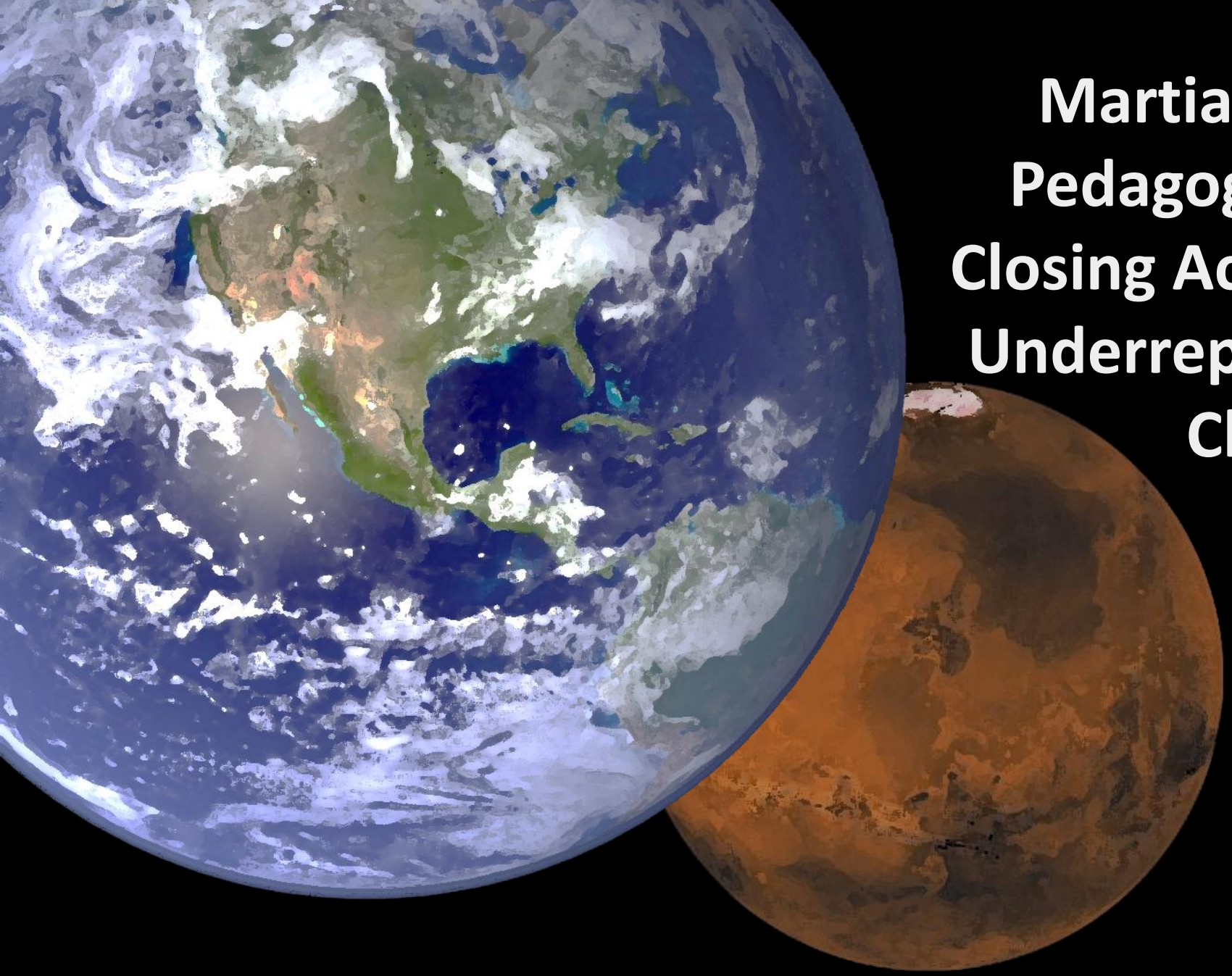

Martian Rocks - A New Pedagogical Approach to Closing Achievement Gaps in Underrepresented Minority Classrooms.

Dr. Strawser
corydon.strawser@ocps.net
corydon.strawser@ucf.edu

FEEC-STEM Workshop 2022 – Room 316A, 2:20-3:10 pm

Presenter

Dr. Strawser, Ed.D.

corydon.strawser@ocps.net

PLTW Teacher

Drone, Coding Club Sponsor

Adjunct Professor, University of Florida Space Sciences

Author *Placed-Based Learning*

Podcaster *Eduplaces*

During this workshop, you'll skills, confidence, AND lessons to:

- Discover new problem-based learning experiences, using NASA Martian rocks and remote access through the nanoHUN and On-line Spectrometry community hubs.
- Learn how to tailor the problem-based experiences to Next Generation Science Standards (NGSS).
- Explore learning experiences and insights into using advanced research tools in their classrooms.

What the Research suggests:

"Despite positive and best efforts trends in high school, fewer minorities [including women] enter college intending to major in a STEM field."

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Glasson, G. E. (2020)

Connecting Content, Community, and Careers

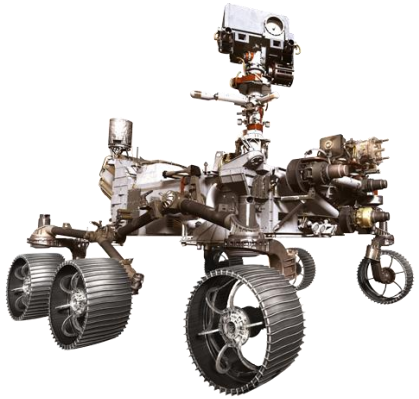
"Advanced Project-Based inquiry is the marriage of engagement and authenticity. – real problems, real tools, and real solutions"

