National MagLab RET:

Collaborating with Research Scientists to Create Engaging Lesson Plans

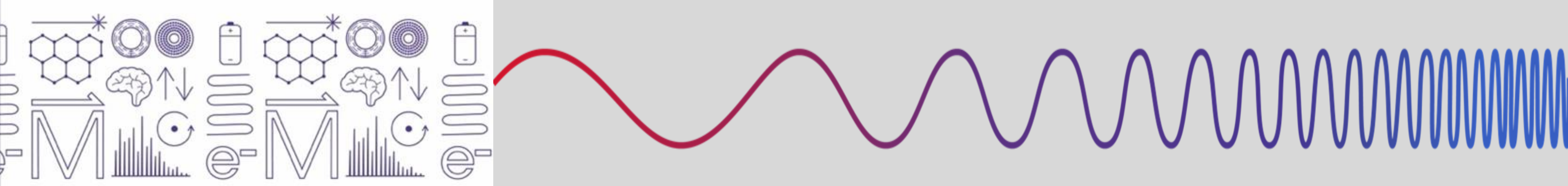
U.S. National Science Foundation

FLORIDA STATE UNIVERSITY

UNIVERSITY of FLORIDA

Los Alamos NATIONAL LABORATORY

About the National High Magnetic Field Laboratory

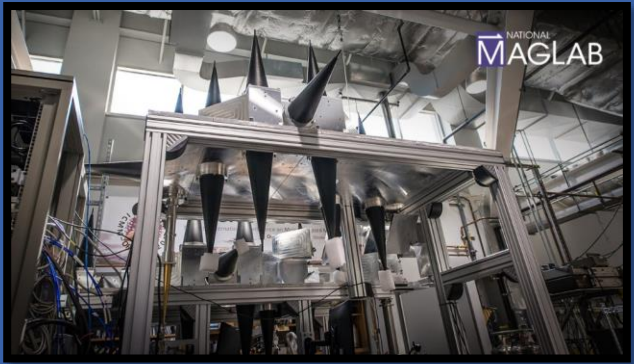


National MagLab

One of 7 high magnetic field labs in the world

Only one in western hemisphere

Largest and highest powered in the world



National MagLab

User Laboratory

- Over 2,096 user visits (2019)
- NSF & State of Florida funded
  - $41 Million Budget
- Research free to scientist:
  - Must share research

National MagLab

Center for Integrating Research & Learning

- Mentoring & Research
- Field Trips & Tours
- Summer Camps
- Professional development
- Workshops and Conferences
- High School Externship
- RET program

National MagLab

Center for Integrating Research & Learning

SciGirls

wfsu PUBLIC MEDIA

NATIONAL MAGLAB

NATIONAL MAGLAB

CAMP TESLA

Technology, Engineering, & Science in a Lab Atmosphere

THE NATIONAL MAGLAB

MORE POWERFUL MAGNETS THAN MEETS THE EYE!

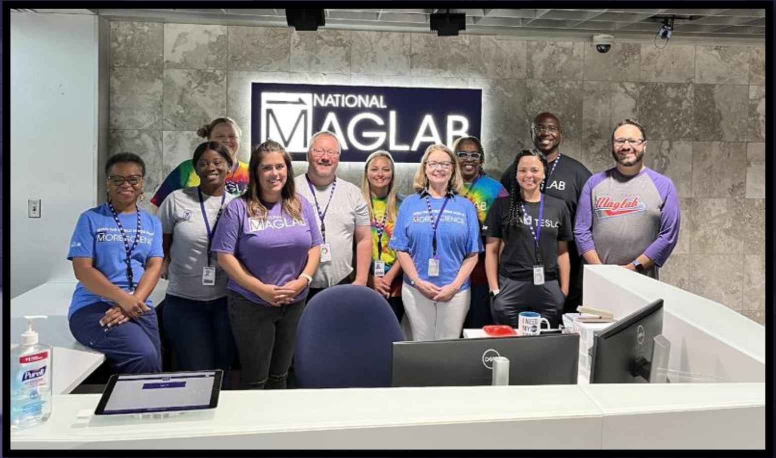
my LITTLE MAGLAB

SUPER MAGLAB WORLD

About the MagLab's Research Experience for Teachers

MagLab RET

- The program's goals are:
  - To help educators connect MagLab science to their STEM teaching lessons.
  - Support teachers in creating MagLab centric lesson plan.
- Program accepts elementary, middle, and high school teachers



