WeTeach_AI

Deforestation and Machine Learning

Grade Level: **9-12** | Duration: **70 minutes** | Subject Area: **Environmental Science**

LESSON TABLE OF CONTENTS

Lesson Details

Launch

Exploration

Whole Class Discussion

Assessment

This lesson was designed for the WeTeach_AI **Advancing AI Literacy Project**. The project supports the development of standards-aligned AI literacy lessons written by teachers for teachers. Additional lesson plan material, such as rubrics, answer keys, activity guides, and instructional considerations can be found here on our website.

The contents of this digital lesson were developed by the Texas Advanced Computing Center (TACC) with the support of Google.org. However, the contents do not necessarily represent the policies of Google.

Lesson Author: Gary Leary, Science Department and Instructional Technology Chair

"I am a long time science teacher who has taught every subject we offer in Texas high schools and I'm also working on increasing the Tech opportunities at the school that I work at. Throughout this lesson series, I am hoping that students and teachers will be able to get an introduction to the idea of using machine learning to solve real world problems and to address issues using some of the same types of tools that scientists do."

Lesson Description

In this lesson, students explore how artificial intelligence (AI) and satellite imagery can be used to monitor deforestation. They begin by analyzing satellite images to identify forest loss over time and then train a simple machine learning model using Teachable Machine to classify land cover types. Through hands-on model building, testing, and evaluation, students gain insight into how AI systems learn from data and how human choices impact model accuracy. The lesson culminates in a whole-class discussion on the ethical and ecological implications of deforestation and the role of AI in supporting sustainable land management.

WeTeach_AI

Lesson Objectives

(formatted as "Students will be able to..." statements)

- Analyze satellite images to identify patterns of forest cover change over time.
- Train and test a basic machine learning model to classify land cover types.
- Evaluate the accuracy and limitations of AI models based on training data and design choices.
- Interpret spatial patterns of deforestation and propose informed solutions for sustainable land management.
- Reflect on the ethical implications of using AI for environmental monitoring and decision-making.

Essential Questions

1. *How can satellite imagery and AI help us detect and understand patterns of deforestation?*
2. *What decisions do humans make when training AI models, and how do those choices affect model accuracy and reliability?*
3. *What are the ecological and societal consequences of deforestation, and how can technology support sustainable solutions?*
4. *What are the strengths and limitations of using AI compared to human observation in environmental monitoring?*
5. *How can students use AI tools responsibly to analyze environmental data and propose informed actions?*

TEKS Alignment (Texas Standards Alignment)

Raster-Based GIS c.9A–9D:

- Identify and collect data necessary to evaluate a local problem.
- Develop a plan and project schedule for completion of a project.
- Create a GIS map using remote sensing images from NASA, NOAA, USGS.
- Evaluate map features to identify solutions to a problem.

WeTeach_AI

CSTA/ISTE Alignment (National Standards Alignment)	
CSTA	**ISTE**
3A-IC-24: Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices. **3B-AP-08:** Describe how artificial intelligence drives many software and physical systems. **3B-DA-05:** Use data analysis tools and techniques to identify patterns in data representing complex systems. **3B-DA-06:** Select data collection tools and techniques to generate data sets that support a claim or communicate information.	**1.1.c:** Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways. **1.3.d:** Build knowledge by exploring real-world issues and gain experience in applying their learning in authentic settings. **1.5.d:** Understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions. **1.7.b:** Use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.

Effective Pedagogical Strategies

The instructor deliberately cultivates a classroom community that recognizes, respects, and includes the voices, ideas, needs, and perspectives of all students.	Curricular content is presented following a trajectory that begins with less complex topics and increases complexity with time. “Low-floor, high-ceiling” activities are encouraged.	The instructor provides opportunities for students to collaborate. Curriculum includes accurate coverage of interdisciplinary topics used in framing (e.g., historical events, groups, science topics, etc.).	Real-world applications and problems allow students to explore structures of power, assess for bias, and provide thoughtful responses that examine those structures and biases.

AI Literacy Competences

(based on TeachAI Framework)

Designing AI: 1. Describe how AI systems can be designed to support a solution to a community problem.

Designing AI: 3. Collect and curate data that could be used to train an AI model by considering relevance, representation, and potential impact.

WeTeach_AI

Designing AI: 4. Evaluate AI systems using defined criteria, expected outcomes, and user feedback. **Designing AI:** 5. Describe an AI model's purpose, its intended users, and its limitations.

Engaging with AI: 6. Analyze how well the use of an AI system aligns with ethical principles and human values. **Managing AI:** 2. Decompose a problem based on the capabilities and limitations of both AI systems and humans.	**Managing AI:** 2. Decompose a problem based on the capabilities and limitations of both AI systems and humans. **Managing AI:** 4. Delegate tasks to AI systems to appropriately automate or augment human workflows.

