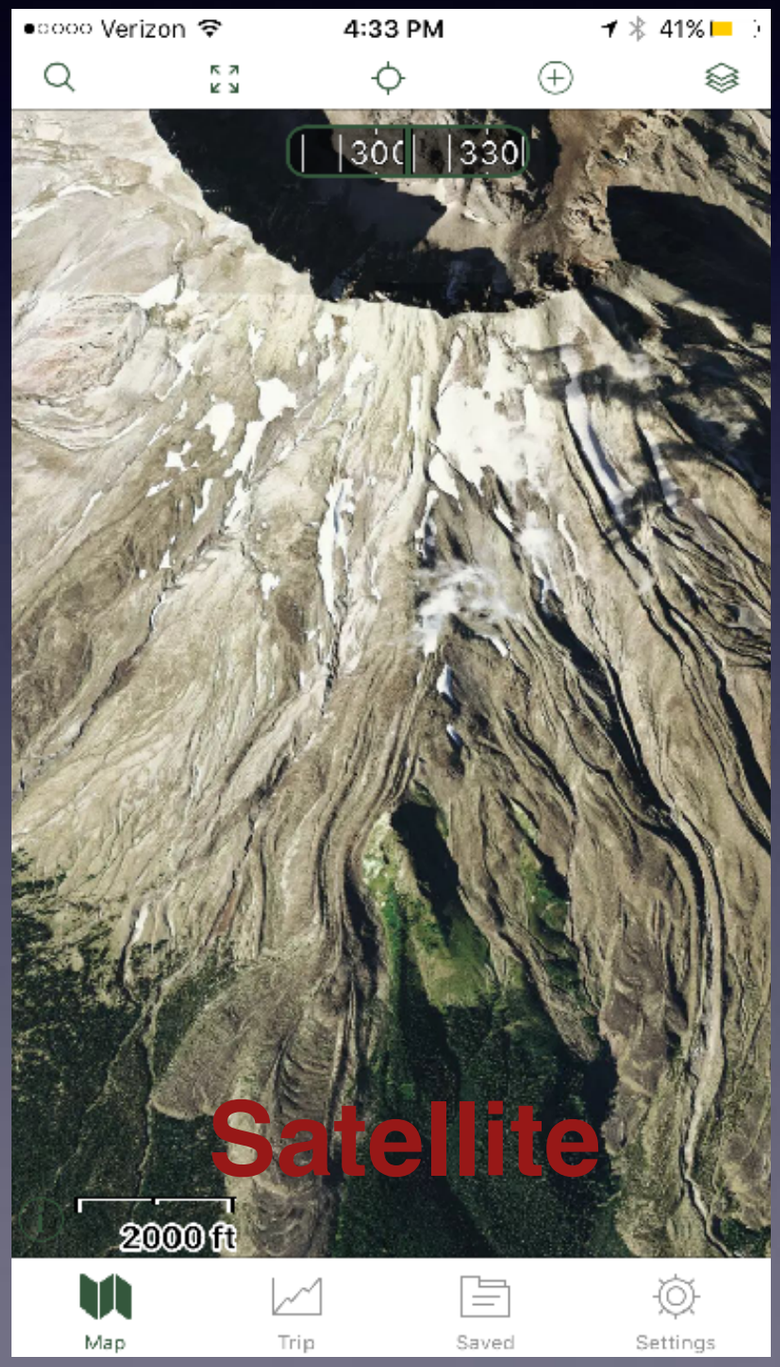
Having roads labeled is even better.



