Earthquake Hazard Mapping

Objectives:

- Students will understand the relationship between surface geology and liquefaction
- Students will understand how seismicity and fault maps can be used to predict earthquake hazards in an area like the SF Bay Area
- Students will understand how earthquake hazard prediction is much more difficult in New England and how the mechanism for earthquakes in New England is not well understood

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San Francisco Bay Area

1. First show examples of surface geology in San Francisco Bay area. Have the students predict, based on this map, where the potential for liquefaction would be highest.
2. Show students the liquefaction susceptibility map and compare this map to their predictions. Discuss why the two maps are so similar.
3. Show students faults map and seismicity map and compare the two.
4. Discuss (1) where the earthquakes are, (2) the relationship between earthquakes and faults in the SF Bay area, (3) the potential for liquefaction close to earthquake-prone areas.
5. Show the earthquake shaking probability map and discuss its relationship to the fault map.
6. Review the cause-effect relationship here:

   Plate boundary → Faults → Earthquakes → Hazards, including Liquefaction

Boston Area

1. Earthquakes in the Boston Area

   It's essential at this point to explain to the students that, yes, there is a risk of earthquakes in the Boston area, and that, in fact, there have been some large earthquakes here in the past. To stress this point, you may want to use journal accounts of the 1755 earthquake, as well as newspaper articles of more recent quakes.

   What makes understanding the potential for earthquakes in our area difficult is that we don't live anywhere near a plate boundary. So the question remains, what is the primary cause of earthquakes in our area? This is a question that remains largely unanswered by geologists. There are old faults in the area, but it's not clear that earthquakes are necessarily associated with them.

   The key points are that (a) earthquakes do occur in this area, albeit more infrequently than, say, along the San Andreas fault, (b) although the cause is unknown, these earthquakes can (and will) cause damage. Understanding the geology of the area can help us (a) protect and prepare ourselves for the possibility of an earthquake, and (b) help us uncover the mystery of what causes these earthquakes.

   ?? → Earthquakes → Hazards, including Liquefaction

2. Show examples of surface geology in the Boston area. Have the students predict, based on this map, where the potential for liquefaction would be highest.
3. Show students the liquefaction susceptibility map and compare this map to their predictions. Discuss why the two maps are so similar.

4. Show students faults map and seismicity map and compare the two. In this case, contrasting with the same type of maps from the SF Bay area, the students will notice that the fault maps and seismicity maps don't correlate.
5. Show the earthquake shaking probability map. Have students compare that map to the fault maps of New England. They should notice that there isn't much visible correlation between the two; this underscores the point that geologists remain uncertain as to the cause of earthquakes in New England.
6. Compare the earthquake shaking probability map of New England to that of California. Explain to the students that the way the maps are created is very different. The New England map is created based on past events which are very sparse, whereas the California map has a great deal more data – challenge the students to think about which map is more reliable? If you were going to base the construction of a building on this information, in which area of the country would you be more likely to use this map?

Summary Presentation

A suggested way to have students synthesize this material is to have them create a presentation (this could be a poster, a PowerPoint presentation, a report) where they summarize the issues of earthquake hazards in New England. They should do a great deal of comparing and contrasting between California and New England. A component of their presentation should include what they learned about soils and buildings.