Key Terms	
Term	**Definition**
Change Detection	Finding differences in something by comparing it over time, like spotting changes in forests using satellite images.
Environmental Monitoring	Tracking things like air, water, and soil to understand how the environment is changing and how humans affect it.
Land Cover	What's physically on the Earth's surface—like trees, water, buildings—not how people use the land.
Machine Learning	Technology that helps computers learn from data and make predictions or decisions without being told exactly what to do.
Model Accuracy	Evaluated during testing and discussed in whole-class reflection
Sustainable Land Management	Using land in ways that protect nature and meet human needs now and in the future.
Training Data	Students collect and label images for model training.

WeTeach_AI

Launch

Engaging activity or prompt to introduce the lesson. **Estimated time: 15 minutes**

Objective: Activate prior knowledge of machine learning from previous lessons and introduce Google's Teachable Machine as a tool for building and testing image classification models related to deforestation.

Materials Needed:

- Projector or screen to display Teachable Machine interface
- Devices with internet access for students
- Tutorial videos on using Teachable Machine (linked in lesson resources)

Videos for the activity:

- Teachable Machine Tutorial 1: Gather
- Teachable Machine Tutorial 2: Train
- Teachable Machine Tutorial 3: Export

Teacher Instructions	Sample Teacher Remarks
Introduce the machine learning model training process Pose a real-world scenario: *"Imagine you're working with a global team to build an AI that can detect illegal deforestation from satellite images. What would your model need to learn? How would you teach it?"* Introduce Google's Teachable Machine: - Explain that it's a simplified tool for training image, sound, or pose recognition models. - Show the interface and walk through the basic steps: uploading images, labeling classes, training the model, and testing predictions. - Emphasize the importance of creating a default class and adjusting essential settings (e.g., image size, number of epochs). - Play all 3 tutorial videos to guide students through the setup. Invite students to explore the tool hands-on, testing the system with their webcam following the instructions provided in the videos.	*"Today we're going to learn how machine learning models are trained — and how they can help us detect deforestation.* *Imagine you're part of a global team trying to stop illegal logging. You have thousands of satellite images. How could you teach a computer to recognize forest loss?* *We'll use a tool called Teachable Machine. It's a simple way to train a model to recognize patterns in images. You'll upload examples, label them, and let the computer learn.* *As we go through this process, think about what decisions you're making. What images are you choosing? How many examples do you need? These choices affect how well your model works — and whether it can be trusted to make real-world decisions."*

Anticipated Student Outcomes

- Students recall key concepts from previous ML lessons (e.g., computer vision, environmental monitoring).
- Students understand how to use Teachable Machine to build a simple image classifier.
- Students recognize the connection between model design and real-world applications like deforestation monitoring.

Exploration

Step-by-step student tasks, experiments, or investigations. **Estimated time: 35 minutes**

Objective: Guide students to create visual representations of forest cover changes over time by analyzing satellite images, aligning them accurately, and mapping deforestation patterns.

Materials Needed:

- Access to Teachable Machine
- Devices with internet access
- Sample images or student-created datasets from previous lessons
  - **Note**: *You may select your own images or use the sample images provided in lesson 2's resources*
- Optional: Google Earth or other online sources for image collection

Teacher Instructions	Sample Teacher Remarks
Divide students into small groups (3–4 students per group). Explain that their goal is to train a basic AI model to recognize different land types using images. Provide students with the following steps: 1. Define Classes (5 minutes) a. Each group selects 3–5 land cover categories (e.g., Forest, Urban, Water, Agriculture). 2. Collect/Prepare Training Images (10 minutes) a. Option A: Use pre-selected images provided by the teacher. b. Option B: Students find their own images using Google Earth or other sources.	*"You're now acting as AI trainers! Your job is to teach a model how to recognize different types of land cover.* *Think carefully about the images you choose — the model will learn from these examples. If your training images are too similar or unclear, the model might struggle to make accurate predictions.* *Once you've trained your model, test it with new images. Does it work well? What might improve its accuracy? These are the same kinds of questions scientists ask when building models to monitor deforestation."* ***Anticipated Student Outcomes*** - Students successfully train a basic ML model using labeled image data. - Students observe how training data affects

3. Upload Images to Teachable Machine (5 minutes) 4. Train the Model (5 minutes) a. Click “Train Model” and observe the training process. 5. Test and Evaluate (10 minutes) a. Use new images to test the model’s predictions. Discuss accuracy and possible improvements. Circulate among groups and prompt students to reflect on what the model is learning and how their choices affect its performance.	model performance. - Students begin to understand the relationship between human decisions and AI accuracy. ***Potential Missteps*** - Poor image selection or inconsistent labeling leading to inaccurate model predictions. - Misinterpreting model outputs without considering training limitations. - Overconfidence in model accuracy without testing with diverse examples.

Whole Class Discussion

Discussion questions, teacher prompts, and expected student responses. **Estimated time: 15 minutes**

Objective: Reflect on the machine learning model training experience and connect AI-based deforestation detection to broader environmental impacts and sustainable solutions.

