

TITLE:
EARTHQUAKES AROUND THE WORLD

SUBJECT:
Earth science

GRADE:
Middle school to high school

GOAL:
Students understand the concepts of plates and tectonic activity zones

OBJECTIVES:
Upon completion of this activity, students will:

- be able to point out on a blank world map some tectonic activity zones
- be able to identify some major cities in close proximity to tectonically active areas
- be able to identify some physiographic features which are related to tectonic activity
- be able to explain the relationship between earthquakes and plate boundaries

MATERIALS:

- ArcView 2.1 or above for Windows or Macintosh installed and operating, with one computer per two to four students
- Student Activity Pages from this document, one per student
- blank world outline maps, one per student
- contents of "LSNQUAKE" directory
 - "lsnquake.pdf" document
 - "lsnquake.apr" ArcView project
 - \data\world30: 30-degree grid from ArcView sample data
 - \data\cntry94: country boundaries from ArcView sample data
 - \data\cities: world cities from ArcView sample data
 - \data\etopo5.tif: georegistered image of coarse scale based on NOAA ETOPO5
 - \data\etopoleg.tif: image showing legend for "etopo.tif"
 - \data\neic.dbf: dBASE file of recent earthquake events, composed from press releases from the USGS National Earthquake Information Center
 - \data\plat_pol: generalized tectonic plates as polygons, constructed from various sources
 - \data\plat_lin: generalized tectonic plate boundaries, constructed from various sources

PROCEDURES:

- Teacher: Ask students to identify some places they know which experience earthquake on a frequent or substantial basis. Examples: California, Alaska, Japan, Mediterranean, etc. Have students pencil these in on their "practice maps" on the STUDENT ACTIVITY PAGE. Have students identify some major world cities which they feel may be subject to earthquake activity.
- Teacher: Have students engage ArcView and load LSNQUAKE.APR project on each computer. The project contains three views. VIEW 1 contains just the background (ocean) and the countries. VIEW 3 is just a legend.

3. Teacher and students: Follow the activities of the STUDENT ACTIVITY PAGE. The activity asks students to do some speculation, some guided exploration, some analysis, and some unguided exploration. It is important for students to "follow the script" up to the last item, which begins the unguided exploration.
4. Coordinate their exploration to highlight other class activities, seeking out features such as mid-ocean ridges or trench and mountain combinations.

EVALUATION:

1. With 10 minutes remaining, have students exit the project.
2. Distribute the empty world maps and have students shade in the zones of intensive earthquake activity. Have students note four major urban populations close to areas of intense earthquake activity.
3. Have students write a single summary sentence which explains the relationship they saw between the location of quakes and plate boundaries.

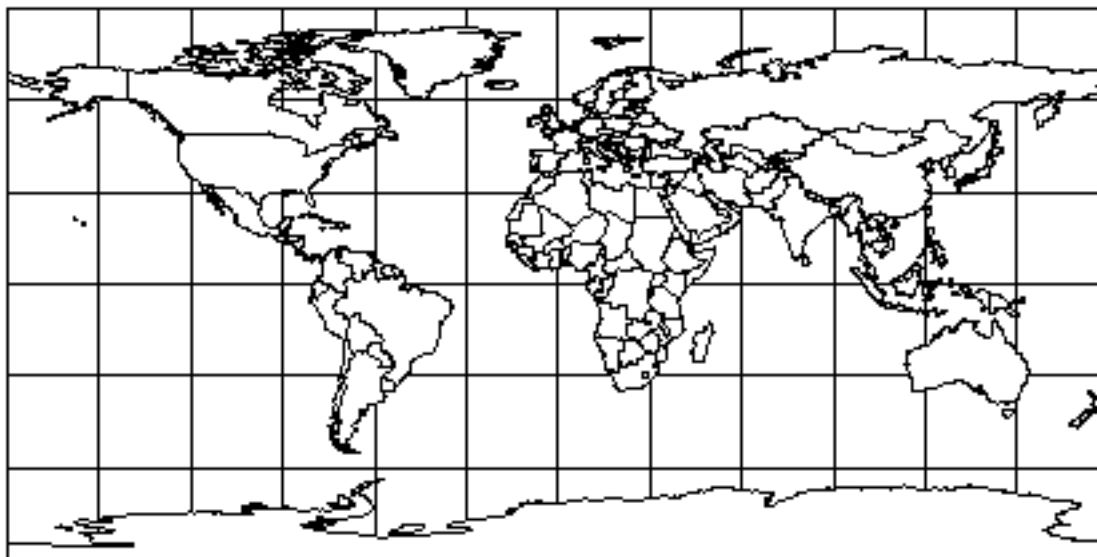
ENHANCEMENTS:

1. Change the map projection to focus on the "Ring of Fire" around the Pacific Ocean.
2. Integrate this exploration with locating and entering information about volcanoes.
3. Explore the smaller subdivisions of tectonic plates.
4. Have students explore the World Wide Web for earthquake information. See if they can find large data sets for quakes through the decades and centuries. Have them create tables that can be brought in and integrated with this map.