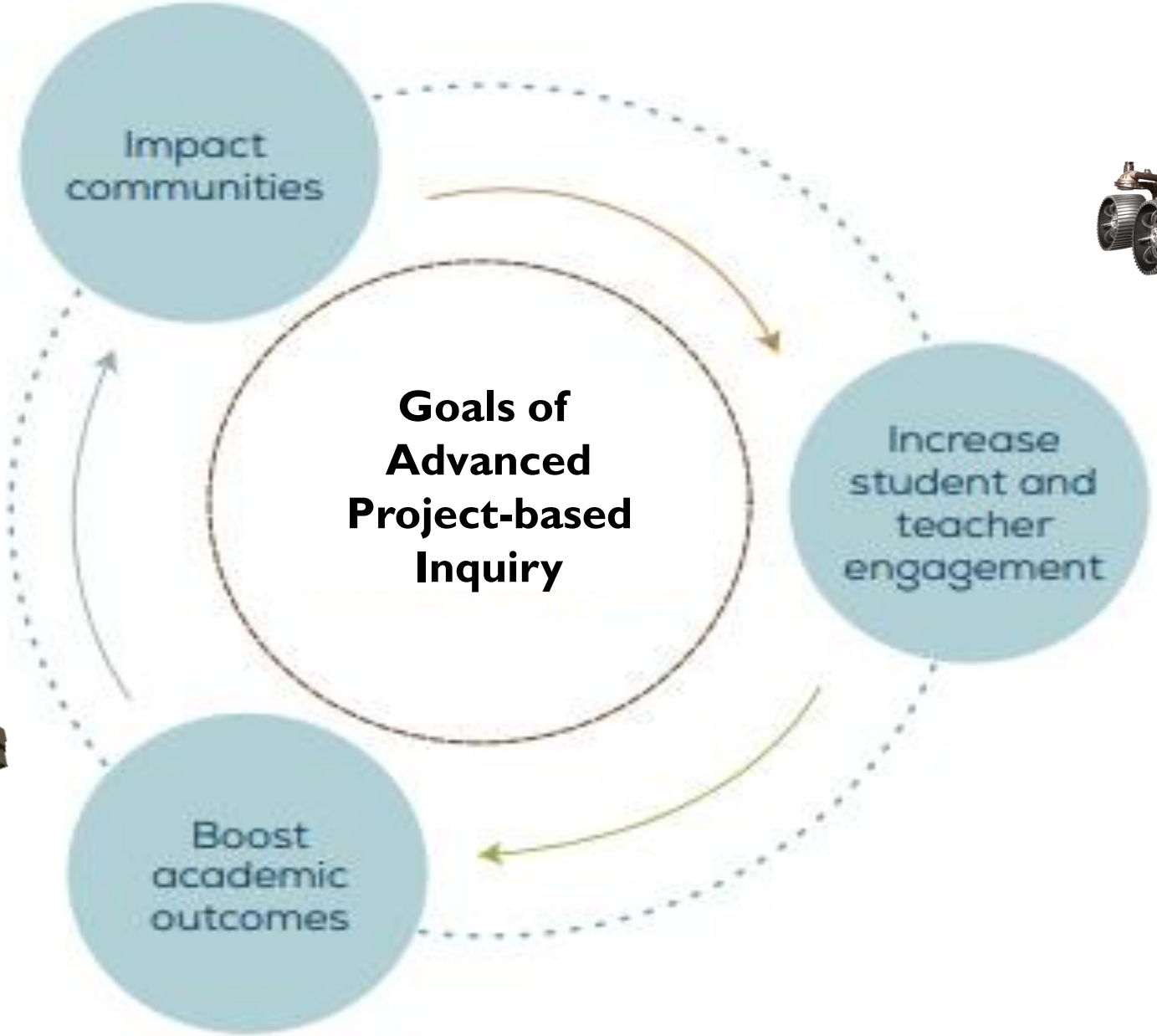
Strawser, C L. (2021)

Emerging Thought from Research

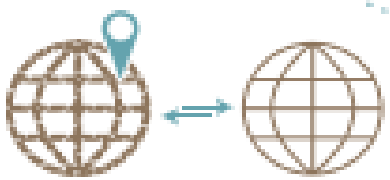
strategies, paradigms, theories, and experiences

- Understanding ***place*** is becoming increasingly important in our rapidly-changing and interconnected world.
- The goals and practices of both place-based learning and STEM education ***complement*** each other.
- Place-Based Learning helps connect local communities, schools, and place in ways that produce more ***engaged, thoughtful learners***.




Goals of Advanced Project-based Inquiry
Impact communities
Increase student and teacher engagement
Boost academic outcomes

Advanced
Project-Based
Inquiry

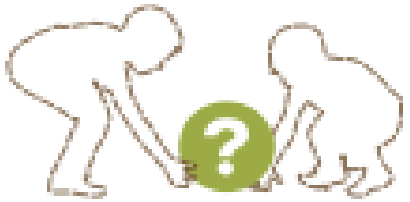


LOCAL TO GLOBAL CONTEXT

Local learning serves as a model for understanding global challenges, opportunities and connections.

LEARNER-CENTERED

Learning is personally relevant to students and enables student agency.



INQUIRY-BASED

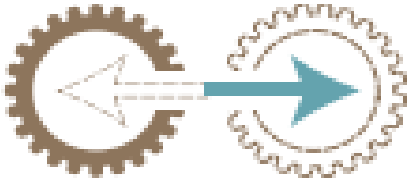
Learning is grounded in observing, asking relevant questions, making predictions, and collecting data to understand the economic, ecological, and socio-political world.

DESIGN THINKING

Design thinking provides a systematic approach for students to make meaningful impact in communities through the curriculum.

COMMUNITY AS CLASSROOM

Communities serve as learning ecosystems for schools where local and regional experts, experiences and places are part of the expanded definition of a classroom.

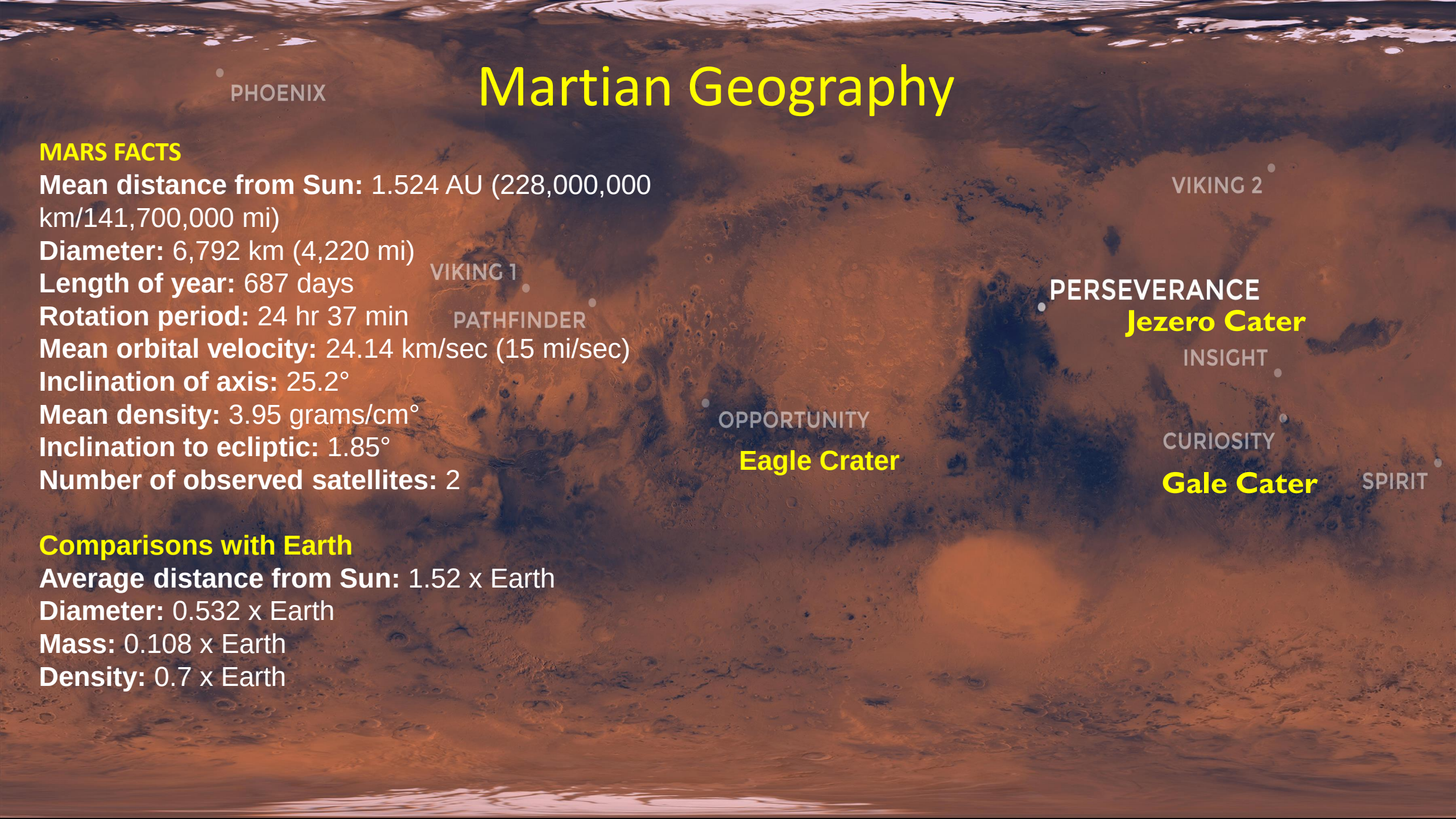


INTERDISCIPLINARY APPROACH

The curriculum matches the real world where the traditional subject area content, skills and dispositions are taught through an integrated, interdisciplinary and frequently project-based approach where all learners are accountable and challenged.

