

Supplementary Material

Using the Multimodal Features of Generative AI to Advance Ecological Engineering

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I used the OpenAI CustomGPT “Epic Tale Sketcher” created by Gordon Banks, which is described as “Creates and refines short stories, then illustrates them as graphic novels”

PROMPT #1:

can you take this story and illustrate it as a graphic comic? When Sylvia Jacobson, an Environmental Science and Technology (ENST) Ph.D. student, embarked on her research project focused on Chesapeake Bay wetlands, she began trudging through more than just mud and marshes. Her summer was a deep dive into the heart of environmental resilience and a hands-on exploration of nature's intricate responses to climate challenges. Knee-deep in wetland waters, Jacobson's journey is a vivid illustration of where passion for the environment meets scientific inquiry.

Jacobson is midway through a two-year Margaret A. Davidson Fellowship with the National Oceanic and Atmospheric Administration (NOAA), in partnership with the Chesapeake Bay-Maryland National Estuarine Research Reserve. She finished her M.S. degree in 2022 with wetland plant ecologist, Dr. Andrew Baldwin and is now working with Dr. Jared Wilmoth, a soil chemist. Her fellowship focuses on the ecological dynamics of coastal wetlands and seeks to gain a deeper understanding of how these wetlands are responding to sea level rise and other environmental changes seen throughout the Chesapeake Bay region.

“It's hard to explain what it's like until you're out there—they're really amazing ecosystems,” Jacobson said of our coastal wetlands, explaining, “in addition to the unique plants that live there, they support so many birds and insects—just looking at the number of different dragonflies out there is incredible.” She added, “One special thing about wetlands is they're not an ecosystem that the general public spends a lot of time in because they're really hard to navigate.”

There are three main wetland reserve sites around Maryland that Jacobson is working with: Otter Point Creek, Jug Bay, and Monie Bay. Teams have been monitoring and collecting data from these sites for over a decade. “The first part of the fellowship was actually doing analysis of their long-term monitoring data to look at changes in plant communities over time ... how they are going to persist or how they are changing under sea level rise,” Jacobson said. The second part of the fellowship is investigating soils as indicators of ecosystem changes. She spent the summer conducting fieldwork and is now analyzing the samples in the lab.

“A lot of the work for the fieldwork is not the day of, but preparing for the [fieldwork] day, so that when everyone gets there everything is ready,” she said. The team would travel to the locations by boat or canoe, though canoe days were Jacobson's favorite, collect soil samples with an auger at specific depths, and install PVC pipes with pressure sensors to track water levels. Wetlands in July are hot and swampy; Jacobson explained that at cooler times of the year you could wear waders and other protective gear, but to stay cool the teams spent much of the summer soaked in mud. She said, “I always manage to get mud all over my face—it's part of my look.”

Through the fieldwork this summer over 250 soil samples were collected, allowing Jacobson and the Maryland Reserve to add an additional soils layer to their data sets. The goal is to analyze soil microbial communities and soil carbon composition. “They can be an indicator of changes that are happening ... and reveal some of the mechanisms of why and how these communities are changing, or not, under sea level rise,” she said.

Most of Jacobson's fellowship days are now spent in the lab as she analyzes the DNA and the carbon composition of the samples. “I'm also thinking about what product I can give back to the Maryland Reserve. In addition to the research findings, I'm trying to make them easily reusable code and data analysis tools that they can use to look at changes over time as they continue to monitor these sites in the future,” she said. A final component is also creating educational and outreach materials about their wetland sites—something they can use when teaching fourth graders or community members.

In creating educational materials, Jacobson translates her research and bridges the gap between complex scientific concepts and community awareness. This aspect of her work is indicative of ENST's commitment to not only studying the environment but also educating and engaging the community in these crucial matters.

Her work has already yielded some interesting trends. In working with the historical plant community data, she said, "Monie Bay, for example, is a poster child for ghost forests and sea level rise ... you would expect really dramatic plant community changes." Instead, what they have seen in the decade of data is a more nuanced picture at the landscape level. Jacobson is quick to point out this could be due to limitations of point sampling or the timescale of the data, but also, "if some marshes can be resilient and hold on in the face of sea level rise ... we want to understand those sites!"

