



Smithsonian

From Grass to Bridge



Ben Nussbaum

Table of Contents


The Incredible Inka	4
A Connected Empire	6
Rebuilding a Grass Bridge.....	10
Other Inka Bridges.....	16
Spanning the World.....	20
A Bridge in DC.....	26
STEAM Challenge.....	28
Glossary.....	30
Index	31
Career Advice.....	32

The Incredible Inka

Hundreds of years ago, the Inka Empire was the largest empire on Earth. It stretched for more than 3,200 kilometers (2,000 miles) along the west side of South America.

The Inka were great builders. They had no iron or steel. They made palaces of stone and gold. They built cities on the sides of mountains. Their walls still exist in places that were part of their empire.

The Inka also used their building skills to create roads. Inka roads went up the Andes (AN-deez) Mountains and down into valleys. They crossed strong rivers. The roads let soldiers move quickly from place to place. People could send news faster. Farmers could bring food to big cities. Inka roads helped the empire run smoothly. The most impressive parts of the Inka roads were the bridges. Amazingly, some Inka bridges were made out of a simple resource. They were made from grass.



Some Inka structures are still standing.

This bridge connects two mountains in Peru.



A Connected Empire

The city of Cusco (KOOS-koh) can be found in Peru. Long ago, Cusco was the home of the Inka. At first, it was the only place the Inka controlled. Cusco was a city-state. There were many other city-states. Each one was like a small country. Each had its own leader.

Around 1400, the Inka wanted more land. Sometimes, they went to war to expand. Sometimes, other groups joined the Inka without war. The empire quickly took over a huge area.

The Inka built a vast system of roads. Together, all of these roads covered 40,234 km (25,000 mi.). That's enough to go from New York City to San Diego nine times.

The Inka Empire stretched between the west coast of South America and the Andes Mountains. It was long and skinny. Two main roads traveled north to south. One of these was near the coast. The other was in the mountains.



Cusco is still one of the largest cities in Peru.

The Inka did not use money. The government gave people food and clothes in exchange for goods and services.

Smaller roads connected the two main roads. Roads branched off toward many other places, too. Some were based on trails that existed before the Inka. The Inka created other roads themselves. The roads were designed based on the land around them.

In the desert, the roads were simple. The Inka marked paths and sometimes built low walls. They did not have to do anything else.

In the mountains, the Inka paved their roads. Snow and freezing cold would have destroyed simple roads. In hilly areas, they cut straight, flat roads. This took a lot of work, but it made walking easy.

