Professor uses imaging technology to enhance upcoming hybrid course

January 20 2016, by Katie Bohn

Credit: Flickr user bgwashburn

High above Raystown Lake in central Pennsylvania, a hawk glides

through the crisp air, its eyes sharply focused on the ground hundreds of feet below as it looks for its next tasty snack. It zeros in on a mouse and dives to the ground in seconds, probably before the mouse knew what was coming.

During its descent, the hawk sees the Pennsylvanian landscape at several different scales within moments, from a literal bird's eye view to mere inches from the ground. It's a point of view that students—and most other people, for that matter—don't get to witness.

Not until now, that is.

Neyda M. Abreu, an associate professor of earth sciences at Penn State DuBois, is working on a project funded by the Center for Online Innovation in Learning (COIL) that is using imaging technology and electron microscopy techniques to create detailed, interactive images of geologic sites like Raystown.

The images, which will include photos taken from several viewpoints, will allow students to interact with the geologic specimens and formations in ways they couldn't in a classroom or out in the field. Students will be able to view sites from high above and then zoom all the way down to look at rocks and other geological specimens at an atomic level.

"I wanted the opportunity to use technology to probe geological sites outside the human scale," said Abreu. "For example, if you're out in the field, you don't always have the chance to take a plane to see the landscape from above or use a powerful microscope to zoom in close. This project will allow students to do that in the classroom."

Abreu hopes to gather images from several locations and, so far, has collected samples and photos from nearby Raystown Lake, where she

gathered geological specimens ("lots of lots of small rocks," according to Abreu) and took GigaPan images of the area.

Getting a new perspective

A GigaPan—based on the same technology used by rovers on Mars to take photos of the red planet—is a robotic arm that works with almost any digital camera to take hundreds of high-resolution, interactive photos in rapid succession. Special software then "stitches" them together into one panoramic image. The resulting panorama is hosted on GigaPan's website, where users can view and interact with them, zooming in to incredible detail.

"The GigaPan allows you to take truly spectacular images that go beyond simple photography," said Abreu. "If you can't physically be at a geologic site, these hyperrealistic images really add to your experience and make it the second best thing."

After processing the GigaPan images, Abreu will take the Raystown samples to her lab to use electron microscopy to get a closer look at the rocky specimens—all the way down to the atomic level.

Abreu will create smaller and smaller specimens that will go into more and more powerful microscopes to create black-and-white, "power of 10" photos (the second photo will be 10 times bigger than the first, the third 10 times bigger than the second, and so on) down to the atomic-scale.

To get up close and personal with a rock's atomic structure, the rocks need to be sliced thin: as thin as a tenth of the diameter of a strand of hair. This allows a beam of electrons to pass through the samples, increasing the magnification up to 1 million times and producing X-rays that reveal the samples' chemical composition.

"These images take the viewer out of their normal reality and transport them to a world they usually aren't able to see," said Abreu.

Eventually, Abreu hopes to get up into the air to take wide, pulled-away shots that give students a broader view of the area they're studying. This has been done in the past by taking a GigaPan up in an airplane or drone, but Abreu is still deciding which method would be best for her project.

Once she has all the images, Abreu will upload them to a website that leads students from one scale to another—from way above the trees down to the rock's atomic structure. Students can then explore the site on their own or use it for class activities.

One activity Abreu has planned is an "Easter Egg Hunt," which will teach students the importance of being selective while collecting samples.

"Even if you wanted to, it would be impossible to sample every single rock in a field site. There's just too many," said Abreu. "Besides, in most cases, it would be overkill. Geoscientists learn to be judicious in which samples they choose to look at more closely."

Abreu says that geoscientists study a few samples of the "common" and a few of the "unusual." Then, they try to explain how the unusual features formed and ended up where they did. Abreu's activity will recreate this experience digitally: Students will describe these common and unusual features as they virtually explore the sites.

There will also be some surprises.

"As the students explore, there will also be some 'easter eggs'—such as mistakes in collection and identification of samples—hidden for them to find, just to keep things interesting," said Abreu. "Nature works that

way. You're always finding unexpected things."

Taking research to scale

Abreu hopes the images and exercises will help show her students the importance of looking at things at scale, which she says is an important concept within the geosciences as well as other disciples.

"Scale is how you truly understand the whole picture," Abreu said. "For example, in my own research, I study meteorites as a way to understand the much bigger solar system. I thought that applying those same principles here on Earth would be a good way for students to not only learn about the geological sites themselves but also how real research is done."

Abreu says she believes that in addition to teaching students facts, instructors should also be teaching them more about the process of learning. She says that while certain concepts and theories students are taught might be eventually disproven, research methods will remain valuable.

"If students come out of my class knowing that looking at the same system with different lenses can reveal profound things we otherwise wouldn't know, then that class will have lasting value, regardless of the material we were reviewing," said Abreu. "This is why I love teaching geology; we get to have mountaintop experiences—those moments of great insight—about mountaintops!"

Provided by Pennsylvania State University

Citation: Professor uses imaging technology to enhance upcoming hybrid course (2016, January 20) retrieved 25 April 2024 from https://phys.org/news/2016-01-professor-imaging-technology-

upcoming-hybrid.html

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