



RET is funded by the
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Beyond Basic Batteries

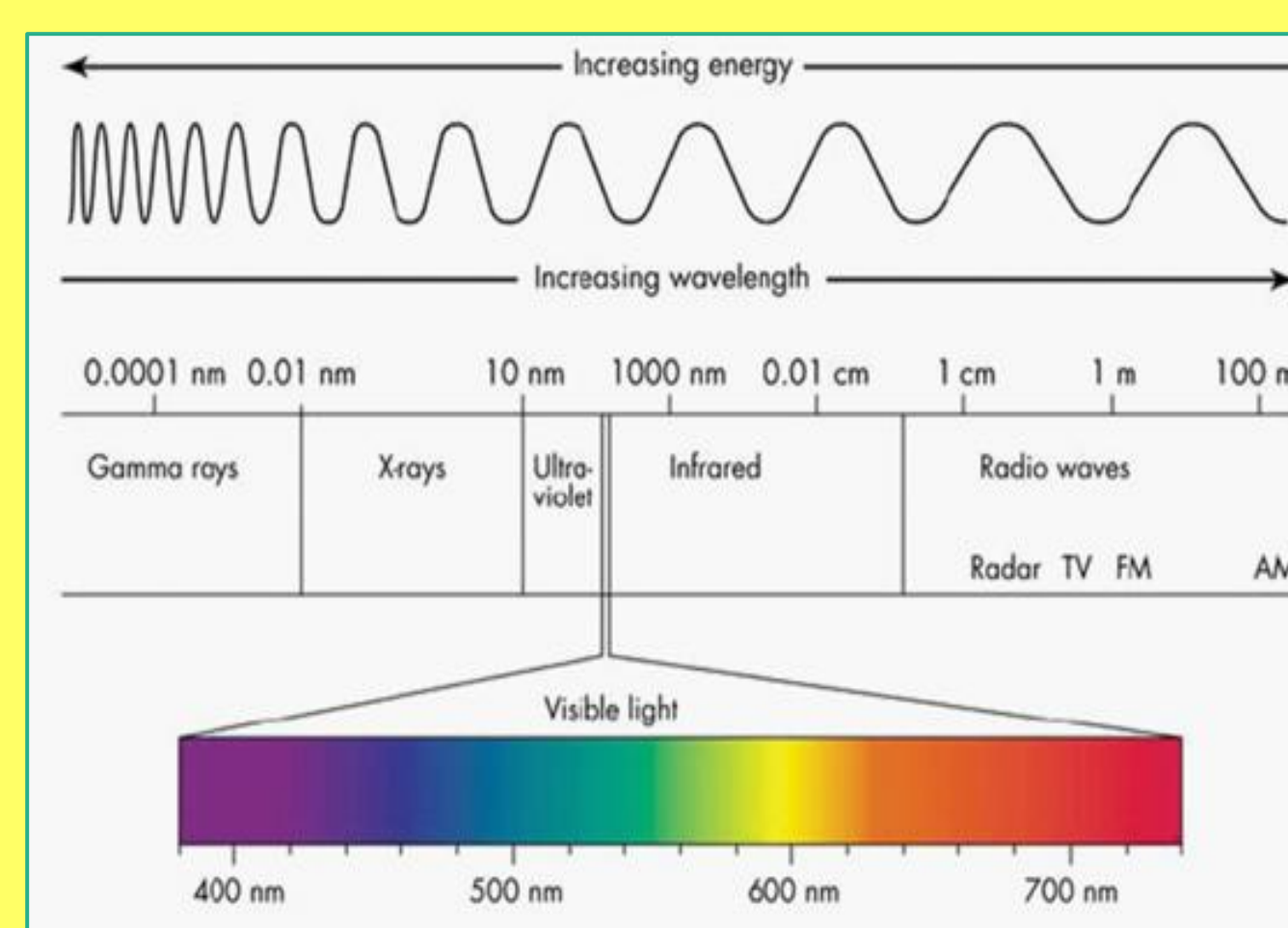
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Summer Research