“Questions or Observations”?
(2 minutes)

Martian Geography



MARS FACTS

Mean distance from Sun: 1.524 AU (228,000,000 km/141,700,000 mi)
Diameter: 6,792 km (4,220 mi)
Length of year: 687 days
Rotation period: 24 hr 37 min
Mean orbital velocity: 24.14 km/sec (15 mi/sec)
Inclination of axis: 25.2°
Mean density: 3.95 grams/cm°
Inclination to ecliptic: 1.85°
Number of observed satellites: 2

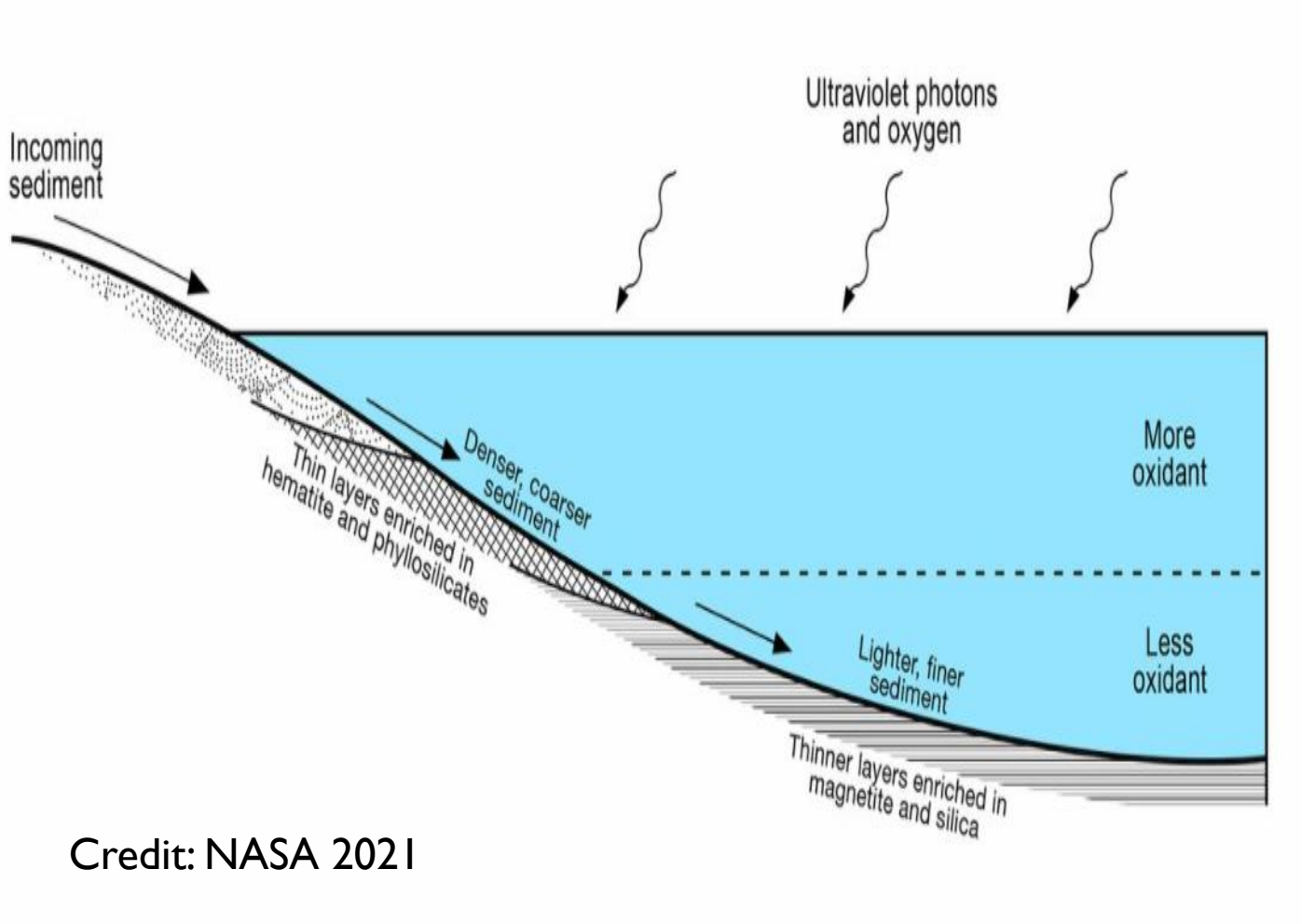
Comparisons with Earth

Average distance from Sun: 1.52 x Earth
Diameter: 0.532 x Earth
Mass: 0.108 x Earth
Density: 0.7 x Earth

A quick lesson in astrogeology

Fast Facts:

- NASA's Curiosity Mars rover mission has provided an unprecedented level of detail about an ancient lake environment on Mars that offered favorable conditions for microbial life.
- A lake in Mars' Gale Crater long ago was stratified, with oxidant-rich shallows and oxidant-poor depths.
- The lake offered multiple types of microbe-friendly environments simultaneously.



Credit: NASA 2021

A quick lesson in astrogeology

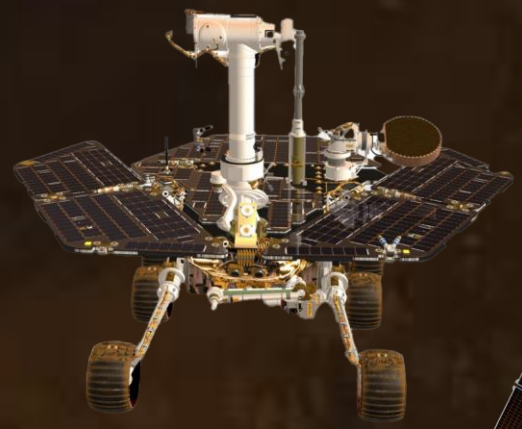
Minerals are like a time capsule; they provide a record of what the environment was like at the time they formed. Clay minerals have water in their structure and are evidence that the soils and rocks that contain them came into contact with water at some point.

Fast Facts:

- NASA's Curiosity Mars rover is finding patterns of change in rock composition at higher, younger layers of a mountain.
- Ancient Mars sedimentary basins with groundwater were chemically active, a factor favorable for possible life.
- Curiosity found boron on Mars, a first for this very soluble element.

