A tsunami is a devastating ocean wave, sometimes over 30 feet high, that can cause terrible devastation to coastal areas in its path. Over 200,000 lives were lost to a tsunami in the Indian Ocean in December 2004.

This unit explores the causes of tsunamis and some ways to alert those in their destructive paths.
Part 1: Tsunamis: Causes and Effects

Pre-Listening Activities

Answer these questions with a partner.

- What do you remember about the 2004 tsunami?
- The epicenter, or point of origin, of the earthquake that caused the tsunami in the Indian Ocean was in Sumatra, Indonesia. Locate that on the map. Which other countries do you think were affected by this tsunami?
Find out what your classmates know about tsunamis and other natural disasters that occur in their countries of origin. Write your classmates’ name and any details they provide in the chart.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Name</th>
<th>Answers/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>What do you think are some possible causes of tsunamis?</td>
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<tr>
<td>Did you hear about the tsunami in the Indian Ocean in 2004? If so, what details do you recall?</td>
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<tr>
<td>Is your family originally from a part of the world where tsunamis occur?</td>
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<tr>
<td>Can you name the three most common natural disasters in your part of the world?</td>
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<tr>
<td>Have you ever personally experienced a devastating natural disaster?</td>
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<tr>
<td>What are some ways a government supports relief efforts for natural disasters around the world like the 2004 tsunami?</td>
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</tbody>
</table>
Writing: Summarize Class Results

How familiar are your classmates with tsunamis and other natural disasters? What sorts of natural disasters have they experienced? Write a few sentences that summarize your findings.

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Note-Taking Strategies

The Cornell note-taking system was devised in the 1950s, but it has become very popular in schools in the past decade. Divide your paper into two columns. The column on the right should be about six inches. As you listen to a lecture, take notes on the lines to the right. After you listen, look at your notes to see what key points and key terms are being used and write those in the two inches to the left. Finally, leave a little room at the bottom of the page to write a summary of the lecture. Use the Cornell note-taking system as you listen to the next lecture.
Lecture, Part 1: Tsunamis: Causes and Effects

Note-Taking Strategies

As you listen to Part 1 of the lecture, use this new technique to take notes. Some information has been given to you.

- 2004 brought 2004 tsunami—Indian Ocean
- tem. public 11 countries, over 200,000 dead
- attention

- Means harbor wave—Japanese
- Meaning of tidal wave misnomer (wrong name)
- ‘Tsunami’ Seismic wave misleading—not always earthquake

Show your notes to a partner. Is there anything you would like to add to your notes now?
Vocabulary Power

There are a number of terms and phrases in this lecture that you may encounter in other academic settings. Add at least five vocabulary items to your vocabulary notebook or log.

Match the words or phrases in bold from the lecture on the left with a definition on the right.

1. _____ I suppose that until 2004 when the horrible tsunami hit in the Indian Ocean, they weren’t really **on your radar screen**, were they?

   a. very difficult to understand
   b. geography of an area
   c. to be revealed or made evident
   d. to spread outward
   e. to be aware of something
   f. an inappropriate name for something
   g. giving the wrong idea about something
   h. the build up or gathering of something

2. _____ It also brought to the surface many of the other issues of natural disasters and their impact in developing countries, in particular the issue of disaster early warning infrastructures which are lacking in these countries.

3. _____ While tsunamis were sometimes referred to as “tidal waves” by the general public in the past, this is a **misnomer**.

4. _____ The scientific community often used the term “seismic sea wave,” but this is also misleading as it suggests that there is always an earthquake-related generation mechanism.

5. _____ They can **propagate** at extremely high speeds and travel transoceanic distances with limited loss of energy.

6. _____ The result is an **accumulation** of energy . . . we call this accumulated seismic energy.

7. _____ The distances these waves can travel is really **mind-boggling**.

8. _____ The **topography** of the coastline and the ocean floor will influence the size of the wave since the height of a wave is dependent on the depth of the sea floor.
So, most of the time, tsunamis are caused by earthquakes that are generated in a subduction zone—that’s an area where an oceanic plate is being forced down into the mantle by plate tectonic forces—as you can see here in Figure A, the mantle is just below the crust of the earth.

1. Earthquake starts tsunami

2. Tsunami waves spread

3. Tide gauge disabled

4. Figure A

5. Slow distortion
Checking Your Understanding: Details

Listen again to Part 1 of the lecture if necessary, and choose the best answer.

1. What does the lecturer say was true before 2004?
   a. The general public was well aware of tsunamis and their devastating destruction.
   b. Relief efforts for tsunamis were often in the news.
   c. Only countries like Japan knew the devastation of tsunamis.