STUDENT ACTIVITY PAGE

NAME _____ CLASS _____ DATE _____

PRACTICE MAP



ARCVIEW INSTRUCTIONS:

ALL CLICKS ARE "SINGLE CLICK" UNLESS NOTED AS "DOUBLE CLICK."

"Make active" = focus the computer's attention on a theme by clicking one time directly on the name of a theme, so it looks "raised" in the list.

"Turn on/off" = click one time in the check box to the left of the theme name, making a check mark appear/disappear, so the theme displays or does not display in the map.

1. Complete the map above as instructed by your teacher.
2. Engage ArcView and load the project file LSNQUAKE.APR.
3. Consult with the other members of your group, and identify up to 10 areas that you think have lots of earthquakes. Use the GRAPHIC TOOL DOT (right end of TOOL BAR) to place dots on the 10 areas which you believe are the areas of strongest earthquake activity. (To move dots, use the GRAPHIC SELECT TOOL, near the left end of TOOL BAR. Click and hold on a dot and drag to a new site.)
4. Open VIEW 2. (From WINDOW menu, choose LSNQUAKE.APR to access the PROJECT window. Click the VIEWS BUTTON. Double click VIEW 2.) VIEW 2 contains oceans, countries, elevation (or depth), earthquakes, and cities.
5. Turn on the QUAKES theme. Make active the COUNTRIES theme. Click on the IDENTIFY TOOL (left end of TOOL BAR). Identify countries that have high earthquake activity. Close the IDENTIFY window.

6. Make active the WORLD CITIES theme, then turn it on. Click the TABLE BUTTON (middle of BUTTON BAR). Click on the field name POPULATION, so the field name darkens. Click on the SORT DESCENDING BUTTON (near the right end of the BUTTON BAR). How many cities are over 10,000,000 population?
7. Turn off the WORLD CITIES theme. Turn on the TOP 10 CITIES theme. Which of these ten most populous cities are near large numbers of earthquakes?
8. Turn off the TOP 10 CITIES theme. Turn on the ELEVATION theme. Open VIEW 3. (From the WINDOW menu, choose LSNQUAKE.APR to access the PROJECT window. Click the VIEWS BUTTON. Double click VIEW 3. This view is simply a movable legend for the elevation image in VIEW 2. Navigate between VIEW 2 and VIEW 3 using the WINDOW menu.) Is there any elevation pattern noticeable where there are large numbers of earthquakes?
9. On your own "practice map" (above Step#1), pencil in lines where you see strings of earthquakes. Try to look for global patterns and long lines. Compare your map with the maps drawn by others in your group. Which lines seem most obvious?
10. In VIEW 2, turn on the PLATE LINE theme. Do these new lines match the lines the lines you have drawn on your map?
11. Make active the QUAKES theme. Click the TABLE BUTTON (middle of BUTTON BAR). Scroll right to see the MAGNITUDE column. Click the field name so it turns dark gray. Click the SORT DESCENDING BUTTON (right end of BUTTON BAR). Scroll down to find the last quake of 7.0 magnitude or higher. Click on this quake to select it (turns yellow). Hold the SHIFT key on the keyboard, then click and drag up to the first quake of magnitude 7.0 or higher, selecting (they turn yellow) the biggest ones. How many quakes are magnitude 7.0 or higher?
12. Unselect (they are no longer yellow) the quakes (click the UNSELECT BUTTON near the right end of the BUTTON BAR). Close the QUAKES table. In VIEW 2, make active the QUAKES theme. Copy and paste this theme (EDIT menu, COPY THEME; EDIT menu, PASTE), and move the new QUAKES theme (click and hold on the name and drag downwards) next to the original. Turn off one of the two QUAKES themes.
13. For the QUAKES THEME that is "on," create a new theme definition (THEME menu, choose PROPERTIES, click the DEFINITION BUTTON at top left, click the QUERY BUILDER hammer-and-question BUTTON). Compose the definition "magnitude > 6.9" (in the FIELD box, double click "MAGNITUDE"; click the ">" symbol; use the keyboard to type "6.9"). Click OK. Change the theme name (top of the THEME PROPERTIES window) to "BIG QUAKES". Click OK again.
14. Use the LEGEND EDITOR to make the BIG QUAKES symbol a 10-point symbol. (Double click the BIG QUAKES theme name. Double click the dot symbol. At the bottom of the MARKER PALETTE, click the SIZE pull-down menu and choose 10. Close the MARKER PALETTE. Click APPLY. Close the LEGEND EDITOR.) Where are the biggest quakes happening? Open VIEW 1. How good were your guesses?
15. In VIEW 2, explore all themes on your own. Explore combinations and patterns. Look for relationships in smaller regions, too, by zooming in and out.