NASA's Current Mars Exploration Missions

- Geologic Exploration
- Habitability and Biosignatures
- Prepare Returnable Artifacts
- Prepare for Human Exploration



Insight, Hope Orbiter, Perseverance, Curiosity, Ingenuity

Earth-based Telescopes, Space Telescopes, Orbiters, Landers, Rovers

A quick lesson in Science Packages

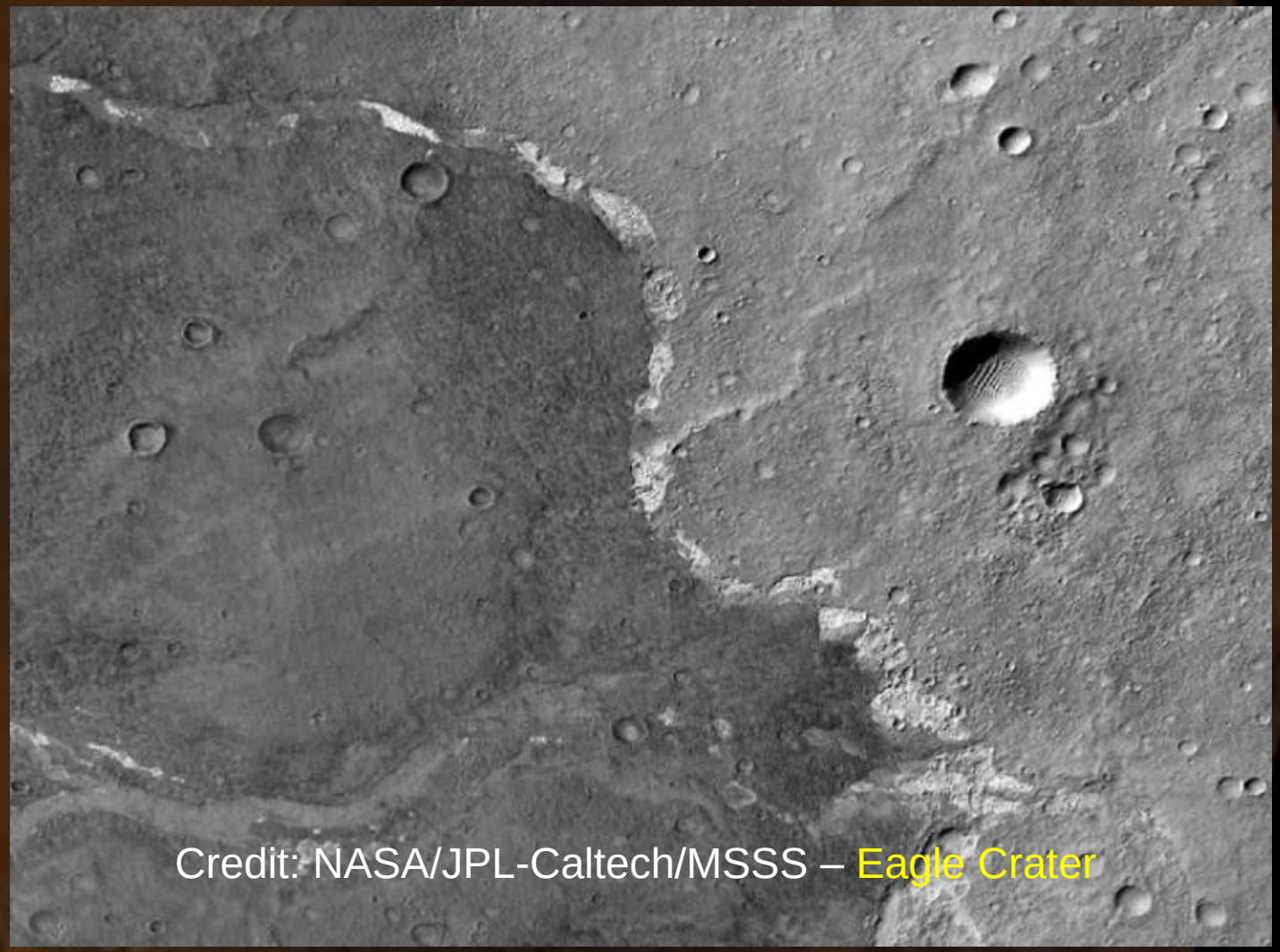
- Weather Station
- Mars Environmental Dynamics Analyzer (MEDA)
- Mars Oxygen ISRU Experiment (MOXIE)
- Planetary Instrument for X-ray Lithochemistry (PIXL)
- Radar Imager for Mars' Subsurface Experiment (RIMFAX)
- Scanning Habitable Environments with Raman & Luminescence for Organics & Chemicals (SHERLOC)
- SuperCam
- CheMin

“Questions or Observations”?
(2 minutes)

Putting it All Together

Mineral Mystery Lab

Background: Even before Dawn arrived at Ceres, scientists had observed bright regions on the dwarf planet through telescopes, but their origin remained a mystery. The Dawn spacecraft's close-up view allowed scientists to gain a better understanding of how the hundreds of bright regions, known as faculae (meaning bright areas) came to be. Even before Dawn arrived at Ceres, scientists had observed bright regions on the dwarf planet through telescopes, but their origin remained a mystery. The Dawn spacecraft's close-up view allowed scientists to gain a