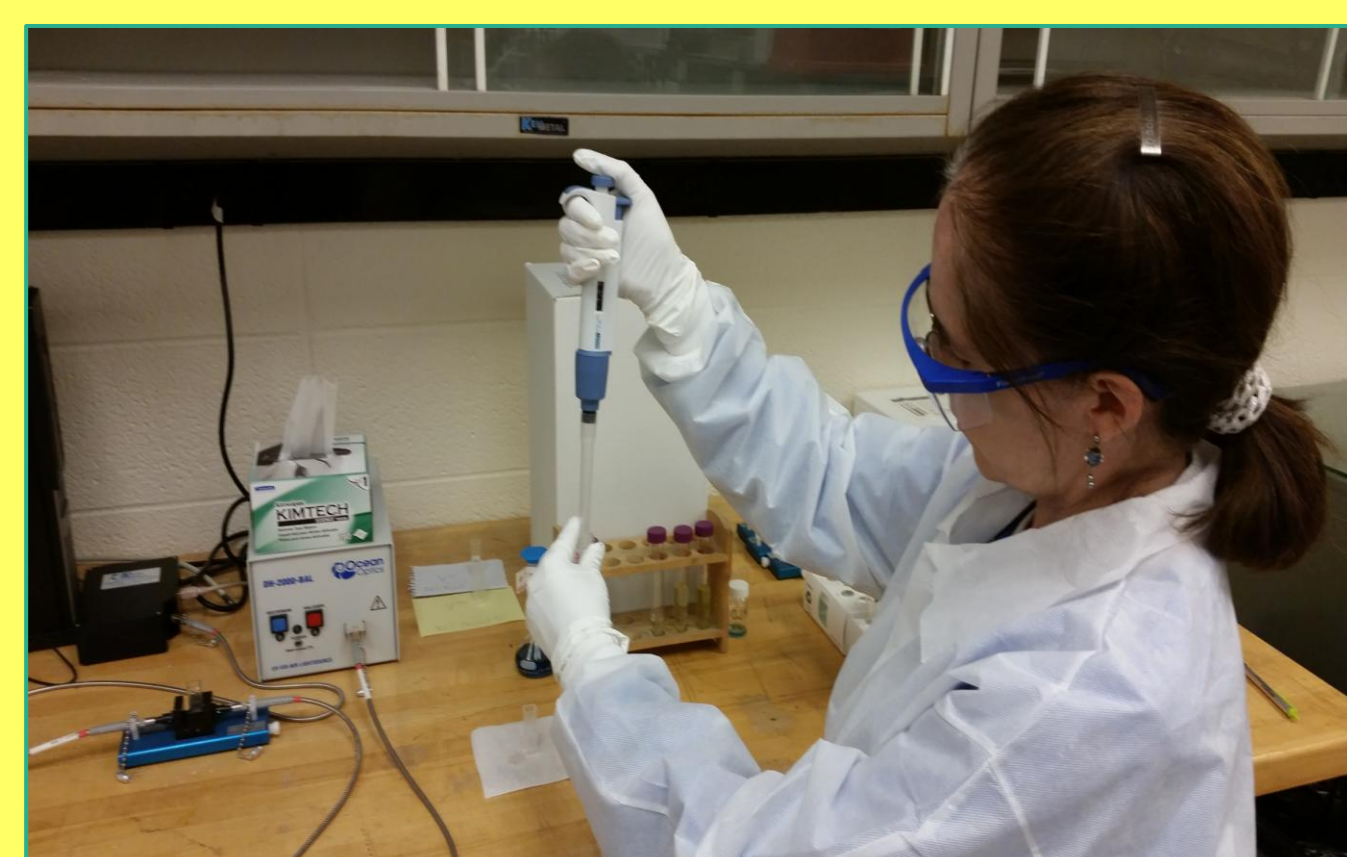
Research Question

Can UV-Vis spectroscopy be used to determine the amount and species of vanadium in solution? This information is needed to evaluate UV-Vis spectroscopy as a method to monitor the performance of Vanadium Redox Flow Batteries (VRFBs). VRFBs show potential for storing excess capacity from solar and wind energy. The portion of the electromagnetic spectrum visible to the typical human eye ranges from 390-700 nm. The colorful vanadium solutions indicate that absorbance will occur in the visible range.