Through the NOAA fellowship, Jacobson's work sheds light on coastal wetland ecological dynamics, a crucial piece of our region's environmental conservation. The data and samples she is working with are more than academic exercises; they are pieces of a larger effort to understand and protect these vital ecosystems in the face of environmental change.

ENST's approach to environmental science education is grounded in the belief that real-world experiences forge the most profound understanding. Jacobson's journey exemplifies this—using innovative tools and methodologies, her research is at the forefront of environmental science. However, it is not just about using the latest technology, it is applying these tools to make tangible contributions to environmental knowledge.

Joining our program means being part of a community where inquiry, innovation, and impact converge. It's a place for those eager to explore, understand, and contribute to environmental sciences. We invite you to be part of a journey that extends beyond academia into the realms of real-world change and environmental stewardship.

RESPONSE #1:

Here's the first frame of your graphic novella, capturing Sylvia Jacobson embarking on her research project in the Chesapeake Bay wetlands. This image sets the scene for her journey, surrounded by the vibrant life of the wetlands as she delves into her environmental studies.

Would you like to continue with more frames to further illustrate Sylvia's story? If so, how many more frames would you prefer, up to a total of 8?

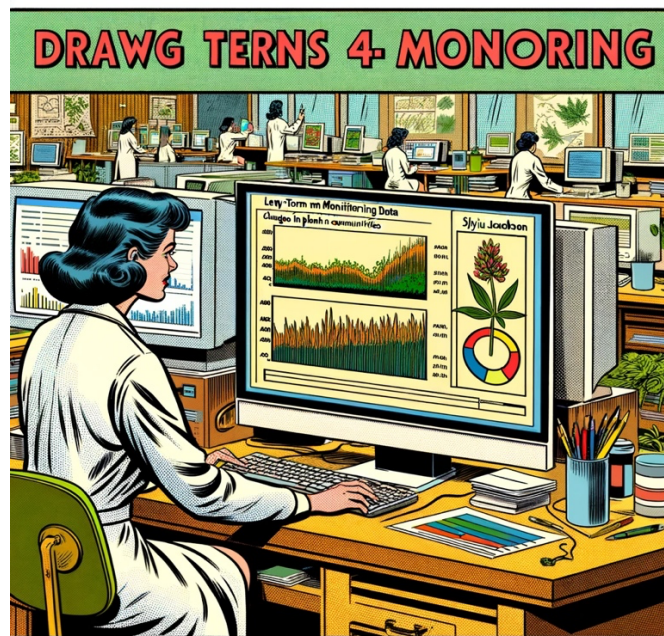
**PROMPT #2:**

this is nice. please make 7 more panels to complete the story.

RESPONSE #2:

Your graphic novella is now complete, illustrating the journey of Sylvia Jacobson, an Environmental Science and Technology Ph.D. student, as she embarks on her research project focused on Chesapeake Bay wetlands. From the initial exploration of the wetlands to the meticulous analysis of data and the sharing of findings with the community, each frame captures a key moment in her story of scientific discovery and environmental stewardship.

I hope these illustrations bring Sylvia's story to life and inspire a deeper appreciation for the dedication behind environmental research and education. Would you like to explore any other stories or need further assistance?