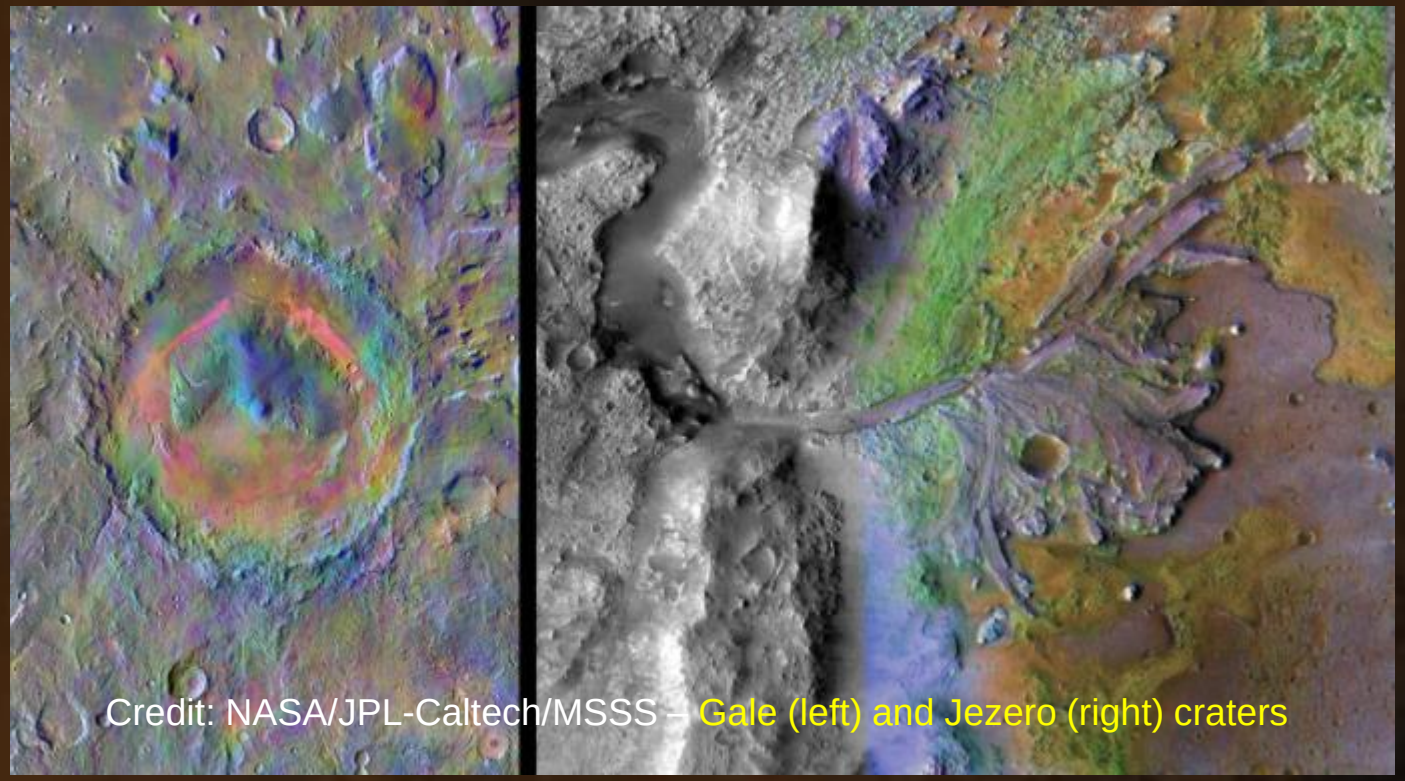


Credit: NASA/JPL-Caltech/MSSS – Eagle Crater

Putting it All Together

Mineral Mystery Lab

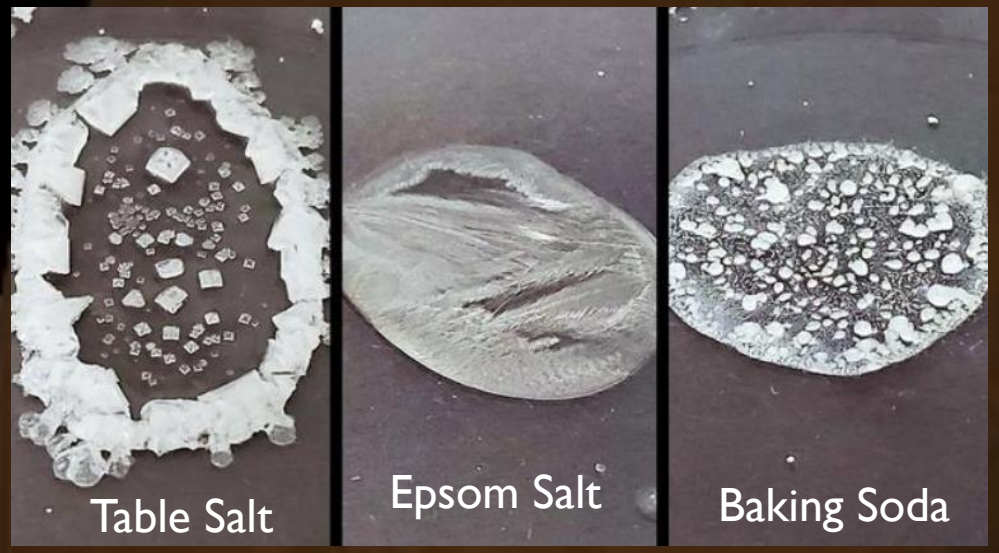
From Space: These satellite images of the Curiosity and Perseverance Mars rover landing sites in Gale and Jezero craters, respectively, have been colored to show the presence of various minerals at each location. Credit: NASA/JPL-Caltech | › Full image and caption: Left image (Gale crater) | Right image (Jezero crater)