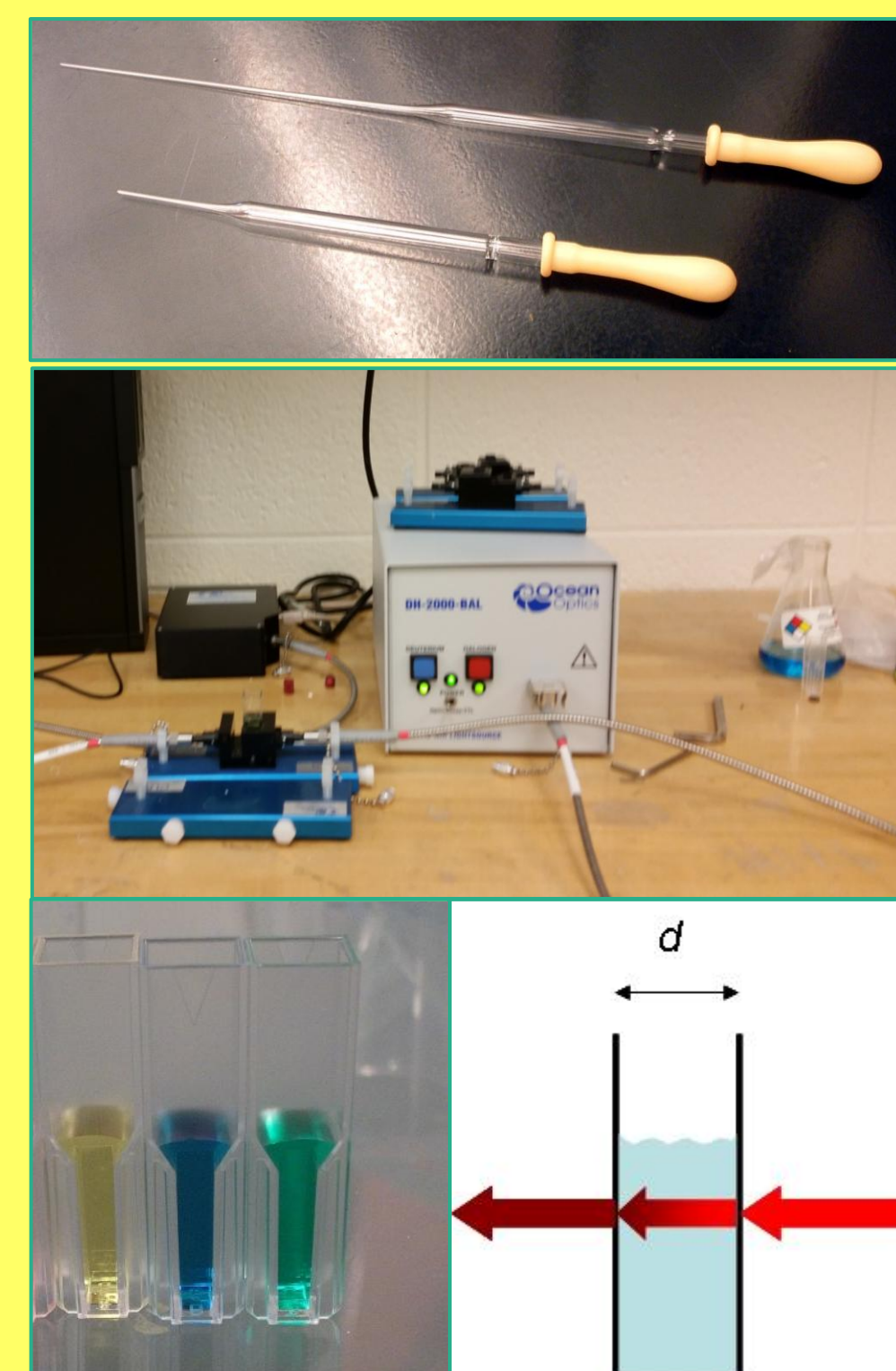


Electromagnetic Spectrum

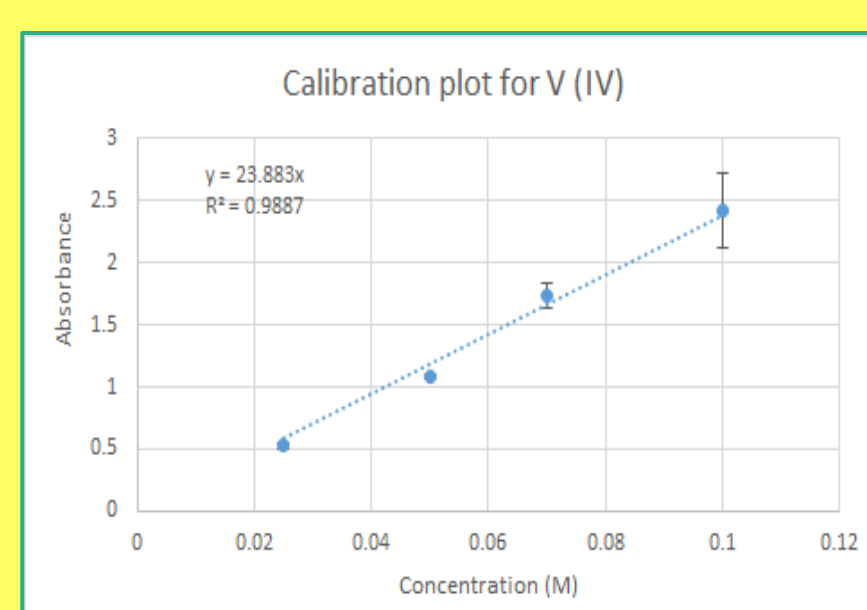
Vanadium
(II, III, IV, V)
