

A Universe Through Pictures



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Science and Chemistry Grades 9-12

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ETP Type: Classroom

Host
Subject/Grade: High School/Earth

Abstract (~150 words)

Students love cell phones and especially cell phone cameras. But today's imaging technology provides incredible possibilities of observation. My fellowship at Lockheed Martin's Optical Payload Center of Excellence provided the window to view an entirely unimagined universe of observation. From being able to witness what is going on at the center of our galaxy, to spotting and intercepting a missile that is being launched from a hiding place, or to literally monitoring a white mother polar bear and her cubs in a den under the snow, imaging today allows us to observe in ways limited only by one's imagination. During my fellowship at Lockheed Martin I was introduced to the idea of 'designing a mission.' Images can represent important qualitative and quantitative data sets for Earth Science to understand phenomena and change in Earth systems. This ETP allows students to apply the knowledge of the EM spectrum to a real life application in analytical optics.

Focal Content & Supporting Practices:

HS-ESS3-3: Use imaging, mathematical engineering applications, and computational representation to illustrate the relationships among Earth systems and space systems.

SEP: Using Mathematics and Computational Thinking

DCI: ESS3.D: Global Climate Change

21st Century Skills and Applications (1 - 2)

Students will learn how various types of data are used to solve real world problems, which data are required and how data drive the problem solving process. In particular, students will learn how imaging data are used to understand and make predictions in science and engineering. Students will learn some basic computer programming involving imaging, turning images into data and then using computational methods to make better observations and predictions. Students will learn to apply their knowledge of earth science to design imaging missions to advance science and engineering.

Measurable Objective(s)

Students will be able to

1. Understand the Electromagnetic Spectrum and all the various forms of radiation from radio waves through visible light to x rays.
2. Students will understand that images provide data that are useful in applications of Science (theory) and in engineering
3. Students will take images and transform them into numerical data (cognitive skills). for comparison.
4. Students will also understand 'NDVI' imaging (Normalized Differential Vegetation Index) as a special topic within Optical imaging in Science and Engineering (computation).

Formative Assessment(s)

Worksheet 1 + a short presentation: [WS1 Student Version](#)
Collab and Python activity showing change through optical imaging:

Collab WS2a: [images of change main worksheet](#)

Collab WS2b: [Images of change Colaboratory supplementary worksheet](#)

Summative Assessment(s)

Test and Final Presentation on Using Imaging

[Unit Test](#)

[Rubric 3 for summative Test and Presentation](#)

Fellowship Description (300-500 words)

My mentor, Todd Kvamme, is a senior manager and Chief Engineer for the OPCoE (Optical payload Center of Excellence). Lockheed Martin is the leader in providing the satellite bus and integrating the bus with the optical payloads. Lockheed Martin also provides important imagers and sensors for astronomical and earth observing missions like the Hubble Telescope which uses visible light and infrared imaging and the upcoming James Webb Space Telescope which will provide imaging with far higher resolution than even Hubble. The OPCoE group also provides mission solutions and creates mission ideas for applications in defense. The fellowship allowed me to meet with important internal stakeholders as part of a team and part of a process to identify the best content for the website.

Fellowship Connection to School/Classroom (300-500 words)

This fellowship has provided me the ability to put together a unique lesson plan unit that is not covered in the traditional curriculum and is a powerful application of the core optical imaging science and engineering applications. Students will have an authentic experience to inform project based learning activities. Students will learn to recognize images from the main seven regions/bands of the Electromagnetic Spectrum. They will learn to recognize the source of these images: for example, Chandra telescope and x-ray images, SUVI and ultraviolet; James Webb and infrared. They will learn to explore images to inform science and engineering applications for the earth and in particular within their communities. Converting images into data and utilizing the NDVI engineering application will introduce students to google Collab and the python programming language and to the use of computational math. By making a critical connection to how the world of satellites and drones, computer science and engineering applications like NDVI can help them provide value in their own lives, we can increase engagement significantly.

Host Organization Engagement (~100 words)

Engineers who are part of The Optical Payload Center of Excellence at Lockheed Martin have created two Collab lessons contained in this ETP to guide students through understanding how optical imaging data can be used to provide analytical information for comparison purposes. If possible, some of these engineers plan to participate in zoom meetings with my students so they can demonstrate the use of imaging including various types of optical instruments. In addition, if in-class learning resumes, they plan to bring a drone and an IR camera to use in the classroom with the students.

Instructional Plan (This is the bulk of your ETP and may take several pages.)

Plan something that can be done remotely.

[Unit Lesson Plan Teacher Notes](#)

[Unit Lesson Teacher Presentation](#)

In-Person Enhancements

Use IR Camera, drone demonstration, and real thermometer

Supply List

References

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NASA - Tour of the Electromagnetic Spectrum. (2012, December 15). [Video]. YouTube.

<https://www.youtube.com/watch?v=HPcAWNIVI-8>

Keywords

EM Spectrum, IR, optical imaging, Collab, Python, reflection, refraction

Links to Files in this ETP

[Unit Lesson Plan Teacher Notes](#)

[Unit Lesson Teacher Presentation](#)

[WS1 Student Version](#)

[WS 1 Teacher Answer Key](#)

[Rubric 1 WS1 Formative Assessment](#)

Collab WS2a: [images of change main worksheet](#)

Collab WS2b: [Images of change Colaboratory supplementary worksheet](#)

[Rubric 2 for Collab WS2ab](#)

[Unit Test](#)

[Rubric 3 for summative Test and Presentation](#)