Name

TA

Geology 12

LG #3: Earthquakes

BIG IDEA: The plate tectonic theory explains the changes that occur within Earth and to Earth's crust throughout geological time.

Fundamental Knowledge (I know):

- Describe fault creep and elastic rebound as they relate to seismic activity.
- Describe the different earthquake waves: P, S, L & R.
- distinguish between magnitude and intensity.
- Compare and contrast Richter and Mercalli scales.
- Manipulate seismic data to determine distance, location and magnitude of an earthquake.
- Assess the seismic risks for a particular area using geographic location, topography, ground strength, rock types, proximity to faults, construction design.
- Evaluate methods of earthquake prediction.

Curricular Competencies (I can)

	Proficiency Scale Teacher and Student self assessment (Circle one)	**Example**	**Evidence (How do you know?)**
Formulate multiple hypotheses and predict multiple outcomes. Construct, analyze, and interpret graphs, models, and/or diagrams.	**Emerging (C-/C) Initial Understanding**	Completed Activity #1 – Journal with fundamental knowledge and vocabulary (in your words).	
	Developing (C+/B) Partial/Near Complete Understanding	Completed Activity #1 – Journal with fundamental knowledge and vocabulary (in your words with details). Completed Activity #2 – Earthquake Epicenter Triangulation. Completed Activity #3 – Earthquake Research.	
	Proficient (B+/A) Complete Understanding	Completed Activity #1 – Journal with fundamental knowledge and vocabulary (in your words, with details). Activity #2 & #3 are completed and well-organized with many details shown.	
	Extending (A+) Sophisticated Understanding		

Student Signature: **Teacher Signature:** **Date:**

Resources can be found at www.THSSscience.com
User: THSS
Password: science

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Learning Activities:

RESOURCES

1. Text: **Physical Geology & the Environment**

2. Online Resources: https://www.earthquakescanada.nrcan.gc.ca/, https://www.usgs.gov/programs/earthquake-hazards, https://sciencetrek.org/topics/earthquakes/resources

Activity #1: Journal

1. Refer to your text Physical Geology & the Environment Ch. 3 Earthquakes. **Read pages 65 to 101**.

You can also check out the online resources listed above and/or find your own to help research the definitions below.

2. In your journal:

- Define the following terms: *earthquake, elastic rebound theory, focus, epicenter, body waves, surface waves, P waves, S waves, Love waves, Rayleigh waves, seismograph, seismogram, intensity, Mercalli scale, magnitude, Richter scale, liquefaction, seismic sea waves.*
- Describe what causes an earthquake.
- Describe the differences between the two body waves (P & S) and the two surface waves (L & R).
- Describe how to determine the epicenter of an earthquake.
- Describe what the difference is between magnitude and intensity.
- List some of the different damages that earthquakes can cause.
- Describe the relationship between earthquakes and plate tectonics.
- Describe some of the methods that predict when an earthquake will occur.

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Activity #2: Earthquake Epicenter Triangulation

Objective: Determine the location of an earthquake's epicenter using triangulation techniques and S-P wave arrival times.

Introduction to Seismic Waves: When an earthquake occurs, seismic waves are produced. There are two main types of seismic waves:

P-Waves (Primary Waves): These are the fastest seismic waves and are the first to be detected by seismographs. *S-Waves (Secondary Waves)*: These waves are slower than P-waves and arrive second. The difference in arrival times between P-waves and S-waves is used to calculate the distance between the epicenter and a given location. The farther the epicenter is, the longer the time difference between the two waves.

Triangulation is a method used to locate an earthquake's epicenter by comparing data from at least three seismic stations. Each station records the arrival times of the fast-moving P-waves and the slower S-waves. The difference between these arrival times, called the S–P time, is used to calculate the distance from the station to the epicenter. On a map, a circle is drawn around each station with a radius equal to this distance. The point where all three circles intersect marks the location of the earthquake's epicenter (roughly near the center of the three distances).

Seismic Station Data:

Station	P-Wave Arrival	S-Wave Arrival	S-P Time (sec)	Distance to Epicenter (km)
Vancouver, BC	10:00:00	10:00:22		
Seattle, WA	10:00:05	10:00:23		
Calgary, AB	10:00:10	10:00:35		

Conversion Rule: Multiply S–P time (sec) × 8 km/sec to estimate distance to the epicenter.

Instructions:

1. Calculate S–P time for each station.
2. Multiply S–P time by 8 to get distance.
3. Plot each station on the provided map (Appendix 1). HINT – use the scale provided to calculate the radius for each of the distances from each city location.
4. Use a compass to draw circles from each station with the calculated radius.
5. The point where all three circles intersect is the earthquake's epicenter.
6. Mark and clearly label the epicenter on the map with a star-shaped symbol.

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Questions:

1. Why is triangulation more accurate with three stations?

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2. What are possible sources of error?

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3. What cities/regions would be most affected based on your epicenter?

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Activity #3: Earthquake Research

Research an earthquake that occurred in the last 100 years. In your write-up of the earthquake, discuss the following:

- Where and when did the earthquake occur?
- What was the magnitude of the earthquake?
- What plates were involved in the earthquake? What type of plate boundary is it? Discuss the geological situation that led to the earthquake occurring.
- What effect did the earthquake have on the people (intensity)?
- Were there any aftershocks? If so, describe them.
- Is this an area that experiences many earthquakes? What precautions did they take (or should have taken)?

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