MagLab RET

Topics covered in 2024

- Magnet Science & Technology
- Materials Engineering
- Superconductivity
- Geochemistry
- Condensed Matter
- Environmental Science
- Quantum Phenomenon
- Materials Characterizations
- Microbiology
- Magnetic Resonance Imaging

Valerie Hucey

Whiddon Rogers Education Center (Ft. Lauderdale, FL)

Scientist Mentor: Dr. Lissa Anderson

Rising CO_2 and Ocean Acidification

Rising CO_2 and Ocean Acidification

Scientist: Lissa Anderson

- MagLab Scientist in Ion Cyclotron Resonance
  - ICR is Super Detailed Mass Spectrometry
- PhD in Bioanalytical Chemistry
- Focus on Dissolved Organic Matter

Rising CO_2 and Ocean Acidification

- HS-PS1-5 - Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
- HS-PS1-7 - Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- HS-PS1-7 - Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- HS-ESS2-4 - Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

Rising CO_2 and Ocean Acidification

STEM Rationale for Lesson

Ocean acidification refers to a reduction in the pH of the ocean over an extended period, caused primarily by the rapid absorption of carbon dioxide from the atmosphere.

Rising CO_2 and Ocean Acidification

$2\ C_8H_{18} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2O$ (combustion of fossil fuels)

$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$ (photosynthesis)

$CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3^-$ (Ocean Acidification)

Rising CO_2 and Ocean Acidification

CULTURALLY RESPONSIVE CONNECTION

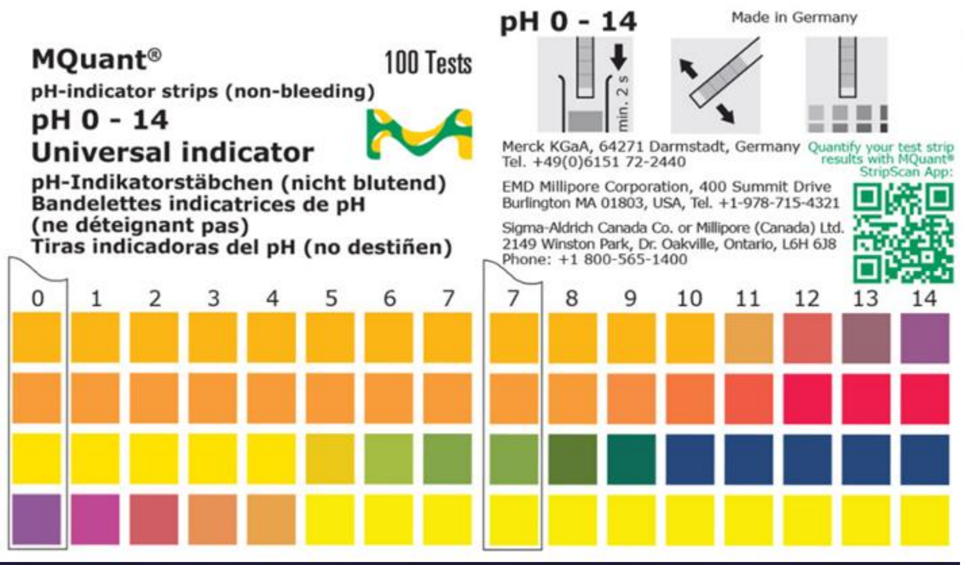
- Florida is surrounded by the Atlantic Ocean and the Gulf of Mexico.
- Marine ecosystems, fisheries, and tourism is at risk from ocean acidification.
- Multicultural students who are familiar with beaches, oceans and marine organisms.