Materials Needed:

- Deforestation case studies and data sets (provided in lesson resources)
- Discussion prompts (can be displayed or distributed)
- Student-trained models (Teachable Machine outputs)

🔍Model Evaluation (5 minutes)

Teacher Instructions	Sample Teacher Remarks
Invite volunteers to briefly share: - Their chosen land cover classes - How accurate their model was during testing - Any challenges they faced during training or testing Facilitate a discussion around model limitations: - What factors affected accuracy? - How does the need for large, high-quality datasets impact real-world AI applications? - What are the risks of relying on AI for environmental monitoring?	*“Let’s start by reflecting on your models. How accurate were they? What challenges did you face when training and testing them?* ***(pause for student responses)*** *Think about what this tells us about using AI in real-world situations. What happens when the data isn’t complete or the model makes a mistake?”*

Sample Student Responses

- *"Our model struggled with distinguishing between forest and agriculture because some of the images looked really similar."*
- *"We didn't have enough images for each class, so the model didn't learn the patterns well."*
- *"Lighting and resolution differences in the images made it harder for the model to predict correctly."*
- *"It means scientists need to collect a lot of clear, labeled images before they can even start training a model."*
- *"If the data isn't good, the AI might make wrong predictions, which could lead to bad decisions."*
- *"In places with limited satellite coverage, it might be hard to get enough data to train a reliable model."*
- *"AI could miss important changes if the data is outdated or incomplete."*
- *"If the model is biased or trained incorrectly, it might ignore deforestation in certain areas."*
- *"People might trust the AI too much and not double-check its results, which could be dangerous."*

🌳Deforestation Analysis & Solutions (10 minutes)

Sample Teacher Remarks: *"Now, let's shift to the bigger picture. Based on the deforestation data and case studies, let's discuss what you think are the biggest threats to biodiversity and ecosystem health."*

Display or distribute deforestation case studies and data, provided in the lesson's resource list. Guide students through a high-level discussion using the below discussion questions:

Sample Discussion Questions	Sample Student Responses
1. What are the most significant impacts of deforestation on biodiversity and ecosystem stability?	*"Animals lose their habitats, which can lead to extinction. Deforestation affects the water cycle and can cause soil erosion. It reduces the number of trees that absorb carbon dioxide, which worsens climate change."*
2. What patterns did you notice in the case studies?	*"In some regions, forest loss increased after new farms or towns were built."*
3. What informed solutions can we propose for sustainable land management?	*"We could use satellite data to monitor forests and respond quickly to illegal activity."*
4. How can AI and remote sensing support these solutions?	*"AI models can predict where deforestation might happen next, so we can prevent it."*

If time is limited or the class size makes whole-group share-outs challenging, consider these alternative formats:

- **Gallery Walk:** Post each group's maps around the room. Students rotate in small groups, viewing others' work and leaving sticky-note comments or questions.
- **Pair-and-Share:** After completing maps, groups pair up and share findings with one other group instead of presenting to the whole class.
- **Quick Highlights:** Ask each group to share just one key observation or surprising pattern in a rapid-fire format (30 seconds per group).
- **Digital Upload:** If technology allows, have groups upload links to their models to a shared platform (e.g., Padlet, Google Slides) for asynchronous review and discussion.

Assessment

Formative or summative assessment tasks and criteria. **Estimated time: 5 minutes**

Objectives: Assess students' understanding of how AI, satellite imagery, and GIS tools contribute to environmental monitoring and decision-making. Encourage reflection on key takeaways from the lesson.

Materials: An exit ticket or digital form for individual responses

Assessment Opportunities	Facilitation Tips
Exit Ticket – Deforestation and Machine Learning Insights Provide the following prompts: *"What are your top 3 takeaways from today's lesson about deforestation and AI? Think about what you learned from training your model, analyzing satellite images, and discussing real-world impacts."* If you have additional time, consider these deeper assessment activities: Prompt: "*What did you notice about how AI sorted images compared to how you did it? What does this tell you about the strengths and limitations of automation?"* Submission Options: - Short paragraph or bullet-point reflection - Think-Pair-Share followed by a written summary	Use sentence starters to support students who need help expressing their thoughts: - "One thing I learned about AI is..." - "A challenge we faced was..." - "This lesson helped me understand that deforestation..." - "If I were designing an AI tool to help the environment, I'd make sure it..." Encourage students to reflect not just on what they learned, but how they learned it — through human observation, group collaboration, and AI experimentation. Consider collecting responses anonymously to promote honest reflection. Use student responses to guide future lessons on: - Environmental ethics - Data literacy

- Optional digital form or discussion board post	- AI bias and transparency - Sustainable technology applications

Extension Ideas:

- Have students write a short blog-style reflection or infographic summarizing their learning.
- Facilitate a mini-debate: “Should governments rely on AI to monitor deforestation?”
- Ask students to sketch a concept for an AI-powered tool that supports sustainable land management.

☑️Use the rubric provided in this lesson’s resources to assess student reflections.