in sulfuric
acid solution



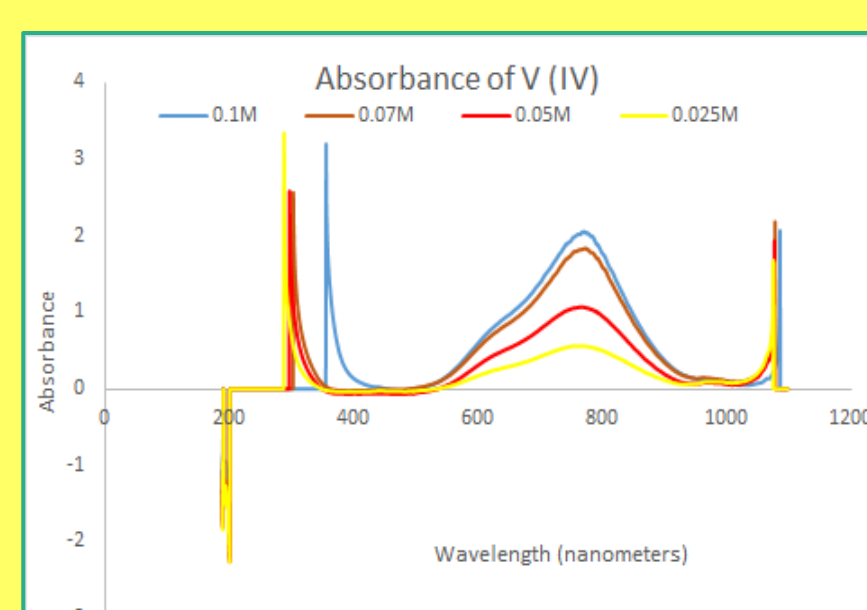
Analyzing vanadium
concentration by
visible spectroscopy



