

Incas' secret world untangled



By Gene Sloan, USA TODAY

In Peru: Scientists are using laser-surveying techniques to measure Machu Picchu, the famed fortress city northwest of the Inca capital of Cuzco.

Archaeologists use high-tech tools to fathom ancient genius

By Dan Vergano

Hidden atop the Andes, the mysteries of the lost Inca Empire are yielding to today's technology.

"We're adding a symphony of instruments to our efforts, which lets us just see more than we ever imagined," says archaeologist Fred Limp of the University of Arkansas in Fayetteville. Archaeological advances and ongoing work in the Andes demonstrate the growing role of high-tech tools, he says.

Along the way, archaeologists are gaining a new appreciation for the elaborate Stone Age skills that allowed the Inca and their predecessors to rule Andean South America. A young empire snuffed out by the Spanish conquest in 1532, the Inca left behind monumental buildings and enigmatic knotted strings, thought to represent numbers and an undeciphered writing.

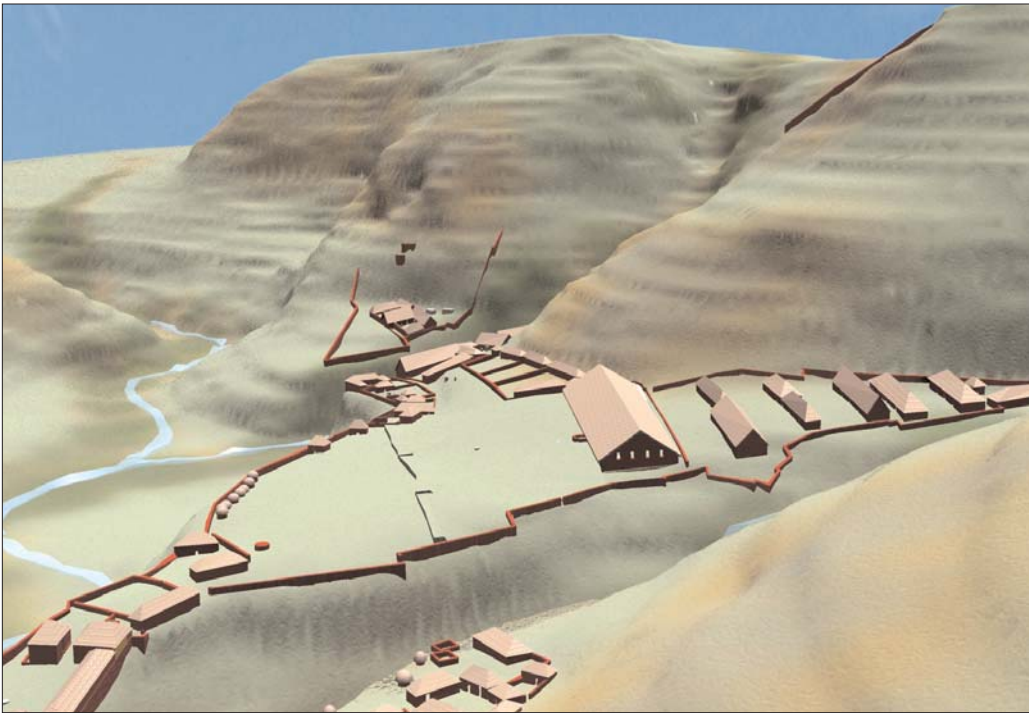
In August, a Harvard team using an innovative computer database showed how *kipu* (KEY-poo), the elaborate knotted strings used by the Inca, served as ledger books for their empire.

KEY

| | |
|----|---------------------------------------|
| R- | Reminds me of – |
| ✓ | I understand/ Confirms what I know |
| ! | Wow! Intrigues me |
| ? | Puzzles or confuses me |

(Thoughts go here)





Project Inkallakta

In Bolivia: Computer imaging is helping archaeologists reconstruct Inkallakta, allowing them to take a virtual walk through the 15th-century city's streets.

Archaeologists have long known that the Inca tallied numbers using *kipu* knot sequences, but they cannot interpret knot clusters that may be words. A computerized comparison of *kipu* hidden in the remains of a high-ranking Inca's home suggests those knotted cords held a tally of the empire's demands for tribute labor from a town called Puruchuco.

And the analysis may have identified the first definitive *kipu* "word," a separate knotted string pattern atop several *kipu*. The word may identify a place or official involved in the tally.

The cache of *kipu* from the Puruchuco site was uncovered in 1956 but was meaningless before the computer analysis, the research team reported in the journal *Science*.

Anthropologist Gary Urton of Harvard University and his colleague Carrie Brezine now have about 300 of the 700 catalogued *kipu* in a computer database. They hope that database will one day reveal a *kipu* whose numbers correspond to one of the Spanish conquistadors' documents known to have been taken from a *kipu* census. Unraveling the meaning of *kipu* from such a translation would tell scholars what meaning — whether it be llamas, labors or other tributes — is attached to the numbers on many other strings.

And it would provide a powerful new understanding of how the Inca ruled their mountainous empire, Urton says. From the capital, Cuzco, the 15th-century empire ruled from Colombia to Argentina at the height of its powers. Using *kipu* tallies, Inca rulers relied on a vast road system and bureaucracy to move food, people and materials over the Andes to various vassal cities.

