

Where on Earth am I? (GPS)



How good is the Global Positioning System (GPS)?

- ❖ Is GPS better indoors or outdoors?
- ❖ How accurate is GPS?
- ❖ What is the difference between accuracy, resolution and precision?

Estimated time: 30 minutes.

No prior knowledge needed.

Instructions

Watch the video ([YouTube T9GNmA5kKIA](https://www.youtube.com/watch?v=T9GNmA5kKIA))

1. Find an app that reports longitude and latitude in decimal format to six decimal places (e.g. 51.000001, -0.816161). Ensure it works on your device at desired location/s (some tablets need to be in range of wi-fi). Good apps are **GPS Status** and **Physics Toolbox GPS**.
2. We need results from two positions: inside and outside a building respectively. In each case, follow steps 3-7.
3. At your measurement position, start app and wait 2 minutes for values to settle. Write down **latitude** reading. If readings still change, take a photo and jot down the value from that.
4. Move your device about 100 paces from your measurement position forcing the GPS device to reset. Return to your measurement position to record **latitude** there again after 2 minutes.
5. Repeat step 4 enough times to collect 5 **latitude** readings.
6. Calculate the range between the smallest and largest values.
e.g. $51.000051 - 51.000001 = 0.000050$
7. Convert decimal latitude range to metres by multiplying by 110000 m.
e.g. $0.00005 \times 110000 \text{ m} = 5.5 \text{ m}$. This is your range in measured location.
8. Perform steps 3-7 indoors and also outdoors (away from trees and buildings). Enter results into NPL webpage:
npl.co.uk/measurement-at-home/where-on-earth-am-i

Weather conditions (sunny, cloudy, etc):	
Indoors: range in measured position (in metres):	
Indoors: number of walls between you and sky:	
Outdoors range in measured position (in metres):	
Outdoors: details (how far from trees/buildings):	
The device you used (optional):	

#MeasurementAtHome
npl.co.uk/measurement-at-home

Equipment required

- Smartphone or tablet with GPS app reporting decimal longitude and latitude to 6 decimal places.
- Paper and pencil for results.

Risks

- ❖ Ensure you have permission of the device's owner before using it in this experiment.
- ❖ Remove dirty footwear before entering house.
- ❖ Don't report your latitude, we want the range of results in metres.

SI measurement units

- ❖ metre (m) for position
- ❖ second (s) for time

Challenge Topics

- ❖ Measurement Science, Maths, Geography.

Thoughts, tips and information

- ❖ How long do readings take to settle? What is happening during this time?
- ❖ Some GPS devices use an additional signal from a nearby receiver of known fixed location to dramatically improve accuracy.
- ❖ Clocks on board satellites have enough resolution to show effects to relativity.

Adult direction or supervision is required. All experiments are carried out at your own risk. For more experiments, visit [NPL Measurement at Home](https://npl.co.uk/measurement-at-home).