Mineral Mystery Lab

Putting it All Together

Mineral Mystery Lab

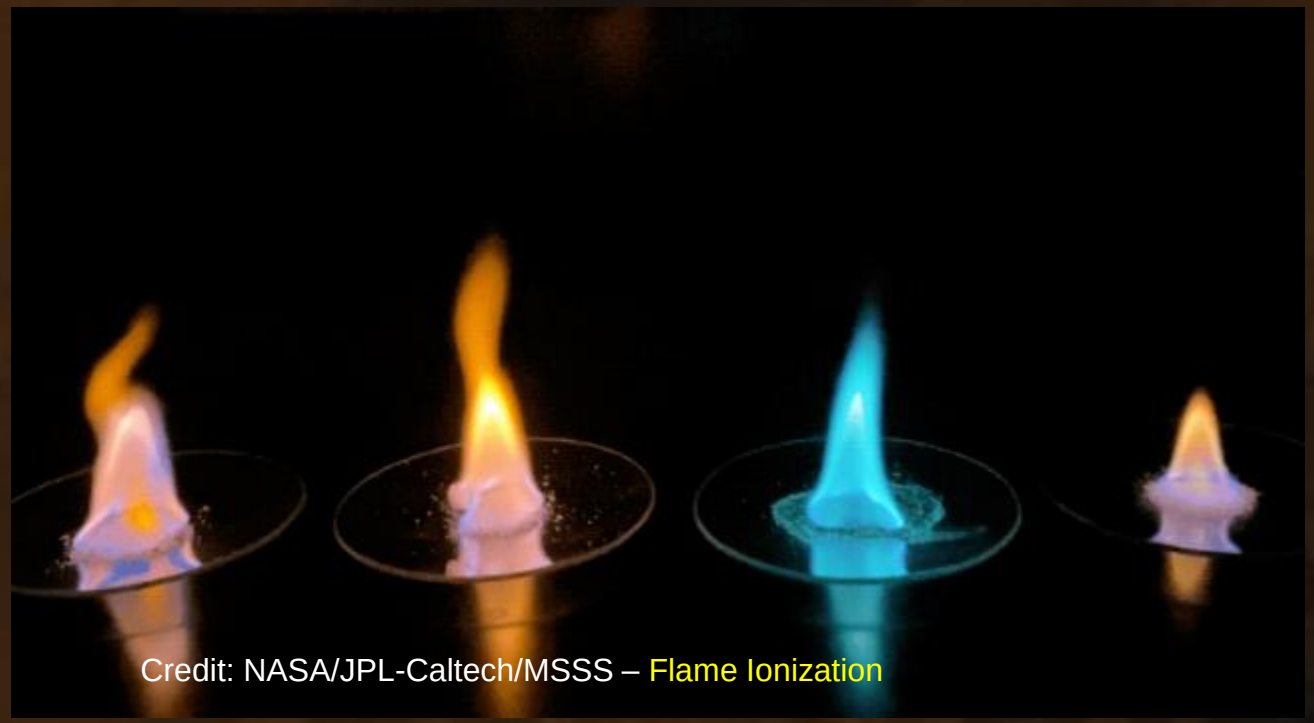


Credit: Dr. Strawser – Mineral Mystery Lab

Putting it All Together

Flame Ionization Lab

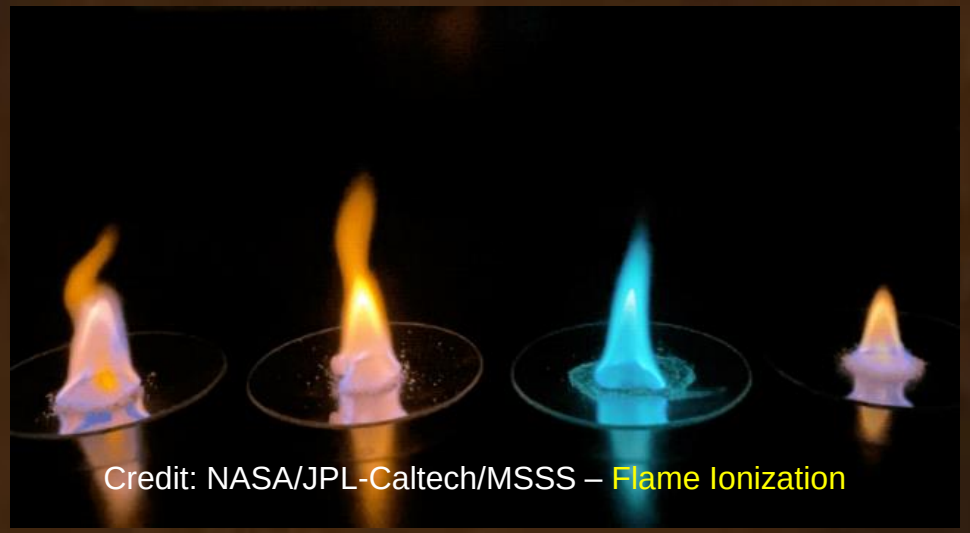
Background: A flame test is used to detect the presence of certain metal ions. The test involves heating a sample of the element and observing the resulting color of the flame. When atoms of elements are heated to high temperatures, some electrons may absorb enough energy to allow them to move to higher energy levels. As the electrons return to their ground state, the energy that was absorbed is given off in the form of visible light. The color of this light can be used to identify the elements involved.



Flame Ionizations Lab

Putting it All Together

Flame Ionization Lab



Credit: NASA/JPL-Caltech/MSSS – Flame Ionization

Credit: Dr. Strawser – Flame Ionization Lab

Adding aPBI

strategies, paradigms, theories, and experiences

Chemistry & Mineralogy X-Ray Diffraction Instrument: Designed to be about the size of a laptop computer inside a carrying case, the Chemistry and Mineralogy Instrument will identify and measure the abundances of minerals on Mars. A rotating wheel in the center of the rectangular housing will carry individual rock and soil samples for chemical analysis.

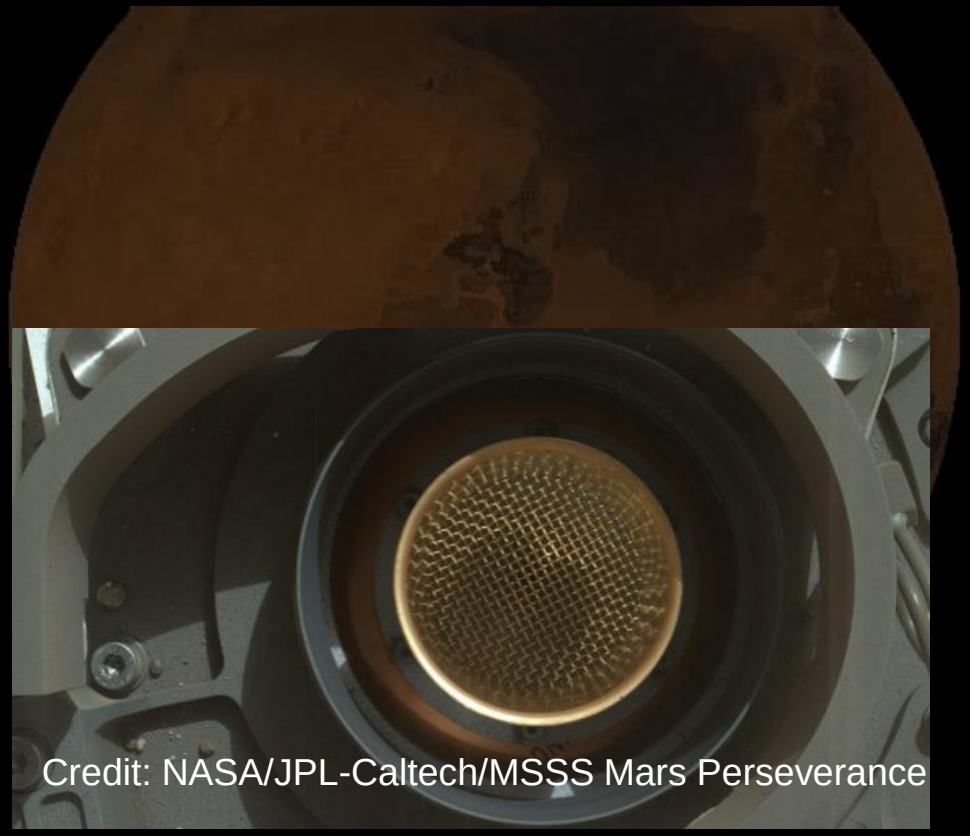
Credit: NASA/JPL-Caltech/MSSS

Adding aPBI

strategies, paradigms, theories, and on-line experiences

To prepare rock samples for analysis, the rover drills into rocks, collects the resulting fine powder, and delivers it to a sample holder. It uses a scoop for collecting soil.

CheMin then directs a beam of X-rays as fine as a human hair through the powdered material. X-rays, like visible light, are a form of electromagnetic radiation. They have a much shorter wavelength that cannot be seen with the naked eye. When the X-ray beam interacts with the rock or soil sample, some of the X-rays are absorbed by atoms in the sample and re-emitted or fluoresced at energies that are characteristic of the particular atoms present.


Credit: NASA/JPL-Caltech/MSSS Mars Perseverance

Adding aPBI

strategies, paradigms, theories, and on-line experiences

Fundamental Principles of X-Ray Fluorescence (XRF).

The XRF method depends on fundamental principles that are common to several other instrumental methods involving interactions between electron beams and x-rays with samples, including: X-ray spectroscopy (e.g., SEM - EDS), X-ray diffraction (XRD), and wavelength dispersive spectroscopy (microprobe WDS).

The analysis of major and trace elements in geological materials by XRF is made possible by the behavior of atoms when they interact with X-radiation. An XRF spectrometer works because if a sample is illuminated by an intense X-ray beam, known as the incident beam, some of the energy is scattered, but some is also absorbed within the sample in a manner that depends on its chemistry. The incident X-ray beam is typically produced from a Rh target, although W, Mo, Cr and others can also be used, depending on the application.

When this primary X-ray beam illuminates the sample, it is said to be excited. The excited sample in turn emits X-rays along a spectrum of wavelengths characteristic of the types of atoms present in the sample.