Equipment: Pipettes
UV-vis spectrophotometer
cuvettes



Calibration plot and absorbance graph
created with MS Excel



Results

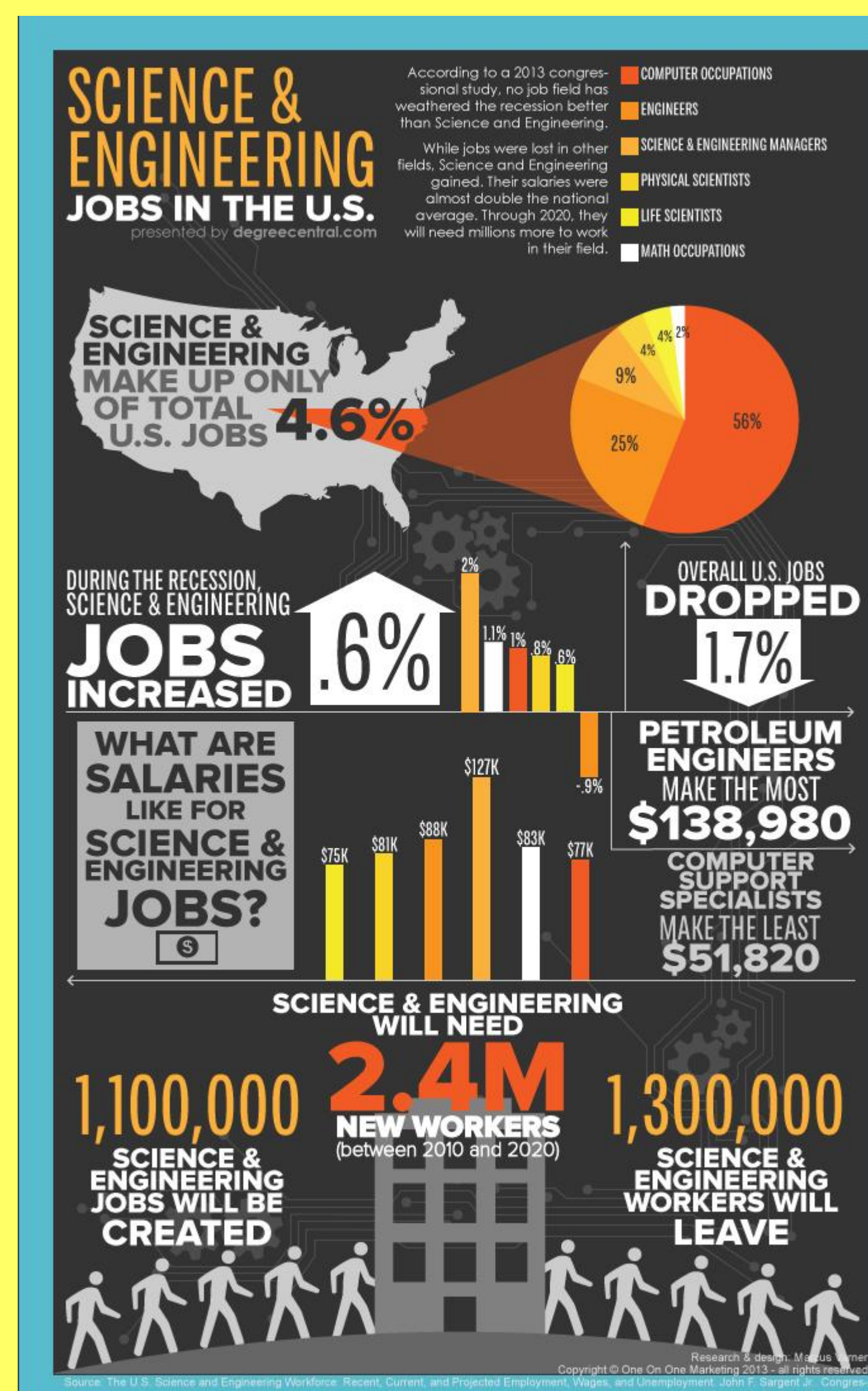
Visible spectroscopy worked well to analyze various vanadium species except in the case of V(II). When exposed to air, the samples change color, indicating oxidation to V(III).

