Using the Global Positioning System: Scavenger Hunt
(Grades 8 to 12)

Preparation:
- On the campus, find locations to place the scavenger hunt items, and make a note of the GPS coordinates.
- For the classroom activity, mark the position of each satellite with masking tape. Pick a point in between, and cut strings measured from this point to each satellite. (Do not mark it on the floor.)

Classroom Activity:
To illustrate the principle of GPS navigation designate three students as GPS-1, 2 and 3, and give each of them one of the precut strings. A fourth student is the "point of interest". Explain student that the GPS receiver, based on information broadcast by the satellites calculates the distance from them.

Question: How one finds the "point of interest" from this information?
It is possible that there isn’t any point, where the all three strings are taut. That is fine, it illustrate measurement error.

Question: What happens if we have only two satellites? Remind students, that this is only a 2D illustration, but the principle is the same in 3D. (If one of the “satellites” stands on a chair, the other on a table, it turns into 3D demonstration.)

Scavenger Hunt:

Form small groups and hand out the receivers and the set of coordinates of the items already scattered on campus. (For visually impaired students use bright markers on a pole, and place the object at the bottom). Initialize the receivers outside, that is make sure they acquires at least three satellites.

Questions: - How does one decide which direction to start? (Look at the difference of the coordinates. If the cardinal directions are known, they can just go. If not, ask the students to pick a direction, go and see how the reading changes.)
- What if there is nothing at the exact location? (Remind them of the classroom demo, measurement errors. Assure them, that with three satellites the target is always close by, the more satellites they can see the smaller the error is.)

Ask students to make a note of what they found and the actual location of the object. (Do not collect the items if multiple groups got the same coordinates). Now start the hunt!

It is helpful to put a time limit for the activity, so the groups all show up at the finish. The group, which collected the most coordinates, visited during the time allotted wins.
Extension for mathematically inclined students

After returning to the classroom ask groups what are the coordinates they originally got, and the actual coordinates they measured. If other group visited the same target, ask them too.
Question: Which measurement is correct? (Cannot tell)
How would they find the true coordinate of the point?
(Averaging usually works, the more number to average the closer it will be to the “truth”.)
Try to estimate, how big the error is? (Spread, half the spread, or you can tell about formulas that are more rigorous.)

Useful educational links:
http://www.howstuffworks.com/gps.htm
http://www.aero.org/education/primers/gps/howgpsworks.html