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At the remains of one of those cities, Inkallakta (inkah-yahk-tah), in modern-day Bolivia, researchers are using another modern tool, computer-assisted design, to re-create virtual versions of the site.

"What's suggested, in fact, is that the city was likely a copy of Cuzco, and probably an important place," says Larry Coben of the University of Pennsylvania. He is part of the team excavating and creating a three-dimensional virtual version of the 15th-century site on a computer.

"It has been helpful in answering a lot of questions," he says, particularly in helping researchers visualize how it felt to live there. For example, an inexplicably large room with no door at the end of an alleyway clearly emerged as a pool at the end of a drainage canal when placed in context.

In Peru, Limp and colleagues are using laser surveying techniques to measure the Inca ruler's retreat at Machu Picchu. "A laser system gives us very detailed and precise measurements of an archaeological site," says Limp, who heads his university's Center for Advanced Spatial Technologies.

The real advantage for archaeologists comes from combining many technologies, tying satellite images to ground surveys, for example, in a package that scholars worldwide can compare and explore. Rather than having to travel, scholars can begin their research via computer, comparing ideas with others based on the same highly accurate reproductions of a site.

At Tiwanaku, a pre-Inca site in Bolivia 13,000 feet above sea level, a team of engineers, mathematicians, computer scientists and anthropologists also are putting technology to work. About 60 acres of stone-block buildings on the Western edge of Lake Titicaca, sometimes called the American Stonehenge, Tiwanaku has long defied archaeologists trying to figure why it was abandoned around A.D. 1000. Backed by a \$1 million National Science Foundation grant, the team hopes to re-create a 3-D model of the site, based on subsurface X-rays.

In Europe, surrounded by reminders of the Roman and medieval past, archaeologists are actually far ahead of their American counterparts in applying high-tech tools to their trade, Limp says. "But we're trying to change that."

In going high-tech, "archaeologists have to stop thinking like jacks-of-all-trades," Coben says. Instead, assembling specialists expert with each technology becomes a priority. "I am not a computer wizard, after all," he says. "But the potential this has to advance our knowledge in new ways is incredible. Right now we're just scratching the surface on what we'll find."

Reading Strategy: Metacognition

Directions: Metacognition is the term for thinking about thinking. When you are reading, it's the little voice in your head that tells you you've been daydreaming, or that you don't understand something. When proficient readers hear this voice, they go back and reread the section in question or look elsewhere for the information they need. Of course, most people don't even realize that they are thinking about thinking. It just comes naturally.

In this exercise, you will be listening to *your* inner voice. As you read the article, "Inca's secret world untangled," try to note when your voice says, "I'm confused" or "That's cool" or "That reminds me of the movie . . ." When you notice these thoughts, simply make the following marks in the margin.

- R-** Reminds me of – (Briefly state what the passage reminds you of, e.g., *R- movie - Raiders of the Lost Ark.*)
- ✓** I understand/Confirms what I know
- !** Wow! Intrigues me
- ?** Puzzles or confuses me

Make sure you read very slowly so that you can concentrate on your thinking. Also, feel free to interact with the text – i.e., to mark it up in any way you see fit.

After reading the article, transfer some of your thoughts to the graphic organizer below.

| R- Reminds me of. . . | ✓ I understand/Confirms what I know |
|---------------------------------------|---------------------------------------|
| Example 1: <hr/> <hr/> <hr/> <hr/> | Example 1: <hr/> <hr/> <hr/> <hr/> |
| Example 2: <hr/> <hr/> <hr/> <hr/> | Example 2: <hr/> <hr/> <hr/> <hr/> |
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| Example 2: <hr/> <hr/> <hr/> <hr/> | Example 2: <hr/> <hr/> <hr/> <hr/> |

Now, share some of your insights and questions with classmates. How easy was it to monitor your own thinking while reading? For what kinds of texts might this reading strategy be particularly useful? Do you think it improved your memory of the article?

Extension questions and activity for “Inca’s secret world untangled”

DISCUSSION

What mysteries are left over from the ancient Inca Empire? What methods are archaeologists using to learn more about this lost culture? What are *kipu*? Why are scientists trying to unravel their meaning? How could deciphering *kipu* help archaeologists gain a better understanding of how the Inca ruled their mountainous empire? What technologies are scientists using to survey various Inca sites? Why are European archaeologists more adept than their American counterparts at applying high-tech tools to their trade? Why do scientists want to learn more about ancient civilizations? In other words, what value is there in studying and analyzing the languages and cultures of the past?

ACTIVITY

In small groups, identify two artifacts that (along with other discoveries) could lead archaeologist to each of the following conclusions: The inhabitants of an ancient civilization: 1.) traded with members of other communities; 2.) worshiped many gods; 3.) were part of a vast empire that stretched for thousands of miles. Using the graphic organizer below, illustrate your idea and explain it in writing.

| | Illustration | Explanation |
|-------------------------------------------------|--------------|-------------|
| Traded with members of other communities | | |
| | | |
| Worshiped many gods | | |
| | | |
| Were part of a vast empire | | |
| | | |