Challenge Based Learning

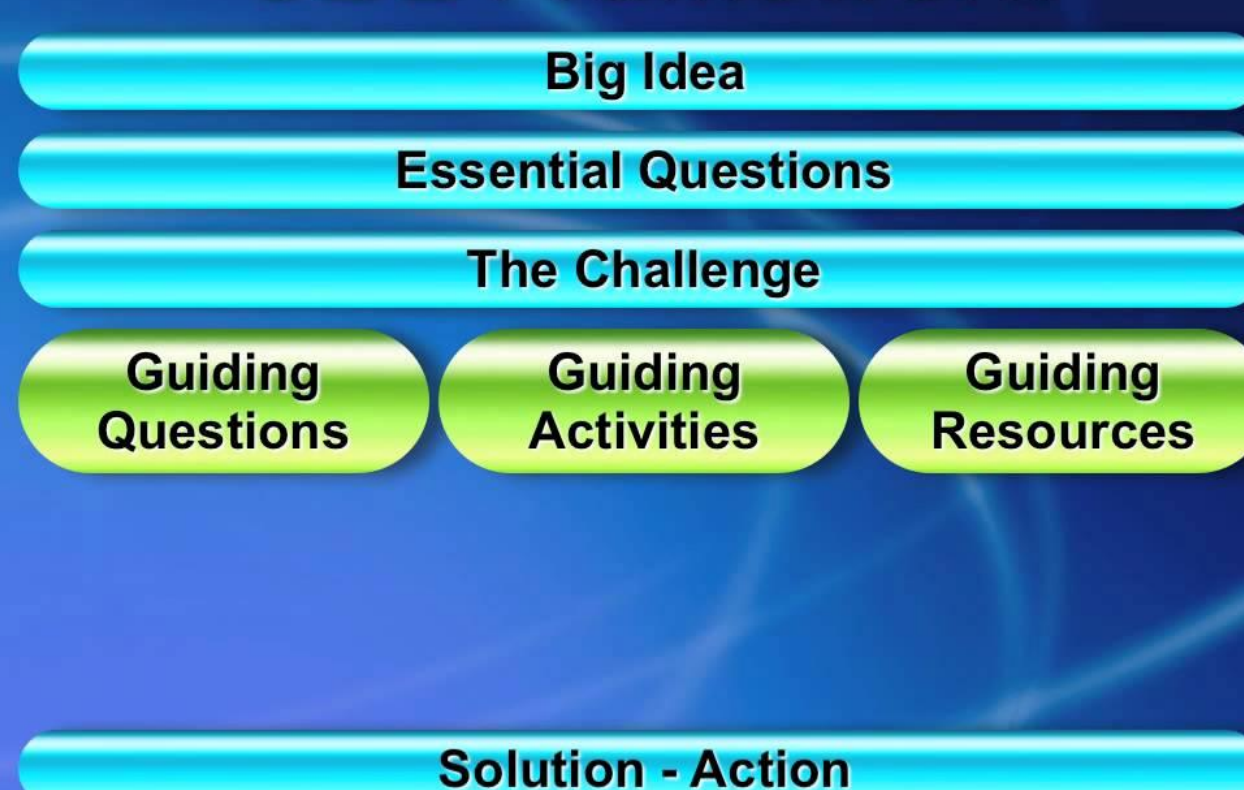
What is CBL?

- Collaborative and hands-on
- Students working with peers, teachers, and experts
- Local and global
- Developing deep knowledge
- Accepting and solving challenges
- Taking action
- Sharing experiences
- Discussing important issues

