NO PREP

The Future of Archaeology

AI, Drones, and Citizen Science

Includes: Student reading, case study, differentiated questions, teacher key

Name: Period: Date:

The Future of Archaeology: AI, Drones, and Citizen Science

Artificial Intelligence and the Digital Revolution

Archaeology is undergoing a technological revolution that is fundamentally changing how sites are discovered, excavated, and analyzed. At the center of this transformation is artificial intelligence. Researchers at institutions around the world are training AI systems to analyze satellite imagery and identify potential archaeological sites from space. These machine learning algorithms can scan thousands of square kilometers of landscape in hours, detecting subtle patterns in terrain, vegetation, and soil color that might indicate buried structures invisible to the human eye. Traditional methods of site identification, such as walking field surveys or manually reviewing aerial photographs, can take months or even years to cover the same area that

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tasks that traditionally required years of specialized expertise in epigraphy. DNA analysis has also been transformed by computational power. Massive databases of ancient genetic material allow researchers to trace migration patterns, identify family relationships within burial sites, and even determine what diseases affected ancient populations. The combination of AI with enormous datasets is enabling archaeologists to ask questions and find answers at a scale that would have been unimaginable just twenty years ago. Some researchers predict that within the next decade, AI will have identified more potential archaeological sites from satellite imagery than human surveyors discovered during the entire twentieth century.

Drones, LiDAR, and Remote Sensing

Unmanned aerial vehicles, commonly known as drones, have become essential tools in modern archaeological fieldwork. Equipped with high-resolution cameras, drones can photograph excavation sites from above, creating detailed orthomosaic maps that stitch hundreds of individual images into a single georeferenced aerial view. These maps allow archaeologists to track changes at a dig site over time with centimeter-level accuracy, making it possible to document each layer of an excavation far more precisely than traditional hand-drawn plans ever could. Drones are also significantly cheaper and more flexible than hiring helicopters or aircraft for aerial photography, which means that even small research teams with limited budgets can now produce professional-quality aerial documentation of their sites. A single survey-grade drone costing a few thousand dollars can replace aerial photography sessions that previously required chartering an aircraft at ten times the expense, and the drone can be deployed repeatedly throughout a dig season to capture progress at every stage of excavation. Some teams program drones to fly identical automated flight paths on a weekly schedule, producing time-lapse documentation that shows each excavation layer being removed in precise sequence. Beyond simple photography, drones can carry specialized sensors including thermal cameras that detect temperature differences in soil caused by buried walls or foundations, and multispectral sensors that identify variations in plant health indicating subsurface features. Perhaps the most powerful remote sensing technology is LiDAR, which stands for Light Detection and Ranging. LiDAR systems mounted on drones or aircraft fire millions of laser pulses at the ground per second. By measuring how long each pulse takes to bounce back, the system creates an extraordinarily detailed

three-dimensional map of the terrain below. The revolutionary aspect of LiDAR is its ability to penetrate dense forest canopy and reveal the ground surface beneath. In 2018, LiDAR surveys of the Guatemalan jungle revealed more than sixty thousand previously unknown Maya structures, including pyramids, palaces, fortifications, and raised highways connecting cities. This single survey reshaped scholarly understanding of the Maya civilization, suggesting a population several times larger than previous estimates. Similar LiDAR discoveries have been made in Cambodia, where laser scanning revealed vast medieval urban networks surrounding the temples of Angkor Wat, showing that the famous temple complex was just the ceremonial center of a sprawling city that had been completely hidden by centuries of jungle growth. These discoveries demonstrate that LiDAR has the potential to fundamentally rewrite the history of civilizations that flourished in heavily forested regions where traditional ground surveys were nearly impossible to conduct.

Citizen Science, Ethics, and Why Archaeology Still Matters

One of the most exciting developments in modern archaeology is the rise of citizen science platforms that allow ordinary people to contribute to real archaeological research. The most prominent example is GlobalXplorer, a platform created by archaeologist and National Geographic Fellow Sarah Parcak. Launched in 2017, GlobalXplorer presents users with small tiles of satellite imagery and asks them to identify features that might indicate looting, encroachment, or undiscovered archaeological sites. By crowdsourcing this analysis to thousands of volunteers, the platform can cover vast geographic areas far more quickly than any research team could alone. Users require no prior training, as the platform provides simple tutorials, and the collective decisions of many users produce remarkably accurate results. GlobalXplorer has already been deployed in Peru and India, where citizen volunteers have flagged hundreds of potential sites for professional follow-up investigation. In its first year of operation in Peru alone, more than fifty thousand volunteers from ninety countries reviewed over fourteen million satellite image tiles, demonstrating a scale of geographic analysis that no research institution could have achieved on its own. The platform deliberately withholds precise GPS coordinates from users to prevent looting, sharing only small anonymized tiles that cannot be geolocated without access to the underlying database. Other citizen science initiatives have engaged the public in different ways, such as the MicroPasts