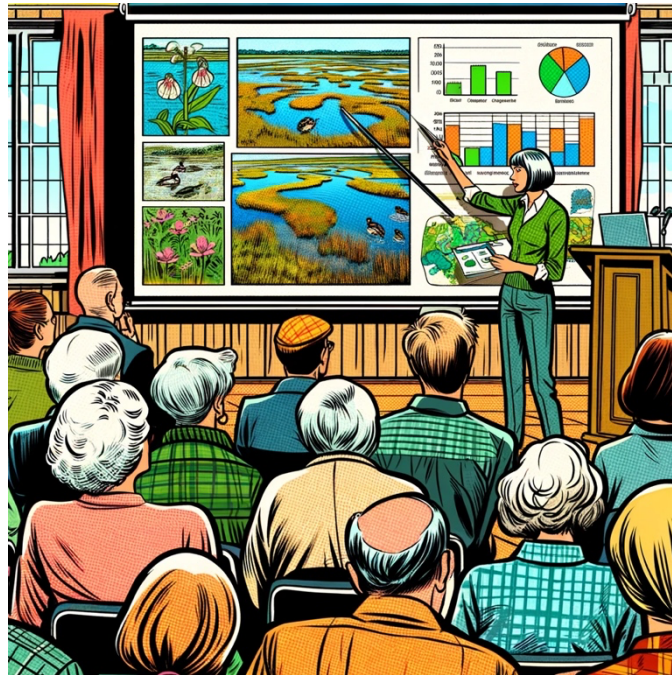




SYLVIA JACOBSON IS FOR THE WATTENS.





**PROMPT #3:**

there are a couple of issues with the images. 1) sylvia's hair keeps changing color from panel to panel. she should look similar in each. 2) avoid adding text to the images because you can't spell (yet). 3) can you compose a snippet of text to go with each panel?

RESPONSE#3:

I understand your concerns and appreciate your feedback. Let's address each issue:

1. For consistency in Sylvia's appearance, I'll make sure to describe her with the same hair color and characteristics in future image requests to maintain visual continuity.
2. I'll ensure that future image prompts avoid specifying text to prevent spelling errors or inconsistencies.

Here are the snippets of text for each panel to accompany the visual narrative:

1. **Panel 1: Beginning the Journey**
"Sylvia Jacobson steps into the heart of Chesapeake Bay's wetlands, embarking on a research quest that marries her passion for environmental science with rigorous scientific inquiry."
2. **Panel 2: The Data Dive**
"In the lab, surrounded by data and graphs, Sylvia delves into the dynamics of coastal wetlands, analyzing years of monitoring data to uncover changes in plant communities."
3. **Panel 3: Fieldwork Adventure**
"Sylvia and her team navigate the wetlands by canoe, armed with augers and PVC pipes, ready to collect soil samples and track the pulse of the wetlands."
4. **Panel 4: Embracing the Mud**
"Covered in mud but undeterred, Sylvia exemplifies the hands-on, gritty nature of fieldwork, finding joy and discovery in the marsh's embrace."
5. **Panel 5: Precision in the Mud**
"Installing PVC pipes with precision, Sylvia's team showcases the collaborative effort required to gather accurate data, ensuring their research captures the wetlands' true dynamics."

6. **Panel 6: Microscopic Discoveries**

"Peering through the microscope, Sylvia investigates the soil's microbial communities, seeking to understand the microscopic engines driving ecosystem changes."

7. **Panel 7: Crafting Knowledge**

"In her office, Sylvia creates educational materials, translating her complex research into engaging stories and visuals for community outreach and education."

8. **Panel 8: Sharing the Vision**

"At a community meeting, Sylvia and her team present their findings, sparking a dialogue on wetland conservation and inspiring stewardship among residents of all ages."

These snippets aim to enrich the visual storytelling, providing context and narrative depth to each panel of your graphic novella. If you need further adjustments or have more requests, feel free to let me know!

PROMPT #4:

snippets are good. Sylvia is a white woman with light brown hair. please redraw the panel images so her appearance is consistent.

RESPONSE #4:

The graphic novella panels have been redrawn to ensure Sylvia Jacobson's appearance, specifically her light brown hair, remains consistent throughout her journey. These images now accurately reflect Sylvia's character as she navigates the complexities of environmental research in the Chesapeake Bay wetlands. From the initial foray into the wetlands to the culmination of her efforts in community engagement, each panel captures a pivotal moment in her story.

1. **Panel 1: Embarking on Research**

Sylvia steps into the wetlands, ready to explore the dynamic interplay between nature and climate change.

2. **Panel 2: Analyzing Data**

Surrounded by data, Sylvia's dedication shines as she delves into the changes within the wetland ecosystems.

3. **Panel 3: Navigating the Wetlands**

In canoes, Sylvia and her team journey through the wetlands, equipped for their soil sample collection mission.