Career Connections



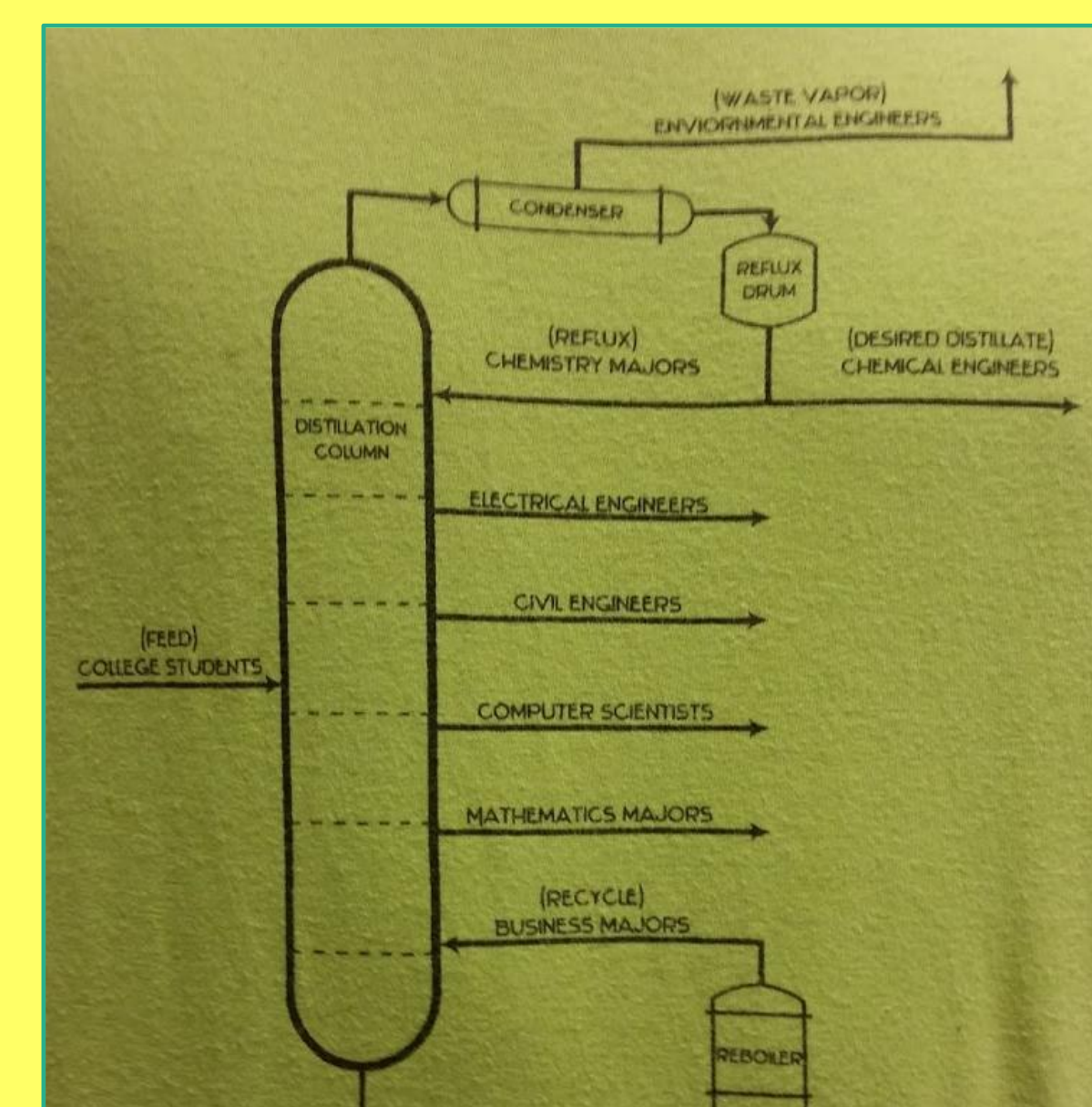
CBL Framework



You can



Explore
my site



Which option would
you choose?

Societal Issues in the Classroom

Big Idea:

Energy Transfer

When supply exceeds demand, alternative energy sources need storage that is easily accessible for later use.



Solar roof at
Cincinnati Zoo



Windfarm off Cape Cod



What is the
essential question?

Are batteries the answer?
If so, which type?
How do batteries work?
Are there other options?