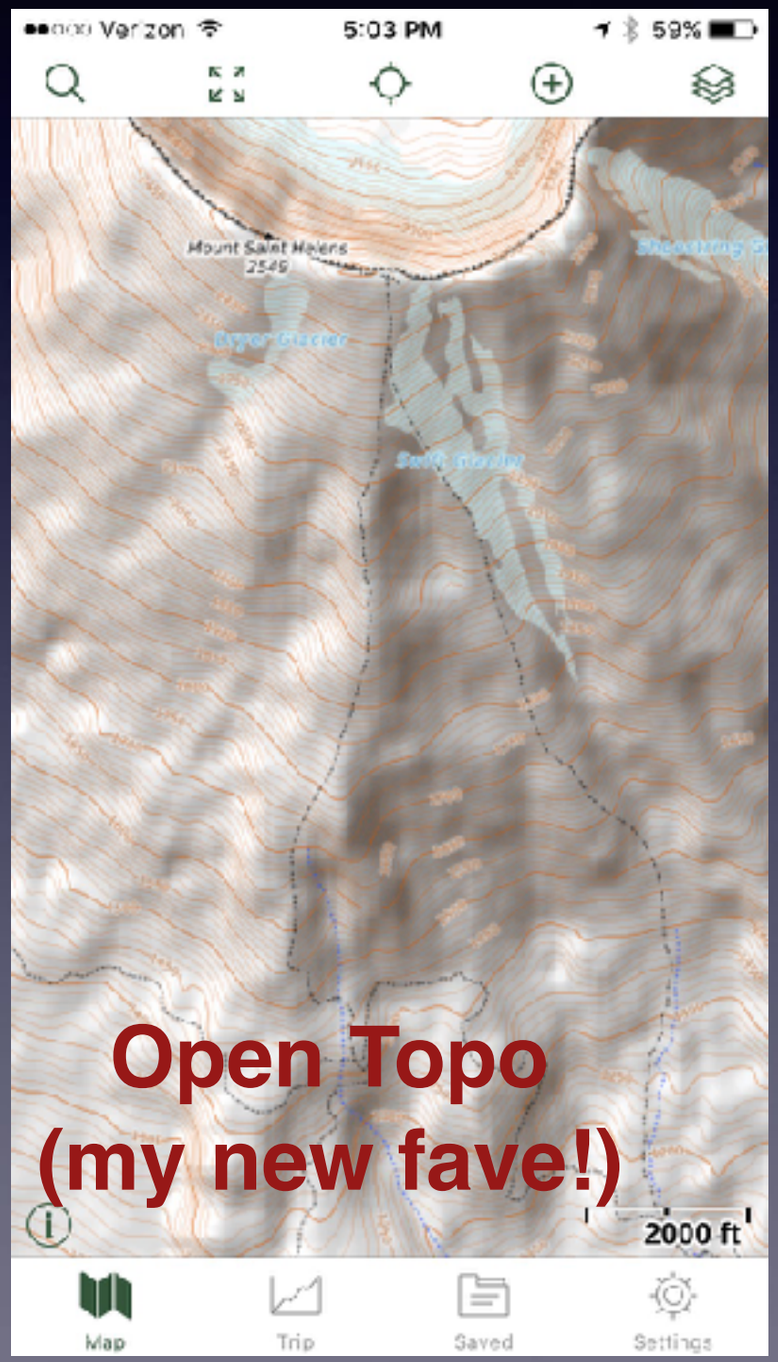
Default map sources in Gaia



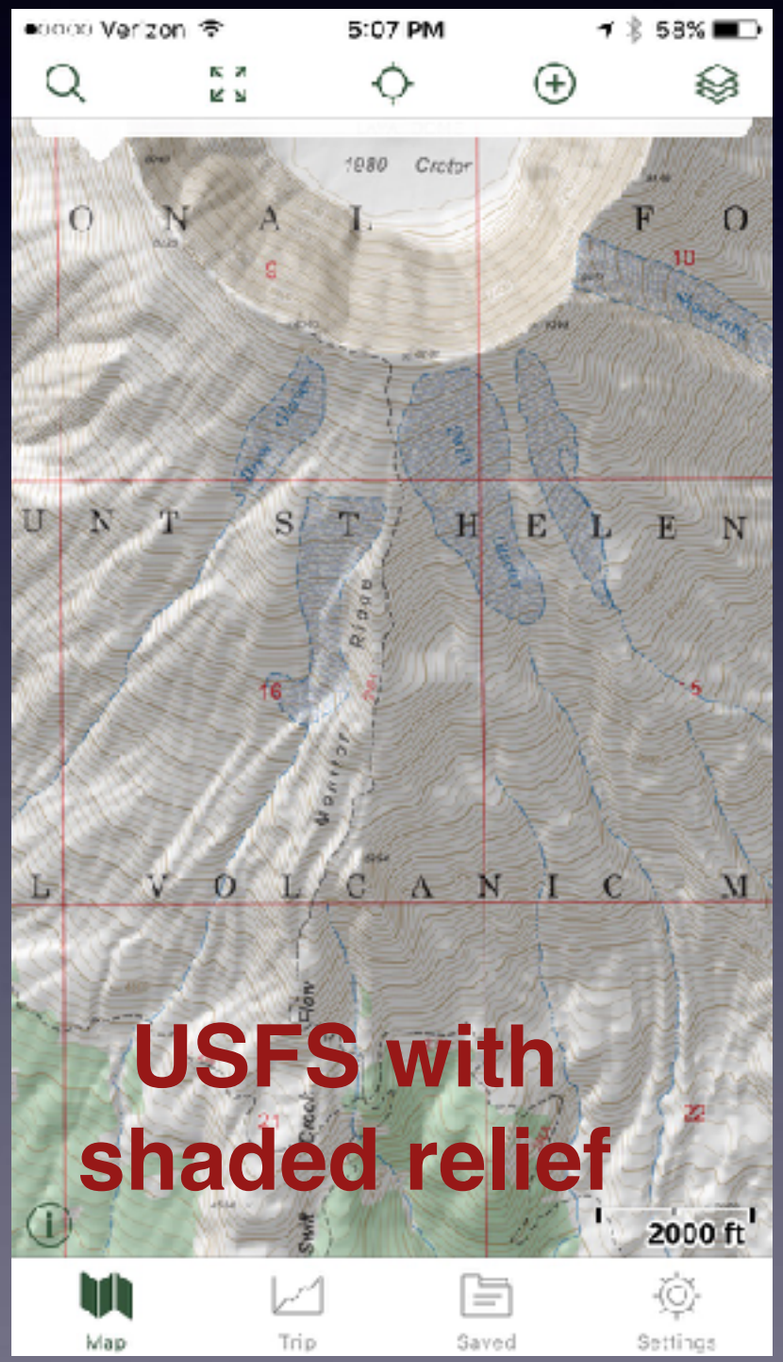




But wait, there's more!



Open Topo (my new fave!)



USFS with shaded relief

Trails Illustrated (Pro version)

Download map layers for off-line use

- **You only need to do this if you are hiking outside cell coverage.**

- Use Wi-Fi (faster) or cell network to download maps.

- Important: you only are downloading the active map layer!

- Use slider bar to adjust zoom, defaults are okay.

Classroom exercises

First off, does everyone have the two Mt. Tabor tracks loaded on your phone?

Loading tracks:

- email it to yourself on the native iPhone email
- “long touch” your email attachment
- open track in Gaia GPS - Saved > Tracks

Classroom exercise -1

Compare offline and online mode

Set map layer to Gaia Topo (feet)
Zoom out so you can see most of Washington state.

1 - **Turn on Airplane mode.** This prevents your phone from downloading maps.

2 - Then, zoom in to the NW corner of the Olympic Peninsula.
Notice the “fuzzy” map. **This is what your map screen will look like in the backcountry when you do NOT have cell coverage.**

3 - Now, turn Airplane Mode Off and zoom into the same area.

Noticed that the map detail continuously refreshes and looks perfect, even for all three layers.

This is your phone constantly refreshing the map over Wi-Fi or cell signal.

Classroom exercise - 2a

Add Waypoints

Zoom into Mt. Tabor.

1 - Set map layer to **Gaia Topo (feet)**

2 - Zoom into the east side of the big rectangular reservoir. **We meet here for the field session**

3 - Give it a good name, like “Tabor start 1”

Classroom exercise - 2b

Add Waypoints

Zoom into Mt. Tabor.

1 - Set map layer to **Gaia Topo (feet)**

2 - Zoom into the drinking fountain shown here. Add a waypoint

3 - Give it a good name like “Tabor drink 2”