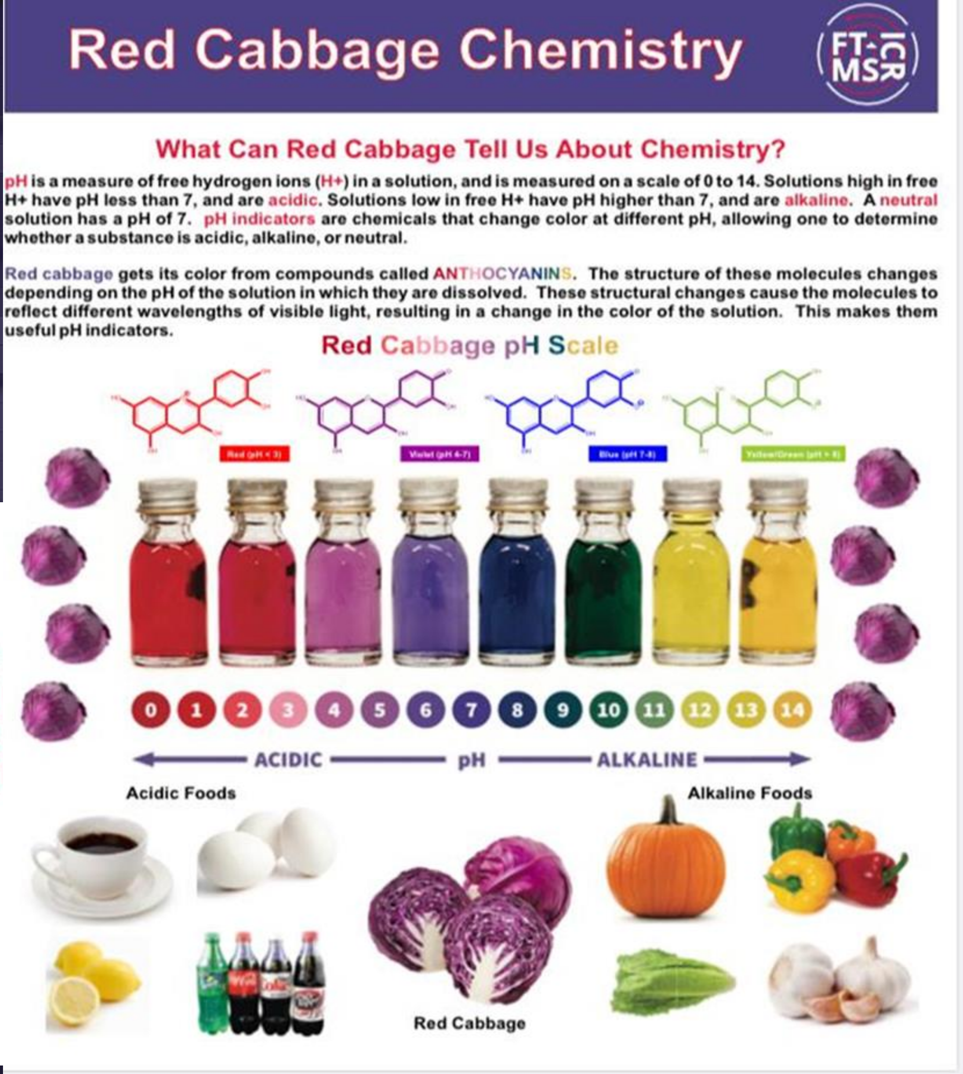
Rising CO_2 and Ocean Acidification

Lesson activities

- Mind map to activate prior knowledge
- Short videos
- Hands-on activities
- Acidity and alkalinity of household products
- Chalk in vinegar demonstration
- Blowing through straw in red cabbage indicator solution