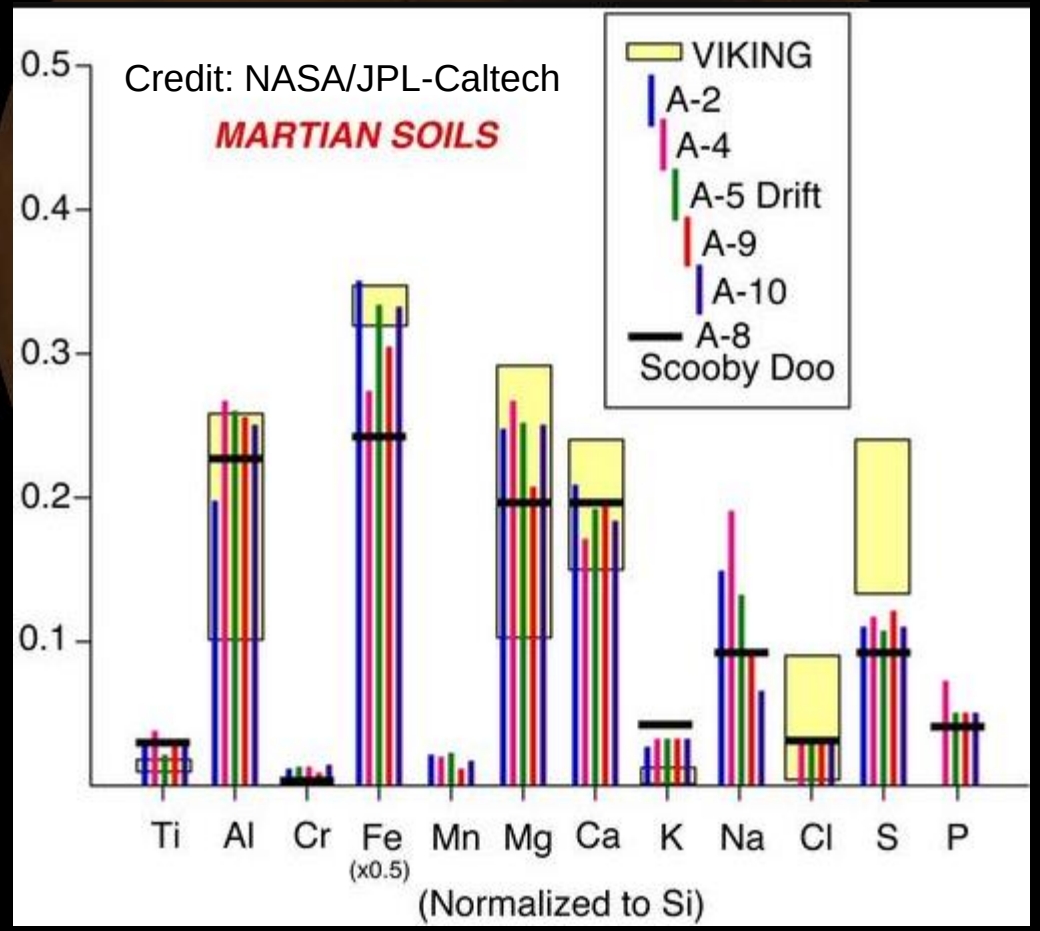
Credit: NASA/JPL-Caltech

Adding aPBI

strategies, paradigms, theories, and on-line experiences

Alpha Proton X-Ray Spectrometer (APXS)

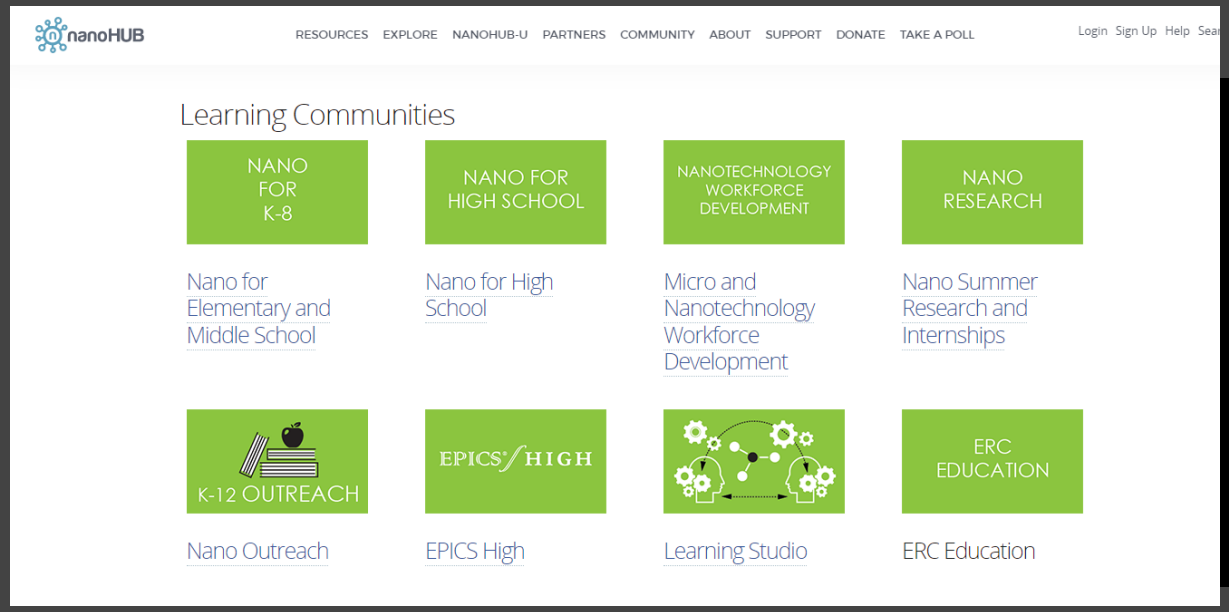
The Alpha Proton X-Ray Spectrometer on the rover measured the compositions of nine rocks. The silicon content of some of the rocks is much higher than that of the Martian meteorites, our only other samples of Mars. The Martian meteorites are all mafic and ultramafic igneous rocks, volcanic and intrusive rocks that are relatively low in silicon and high in iron and magnesium. Such rocks would be expected to form by partial melting of the upper mantle of Mars. The melt rises up through the crust and solidifies at or near the surface. The mafic volcanic Martian meteorites, referred to as basalts, are the most common rock on Earth and have also been found on the Moon.

