# Earthquake Early Warning Demonstration

This hands-on demonstration illustrates how GPS instruments can be used in earthquake early warning systems to alert people of impending shaking. The same principles can be applied to other types of early warning systems (such as tsunami) or to early warning systems using a different type of geophysical sensor (such as a seismometer instead of a GPS).

This demo is essentially a game that works best with a large audience (ideally over 30 people) in an auditorium. A few people are selected to be either surgeons, GPS stations, or a warning siren, with everyone else forming an earthquake "wave."

**Major concepts**

- When earthquakes happen, they radiate seismic energy as different types of waves.
- The farther you are from an earthquake, the longer it takes to begin feeling shaking.
- A network of GPS systems can be used to monitor the motion of the ground and how the earthquake waves are moving.
- Knowing when shaking will begin is important to the general public (in order to get to safety), infrastructure (to protect power stations or shut down public transportation), medical services (to halt on-going surgeries), and emergency personnel.

**Supplies**

- Mason jars with lids (the total number depends on the number of participants - with 50 people, we recommend 3 jars)
- Pencils (equal number to your total number of mason jars)
- Printed signs of GPS stations (again, the number depends on the number of participants - with 50 people, we recommend 5 GPS signs)

**Instructions for assembly**

- Arrange the audience such that they are sitting in a formation longer than it is deep.

**Leading the demonstration**

1. Begin by describing the types of earthquake waves and how the audience will simulate an S-wave (just like doing the wave at a sporting event). Practice a few waves.
2. Select surgeons and give these people a mason jar and pencil (representing a scalpel). It works best if the surgeons are scattered all throughout the audience and not just in one location.
3. Explain to the surgeons that it is their job to stop surgery (by opening the mason jar and dropping in their scalpel) before shaking arrives (in other words, when the person seated next to them

stands in the wave). The surgeons must keep their eyes closed until they know an earthquake is coming.
4. With the surgeons' eyes closed, silently start the wave. It is best to switch up from which end the wave starts so that the surgeons don't know when the wave will arrive at where they're seated.
5. Ask the surgeons what would have made it easier to stop their surgeries. They should answer along the lines of knowing when the earthquake is coming.
6. Now assign people to be GPS stations and one person to be the warning siren. As the wave goes by, participants that are GPS stations will stand and remain standing, holding their GPS sign high in the air.
7. Have the audience decide for themselves where the best position is for the GPS stations within the audience and how many GPS stations must detect the wave before sending out an alert, at which point the person selected to be the warning siren will start shouting "Warning, warning."
8. With the surgeons' eyes closed again, start another wave, but with the earthquake early warning system in place.
9. If the warning system wasn't effective, have the audience reconfigure the placement of the GPS stations and possibly the number of GPS stations needed to trigger a warning. Discuss how GPS configuration matters, and the pros and cons of the number of stations needed for a warning (e.g., triggering a false warning).

**Sample questions to consider**

- What would make it easier to stop medical or public services before an earthquake?
- How should the GPS stations in the earthquake early warning system be spatially configured?
- How many GPS stations should detect an earthquake before triggering a warning? Why would you want more than just one or two?