Ed G.'s Wave bending in the Earth Experiment for a large class room (150+)

I do this in a 220 student amphitheater classroom. The goal is to demonstrate that the fastest path for a seismic wave from an earthquake to a very distant recorder is a path into the interior of the earth, via a bent seismic wave path. It goes something like this:

1) I inform the students that we are going to do a classroom experiment, whereby we imagine every row of seats in the classroom is a layer in the earth; the rows in the front of the room are deep in the earth, the row in the back of the room is Earth's surface.

2) I ask students not to kill me, because students in the back rows need to come to the front to fill up any empty seats, if present (I know how students feel about the space they camp out in…). I emphasize that we can't have "holes" in the deep Earth (and joke about the movie 'The Core'), so we fill up every seat in the auditorium, from the front, towards the back until we run out of bodies. I note that the "surface" of the Earth has topography (since the last row(s) may not be filled up). Ask students that change seats to bring their belongings w/ them, and they can stay in their new seat for the remaining of the hour (so they don't need to change *again*.)

3) Ok, now we have a room filled from the front. I walk up the aisle and re-emphasize every row is a layer. I start at the front, and I count the rows out loud, pointing to it, telling students to know their row: "You guys are the center of the Earth, you are row 1, you're THE CORE!", continuing, "you are row 2", and so on to the surface.

4) I tell the students that they each have different properties. "The deeper rows are under incredible pressure from the weight of all the overlying rows. Thus seismic waves travel very fast through you. When you are vibrated by motion from an earthquake, the wave travels through you in a specific amount of time. Row 1: you count '1 Mississippi' for a wave to go through you. Row 2, you count '1 Mississippi 2 Mississippi' for a wave to go through you.' And so on. They are confused by now as to what this all means. I assure them it is okay, and the hang in there with me.

5) I inform them that the student in the back right corner of the room is the "earthquake". A wave via students touching neighboring students will start to propagate from the earthquake. And there are some rules about how this works, which are:

   - the "earthquake" student will start the experiment by touch students next to him/her.
   - as soon as you are touched, i.e., the first time you are touched, you count your property's time. That is, if you are Row 5, the first time you are touched, you count your 5 Mississippi's.
   - REMEMBER who the student that touched you first was.
   - ignore all subsequent times you are touched.
   - As soon as you finish counting your Mississippi's, touch every student that neighbors you (on each side, directly and diagonally in front of you and behind you).
   - then wait

6) I explain that as soon as the “seismometer”, our student in the very back on the left is touched, that student will stand up, and we are done. I ask who may not understand the rules (it’s a bit confusing, so some students will need to be reminded of things). I ask if everyone remembers their “property”, i.e., their wave speed, specifically, how long the count.

7) Tell the ‘earthquake’ student to go. He or she touches the neighbors, and it all starts. It’s awesome to watch from the front of the room. The activity is partly mayhem, but you will see the mayhem has a front to the wave, and it is moving towards the center faster that laterally along the low speed outer layers.

8) Within a minute or so, the ‘seismometer’ stands up. I yell “STOP, we’re done!”

9) I ask the seismometer to keep standing, and to point to the first person that touched her/him, and for that person to stand up. And then for that person to point to the first person that touched them, and for that person to stand up. And so on, right on back to the earthquake.

10) What everyone sees is a beautiful “ray path” that dove deep into the deepest Earth to get to the recording device as fast as possible. There are many many points one might choose to make. (I invite them to all sit down). I note this is not the shortest path. I point out that we watched the waves traveling and bouncing, much like they really do in the Earth, and that the “ray path” is just the fastest trajectory, but the waves are indeed traveling everywhere.

This is a really fun experiment! Do it and tell me how it goes. Afterwards, the students tell me it was worth changing seats to do it.