

TexNet Lesson Plan — Seismicity Across Texas

Grade Level: 9-12

Subject: Earth Science / Geology / Environmental Science

Duration: 60 - 90 minutes

Prepared by: Texas Seismological Network (TexNet), Bureau of Economic Geology

1) Overview

Students will explore real earthquake data from the TexNet Earthquake Catalog to answer the driving question: “What does seismicity in Texas look like?”. In small teams, students will investigate seismicity in distinct regions (DFW, the Eagle Ford, Midland Basin, and Delaware Basin), download earthquake data, visualize patterns using simple graphs, and analyze similarities and/or differences between regions, supporting with evidence.

2) Learning Objectives

By the end of the lesson, students will be able to:

1. Locate and describe major regions of seismic activity in Texas.
2. Query and filter the TexNet catalog to obtain recent earthquake data for a given region.
3. Create and label at least two basic visuals (e.g., Magnitude vs. Date and Event Count by Magnitude bin).
4. Interpret patterns (clustering, depth ranges, magnitude ranges, temporal changes) and connect them to geology and human activity.
5. Communicate their findings through a short writeup.

Success Criteria:

- I used filters to download relevant earthquake data.
- My graphs have clear titles, axis labels/units, and readable scales.
- My explanation uses evidence from the graphs and references geologic or human factors.



3) Materials & Tech

- Computers or tablets with internet access
- Spreadsheet software (Google Sheets, Excel)
- Projector/whiteboard
- Optional printed Texas map and regional geology/fault maps
- Website: TexNet Earthquake Catalog (<https://catalog.texnet.beg.utexas.edu/>)
- Teacher Slide Deck (optional): 3-5 slides with the driving question, regions map, and vocabulary

Low-Tech Fallback: Provide predownloaded CSVs and premade screenshots of maps/plots in case of connectivity issues.

4) Teacher Preparation

1. Open the TexNet Earthquake Catalog and test filters (date range, magnitude).
2. Decide whether you'll assign regions or let teams choose: DFW, Eagle Ford, Midland Basin, Delaware Basin.
3. Prepare a quick demo dataset (last 60-365 days, $M \geq 1.5$) as a backup.
4. Print/prepare the Student Investigation Sheet (included at the end of this document).

Pro Tip: To view station locations on the TexNet map, set the magnitude filter to a high value (e.g., 8-9) and lock it. This will display the stations while hiding seismic. Afterward, restore normal filters for data downloads.

5) Vocabulary and Common Misconceptions

Vocabulary: seismicity, magnitude, epicenter, hypocenter (focus), depth, fault, basin, induced seismicity.

Misconceptions to address:

- Bigger magnitude $\neq$ deeper earthquake.
- All earthquakes do not necessarily occur along the plate boundaries only; earthquakes can occur within the intraplate, either natural or induced.
- More seismic stations $\neq$ more earthquakes; more seismic stations can improve the detection efficacy. It does not reflect the actual seismicity rate.

6) Lesson Timeline (60 minutes)

Time	Phase	What students do	What teacher does
5 min	Engage	Quick think--pair--share: “Where would you expect earthquakes in Texas and why?”	Show Texas regions map; collect ideas on board.
10 min	Explore (Catalog Intro)	Navigate to catalog, see map, click events, try Play timeline.	Live demo: filters, event details, station overlay tip.
20-40 min	Investigate (Teams)	Choose/assign a region to teams; set filters (e.g., last 90-365 days, $M \geq 1.5$); download CSV; build graphs.	Circulate, coach on filtering, binning magnitudes, labeling graphs.
15 min	Explain/Analyze	Answer guiding questions; prepare a 2slide mini-share- or short poster.	Provide sentence starters; check for evidence--based claims.
10-20 min	Share & Reflect	Teams present.	Facilitate comparisons across regions; optional: connect to geology & human activity.

7) Step-by-Step Directions

A) Getting the Data (Teams)

1. Open the TexNet Earthquake Catalog.
2. Zoom to Texas; use Filters (left panel) to select a date window (e.g., last 90-365 days) and set Magnitude ≥ 1.5 (adjust if your region is sparse).
3. Click Download/CSV (or follow catalog instructions to export).
4. Optional: briefly show stations (magnitude 8-9 locked) to notice coverage differences.

B) Making the Graphs (Spreadsheet)

1. Magnitude vs. Date: Insert a bar chart; x-axis = Date/Time; y-axis = Magnitude.
2. Event Count by Magnitude Bin: Create bar size (e.g., bin width of the magnitude = 0.1 or 0.2). Use FREQUENCY/COUNT to present the statistics.
3. Optional: Depth vs. Magnitude scatter (x =Depth km, y =Magnitude). Discuss that depth is relative to ground surface.

C) Analyzing & Explaining

- Guiding Questions:
 - How many earthquakes occurred in your region during the time window?
 - What magnitude range is most common? Any outliers?
 - Do you see time periods of increased activity?
 - How deep are most events? Any clusters or trends?
 - Optional: How might geology (faults/basins) or human activity (e.g. injection and production) relate to the patterns?

C) Conclusions

1. Emphasize the importance of seismic monitoring in understanding natural and human earthquakes.
2. Investigate how TexNet program and its data contribute to public understanding of seismic hazards in Texas.

8) About the CSV Export (TexNet Earthquake Catalog)

The CSV you downloaded contains one row per event with fields for identification, when and where the earthquake occurred, how large it was, and quality/control information (e.g., how many stations contributed). For this lesson, students will mainly use the columns below.

Key columns for this lesson:

- **EventID:** Unique identifier for each earthquake in the TexNet catalog. Use it to trace an event back to the map/details page.
- **Evaluation Status:** Indicates the review level (e.g., Automatic, Reviewed, or Final). Encourage students to note whether results are automatic or have been vetted.
- **Origin Date:** Calendar date of the earthquake's origin (the time the rupture began).
- **Origin Time:** Time of the earthquake's origin (HH:MM:SS).

Tip: Combine Origin Date and Origin Time into a single timestamp for plotting:

- In Excel/Google Sheets use: =DATEVALUE([Origin Date]) + TIMEVALUE([Origin Time]), then format as Date-Time.
- **Local Magnitude:** Earthquake size on the local magnitude (ML) scale. This is the magnitude we'll plot and bin for counts.
- **Latitude (WGS84):** Epicenter latitude in decimal degrees (CRS WGS84 / EPSG:4326).
- **Longitude (WGS84):** Epicenter longitude in decimal degrees (CRS WGS84 / EPSG:4326).

- **Depth of Hypocenter (Km. Rel to Ground Surface):** Event depth in kilometers below the ground surface (positive values = deeper).

Important: The CSV also includes a depth relative to mean sea level (MSL). For this lesson, use the “Rel to Ground Surface” column to help students reason about earthquake depth relative to the surface.

Notes and classroom tips:

- Missing values (blank cells) can occur (e.g., moment magnitude). That’s normal! Stick to the columns above for this activity.
- Quality context: If students compare regions, have them check Evaluation Status to see whether they’re looking at automatic vs reviewed solutions.
- Units recap: Magnitude is unitless; depth is km; latitude/longitude are in decimal degrees.

12) Teacher Notes and Troubleshooting

- Sparse regions? Widen the date range or lower the magnitude threshold.
- Over-dense? Narrow the date range or increase M threshold.
- Remind students that depth is in km relative to ground surface.
- Encourage evidence-based discussion: correlation $\neq$ causation.

Acknowledgment

This lesson leverages public data from the Texas Seismological Network and Seismology Research (TexNet) at the Bureau of Economic Geology.