Poster and pH strips provided by Scientist mentor Dr. Lissa Anderson



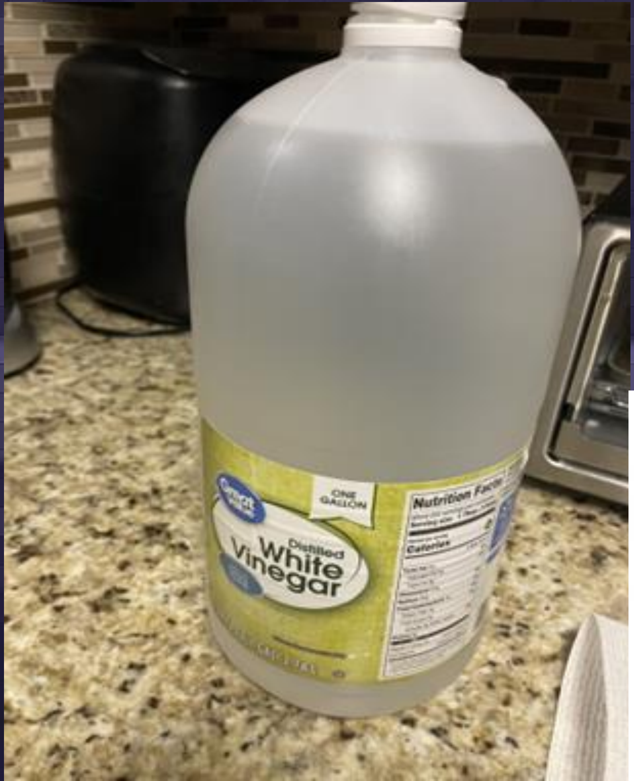


Rising CO_2 and Ocean Acidification

LESSON CAN BE COMPLETED IN FOUR(4) SECTIONS

- Part 1 - POE pH of household substances with pH strips
- Part 2 - POE pH of household substances with red cabbage indicator solution
- Part 3- POE Blowing into red cabbage indicator solution with a straw
- Part 4 - View 1 minute NOAA video and chalk in vinegar demonstration

Use POE worksheets to record pH of various household substances



English	Spanish	Haitian Creole
Acid	ácido, ácida	asid
Alkaline	alcalina	alkalin
Baking Soda	bicarbonato	bikabonat
Carbon Dioxide	dióxido de carbono	gaz kabonik
Chalk	tiza	lakre
Coffee	café	kafe
Lemon Juice	jugo de limon	ji sitwon
Ocean	océano	oseyan
Red Cabbage	repollo rojo	chou wouj
Shellfish	mariscos	kristase

- Choice of work, Use of technology to translate work in Canvas
- ELLs : Key Vocabulary words in Native language, Google Translate, Teaching Assistant, pairing with ELL students who are more proficient in English;

Rising CO_2 and Ocean Acidification

Acknowledgements

- Carlos Villa and National Maglab team
- Dr. Lissa Anderson
- Speakers for the RET Professional Development topics

Ann Marie Dubick

Campbell Middle School (Atlanta, GA)

8th Grade Physical Science

MagLev Trains

MagLev Trains

Scientist: Ernesto Bosque

- MagLab Scientist in Magnet Science & Technology
- PhD in Cryogenic Systems
- Focus on Magnetic and Electrical Forces
  - Can be Applied to MagLev Trains.

MagLev Trains

NGSS Standards

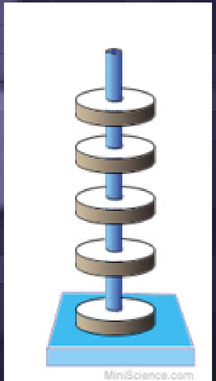
- DCI: Forces and Motion and Types of Interactions
- SEPs: Asking Questions, Developing Models
- CCCs: Cause and Effect, Systems and Systems Models, Stability and Change

Lesson Sequence: Explore and Explain

MagLev Trains

Lesson Sequence

- Magnets
  - Begin with exploration of magnets (this will help to guide the students before the phenomenon)
    - Example activity: Floating paper clip, Floating Magnets
- MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact



MagLev Trains

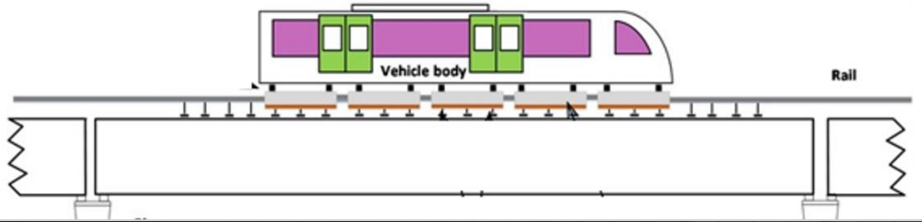
Phenomenon and Initial Models

- Elicit Student Ideas and Questions

See	Think	Wonder

Initial Ideas about how the Maglev Train works

Add to the diagram. Include parts you think make the Maglev Train move.



