5E STEM Invasive Species Impact on Biodiversity Unit Plan with Integrated AI Elements

(7-8 Days)

Authors

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SUBJECT/GRADE LEVEL

Subject Area: Science

Grade Level: Middle School

Materials

- Computer for module work & individual research
- PAL3 Invasive Species & AI Module
  - Sites for use in class (included in PAL3 module but listed in resources below)
- Access to graphic design apps canva for digital poster creation (example: canva)
- Webcam
- Option 1 for Elaborate: Devices to take pictures
- Optional 2 for Elaborate: Biome Species Pictures sorted into each biome with both invasive and native images
  - Invasive & Native Biome Exploration Pictures
- Invasive Species Poster Assignment & Rubric

- Plan for a class of 30 students.

STANDARDS

Next Generation Science Standards

- MS-LS2-4
  Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- MS-LS2-5
  Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS- ETS1.A
  Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

English Language Arts Standards | Common Core State

- **CCSS.ELA-LITERACY.W.7.9**
  Draw evidence from literary or informational texts to support analysis, reflection, and research.

LESSON OBJECTIVE(S)

Students will be able to explain with evidence how invasive species affect populations of other species within ecosystems.

Students will be able to describe how artificial intelligence and machine learning are being used as a design solution for maintaining biodiversity and ecosystem services in fighting invasive species.

Students will be able to explain the problem that invasive species pose to native populations and offer a design solution idea to help fight these invasive species incorporating how innovative STEM technologies can be used within the fight.

Lesson Description

Within this unit, students will work on Invasive Species and an AI module on PAL3--Personalized Assistant for Lifelong Learning (a program designed by the Learning Sciences Department at The Institute for Creative Technologies). This module will integrate web-based resources, multiple choice, and Open Tutor (an AI tutor interactive chat) to learn all about how innovations in AI and Machine Learning are helping to fight invasive species. Students will explore how AI/Machine Learning work. They will then learn about invasive species and the impact these have on native populations of species and how AI/Machine Learning is being used as a design solution in the fight against invasive species. Students will have a chance to train Google's Teachable Machine to recognize invasive and native species before doing research on a specific species. With their research, they will create a digital poster to explain the impacts this specific invasive species is having on native populations in the area it has been found in. They will develop an idea about how AI, Machine Learning, or other technologies could be used as a design solution in rapid response to this invasive species.

CAREER CONNECTION(S)

Mentor Background: Dr. Benjamin Nye

Dr. Benjamin D. Nye is the Director of Learning Sciences at USC-ICT. Ben's major research interest is to identify best-practices in advanced learning technology, particularly for frontiers such as AI in distributed learning technologies (e.g., cloud-based, device-agnostic) and socially-situated learning (e.g., face-to-face mobile use).

His research interests include modular intelligent tutoring system (ITS) designs, modeling social learning, cognitive agents, and educational tools for the developing world and low-resource/low-income contexts. He received his Ph.D. in Systems Engineering from the University of Pennsylvania in 2011, and served as a Research Assistant Professor with the University of Memphis Institute for Intelligent Systems prior to joining USC.

More bio information can be found here:
https://ict.usc.edu/about-us/leadership/research-leadership/benjamin-nye/

STEM Careers: Artificial Intelligence Scientist, Data Scientist, Computer Scientist: Software Engineering

ENGAGEMENT (⅓ Day)

Brief Description: **Introduction to Teachable Machine**

Procedures:

Students will work through a PAL3 module that introduces and explains machine learning to them using Google's Teachable Machine. Students will watch 4 short videos explaining what it is and how it works and answer a multiple choice question to go along with each video.

Google's Teachable Machine: https://teachablemachine.withgoogle.com/train/image	
Video: What is Teachable Machine, & how does it work?	https://youtu.be/T2qQGqZxkD0?si=Qtnnh6lkO3qRL39T
Video:Gather	https://youtu.be/DFBbSTvtpy4?si=YabchW7D6AP030Ew
Video: Train	https://youtu.be/CO67EQ0ZWgA?si=uqNR2VZSDykbZ9EF
Video: Export	https://youtu.be/n-zeeRLBgd0?si=ycAtbJrpnHhmwHTu

EXPLORATION (⅔ Day)

Brief Description: **Maui Fires, Zebra Mussels, etc Invasive Species Mini Lesson on Pal3**

Procedures:

Students will read the article "Invasive Plants Brought to Maui by Colonists Helped Fuel the Wildfires" on the PAL3 module and answer a series of multiple choice questions to demonstrate their understanding of the invasive grasses and how they contributed to the Maui wildfires. Students will then watch 4 short videos: "The Invasion: A Case Study on the Hudson River" to learn about the problem with Zebra mussels in the Hudson River. Each short video will include a multiple choice question to check for understanding.

Video: Part 1: The Problem	https://youtu.be/xARjHpZf728
Video: Part 2: Observation	https://youtu.be/KpFa0b9FpEI?si=10GsZWJzByYda-lD
Video: Part 3: The Short-Term Impact of the Zebra Mussel Invasion	https://youtu.be/zXpyRwWBPdc?si=YafjCtQ7pNAydGaD
Video: Part 4: Long-Term Monitoring of the Hudson River	https://youtu.be/NQ-HMfB6Vo0?si=U2aCyAk8dSkis3zv
Saiwa Article: "Critical Role of Invasive Species Monitoring and Management"	https://saiwa.ai/blog/invasive-species-monitoring/

EXPLANATION (1-2 Days)

Brief Description: **Using AI to Manage Invasive Species**

Procedures:

On the PAL3 module, students will read an article from Saiwa: From Vision to Innovation entitled "Critical Role of Invasive Species Monitoring and Management" and answer a couple multiple choice questions on how and why scientists monitor invasive species using AI and Machine Learning.