2. According to the lecture, about how many people died in the 2004 tsunami?
   a. nearly a quarter million
   b. 100,000
   c. nearly half a million

3. Which of the following statements is true?
   a. Tidal wave is an appropriate term for a tsunami.
   b. Tsunamis can also be called seismic sea waves.
   c. Tsunamis are not necessarily caused by seismic activity.

4. What does the lecturer say can cause tsunamis?
   a. any sudden disturbance occurring on the ocean floor
   b. a large wind-generated wave
   c. an earthquake of any magnitude on land or sea

5. According to the lecture, what is true about solitary waves?
   a. They have properties very similar to wind-generated waves.
   b. They can move very long distances at incredible speeds.
   c. They do not tend to store significant amounts of energy.
6. According to the lecturer, what does the friction between two plates (overriding and underriding) do?
   a. It allows plates to move at a slow, even pace.
   b. It causes plates to get blocked.
   c. It does little of magnitude.

7. When is a tsunami provoked?
   a. when energy stored in an overriding plate is released over time
   b. when a solitary wave breaks in the ocean
   c. when an overriding plate snaps due to extreme pressure

8. What does the lecturer say about a “wave train”?
   a. It is affected by the tides.
   b. It occurs after the wave hits the shoreline.
   c. It is a series of solitary waves.
Pronunciation

Each multisyllabic word in English has one syllable with primary stress. The stressed syllable is longer and louder than the other syllables in the word. There are many ways to represent word stress patterns. In this book, we are using bubbles to show a pattern.

Word Stress and Reduced Vowels

In the word India, the first syllable takes the primary stress.

\[
\begin{align*}
\text{O o o} \\
\text{In-di-a}
\end{align*}
\]

Listen to your teacher say each country name, and write it under the appropriate word stress pattern. Two have been done for you as examples.

Bangladesh        India        Maldives        Sri Lanka
Kenya            Madagascar    Seychelles    Tanzania
Indonesia        Malaysia       South Africa    Thailand

<table>
<thead>
<tr>
<th>o O</th>
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<th>o O</th>
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<th>o o O o</th>
<th>o O o o</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>India</td>
<td></td>
<td></td>
<td>Bangladesh</td>
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</tbody>
</table>

Stressed Syllables | Unstressed Syllables
---|---
Carry primary stress and are longer and louder | Reduced to a neutral vowel sound—the schwa /ə/

Examples

<table>
<thead>
<tr>
<th>o O o</th>
<th>MA-lay-SIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ma-LAY-sia</td>
<td></td>
</tr>
<tr>
<td>KEN-ya</td>
<td>Ken-YA</td>
</tr>
</tbody>
</table>
In North American English, the unstressed syllables are often reduced to a neutral vowel called schwa /ə/, particularly at the end of words. Not all speakers do that with country names, but many will. Noticing these sounds will help your comprehension. Stressing one syllable more prominently will help you sound more comprehensible to others.

Listen and notice how the endings of these country names are reduced to the /ə/ sound.

Malaysia
Kenya

Listen again as your teacher pronounces these country names, and circle the vowels that are reduced. Two have been done for you as examples.

Bangladesh    Madagascar    South Africa
India         Malaysia       Sri Lanka
Indonesia     Maldives       Tanzania
Kenya         Seychelles     Thailand

Practice

Practice word stress and vowel reduction with country names and numbers.

As with countries, pay attention to your word stress when you say numbers.

O o O o

Six-ty thou-sand

Work with a partner to find the information that is missing from the Deadliest Tsunamis in History charts. One student should work with Chart 1 in Appendix B on page 176. The other student should use Chart 2 in Appendix B on page 177. Without looking at your partner’s paper ask each other questions to complete your chart. Compare your charts.
Part 2: Minimizing the Devastation of Tsunamis

Pre-Listening Activities

Part of the work of geologists is to develop ways to minimize the devastation of natural disasters such as tsunamis. The portion of the text provided addresses the dire consequences of tsunamis to the residents in their path.

Reading

Read, and look for evidence of regrets the scientists have about the 2004 tsunami.

Wave of the Future

(1) One of the most wrenching signs of the lack of readiness for the tsunami in the Indian Ocean was the enthusiasm of children, as reported by survivors, who rushed excitedly down to the beach during the initial drawdown of water to gather fish left suddenly stranded. Those children, their parents, and most everyone else in the ill-fated coastal communities struck that day had no idea what the sea’s strange retreat meant—namely, that it would be returning within minutes with unthinkable fury, bulldozing everything in its path.