MagLev Trains

Lesson Sequence

- Electrical Forces
  - Example activity: Balloon and can and PhET Simulation
- MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact

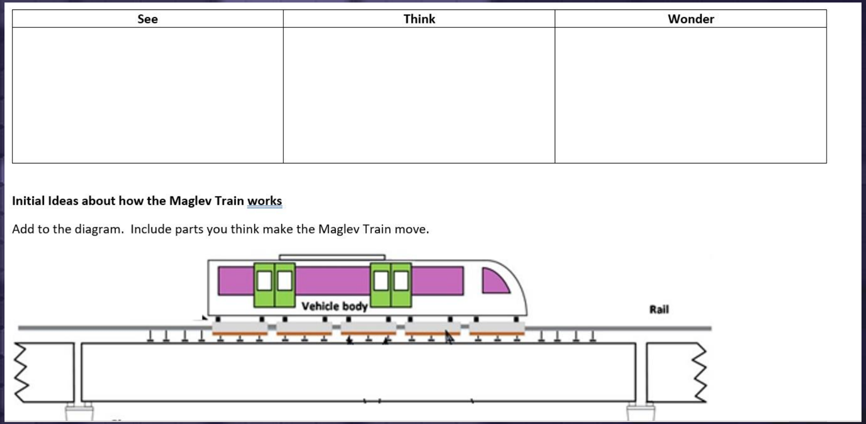
MagLev Trains

- Lesson Sequence
  - Electromagnets and Motors
    - Making the connections
    - Claims, Evidence, Reasoning
    - MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact

MagLev Trains

Designing a MagLev Train

- Revisit model - add new understanding
- Include the “must have” checklist to include on model
- Reflect on how thinking has changed



See	Think	Wonder

Initial Ideas about how the Maglev Train works

Add to the diagram. Include parts you think make the Maglev Train move.

MagLev Trains

Designing a MagLev Train

- Provide students with vetted resources
  - Ex. https://www.energy.gov/articles/how-maglev-works
  - https://sites.tufts.edu/eeseniordesignhandbook/2015/maglev-magnetic-levitating-trains/
  - https://nationalmaglab.org/magnet-academy/history-of-electricity-magnetism/museum/maglev-trains-1984/
  - https://physics.anu.edu.au/engage/outreach/_files/MAGLEV.pdf

MagLev Trains

Designing a MagLev Train

- Provide students with vetted resources
  - **MagLab Video:** https://nationalmaglab.org/magnet-academy/watch-play/science-demos/maglev-trains/

MagLev Trains

Designing a MagLev Train

MagLev Trains

Designing a MagLev Train

- Design
- Place (in community)
- Need for Maglev (transportation) - Rationale
- Cross-Curricular - Land Acknowledgement
  - https://nativegov.org/news/a-guide-to-indigenous-land-acknowledgment/

MagLab Resources

Use Our Magnets

Magnet Academy Search

NATIONAL HIGH MAGNETIC FIELD LABORATORY

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Home / Education

With a strong commitment to education, the lab supports educational programming at all academic levels: K-12, technical, undergraduate, graduate and postdoctoral.

Bulletin Board

2023 Florida

Use Our Magnets

Magnet Academy | Search

NATIONAL HIGH MAGNETIC FIELD LABORATORY

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MagLab RET

Summer 2025 Program (June 23-27)

- Summer Program
  - 1 Week in Person
    - In the MagLab
  - 4 weeks virtual
    - Wherever Home Is
- $3600 stipend

- How Do I Get Accepted
  - Complete online application
  - Complete program surveys
  - Submit lesson plan

2025 MagLab RET

- Week in Tallahassee we supply
  - Housing
  - Travel stipend
- Program is open to Elementary, Middle, and High School teachers
- Pre-service teacher positions available

2025 MagLab RET

- Focus of the program
  - Nature of Science
  - Argument Driven Inquiry
  - Communicating in science
  - Experimental Design
  - Culturally Responsive Pedagogy
- Topics for Lesson Plan Research
  - Materials Engineering
  - Superconductivity
  - Condensed Matter
  - Environmental Science
  - Quantum Phenomenon
  - Theoretical Physics

2025 MagLab RET

Applications Open now!

Thank you!

Carlos R. Villa
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U.S. National Science Foundation
FSU | FLORIDA STATE UNIVERSITY
UF | UNIVERSITY of FLORIDA
Los Alamos NATIONAL LABORATORY