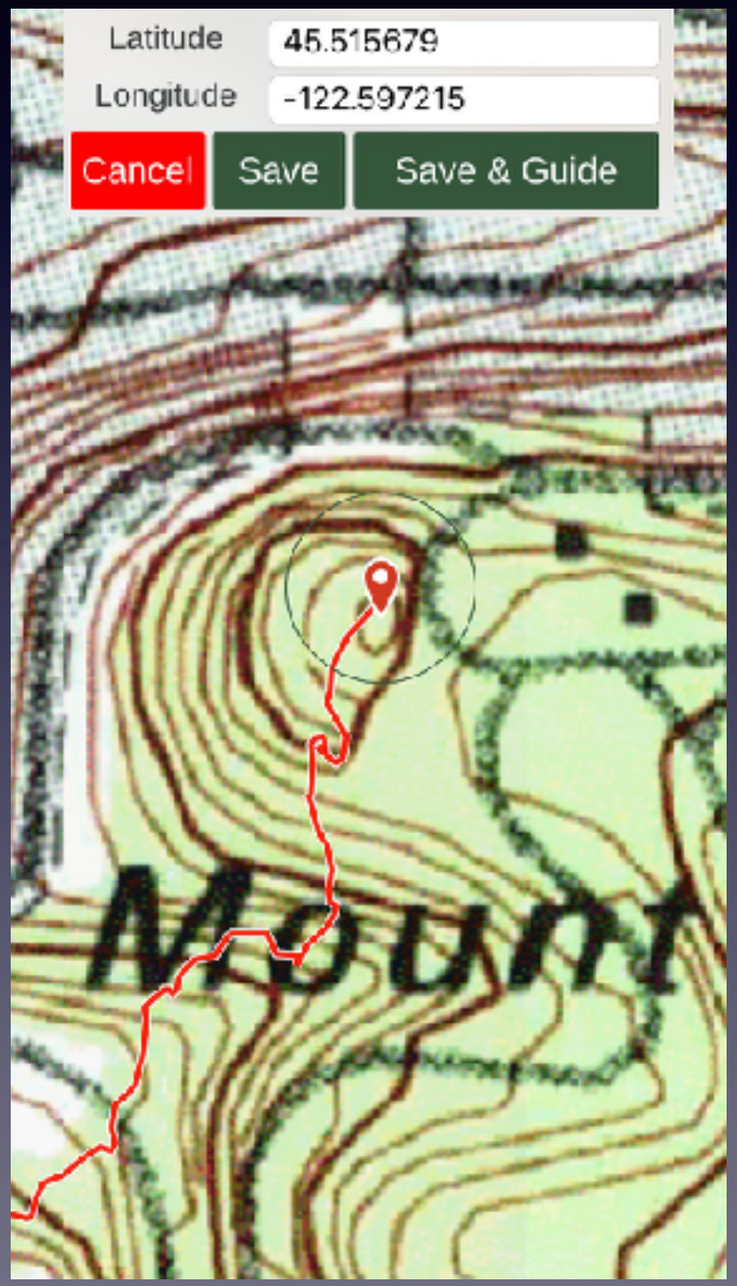
Classroom exercise - 2c

Add Waypoints

1 - Set map layer to **US Topo.** Zoom into Mt Tabor.

2 - “Add Waypoint” at the volcano summit in the NW part of the park. Drag the blue circle so it’s in the correct spot.

3 - Tap “Save”. Give it a good title, like “Tabor volcano 1”



Classroom exercise - 2d

Add Waypoints

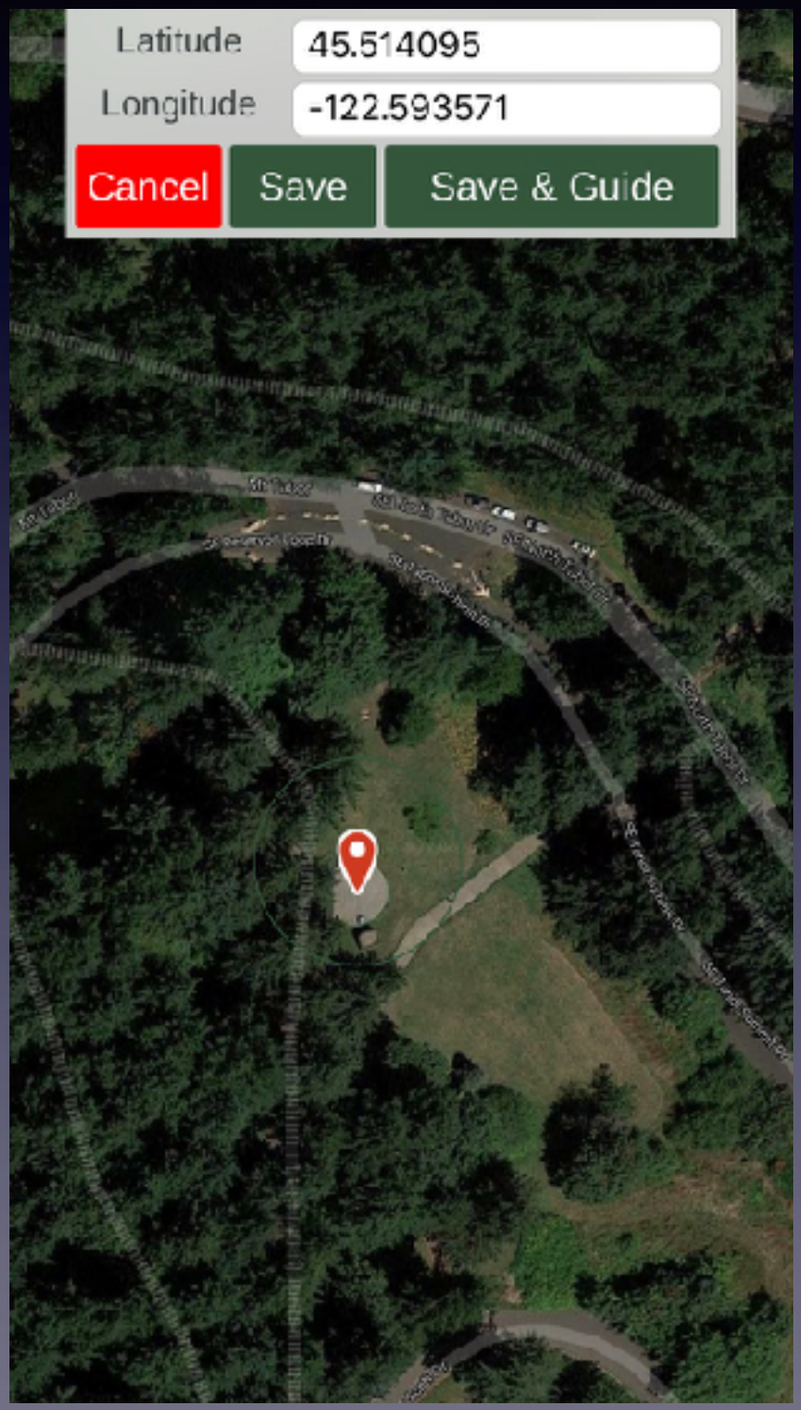
Zoom into Mt. Tabor.