4. **Panel 4: Embracing the Fieldwork**

Covered in mud, Sylvia's joy and dedication to her research are evident, showcasing the messy yet rewarding nature of fieldwork.

5. **Panel 5: Installing Equipment**

The team works together to install PVC pipes with sensors, emphasizing precision and collaboration in their research methods.

6. **Panel 6: Lab Analysis**

In the lab, Sylvia examines soil samples under a microscope, uncovering the micro-level dynamics of the wetland ecosystem.

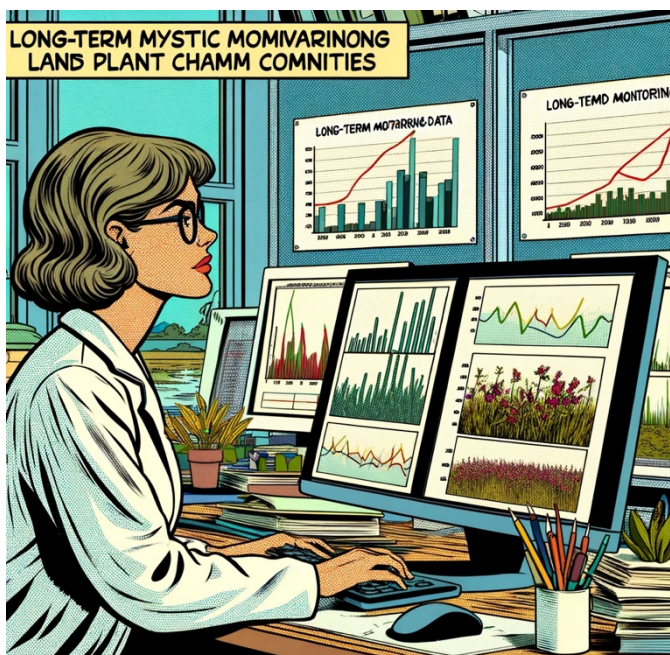
7. **Panel 7: Creating Educational Materials**

Focused on outreach, Sylvia prepares materials that translate her complex research into accessible knowledge for the community.

