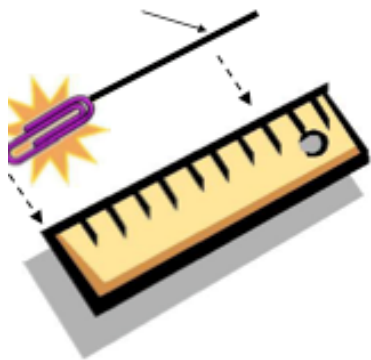


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Name: _____ Date: _____

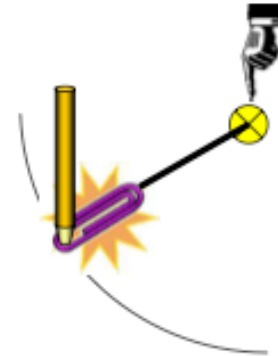
GPS Worksheet

Where am I? – You have been dropped off at mystery spot somewhere in the United States. Your GPS unit has malfunctioned: it only gives you distances from the satellites and where the satellites are, but will not do the calculation to find your position (and today is the one day you left your sextant at home). Fortunately, you have a U.S. map and quickly program your GPS unit to give you the satellite distances relative to your map (quick thinking!). Time for some triangulation.



Arc Instructions: Lay your GPS States Map flat on a table. When you get the distance data from a satellite (see below), have one person in the group measure and mark that distance on your string tied to the paper clip (including the paper clip).

The second group member will hold the marked spot on the string to the circled "x" by the correct satellite. Now your paper clip can swing in an arc across your map. Have the third group member insert a pencil into the end of the paper clip and draw an arc holding the string tight.



Turn on the GPS receiver to get started:

1. Your receiver has picked up data from Satellite 1: you are approximately 12 cm from Satellite 1. Make an arc using the method above and then list all the States that you may be in (every state the arc crosses):

2. Now, you have locked onto Satellite 4: 15 cm from your position. Make another arc. Which States might you be in now (where do the two arcs cross)? Remember, these distances may be off by 2-3 mm so if you are near a border you should include both States as possible locations.

3. Finally, you have Satellite 2 data: 18 cm away. Make a 3rd arc. Why don't the three arcs cross at exactly the same point?

What if one of the signals had a large error and was off by 5-6 mm? Which States are still possibilities for your location?

4. Sometimes it is good to have 4 satellites locked in because you can get a much more accurate position. Luckily, Satellite 3 distance pops up: 9 cm. Can you confidently name your location now? _____

Use the table on the back of this sheet to help locate some friends with the GPS data they have supplied!

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Where Are They? — Note: Distances may be off by +/- 0.5 cm to make the triangulation slightly more challenging.

Name	Distance to Satellite 1 (cm)	Distance to Satellite 2 (cm)	Distance to Satellite 3 (cm)	Distance to Satellite 4 (cm)	Which State?
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YOU 5.5 21 12 22

George	5	20	13	22	
Patricia	23	15	16	3	
Shawn	12	14	13	15	

Isaac	17	9	17	11	
Sarah	21	7	20	11	
Carla	14	15	11	12	

Oscar	17	12	14	10	
Olivia	19	11	15	8	
Lin	9	23	9	21	

BONUS CONVERSION: The actual accuracy of typical commercial GPS receivers (with 4 satellites locked) is roughly 5 meters. On the scale of this map, 5 meters is what fraction of a cm?

Hint: 5 meters should be equal to a VERY small fraction of a centimeter. Do not forget to convert km to meters.

Worksheet adapted from Teach Engineering: State Your Position activity, Integrated Teaching and Learning Program, Boulder, CO 80309-0522
http://www.teachengineering.org/view_activity.php?url=http://www.teachengineering.com/collection/cub_/activities/cub_navigation/cub_navigation_lesson08_activity1.xml