1 - Set map layer to **Satellite with labels**.

2 - Zoom into the NE part of the park. Add a waypoint at this concrete circle.

3 - Give it a good name like “Tabor circle 3”

Note - you see different resolution at various zoom levels, zoom WAY close.



Classroom exercise - 2e

Check your saved waypoints

Tap “Saved”

Tap the “3 lines” in the top left corner. This shows you all the saved map data you have.

Tap Waypoints.

You should see the 4 saved waypoints you just made.

Classroom exercise - 2f

Use “Guide Me” to see distance and bearing to a waypoint

Tap “Saved”

Tap the “3 lines” in the top left corner. Tap “Waypoints”. Select the last waypoint you created, “Tabor circle 3”.

Notice the distance and bearing from your current location to the waypoint.

Tap the “3 dots” in the top right corner of your screen. (This is the “action” icon.)

Tap “Guide Me”. This should draw a red line on your screen showing distance and bearing from you to the waypoint.

Tap the “X” to turn Guide Me off.

Classroom exercise - 3

Change Coordinate Display

1 - Go to **Settings** > **Units > Coordinate Type.** Note the coordinate type, which should be decimal degrees.

2 - Scroll with your finger, and change coordinates to UTM.

3 - Go to **Saved.** You should see your 3 saved waypoints. Tap a waypoint, and see how the display coordinates are now UTM and not lat/long.

4 - Go to **Settings > Coordinate Type**. Change coordinate display back to decimal degrees.