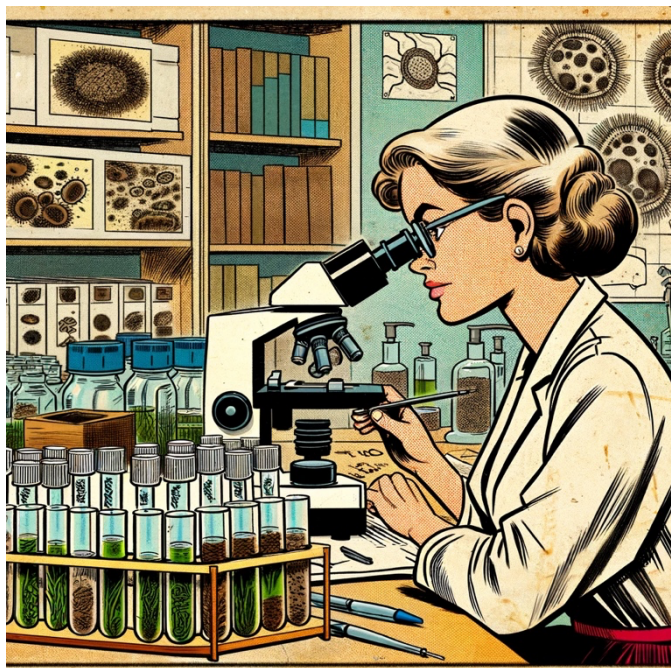
8. **Panel 8: Community Engagement**

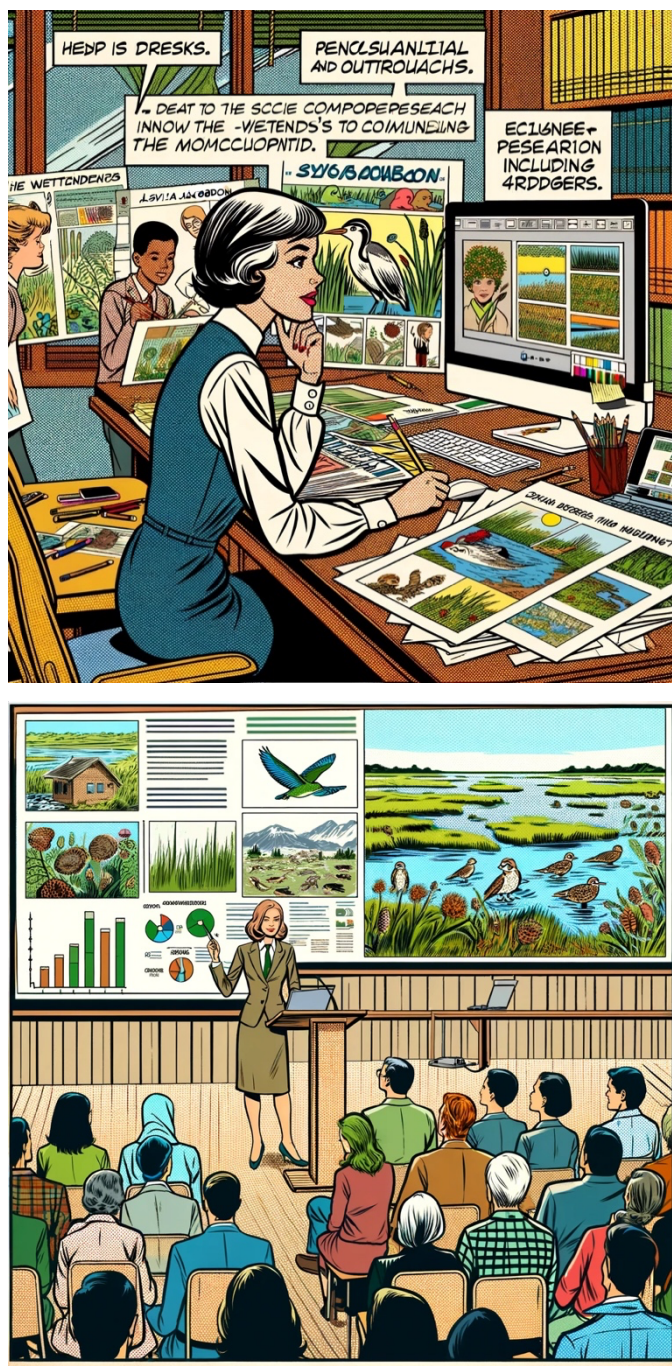
Presenting their findings, Sylvia and her team foster environmental stewardship, sharing their research's significance with the community.

These panels, paired with the provided snippets, offer a comprehensive narrative of Sylvia's journey, blending scientific exploration with community engagement. If there's anything more you'd like to explore or adjust, please let me know!







**PROMPT #4:**

Great job. This was the title for the text version: Sylvia Jacobson, ENST Ph.D. Student, Ventures Deep into Mud Through a NOAA Fellowship to Explore Wetlands. I think the comic strip needs a more media appropriate title. can you develop one?

RESPONSE#4:

Certainly! For a graphic novella that captures the essence of Sylvia's journey in a compelling and succinct manner, the title could be:

"Sylvia's Quest: Unearthing Wetland Wonders"

This title conveys both the personal nature of Sylvia's academic venture and the broader significance of her research, hinting at the exploration and discoveries within the wetland environment.

PROMPT #5:

let's return to Sylvia's imagery. please create an image of her that captures the following: we extract microbial DNA from soil in the lab with a process that involves pipetting different chemicals into test tubes, centrifuging, and then sequencing on a machine.

RESPONSE #5:

The image portrays Sylvia Jacobson in the midst of a DNA extraction process in the lab, highlighting the precision and technical expertise required in environmental research. The detailed environment captures the essential steps of pipetting, centrifuging, and DNA sequencing, all integral to her scientific exploration. If you need further illustrations or modifications, feel free to let me know!

**FINAL EDITING**

After collaborating with Epic Tale Sketcher to create the text and images, I manually created the "comic strip" in Microsoft Powerpoint. I edited some of the panel captions for consistency and brevity.