(2) No one knew because nothing like that had happened in living memory. The last widely devastating tsunami in the Indian Ocean was that spawned by the eruption of Krakatoa in 1883, which killed 36,000 people. Disaster officials in the region understandably have focused on cyclones, floods, and other natural calamities that strike the region every year.

(3) Now, in the wake of one of the worst natural disasters in recorded history, their focus has broadened. Within days of the catastrophe, with the adage “better late than never” sitting heavily on everyone’s minds, commentators worldwide were calling for a tsunami warning system in the Indian Ocean akin to a successful one now operating in the Pacific. If such a system had been up and running in the Indian Ocean, experts agree that many of the thousands of lives lost in places relatively distant from the quake’s epicenter, such as Thailand, Sri Lanka, and India, might have been saved.
But setting up a truly effective warning system, one that can alert coastlines even as close to a tsunami’s birthplace as northwest Sumatra was last December, is a daunting task. In talking to a host of experts on tsunami detection and hazard mitigation, it’s clear that numerous challenges exist to ensuring that disaster officials are well-prepared for the next big tsunami—which, incidentally, could arise at any time off the coast of the United States as close as it was off Sumatra.

Vocabulary that Shows Emotion

There are many words and phrases in the reading that show how emotional this disaster was to everyone, scientists included. Match the words and phrases from the reading on the left with a definition on the right.

1. wrenching  a. proverb or saying
2. ill-fated  b. unbelievable power
3. unthinkable fury  c. overwhelming job
4. the adage  d. a multitude
5. a daunting task  e. sad and distressful
6. a host  f. unlucky
Discussion

Based on what you have read, what regrets do you think scientists might have had after the tsunami of 2004? Talk in a small group, and list some ideas.

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Answer this question with a small group.

• You are not geologists or specialists in the science of earthquakes, but from what you’ve learned in the lecture so far and from the reading, imagine what could be done to warn residents in high risk areas. Talk in your groups again and write your ideas. Be ready to share them with the class.

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Lecture, Part 2: Minimizing the Devastation

As you listen to Part 2 of the lecture, determine if the instructor addresses any of your ideas. Use the Cornell method of note-taking.

Review your notes, and write the key points and key terms you can identify in the left column. Write your summary for Part 2 of the lecture. Show your notes to a partner. Is there anything you would like to add to your notes now?
Vocabulary Power

There are a number of terms and phrases in this lecture that you may encounter in other academic settings. Add at least five vocabulary items to your vocabulary notebook or log.

Match the words or phrases in bold from the lecture on the left with a definition on the right.

1. _____ Had these people been warned of the **impending** strike, thousands of lives would have been saved.
   a. geography
   b. size and scale

2. _____ While the human reaction was to run in the direction of the shore to see what was happening, the animals **retreated** inland.
   c. move away or back from
   d. approaching

3. _____ They also need to map the seafloor **topography** as this has an impact on wave propagation.
   e. a crack or opening
   f. position

4. _____ . . . they cannot pinpoint the **alignment** of the rupture that is causing the earthquake.

5. _____ . . . they cannot pinpoint the alignment of the **rupture** that is causing the earthquake.

6. _____ When we hear about the report of on-land earthquakes, we seem to get an immediate report of the **magnitude** of the quake, right?
Listening

Checking Your Understanding: Details

Listen again to Part 2 of the lecture if necessary, and choose the best answer.

1. What is true about the tsunami in Sri Lanka?
   a. It frightened people away due to the exposed beach.
   b. It was announced well before it hit shore.
   c. It drew children and adults alike to the shoreline.

2. Which of the following statements is true?
   a. Humans and animals in Sri Lanka had the same reaction to the oncoming tsunami.
   b. Had humans reacted as some animals did, some lives may have been saved.
   c. Most people in Sri Lanka had been educated about the signs of an incoming tsunami.

3. According to the lecture, what happens when a tsunami reaches the shoreline?
   a. Normally exposed beaches are flooded.
   b. Normally unexposed beaches are exposed.
   c. The shore is exposed for several minutes.

4. What does the lecturer say the direction of alignment of two plates can do?
   a. It can tell scientists the direction a tsunami will travel.
   b. It can determine the distance a tsunami wave will travel.
   c. It can predict the intensity of a solitary wave.