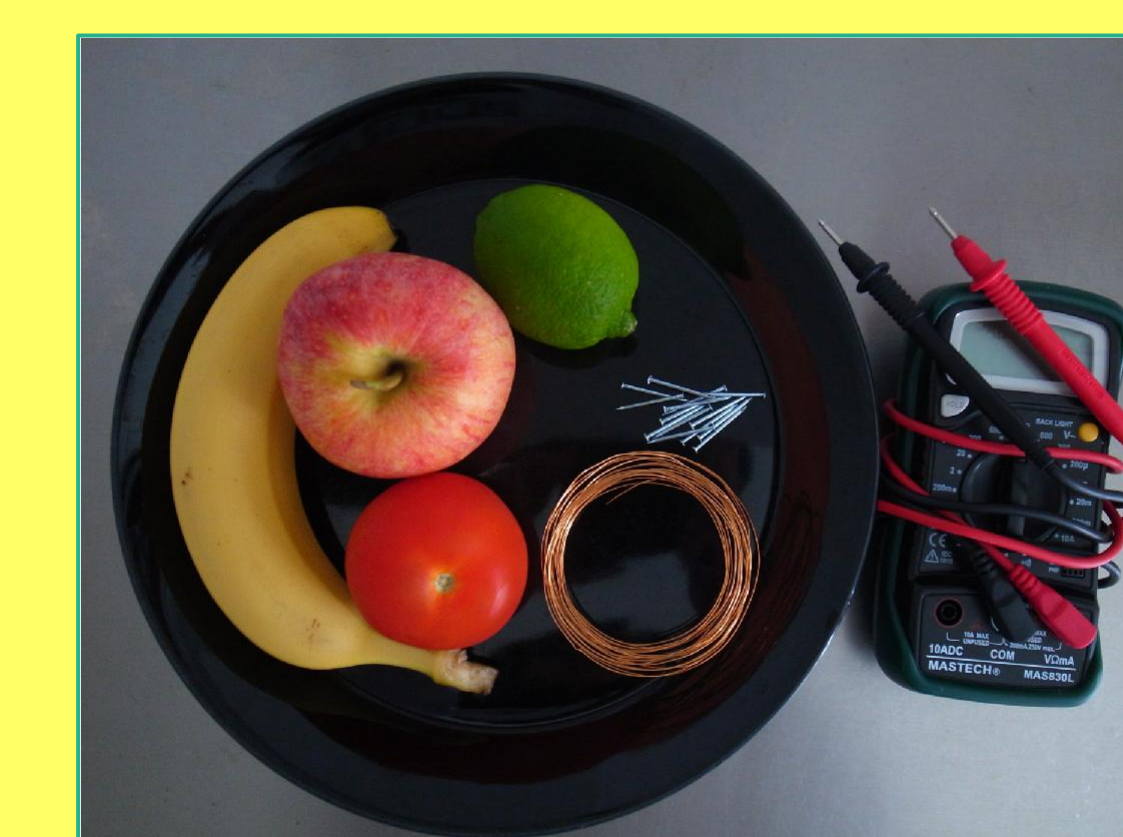
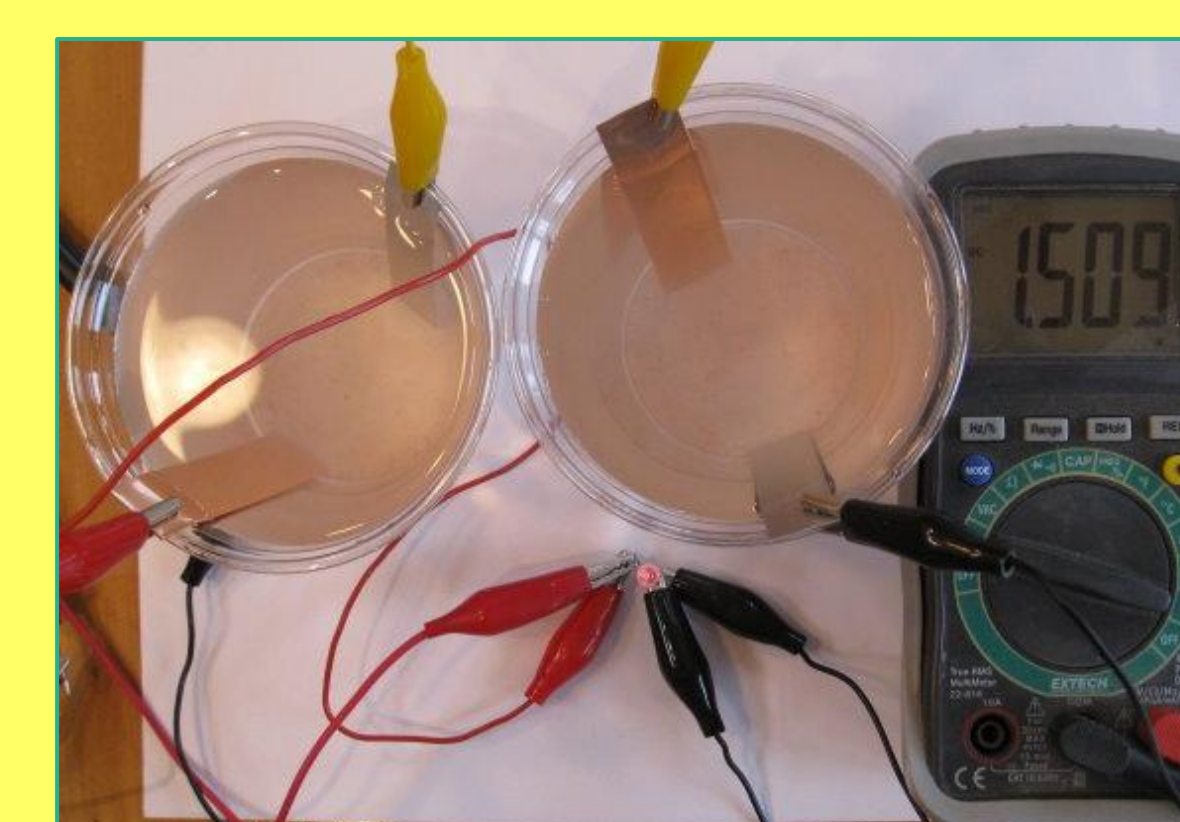


Common household batteries



Cut-away
view of lead
acid battery

How can you power
essential devices during
an outage?



How else can energy be
stored?