AI for Impact: Mapping Hurricane Destruction and Designing Response Plans

Teacher: Maria Ines Martinez	**Date**: 8/7/2025
Class Type:504/IPE/ESE/ELL	**Grade**: 11th
Time Frame: 450 minutes (3 class sessions)	

Lesson Overview

Unit/ Overarching Focus of Lesson:

- This unit explores how AI can support engineering decisions in the aftermath of natural disasters. Students analyze satellite data to identify damage, apply data visualization techniques, and use engineering and project management principles to design an optimized cleanup and recovery schedule.

Objectives/Aims: Students will demonstrate understanding/learning around the following Big Ideas:

(1) Data-Driven Decision Making

- Use AI-generated data (e.g., image analysis or damage detection models) to assess the severity and distribution of hurricane impacts.
- Interpret and represent this data using graphs, tables, and spatial tools.

(2) Project Management in Engineering Design Thinking

- Apply principles of project management and engineering design to propose feasible and effective cleanup/recovery plans,
- Consider constraints such as time, resources, accessibility, and population vulnerability (based on student research).

(3) Communication of Technical Information

- Communicate findings and solutions using clear visual, oral, and written formats, including charts, maps, and planning documents.
- Justify decisions using evidence-based reasoning.

(4) Real-World Relevance & Resilience

- Understand how technology (AI) and engineering can intersect in disaster recovery.
- Reflect on the importance of prioritization and community-centered design in the context of natural disasters and urban resilience.

Aligned Standards

PLTW Framework

- CAR-A.1 - *Define engineering as the creation of solutions, such as new and improved products, technologies, systems and processes), to meet the needs of people and society.*

- COM-A.2 - *Use sketches, tables, charts, and graphs when appropriate to clearly communicate information and in making arguments and claims in oral, written, and visual presentations.*
- COM-A.4 - *Present information, findings, and supporting evidence clearly, concisely, and logically in writing in which the development, organization, and style are appropriate to task, purpose, and audience.*
- CCP-H.2 - *Develop a project schedule (with the critical path identified when appropriate), allocate tasks among team members, and track progress for successful completion of the project.*

(Next Gen Science Standards):

- *HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.*

(Common Core State Standards):

- CCSS.MATH.CONTENT.HSS.IC.B.6 - *Evaluate reports based on data. (Students can critique AI damage analysis models and cleanup schedules.)*
- CCSS.ELA-LITERACY.WHST.11-12.4 - *Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.*

Key Vocabulary and Concepts:

- Federal Emergency Management Agency (FEMA)
- Equity
- Neural Networks
- Artificial Intelligence (AI)
- Critical Path (schedule)
- Risk Management
- Community-centered design
- Risk mitigation
- Gantt chart

Materials & Resources:

- Computers/laptops with internet access for all students or small groups.
- Projector/Smartboard for whole-class instruction and visual aids.
- CVAT (Computer Vision Annotation Tool) or similar online labeling tool: For hands-on data labeling. (https://www.cvat.ai/).
- Deepnote (or Google Colab/Jupyter Notebook equivalent): For running simplified Python notebooks for AI model training and application.
- Pre-trained AI Model: Access to the provided model for post-hurricane damage identification.
- Satellite Imagery: Curated "before and after" satellite images of specific Florida hurricane impacts (e.g., from NOAA, NASA, or Google Maps).
- Google My Maps (free mapping software to create layered data maps)

Safety Practices:

- N/A

Preparation for Teaching Diverse Students:

- Scaffolding, Team groups

Cultural context within which the lesson will be grounded, and specific ideas/practices to be included in the lesson:

Intro:

- Start by asking: How many of you, your families, or someone you know, have been impacted by a hurricane or other natural disaster in Florida?" (Acknowledge that nearly everyone in Florida has a story)
- Think about the immediate aftermath: the power outages, the debris, the uncertainty. What was the hardest part? What did you wish could happen faster?
- Cultural Alignment: This immediately taps into shared experiences and local knowledge. Many students will have personal anecdotes, fostering empathy and a sense of collective purpose. It validates their lived experiences as part of the learning.
- Explore how engineers could help make that recovery faster, smarter, and more equitable for all Floridians..

Important Cultural Items:

- Display compelling "before and after" satellite images of a specific, recent hurricane in Florida and identify the immediate challenges you notice on these photos.
- Discuss how these impacts ripple through communities, affecting livelihoods, cultural sites, and social gatherings. Ask: "How might this damage affect a local fishing community? Or a family whose home is also their small business?
- Share a brief, powerful story (or show a short video clip) of a local community's resilience or a specific engineer/volunteer who made a significant difference during a Florida hurricane recovery.
- Highlight the diverse cultural responses to disaster – the way different communities organize, support each other, and rebuild, often drawing on unique traditions, faith, or social networks. Emphasize that recovery isn't just about concrete and steel, but about restoring the fabric of society.

Prior Knowledge:

- Computer Literacy: Ability to navigate web browsers, use online platforms (like Google Docs/Slides), and basic file management.
- Algebraic Concepts: Familiarity with variables, functions, and interpreting graphs.
- Basic Data Interpretation: Ability to read simple charts and graphs.
- General Science Concepts: Awareness of natural disasters (e.g., hurricanes) and their impacts.
- Collaborative Skills: Experience working in groups and contributing to shared projects.
- Ability to read research papers and extract relevant information.

Prior Lesson:

- Project Management Concepts (Initiation, Planning, Execution, Monitoring & Controlling, Closing)

Followup Lesson:

- Investigate the energy requirements of using AI models.