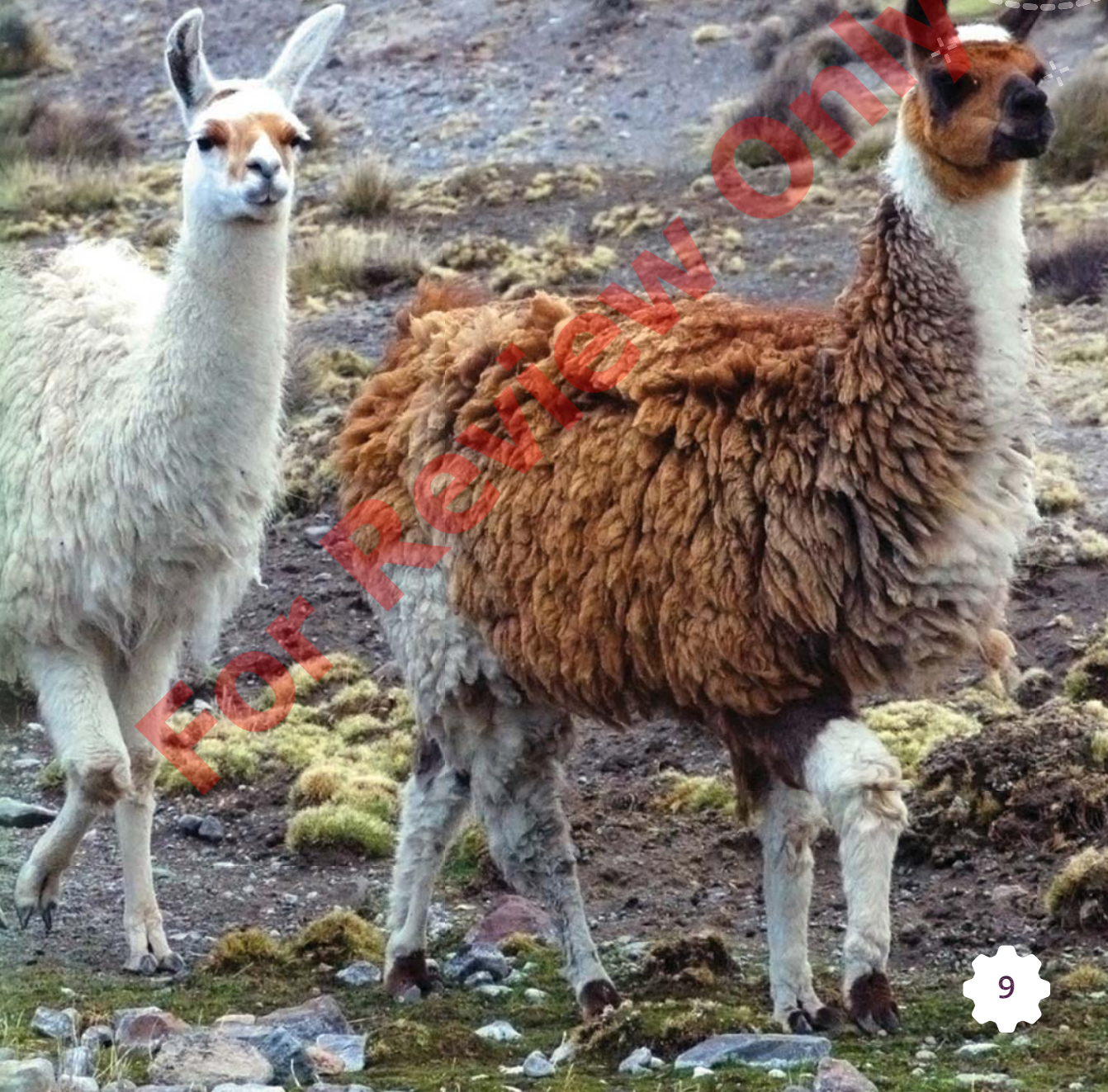
In many areas, the Inka built walls on either side of the road to keep it flat and wide. Many of these walls are still standing.

The Inka also built bridges. About 200 bridges let the roads cross over canyons that were too steep to climb down.





The Inka used **llamas** to carry heavy loads. Llamas have soft feet, so the roads did not suffer too much wear and tear.



STEAM CHALLENGE

Define the Problem

You are a civil engineer. The city planner seeks your advice on a new bridge. She has asked you to design a model of a bridge that will be used by cars, bikes, and travelers on foot. Use what you have learned about ancient and modern bridges to complete this task!



Constraints: The bridge must extend 7 inches. You can use 200 craft sticks and a roll of tape to build your bridge.



Criteria: Your bridge must be able to hold a textbook for 30 seconds.





Research and Brainstorm

What type of bridge will you build? Which part of a bridge must withstand the most force? Will you use all the materials available?



Design and Build

Sketch your bridge design. Include how many sticks you will use to build each part of the bridge. Where will you use the tape? Build the model. Make note of any changes you make to the plan.



Test and Improve

Test your bridge by setting a textbook on the bridge. Was the model successful? Did any part of the bridge fail during the test? How can you improve it? Modify your design, and try again.



Reflect and Share

Would more of either material improve the strength and stability? Could you make a successful bridge using fewer materials? What other forces do you think engineers consider when designing bridges?