5. With more information, what could scientists looking at the Sumatran earthquake have known?
   a. The rupture was on the east-west portion of the fault.
   b. The wave would move from east to west.
   c. The wave would hit different areas along the Indian Ocean at different times.
6. According to the lecturer, what is true about on-land earthquake magnitude?
   a. It is typically registered very quickly.
   b. It is registered at the same time as tsunami notification.
   c. It tells us little about the strength of a tsunami.

7. What is said about the Sumatran earthquake in 2004?
   a. It was at a magnitude that has always caused tsunamis.
   b. It was at a very low-risk magnitude.
   c. It was known to tsunami experts immediately after it occurred.

8. What does the lecturer say about early warning systems?
   a. They consist of a series of buoys for collecting data on the bottom of the sea.
   b. They have not yet been put to the test.
   c. They make use of a series of buoys that collect information at the surface of the ocean.
**Synthesizing: Projects and Presentations**

**Handling Informal Classroom Interactions (Video 2)**

Listen to the instructor talk about the upcoming exam. Discuss the questions in a small group.

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**Focus on Language**

1. What questions are asked by the instructor to clarify students’ understanding? **Note:** Don’t worry about writing the exact words.

2. What questions are asked by the students to get more information? **Note:** Don’t worry about writing the exact words.

3. Why did the student ask if today’s lecture is on the exam? Why is one question repeated?

4. What strategies do the speakers use to seek and give clarification?

5. What hesitation devices does the instructor use? How do you think this affects the communication? Do you have trouble understanding people who use hesitation devices? Do you use them? How can they help a discussion? Can they ever hurt a discussion?

6. The instructor uses the idioms *check that out* and *all set*. Discuss what these mean and express your opinion of their use by the instructor.
1. Are all of the questions meant to be answered? How can you tell?

___________________________________________________________________
___________________________________________________________________

2. The phrase I’m sorry is used three times. Discuss its meanings.

___________________________________________________________________
___________________________________________________________________

Focus on Nonverbal Communication

1. What does the instructor communicate nonverbally when the student repeats his question?

___________________________________________________________________
___________________________________________________________________

2. Is the nonverbal cue effective? Why or why not?

___________________________________________________________________
___________________________________________________________________

3. How do the students feel about the review session?

___________________________________________________________________
___________________________________________________________________
Summary

1. Based on this interaction, do you think the students are ready for the exam? Comment on language, tone, and nonverbal communication.

___________________________________________________________________
___________________________________________________________________

2. What do you like about the instructor’s communication? What do you dislike?

___________________________________________________________________
___________________________________________________________________

3. In some cultures, asking for clarification is inappropriate. How do you feel about asking for clarification? Is this a language difference that is challenging for you? Why or why not?

___________________________________________________________________
___________________________________________________________________
Reading

Read, and think about the solution the text proposes.

Creative Solutions: Engineers Design Tsunami-Resistant Homes

(1) Not long after the devastating December tsunami, a team of structural engineers from London visited Sri Lanka and noticed a trend as they surveyed destroyed homes: Walls facing the sea were leveled, while those perpendicular to it were standing.

(2) That inspired a group of researchers from the Massachusetts Institute of Technology and Harvard University to design what they’re calling a “tsunami-safe(r) house” that is less likely to collapse under wind and pounding surf.

(3) Instead of having four solid walls, the tsunami-resistant houses have thick concrete-block corners and exterior walls made of bamboo. The houses, about 80 of which have already been built, are designed to be built on top of blocks of concrete or wood, one or two feet above the ground.

(4) The design allows waves to wash through the bamboo walls while the concrete structure of the house remains standing, said Carlo Ratti, director of MIT’s Senseable City Laboratory.

(5) “Of course, you would have water in the house, and there is no way to avoid that, but the houses will be much more resilient,” Ratti said.

(6) Buro Happold, a London-based engineering firm, used computer models to show that the houses would be five times more resistant to a tsunami than Sri Lanka’s traditional homes.

(7) “When the wave comes through, the water flushes everything out, but the walls remain standing,” said Domenico del Re, a structural engineer at Buro Happold. The design is for a home measuring about 400 square feet that would cost roughly $1,200 to build. It was designed to be made from materials readily available in Sri Lanka.
Discuss the Idea

Based on what you read, discuss these questions about the proposed solution with a small group.

1. What problem does this solution propose to remedy?
2. How feasible is the solution proposed in this article?
3. What materials and resources are needed for this solution?
4. What are the benefits of this solution?

In-Class Group Project

You work for an NGO, a Non-Government Organization, that has offices in several developing countries. You have been given the task of developing a creative proposal for assisting with post-disaster relief efforts. You are assigned to small groups. Some possible topics are listed.