Lesson Overview/ Abstract:

- This multi-day project engages high school students in a compelling, real-world application of Artificial Intelligence and engineering principles. Focusing on post-natural disaster recovery in Florida, students will first gain foundational knowledge of AI and neural networks through hands-on data labeling and a simplified model training exercise.
- They will then apply a pre-trained AI model to analyze satellite data for hurricane damage assessment. Integrating this data with other relevant information (e.g., critical infrastructure, socio-economic vulnerability), students will employ project management concepts to design an optimized cleanup and recovery schedule.
- The lesson emphasizes interdisciplinary connections, the diverse roles of engineers, and meaningful cultural ties, encouraging students to consider equitable and resilient solutions for their communities.

Lesson Activities			
Time	**Activity**	**Materials**	**Rationale**
1	**Do Now:** Start by asking: How many of you, your families, or someone you know, have been impacted by a hurricane or other natural disaster in Florida? (Acknowledge that nearly everyone in Florida has a story, start sharing my own stories)	N/A	Establish students' familiarity with hurricanes
2	**Discussion:** Think about the immediate aftermath: the power outages, the debris, the uncertainty. What was the hardest part? What did you wish could happen faster?	Before and after photos on smartboard	Show damage of hurricane Irma (2017), Michael (2018), and Sally (2020)
3	**Discussion:** How could engineers and innovators help make that recovery faster, smarter, and more equitable for all Floridians.	Show picture of organization / innovator / engineer /engineering firm that contributed meaningfully to post hurricane action items	Students should be aware that engineers not only make things but also create solutions for problems related to social issues, environmental, technological, innovation, health, etc.
4	**Do Now:** Introduce the Reading Source Equity-Integrated Infrastructure Resilience Analysis: Case Studies of Florida Communities	Equity-Integrated Infrastructure Resilience Analysis: Case Studies of Florida Communities	Research article to consider the equity of hurricanes and to incorporate lessons learned into the optimized schedule of repairs
5	**Do Now:** Students work on the article using the reading guide to answer questions.	Student Reading Guide	Learn about how natural disasters and post-storm assistance affect communities in different ways. This information is needed to create a human-centered design of the optimized schedule
6	**Do Now:** Introduce students to the concept of Neural Networks (strawberry/blueberry interactive handout from CS3)	CS3 Handout on Neural Networks: Neural Networks	Background Knowledge on Neural Networks
7	**Do Now:** Students will train a small AI model to	Access to CVAT, Deepnote	Provide students with

	get hands-on experience on how to train an AI model. This will include: (1) CVAT database (https://www.cvat.ai/) to label the item. (2) Access Deepnote to access YOLO (https://deepnote.com/workspace/RET-Teaching-Kit-d30b6e8f-b0f2-4db7-b073-703024df4ff1/project/RET-Teaching-Kit-Localization-cc57e00f-e4ab-4230-9116-2763a5bc4da6/notebook/6cf96734f7f542b8b37b57aaa858a5e9) to run the model (step by step, highly controlled by teacher)		hands-on experience on training an AI model
8	(1) **Discussion:** Let's discuss the results of the model. Was it successful? If not, what might be the causes that the model had a low percentage success rate?	N/A	Be aware that it takes quite a bit of data to be able to train a model successfully
9	**Discussion:** Walk students through the methodology of how to label the layers. (2) Go to Google maps for satellite images of the hurricanes. Research dates of when hurricanes made landfall in florida and look at data before and after. (3) Use the sniptool to capture the before and after photo. (4) Use photopea (www.photopea.com) to paint the areas in the post storm photos that exhibit damage. (5) Export each of these edited photos to png or jpg format	N/A	The hurricane model is a variation of the hands-on project that the students worked on. At this point, the teacher will provide a high-level explanation of how the hurricane model was trained for completeness purposes. Students will not be training this model as it is time-consuming and they already had hands-on experience with the window project.
10	(1) **Discussion:** Discuss whether the hurricane model was successful or not. If not, have a discussion of the possible reasons why.	N/A	Be able to determine success rate and determine next steps to fix it if unsuccessful
11	**Do Now:** Students to perform data analysis that consists of: (1) Identify critical infrastructure affected by the hurricane (hospitals, fire stations, major roads, power plants,	Census data / population density maps/ research article	Be able to interpret data, maps and draw conclusions and action items on the data.

	etc) (2) Look at population density maps in the affected areas (3) Look at socio-economic data (simplified census tract data on income, age, etc) (4) Environmental Sensitivity map (protected areas, wetlands, etc)		
12	**Student Deliverable:** Group project presentation slides and verbal presentation includes: (1) Project description (2) Data Analysis (include data on step 10 above) (3) Summary of article on Equity (4) Schedule on Gantt chart based on results of data analysis and lessons learned from 4 articles. Include extensive explanation of the reasons behind the priorities on the schedule. (5) Conclusion about the relationship between AI models, roles of engineers, and community-centered design. (6) Propose alternate action items/projects/ideas to pursue based on the AI model of identifying damage.	Slide Presentation (group)	Work deliverable: group slide presentation and verbal presentation

Lesson Assessments
Follow-Up Assignment: ● **Group Slide and Verbal Presentations**
Additional Accommodations for Students: ● Language support: Vocabulary terms printouts in Russian and French
Methods of Assessment: ● Formative Assessments: ○ On-going alternating class and small group discussions and hands-on work ● Summative Assessments: ○ Slide Presentation ○ Oral Presentation