Classroom exercise - 3a

Add a waypoint by entering lat/long coordinates

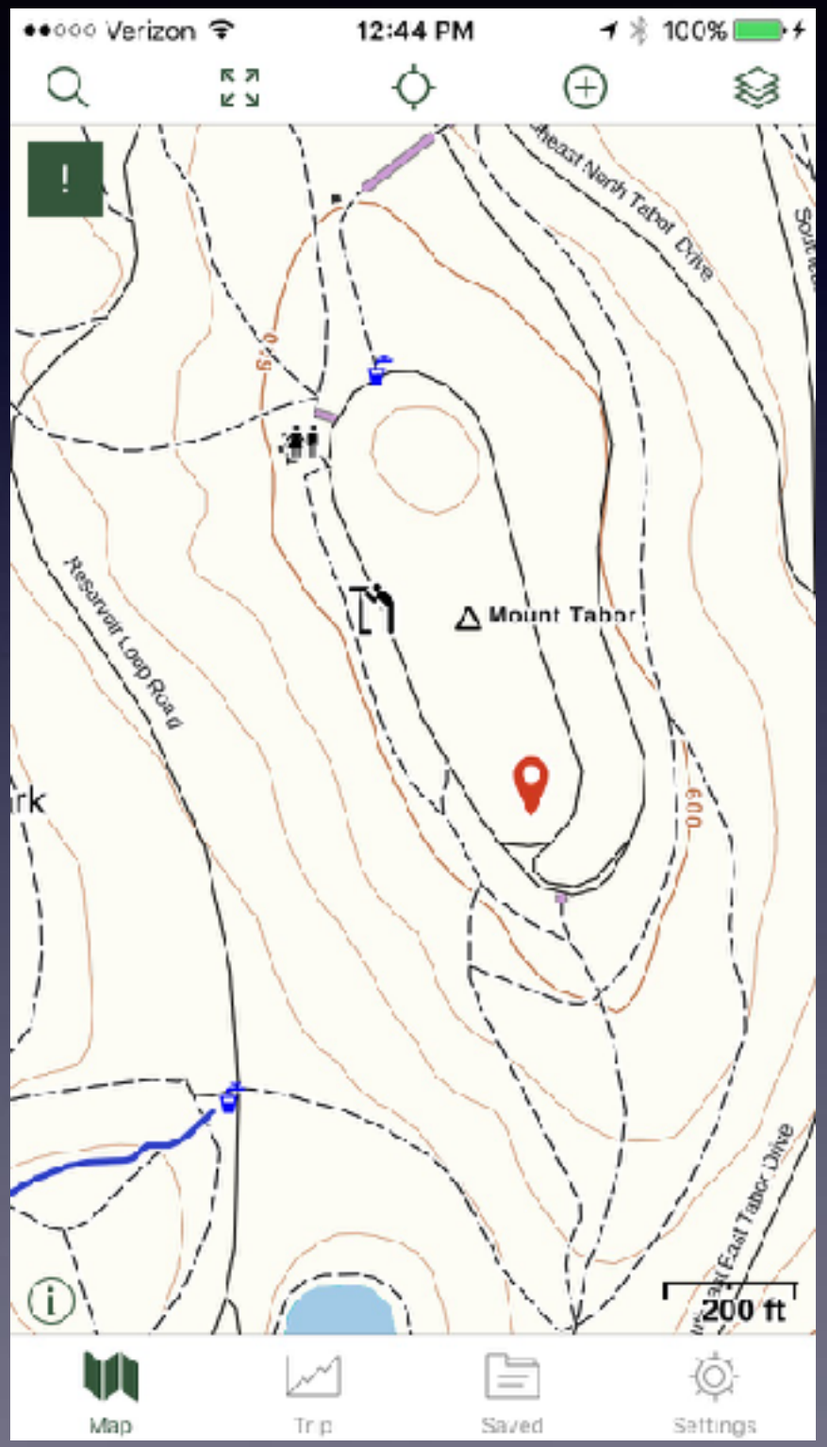
1 - Set map layer to **Gaia Feet.**

2 - Tap “Add Waypoint.”

3 - Enter “**45.5115**” as the latitude and “**-122.5924**” as the longitude.

4 - Name this point “**Tabor statue 4”**, and tap **Save**.

This should create a new waypoint at your specified coordinates, at the spot seen on this map.



Classroom exercise - 4

Map display options and display useful stats

Long touch the second icon on the top row, the “4 Arrows”.

Toggle on and off the Stats Bar.

Long touch the Stats Bar. Scroll through the many options.

Change stats to:

- column 1 **altitude**
- column 2 **coordinates**
- column 3 **record**

Classroom exercise - 5

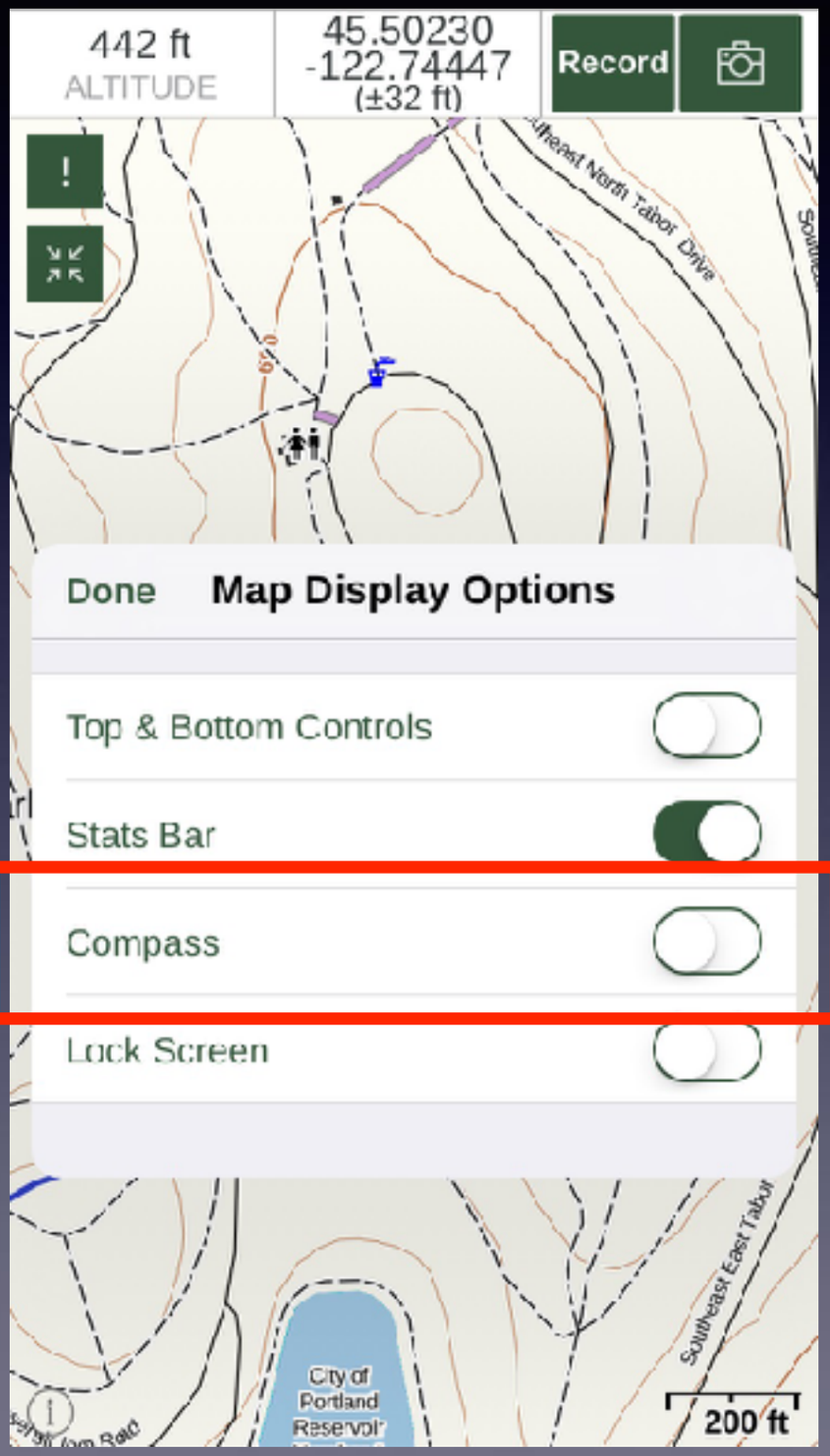
Show Compass

Long touch the second icon on the top row, the “4 Arrows”.

Toggle the compass on and off.

Hold the phone flat in front of you and turn your body in a circle. It should display direction and bearings.

(It uses extra battery; turn compass off if you don’t need it.)



Classroom exercise - 6

Add more map layers

Gaia has LOTS of maps! Don't get too crazy with them, having 4-6 visible is usually fine.

Tap the last icon on the top row, Map Sources. Tap “Edit”

Tap “North America” and scroll through the options.

Note that “USGS Topo” has a red X inside a circle. That means it’s already loaded to your main map menu.

Tap “Topo Maps.” Tap the “+” sign to add the layer “**Open Topo**” to your active map layers. Go back to your map layers. You should see it.

To delete a map layer, toggle the red X to a green +. (This does NOT permanently delete a map layer, just removes it from your visible map sources.)

Classroom exercise - 7a

Download maps for offline use

Load the Mt. Tabor tracks, and then download 3 types of maps to cover them.

- Saved > Tracks (top left corner) > Tap Tabor track > Show on Map
- Set Map Layer to US Topo. Tap icon 4, “plus in circle”. Tap Download Maps.
- Drag the red selection box to cover all of Mt Tabor and the tracks.
- Tap Save. Name map “tabor US topo”. Tap Save again.

Classroom exercise - 7b

Download maps for offline use

- Saved > Tracks (top left corner) > Tap Tabor track > Show on Map
- Set Map Layer to Open Topo. Tap icon 4, “plus in circle”. Tap Download Maps.
- Drag the red selection box to cover all of Mt Tabor and the tracks.
- Tap Save. Name map “tabor open topo”. Tap Save again.

Classroom exercise - 7c

Download maps for offline use

- Saved > Tracks (top left corner) > Tap Tabor track > Show on Map
- Set Map Layer to Satellite with labels. Tap icon 4, “plus in circle”. Tap Download Maps.
- Drag the red selection box to cover all of Mt Tabor and the tracks.
- Tap Save. Name map “tabor satellite”. Tap Save again.
- **Go to Saved >> Maps**. You should see your three saved maps, now available for use off-line.

Classroom exercise - 8

Make a Route and download maps

Set map layer to “Open Topo”. Zoom into Mt Hood, close to Timberline Lodge.

Tap the fourth icon on the top, the “plus circle”.

Select “Create Route”. You should see a blue circle. Drag it to the Timberline Lodge parking lot.

Move map to the top of the Palmer Chairlift. Long touch to add a second point.

Add 2 more points: Crater Rock, and the summit. (Note the distance, elevation gain and elevation profile on the bottom.)

Tap Save, name it “Mt Hood route test”.

Tap “Low-Medium-High” under resolution. Notice the download size changes. Toggle on Open Topo. Tap Save to save that map layer that covers your route.

Classroom exercise - 9

Storage Use and Clear Cache

The Gaia app is about 175 Mb.

Panning around and viewing a lot of maps saves these maps to the phone memory.
Saving large maps files can also eat up storage.

Go to Settings > Storage > Storage use. Note the cache size.
Go to Settings > Storage > Clear Cache.

Doing this erases “map surfing” data stored in the phone memory.
(If you have a lot of memory on your phone, then this is less important.)

Tap “Storage Use" again. Your “Caches - Other” MB stored should be much smaller.

Classroom exercise - 10a

Editing and sharing saved data

Tap Saved. Tap the “3 horizontal bars” icon in the top left corner. Choose Tracks.

1) Tap the green “eye” to toggle the Tabor tracks to “not visible” on your main map. Tap the Map icon on the bottom left corner. The tracks should not be visible. Reverse this process and toggle the tracks back to visible.

2) Select the Tabor north track. Tap the small “pen in a circle" edit icon in the top right corner of your screen. Change the color or title here if you want to.

Classroom exercise - 10b

Editing and sharing saved data

Tap Saved. Tap the “3 horizontal bars” icon in the top left corner. Tap Tracks. Tap Tabor North.