ELABORATE (1 Day)

Brief Description: **Teachable Machine: Native vs Invasive Species**

Procedures: There are two options for this portion of the lesson. *Have students go back onto the PAL3 module to review how to use Teachable Machine if they need a refresher. They can click the Robot AI in the top right corner to ask questions.

Option 1: Local Environment Exploration

Students can take personal devices or class ipads out around the school environment to take pictures of species in the environment. Students will take the pictures then using Google Lens, identify what the species are and if they are native or invasive. Students can even take pictures of fake items outside to label as “invasive” if no invasive species are found on the grounds. Students will then go back into the classroom and upload their photos to Teachable Machine and train the machine on which items are invasive and which are native to the local area. Toward the end of class, students will demonstrate to the class how their machine works by showing the photos to the webcam and demonstrating the Teachable Machine’s distinction on whether it is an invasive species or native species.

ELABORATE continued (1 Day)

Option 2: Biome Exploration **(There are 3 invasive species for each biome.)**

Using the biome pictures of native and invasive species. Students will use Google Lens to identify what the species are and if they are native or invasive to that area. Students may need to do some research in Google or on related invasive species sites included here to make these determinations. Students will then upload their photos to Teachable Machine with the webcam and train the machine on which items are invasive and which are native to the area. Toward the end of class, students will explain what biome they received and demonstrate to the class how their machine works by showing the photos to the webcam and demonstrating the Teachable Machine’s distinction on whether it is an invasive species or native species.

EVALUATION (4 Days)

Brief Description: **Investigate one invasive species and create a digital poster highlighting the impact of the invasive species and how AI can be used to control/stop the spread of this species.**

Procedures:

Students will select an invasive species from a provided database and conduct research about their impact on the ecosystem and strategies used to control their spread, specifically focusing on how AI is or can be used. 1 day

Students will design a digital poster that shares information from their research in a visual and creative method. Students will highlight how AI can be used to control the spread of the species in the invasive range. The digital poster will be used as a formative assessment and scored with attached rubric. 3 days

Invasive Species Poster Assignment & Rubric

REFERENCES

PAL3 Invasive Species & AI Module:	
Google's Teachable Machine: https://teachablemachine.withgoogle.com/train/image	
Video: What is Teachable Machine, & how does it work?	https://youtu.be/T2qQGqZxkD0?si=Qtnnh6lkO3qRL39T
Video:Gather	https://youtu.be/DFBbSTvtpy4?si=YabchW7D6AP030Ew
Video: Train	https://youtu.be/CO67EQ0ZWgA?si=uqNR2VZSDykbZ9EF
Video: Export	https://youtu.be/n-zeeRLBgd0?si=ycAtbJrpnHhmwHTu
Time Magazine Article: "Invasive Plants Brought to Maui by Colonists Helped Fuel the Wildfires"	https://time.com/6305735/invasive-plants-from-colonists-fueled-maui-wildfires/
American Museum of Natural History River Ecology Videos: "The Invasion: A Case Study on the Hudson River"	
Video: Part 1: The Problem	https://youtu.be/xARjHpZf728
Video: Part 2: Observation	https://youtu.be/KpFa0b9FpEI?si=10GsZWJzByYda-lD
Video: Part 3: The Short-Term Impact of the Zebra Mussel Invasion	https://youtu.be/zXpyRwWBPdc?si=YafjCtQ7pNAydGaD
Video: Part 4: Long-Term Monitoring of the Hudson River	https://youtu.be/NQ-HMfB6Vo0?si=U2aCyAk8dSkis3zv
Saiwa Article: "Critical Role of Invasive Species Monitoring and Management"	https://saiwa.ai/blog/invasive-species-monitoring/
Open Tutor AI: Discussion: Why is it so critical to monitor invasive species, and how AI and Machine Learning is assisting?	https://dev.opentutor.info/tutor?lesson=efacdd7e-94ae-45e3-8ef7-91d4e3728b76
How AI & Machine Learning is Impacting the fight against Invasive Species Canva Page 4 Sites & 1 Video https://www.canva.com/design/DAGKqr0MVJI/isgIKwsAI1vYmz6o9Of7BA/view?embed	

Society For Science YouTube Channel: Selina Zhang	https://www.youtube.com/watch?v=8M0QWc9nr8Y
Smithsonian Magazine Article: This High Schooler Invented an A.I.-Powered Trap That Zaps Invasive Lanternflies	https://www.smithsonianmag.com/innovation/this-high-schooler-invented-an-ai-powered-trap-that-zaps-invasive-lanternflies-180983918/
Can AI outsmart invasive species? UF/IFAS study is targeting tegus.	https://news.wgcu.org/section/science/2024-03-04/can-ai-outsmart-invasive-species-uf-ifas-study-is-targeting-tegus
Vector Institute Article: "New AI framework helps map and manage invasive mussel species in Canada's lakes"	https://vectorinstitute.ai/new-ai-framework-helps-map-and-manage-invasive-mussel-species-in-canadas-lakes/
Maui Invasive Species Committee Article: "For healthy reefs and productive watersheds, resource managers are turning to AI"	https://mauiinvasive.org/2024/05/03/for-healthy-reefs-and-productive-watersheds-resource-managers-are-turning-to-ai/
National Invasive Species Information Center Website: "What are Species Profiles?"	*https://www.invasivespeciesinfo.gov/species-type*
MIchigan Invasive Species Website: "Invasive Species: Identify and Report"	*https://www.michigan.gov/invasives/id-report*