- Food relief
- Clothing and household items
- Rebuilding efforts for homes
- Rebuilding schools and government buildings
- Educating local populations on how to rebuild

<table>
<thead>
<tr>
<th>Brainstorming on Relief Efforts</th>
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</table>


Gather information. Some ways to collect information are listed.

- Interview experts.
- Do Internet research.
- Go to the library.

### Brainstorming about Collecting Information

After you have conducted your research and gathered all of your information, create a poster that includes:

- The problem you pose to solve
- Objectives of your project
- The steps you plan to take
- The resources that will be needed
- A timeline

You want to convince your audience that you have the best proposal. Your poster should be attractive, with short, catchy phrases, and visuals (pictures or charts). Before your in-class presentation, decide who is going to present which portions.
Evaluating Your Classmates

As you listen to the proposals given by your classmates, complete the chart. Don’t hesitate to ask for clarification if something is unclear to you about a proposal.

<table>
<thead>
<tr>
<th>Group 1:</th>
<th>Problem</th>
<th>Objectives</th>
<th>Steps</th>
<th>Resources and Timeline</th>
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<tr>
<td>Group 2:</td>
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<td>Group 3:</td>
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<td>Group 6:</td>
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Working in new groups, use your notes to evaluate the proposals you have just heard. Answer the questions.

1. What problem does this solution propose to remedy?
2. How feasible is the solution proposed by the group?
3. What materials and resources are needed for this solution? Are they accessible and affordable?
4. What are the benefits of this solution?
5. If you could choose only one project, which one would it be and why?
**Rapid Vocabulary Review**

From the three answers on the right, circle the one that best explains, is an example of, or combines with the vocabulary word on the left, *as it was used in the lectures.*

<table>
<thead>
<tr>
<th><strong>Vocabulary</strong></th>
<th><strong>Answers</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Synonyms</strong></td>
<td></td>
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<tr>
<td>misnomer</td>
<td>unsuitable name</td>
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<td>propagate</td>
<td>excel</td>
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<tr>
<td>accumulation</td>
<td>gathering</td>
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<tr>
<td>ill-fated</td>
<td>fortunate</td>
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<td>wrenching</td>
<td>disturbing</td>
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<tr>
<td>impending</td>
<td>ongoing</td>
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<td>magnitude</td>
<td>size</td>
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<td>rupture</td>
<td>crack</td>
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<tr>
<td>alignment</td>
<td>arrangement</td>
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<tr>
<td>topography</td>
<td>shoreline</td>
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</table>

**Combinations and Associations**

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<th>at</th>
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<td>is dependent _____</td>
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<td>waves can _____ aware</td>
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<td>die</td>
<td>travel</td>
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<td>in _____ particular</td>
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<td>accumulation</td>
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<td>a slow _____ magnitude pace</td>
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<td>tide</td>
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<td>extreme _____ shoreline</td>
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<td>properties</td>
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<td>dire _____ memories</td>
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<td>consequences</td>
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<td>within _____ minutes</td>
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<td>survivors</td>
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<td>is akin _____ to</td>
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<td>daunting _____ a sandwich</td>
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<td>a letter</td>
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<td>a problem</td>
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</table>
**Vocabulary Log**

To increase your vocabulary knowledge, write a definition or translation for each vocabulary item. Then write an original phrase, sentence, or note that will help you remember it.

<table>
<thead>
<tr>
<th>Vocabulary Item</th>
<th>Definition or Translation</th>
<th>Your Original Phrase, Sentence, or Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>underlying</td>
<td>fundamental, basic</td>
<td>causes underlying the problem</td>
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<td>be on a radar screen</td>
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<td>devastated</td>
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<tr>
<td>Vocabulary Item</td>
<td>Definition or Translation</td>
<td>Your Original Phrase, Sentence, or Note</td>
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Think about Your Learning

Evaluate how effective the different activities in this unit were for you. Consider how likely you are to use the skills and strategies when you practice on your own and when you are in other classes.

1. Note-taking using Cornell Notes
   
   5  4  3  2  1
   
   Very effective  Effective  Not very effective

2. Listening for and practicing word stress and vowel reduction
   
   5  4  3  2  1
   
   Very effective  Effective  Not very effective

3. Practicing asking for clarification
   
   5  4  3  2  1
   
   Very effective  Effective  Not very effective

4. Doing a group project and creating posters for a presentation
   
   5  4  3  2  1
   
   Very effective  Effective  Not very effective

5. Evaluating my classmates proposals
   
   5  4  3  2  1
   
   Very effective  Effective  Not very effective