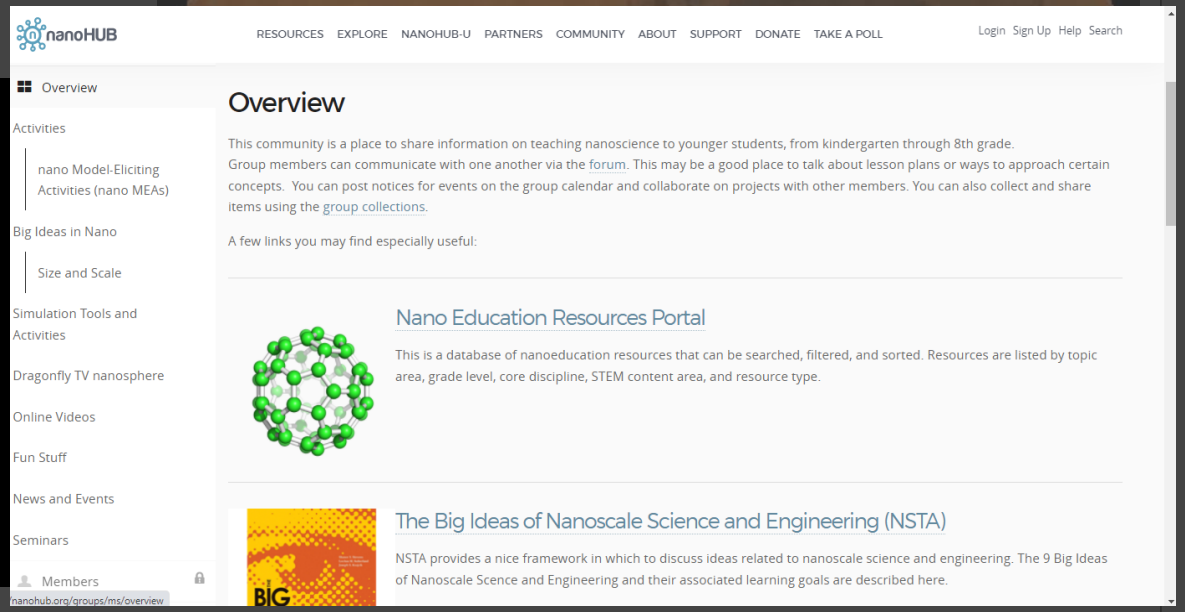


Adding aPBI

strategies, paradigms, theories, and experiences

NanoHub





Adding aPBI

strategies, paradigms, theories, and on-line experiences

Available Tools

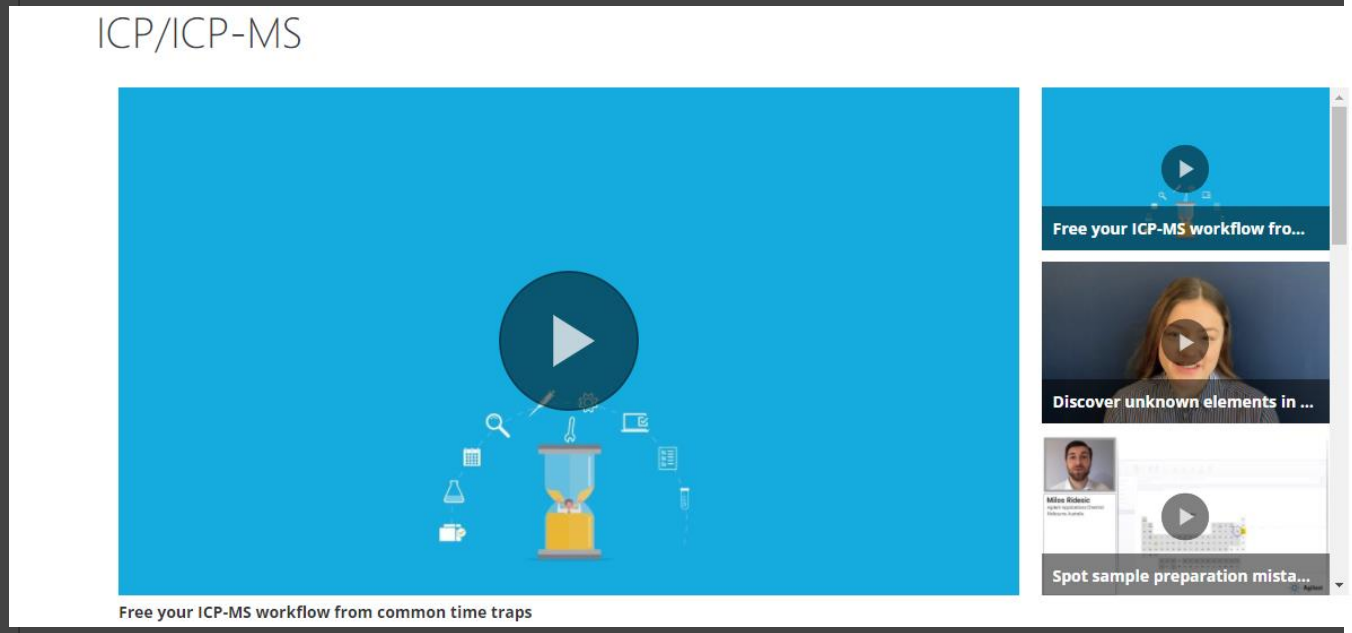
NanoHub

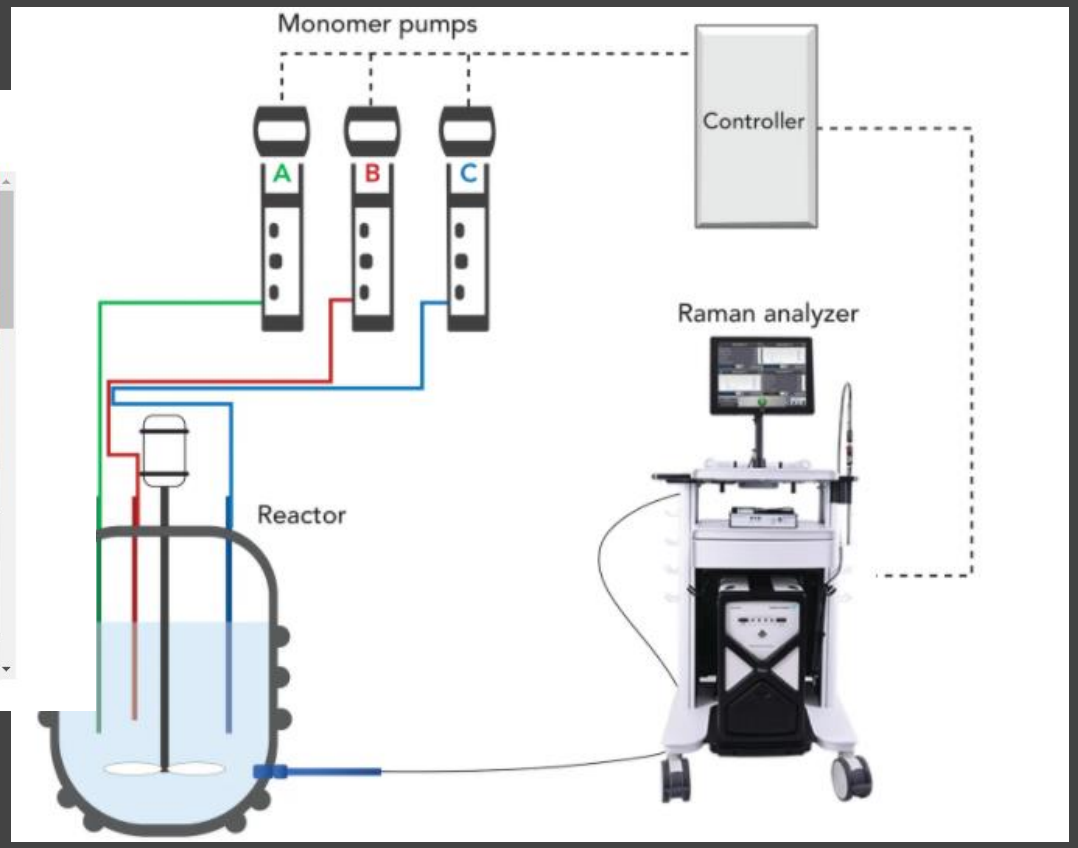
Title	Alias	Status
1-D Chain Dispersions	1dchainmd	open source
1D Finite Difference Method Conduction Heat...	1dfdmht	open source
One-dimensional function specification for IHCP	1dfs	open source
1D Heterostructure Tool	1dhetero	closed source
Toy 1-dimensional model to understand Molecular...	1dmd	open source
1-D Phonon BTE Solver	1dphononbte	closed source
Semiconductor Superlattice Design Tool	1sl	closed source
Percolation Threshold Simulator for 2D...	2daiperc	open source
Approximate self-consistent potential in a...	2degpot	closed source
2DFET	2dfets	open source
Electrostatic Properties Simulation of Layered...	2dmatstacks	open source
2D material reflectance spectra	2dreflect	closed source
3D-Atoms-Model	3datomsmodel	open source
Hierarchical material optimization	3dmatopt	closed source
RF Though Silicon Via for 3D IC	3drftsv	closed source
Calculating Semiconductor Raman Spectra	670raman	open source

Adding aPBI

strategies, paradigms, theories, and on-line experiences

Spectrometry On-line





“Questions or Observations”?

Thank you for Attending

Email Me