Tap the “3 dots” icon in the top right of your screen. Here, you can do some fun stuff - email a track to a friend via “Export”, and “Download Maps for Track”.

1) Try exporting a track by emailing a GPX track to yourself.

2) Tap “Download Maps for Track”, Choose Open Topo, Tap High resolution, then tap Download.

EVERY climber or hiker with a smart phone should have a GPS app (or at least know how to get their coordinates.)

Classroom exercise - 11

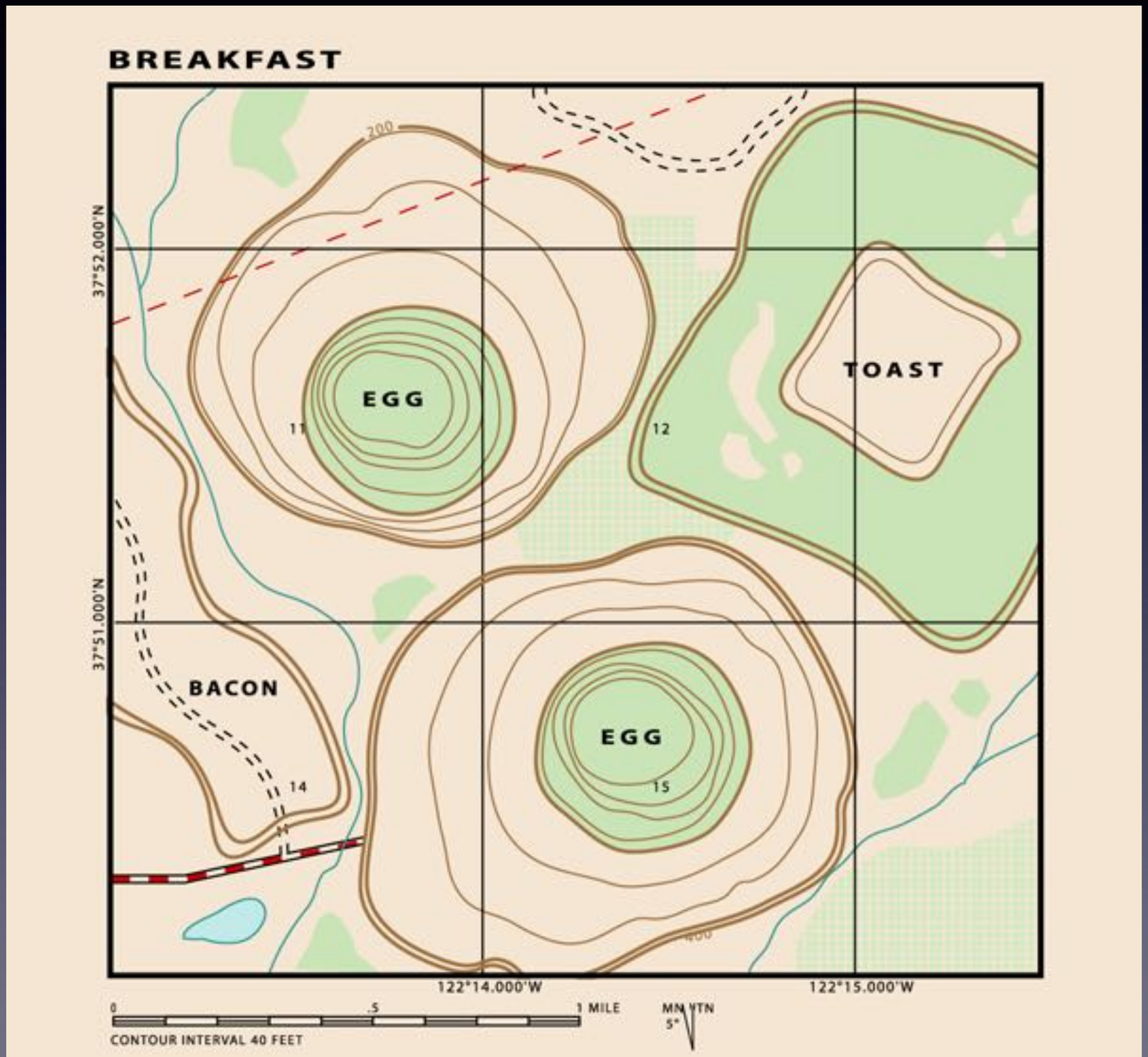
Text me your coordinates and a message

Determine your current coordinates using any method you like (built in iPhone compass, Gaia save waypoint)

Copy them carefully, and text me your position with your name and a funny message.

503-502-1844

Thats It!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200
37°52.000'N
EGG
11
12
TOAST
BACON
14
EGG
15
37°51.000'N
122°14.000'W
122°15.000'W
0
.5
1 MILE
CONTOUR INTERVAL 40 FEET
MN VTN
5°