

Sample Lesson

Why Doesn't the Leaning Tower of Pisa Topple Over?

In 1173, workers began building the bell tower of a beautiful new cathedral. The Field of Miracles, as the site was called, would be a symbol of Pisa's wealth and importance. But the heavy tower pressed down upon the shifting layers of sand, mud, and clay beneath it. This, along with changes in underground water pressure, caused the tower to tilt northward. After building just three floors, the workers abruptly halted construction.

Nearly 200 years later, the work finally began again. Over time, the Tower of Pisa had begun to lean southward. During the long delay, the soil underneath had hardened and compressed, causing the tower to lean in the opposite direction. With the ground being more solid, workers could finish the tower without facing a disaster.

The builders tried to straighten the tower by lengthening the columns on one side. This did nothing to straighten the tower but instead, gave it a slight banana-like curve. When completed, the structure was eight stories high. Many people considered it an architectural failure.

Over time, the tower tilted further and further. People feared it would topple over. In 1989, a tower in northern Italy collapsed without warning, killing four people. After that, Italian authorities closed Pisa's cathedral bell tower for the first time in its history. Visitors were no longer permitted to climb the eight stories to the top. Engineers, including John B. Burland, were hired to find a way to keep the tower upright. They were not permitted to use any visible supports. Nor could they rebuild any part of the tower.

Burland's team came up with a temporary fix. They attached counterweights to one side of the tower to balance it. The counterweights bought some time while engineers brainstormed a permanent solution. That solution was something called under-excavation. And it worked!

The workers extracted soil from beneath one side of the tower's foundation. This allowed the tower to tip about 19 inches in the opposite direction. Burland reported that the tower continued to correct itself for a time, tilting northward but at a much slower rate than ever before. He predicted that the tower may one day lean northward, as it had 800 years ago. But it would probably never topple over.

Today, electronic monitors record every movement of the tower, and engineers control underground water pressure. If the tower begins to slant dangerously, engineers already have a fix in mind.

The Leaning Tower of Pisa has lasted 800 years. It has withstood two world wars and four powerful earthquakes. Shifting soils and strong winds have not caused it to topple. This "architectural failure" is a tourist attraction that draws millions of travelers to Pisa, Italy. Now, the Leaning Tower of Pisa is considered an architectural triumph.



1. Choose four synonyms of the word, *leaning*.

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|-----------|----------|-------------|----------|
| tempering | tilting | lengthening | tipping |
| slanting | toppling | sloping | shifting |

2. From the context clues, you can tell that *extracted* means _____.

- | | | | |
|----------|----------|-----------|---------|
| obtained | believed | continued | removed |
|----------|----------|-----------|---------|

3. After nearly 200 years, builders were able to finish the tower without disaster because _____

4. How did engineers try to prevent the leaning tower of Pisa from toppling?

- _____ lengthened the columns on one side
- _____ tore down and rebuilt the tower
- _____ attached counterweights to one side of the tower
- _____ removed soil from beneath the tower's foundation
- _____ built highly visible supports all around the tower

5. What factors have threatened the Leaning Tower of Pisa?

- | | |
|-------------------------|--------------------------------------|
| _____ shifting soil | _____ cracking marble columns |
| _____ major earthquakes | _____ being overloaded with tourists |
| _____ world wars | _____ changes in water pressure |
| _____ strong winds | _____ lack of interest in saving it |

6. Why did people call the Tower of Pisa an architectural failure?

- A) Many people were killed during its construction.
- B) It withstood earthquakes, wars, and high winds.
- C) The completed eight-story building leaned southward.
- D) It became a symbol of Pisa's wealth and importance.

7. Today, people think of the Tower of Pisa as an architectural triumph. Why?

- A) Engineers watch it closely and are prepared to fix it again.
- B) The tower leans southward now, instead of northward.
- C) The tower has withstood various threats for centuries.
- D) all of these