platform, which recruits volunteers to help transcribe handwritten museum records, create three-dimensional models of artifacts from photographs, and tag archaeological images with descriptive metadata that makes them searchable in digital archives. However, the rapid advance of archaeological technology raises serious ethical questions that the discipline must confront. Who owns the data collected by AI and drones? Should ancient DNA be extracted from Indigenous burial sites without community consent? How can technology be shared equitably with archaeologists in developing nations where many of the most significant sites are located? There are also concerns about dual-use technology, where the same satellite imagery and AI tools that help archaeologists find sites could also be exploited by looters to locate and plunder them. Despite these challenges, the future of archaeology is bright. These new tools do not replace the careful, hands-on work of excavation and analysis. Instead, they amplify human expertise, helping archaeologists protect cultural heritage for future generations while uncovering stories about our shared past that might otherwise remain hidden forever.

Key Information: Emerging Archaeological Technologies

Technology	Application in Archaeology
Artificial Intelligence	Analyzes satellite imagery to detect buried sites and classifies artifacts
LiDAR	Uses laser pulses to map terrain beneath dense vegetation and forest canopy
Drones	Capture aerial photographs, thermal images, and multispectral data of sites
Ancient DNA Analysis	Traces migration patterns, family relationships, and diseases in past populations
GlobalXplorer	Citizen science platform where volunteers flag potential sites in satellite imagery
Natural Language Processing	Helps decipher damaged or incomplete ancient texts and inscriptions

Technology	Application in Archaeology
Thermal Imaging	Detects temperature differences in soil caused by buried walls or foundations

Case Study: A Discovery from the Couch

Sixteen-year-old Maya Chen was scrolling through apps on her phone when she remembered a presentation from her world history class about GlobalXplorer. She downloaded the app and started reviewing satellite image tiles of a region in southern Peru during a quiet evening at home. After completing the brief tutorial, Maya began tapping through tiles, marking most as showing no unusual features. On her forty-third tile, she noticed a faint rectangular discoloration in the soil surrounded by what appeared to be a pattern of small dots. The shape did not match natural terrain formations she had seen in previous tiles. Maya flagged the tile as a potential site of interest. Over the following weeks, her flag was independently confirmed by dozens of other GlobalXplorer users who reviewed the same tile. The platform's algorithm elevated the location for professional review. Three months later, a team of Peruvian archaeologists conducted a ground survey at the coordinates and discovered the remains of a previously unknown pre-Inca agricultural terrace complex with associated storage structures. The find was reported in a regional archaeology journal, crediting the GlobalXplorer community for the initial identification.

1. What made the GlobalXplorer platform effective at identifying this site even though Maya had no formal archaeological training?

2. What ethical considerations should archaeologists address when citizen science leads to the discovery of a new site?

Multiple Choice

1. What did LiDAR surveys of the Guatemalan jungle reveal in 2018?

    a) More than sixty thousand previously unknown Maya structures

    b) Ancient irrigation canals built by an earlier pre-Maya civilization

    c) Fossilized remains of extinct animals hunted by the Maya

    d) A network of underground Maya tunnels used for trade

2. What is the primary purpose of the GlobalXplorer platform?

    a) To train professional archaeologists in satellite image analysis

    b) To sell access to archaeological databases and artifact catalogs

    c) To allow volunteers to review satellite images and flag sites

    d) To create three-dimensional models of excavation sites for museums

3. Which ethical concern is raised by the use of AI and satellite imagery in archaeology?

    a) AI may replace all human archaeologists within the next decade

    b) Satellite imagery is too expensive for any university to afford

    c) Drones are banned in every country with major archaeological sites

    d) The same tools that find sites could help looters plunder them

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ LiDAR	A) Citizen science platform created by Sarah Parcak for crowdsourced satellite image review
2. ___ GlobalXplorer	B) Genetic material from past populations used to trace migrations and family relationships
3. ___ Drone	C) Question of whether site-finding technology could be exploited by looters to plunder discoveries
4. ___ Ancient DNA	D) Unmanned aerial vehicle used to capture aerial photos and carry specialized sensors over sites
5. ___ Ethical concern	E) Remote sensing technology that fires laser pulses to create 3D terrain maps through forest canopy

Fill-in-the-Blank

1. LiDAR can penetrate dense forest _____ to reveal the ground below.

2. The GlobalXplorer platform was created by archaeologist _____ Parcak.

3. Researchers discovered 143 new geoglyphs in the _____ Desert of Peru.

Short Answer

Answer each question in 2-4 complete sentences.

1. How does crowdsourcing on GlobalXplorer produce accurate results without trained experts?

2. Why was the 2018 LiDAR survey of Guatemala so significant for Maya scholarship?

3. Why is it important that new archaeological technologies do not replace traditional fieldwork?